



THE SUSTAINABILITY OF MEAT AND CURED MEATS IN ITALY



2016



THE 5 ASPECTS OF MEAT SUSTAINABILITY

To analyse the sustainability of meat and cured meats, means to study as objectively as possible the different topics that concern both the consumer and livestock production. For this reason the Study written by **Sustainable Meat** analyses **nutrition, environmental impacts, food safety, animal welfare, economic aspect and food waste**.



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THE NOVELTIES OF THIS EDITION

The 2016 version of the Meat and cured meats Sustainability Report in Italy is characterised by a **higher level of discussion** on the issues proposed with particular reference to the themes of nutrition, environmental impacts, food safety, animal welfare, economic aspect and food waste. The goal is always to handle as objectively as possible an extremely complex subject that foresees the integrated analysis of aspects that are also very different.

The objective of these documents and communications is not to convince those who for indisputable personal reasons choose not to eat meat, but to reassure those who, equally consciously, choose to include also animal protein in their diet, informing them that **consuming meat with equilibrium is sustainable both for health and environment as well**.

THE REASONS FOR THIS PROJECT

Meat consumption is increasingly becoming the subject of attention and criticism, principally related to nutritional, ethical and environmental reasons. To this international debate, organisations and stakeholders have participated and will participate driven by different motivations: animal welfare organisations and/or environmental organisations, research centres, media, etc. In this context, at least in Italy, the point of view of meat producers has never been inserted. That's why they felt the need to **join the discussion** by providing information, details and objective data useful to correct, where necessary, some preliminary or not completely correct positions. With this goal, in 2012, the Sustainable Meat Project was born, which by exploiting the various communication systems, is bringing to people's attention the results of the commitments of the various operators of the sector with the intention of offering not a monolithic and uncompromising position but **a starting point** for a constructive and transparent debate, free from preconceptions and extreme positions, and moved by the desire for scientific and objective analysis.



CONTEXT

The growing awareness towards food sustainability, and in particular that of meat and cured meats, leads to increase the attention ever more to the elements that define the main features: **health, safety, production respectful of the environment** as well as **economic viability** for businesses and consumers.

Talking about **nutrition** means discussing both the theme of **consumption** and of the **nutritional value** of meat and cured meats in people's diet. With regards to consumption, there is no doubt that the growth of the world population, expected to be 9 billion people in 2050, compared with 7 billion today, will inevitably result in an increased demand for food, especially animal protein, for which there is expected an increase in demand of about 60% [Source: FAO].

In assessing the current level of meat consumption worldwide it is not the absolute value that should make us reflect but rather the **extreme difference between per capita consumption** in the various areas of the world, with values ranging from about **120 kg/year in North American countries** to less than **40 in Asia and Africa**. This variability is critical because all the recent considerations regarding the alleged diseases and the environmental impacts associated with meat consumption **should be measured by the real local scenarios**.

Regarding the nutritional issue in a strict sense, science has however identified very clearly what the **nutritional value** of meat is and of the micronutrients contained in them. What is not so clear instead are the associations, assumed by some studies, between **meat consumption and the onset of certain diseases** such as cancer. In both cases, the most certain conclusion is that a **balanced diet**, consistent with the Mediterranean Diet, that proposes a moderate consumption of meat represents an adequate nutritional model, capable of delivering all the **necessary nutrients to our body without risks to health**.

In addition to being nutrient, food should also be **safe**. The quality and food safety, in Italy as well as throughout the European Union, are based on a strategy that foresees the prevention of any risk to consumer health **all along the production chain**. Regarding the issue of security it is also important to dispel some **false stereotypes**, such as those relating to the systematic use of hormones and antibiotics in livestock: in fact **hormones** have been banned in the whole of Europe for decades, while **antibiotics are permitted only under strict veterinary control** and following strict administrative protocols, designed to avoid, on the one hand the presence of antibiotic residues in meat, and on the other, the onset of possible phenomena of antibiotic-resistance.

The issue of security is closely linked to that of **animal welfare**. Maintaining in animals a state of good physical and mental health is an indispensable prerequisite to ensure their sustainable livelihoods, but is also a crucial element in ensuring the safety of foods derived from them. The evolution of public awareness **has meant that, since the 80s**, this issue is fully covered by legislation, establishing minimum conditions of well-being that must be respected: in many cases a violation of these rules is considered a **criminal offense** in Italy.

That of **respect for the environment** is one of the latest issues that is faced when it comes to talking about food; with regards to meat and cured meats it is also one of the most controversial because these products are characterised by a **higher impact per kg**: but limiting oneself to just this data, you lose however some very important aspects.

The first is that **the analysis per kg does not take into account the actual consumption of food**. If environmental impacts are related to the **reduced weekly servings recommended by nutritionists**, in fact, it can be seen how in a balanced diet the impacts of meat and cured meats are not as high as would be

supposed by the analysis of data per kg. This message is the basis of the **Environmental Hourglass**, the communication symbol of the entire Sustainable Meat Project.

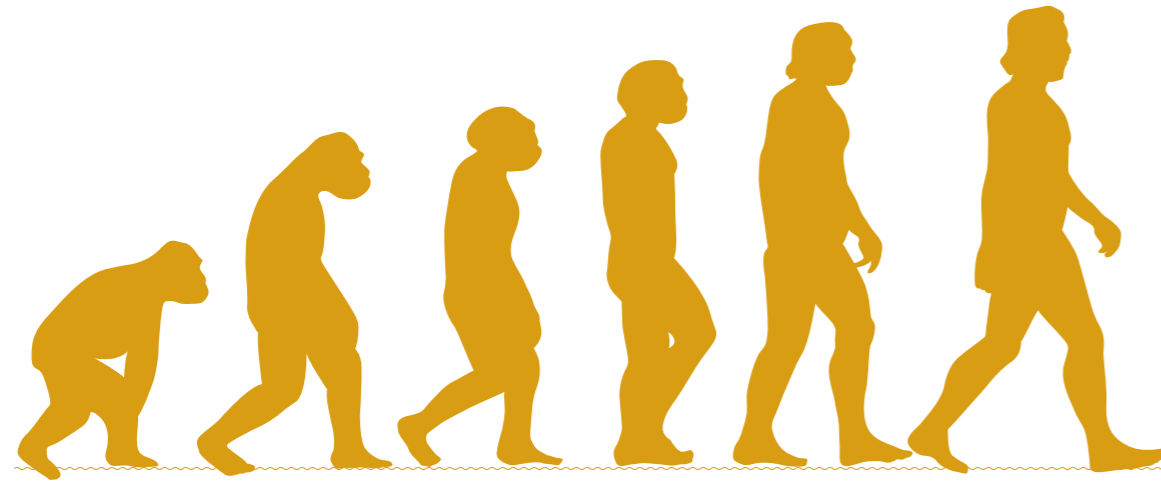
The second refers to the deep integration of animal husbandry in the whole agri-food sector, which through multiple and continuous exchanges of raw materials and resources makes the various systems (agricultural and livestock) more efficient and sustainable from an **economical** point of view.

In fact the pursuit of **economic** sustainability is one of the **objectives to be pursued** in order to reduce the risk of abandonment of the countryside by farmers. To such an end, the tendency is increasingly widespread of small operators to **aggregate** into cooperatives or into small and **large industries**. This permits them to optimise costs and especially to access advanced technological systems that allow the increase in productive efficiency, with a consequent **saving of resources and reduction of the environmental impact**.

A similar form of "efficient farming" should be seen in a positive way, because it is one of the ways to meet the challenge that is the basis of sustainability: **"produce more to meet the needs of a growing number of inhabitants of the planet, consuming fewer resources"**.



MEAT IN THE MEDITERRANEAN DIET



The meat is part of human nutrition since the dawn of human history.

The first tribes of hunter-gatherers based their livelihood on hunting and wild growing plants. Subsequently, the constant use of fire to cook (**the first processed food was bread**) food and the phasing out of hunting and harvesting practices in favour of farming laid the basis for the **birth of agriculture**.

With it man changed not only his lifestyle, which from nomadic became stable, but also his eating habits and the natural environment where he settled. **The practices of cultivation are accompanied by the first forms of animal domestication**, selected and bred to help work in the fields and to provide food, wool, and leather. The **foundations of what is now known as the “Mediterranean Diet” was created: a diet based on bread, cereals, fruit, vegetables, fish and meat.**

Over the centuries, the influences of first the Roman-barbarians and then medievalism reinforce the idea of eating meat as an essential requirement for a healthy diet. Meat remains an aspired food and desired over time, although the consumption habits vary a lot depending on the historical period and social class. Indeed, if until the thirteenth century, the practice of agricultural, forestry and sheep-farming systems offered a varied diet, and allowed meat to

be accessible to the entire population, successively one witnessed the formation of a gap between the rich and varied food supply of nobles in the cities, and the rural population, where economic hardship relegate the consumption of meat only to festive occasions. The culinary culture of the countryside develops, consequently giving priority to cereals, breads, legumes and vegetables, and inventing recipes to reuse all the cuts of meat, including offals, and minimising waste.

The shortage of meat in the diet of the rural population remains constant until the early twentieth century. In Italy it is only **since the Sixties** that the strong economic growth leads to an increase in meat consumption which becomes the **symbol of freedom from misery and poverty**.

To meet the growth in population and food consumption meat production is intensified: the food industry is structured to cope with the demand, on farms the watchword becomes efficiency in production. Since the eighties meat consumption in Italy is stable, and after food safety has become well-established, a change in sensitivity to issues of an ethical matrix, such as animal welfare, has occurred.

The challenge the meat industry faces today, is a more “sustainable” offer that can ensure efficient production, safe food and that cares about the environment and animal welfare.



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Introduction

MEAT IS AN IMPORTANT SOURCE OF PROTEIN, ESSENTIAL AMINO ACIDS AND OTHER MICRONUTRIENTS USEFUL TO THE HUMAN BODY

THE MEDITERRANEAN DIET SUGGESTS A MODERATE MEAT CONSUMPTION

MEAT CONSUMPTION PER CAPITA IN ITALY IS LOWER THAN OTHER DEVELOPED COUNTRIES

THE NUTRITIONAL VALUE OF MEAT

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When it comes to nutrition, the subjects discussed are extremely articulate and require a wide variety of skills.

A first way to approach the subject is to start from the concept of diet, according to the model from Greek medicine, that is, as a way of life to increase health, which provides information with respect to all the aspects of daily life, from food consumption to exercise, to rest. Therefore not a weight loss therapy as a temporary remedy of an excessive consumption of food nor facing specific diseases. The education in food consumption should then push people to follow a balanced "dietary pattern", where one can consume all foods without excess. In this sense, the **Mediterranean Diet** is a big help because the suggestions we receive from **this model help consume all foods** necessary to supply healthy nutrition to people, including meat and cured meats.

More specifically, each food provides **the body with the nutrients** necessary to the physiology of the body. **Meats and cured meats** are for example **sources of essen-**

tial proteins, but also of many **micronutrients** and **bioactive compounds** that support some special functions. Sometimes these components are more bio available (that is, better digestible with respect to the type of plant sources, in some cases (for example **vitamin B12**) are present only in foods of animal origin precisely such as meat and cured meats. It is therefore interesting to investigate the functions of individual nutrients, by placing them in relation with the needs of the human body at **different stages of life**.

Moving from the nutritional to the medical sphere one enters the area of **clinical diseases**, which in many cases may be related more or less directly with the consumption of food. In the case of meat, particular attention regards the alleged correlation between the consumption of meat and cured meats and some cancers. Despite the many assumptions in this field, **the relationship between diseases and moderate consumption is not currently ascertainable** and scientific studies lead to no firm conclusions, other

than those of maintaining consumption within the recommended levels of the most widespread nutritional models. However, it is interesting to investigate the reasons for these alleged reports, in order to understand the possible modalities to control them.

Consumption is therefore a key link for relating a food with its repercussions on health and its sustainability in general. When asked "how much meat you eat?", it is not easy to answer, because there is very little available data and very often refers to the availability of food (**apparent consumption**) and not to "**real consumption**". However, with a thorough analysis of the available information, we can draw some general considerations: the first is that the actual consumption of meat and cured meat in Italy is quite in line with that indicated by the nutritional guidelines; the second is that **the consumption of meat (per capita) in the world has some important differences between the North American and Asian countries**.

DIET AS A FOOD MODEL: THE FOOD PYRAMID



The Mediterranean Diet is the result of millennia of exchanges of food and cultures among all people of the countries bordering the Mediterranean basin. This model, known for being one of the most healthy and balanced, in the twentieth century has characterised the eating habits of the inhabitants of the Mediterranean region, which was originally based on patterns of agriculture and local rural models.

The **Mediterranean Diet** includes the **consumption of all foods**, without exclusion, and suggests a high intake of vegetables, legumes, fresh and dried fruits, olive oil and cereals (mostly wholemeal); a moderate consumption of fish, dairy products (especially cheese and yogurt), meat and occasional sweets. For this reason the model should be not be considered as one of a single predominant nutrient or food, but as the overall effect of the diet. It is no coincidence that the benefits of the Mediterranean Diet are due to synergistic combinations of nutrients and protective substances in food, to an adequate daily intake of energy, **water** and the **practice of exercise**, in order to maintain a healthy mental and physical state. Other strengths of the Mediterranean dietary pattern are the consumption of traditional and local foods and the preference for wholemeal grains and unsaturated fats, seasonality and the biodiversity of the food.



> The food pyramid

Starting with the first definition of the Mediterranean Diet, defined in the early 50s by the scientist Ancel Benjamin Keys, who for first highlighted how cardiovascular diseases in Italy, Spain and Crete were virtually unknown compared to the worrying levels already reached at that time in the United States, and that such a low rate was due to the different eating habits of those countries¹, followed by many examples of graphical representation of the Mediterranean Diet. Always with one goal: to make communication easy and to educate people.

After the recognition of the Mediterranean Diet as an Intangible Cultural Heritage of Humanity by UNESCO in 2010² and considering the world's interest, in 2011³ the Mediterranean Diet Foundation and its International Scientific Committee have developed a consensus, by presenting a new pyramid in which scientists hoped to contribute to a better adherence to this healthy eating pattern and the lifestyle of the Mediterranean basin.

The **food pyramid** shows the lifestyles to be adopted and the frequency of consumption of foods in order to adhere closely to the Mediterranean Diet and thus maintain the nutritional balance. As shown in the figure, the base of the pyramid provides a set of skills, knowledge, rituals, symbols and traditions **in the field of agriculture, fisheries and animal husbandry** and especially valorises the sharing of food consumption. **Eating together** is one of the fundamental elements to be favored as are also an active lifestyle, adequate rest and food to be consumed preferably following seasonality.

The pyramid is structured so as to make obvious the frequencies of consumption, with at the base the food to be consumed every day and at the apex those to be consumed weekly.

Every day you should drink at least 8-10 glasses of water, which corresponds to 1.5-2 litres, but if the diet is rich in fruits and vegetables the recommended amount drops to 1.2 litres per day, i.e. 6-8 glasses, to be enjoyed both during meals and during the day.

Climbing alongside the pyramid you will meet the vegetable group, fruits and nuts, foods that provide fibre, vitamins, minerals and chemical compounds such as flavonoids, phytosterols, terpenes and phenols, which offer protection against oxidative processes, thus reducing the incidence of cardiovascular diseases⁴. Here can be found also cereals, which provide low-glycemic carbohydrates, provided you choose often wholemeal.

The consumption of products rich in fibre has been associated with a lower risk of diabetes, especially type 2, coronary heart disease and cancer, while refined grains are linked to an increased risk of diabetes, obesity, coronary heart disease and other



The food pyramid defined by the Mediterranean Diet Foundation

be the predominant condiment, because it provides
¹Keys A, Menotti A, Karvonen MJ et al. (1986) The diet and 15-year death rate in the Seven Countries Study. *Am J Epidemiol* 124, 903-915

²UNESCO (2010) Representative List of the Intangible Cultural Heritage of Humanity. <http://www.unesco.org/culture/ich/en/RL/00394>

³Bach-Faig A, Berry EM, Lairon D, Reguant J, Trichopoulos A, Dernini S, Medina FX, Battino M, Belahsen R, Miranda G, Serra-Majem L; Mediterranean Diet Foundation Expert Group. Mediterranean Diet pyramid today. Science and cultural updates. *Public Health Nutr.* 2011 Dec;14(12A):2274-84

⁴Ros E, Martínez-González MA, Estruch R, Salas-Salvadó J, Fitó M, Martínez JA, Corella D. Mediterranean Diet and cardiovascular health: Teachings of the PREDIMED study. *Adv Nutr.* 2014 May 14;5(3):330S-6S.

a high content of oleic acid and polyphenols, which have atherogenic, antioxidant and anti-inflammatory effects⁶.

Half way up the pyramid there are milk and dairy products like yogurt and cheese, which provide excellent quality proteins and easily assimilated calcium. Moreover, the lactic acid bacteria contained in yogurt can help to improve gastrointestinal health and immune response, in addition to inducing changes in the intestinal flora associated with a reduction in the risk of colon cancer⁷.

The upper part of the pyramid comprises the “**protein**” group of foods. Foods such as **meat, fish and eggs** are valuable sources of high quality proteins, easily digestible and high in many essential micronutrients such as **iron, zinc, vitamin A and vitamin B12**, which can contribute substantially to ensure the adequacy of the diet, preventing any nutritional deficiencies⁸. These foods also contribute to a **positive impact on growth, cognitive function and physical activity, particularly in children**.

Inflammation is now recognised as an important factor in the course of many chronic diseases, including cardiovascular disease, cancer, type 2 diabetes, metabolic syndrome, Alzheimer’s disease, and is also associated with obesity. Once again the Mediterranean Diet is to be evaluated in a positive way, because many of the nutrients responsible for inflammation, such as saturated fats and refined carbohydrates, are present in a very limited way.

This model, in addition to stating the benefits related to a high consumption of antioxidants and polyphenols, is characterised by an excellent ratio between essential fatty acids omega-6 and omega-3. Polyunsaturated fats (PUFA) contained in fish (for example, eicosapentaenoic acid and docosahexaenoic acid), regulate the haemostatic factors and provide protection against heart arrhythmias, cancer and hypertension⁹, and play an important role in the preservation of cognitive functions¹⁰.

Another important aspect in the Mediterranean Dietary pattern is the reduced consumption of sodium which, when taken in large amounts, can cause disorders related to high blood pressure; the high con-

sumption of salt-preserved foods has been linked in several studies with an increased risk of stomach cancer and coronary heart disease¹¹.

The way to maintain a healthy nutritional balance is thus to follow a varied diet, which includes foods from all food groups. Only in this way can one compile the complex puzzle of nutrients and protective substances useful to keep our body healthy¹².

⁵ Haas, P.; Machado, M.J.; Anton, A.A.; Silva, A.S.S.; de Francisco, A. Effectiveness of whole grain consumption in the prevention of colorectal cancer: Meta-analysis of cohort studies. *Int. J. Food Sci. Nutr.* 2009, 60, S6. - 18. Barclay, A.W.; Petocz, P.; McMillan-Price, J.; Flood, V.M.; Prvan, T.; Mitchell, P.; Brand-Miller, J.C. Glycemic index, glycemic load, and chronic disease risk—A meta-analysis of observational studies. *Am. J. Clin. Nutr.* 2008, 87, 627–637

⁶ Bos, M.B.; de Vries, J.H.M.; Feskens, E.J.M.; van Dijk, S.J.; Hoelen, D.W.M.; Siebelink, E.; Heijligenberg, R.; de Groot, L.C.P.G.M. Effects of a high monounsaturated fatty acids diet and a Mediterranean Diet on serum lipids and insulin sensitivity in adults with mild abdominal obesity. *Nutr. Metab. Cardiovasc. Dis.* 2010, 20, 591–598.

⁷ Bartram, H.P.; Scheppach, W.; Gerlach, S.; Ruckdeschel, G.; Kelber, E.; Kasper, H. Does yogurt enriched with Bifidobacterium longum affect colonic microbiology and fecal metabolites in health subjects? *Am. J. Clin. Nutr.* 1994, 59, 428–432

⁸ Phillips SM, Fulgoni VL 3rd, Heaney RP, Nicklas TA, Slavin JL, Weaver CM. Commonly consumed protein foods contribute to nutrient intake, diet quality, and nutrient adequacy. *Am J Clin Nutr.* 2015 Apr 29.

⁹ Jakobsen, M.U.; O’Reilly, E.J.; Heitmann, B.L.; Pereira, M.A.; Balter, K.; Fraser, G.E.; Goldbourt, U.; Hallmans, G.; Knekt, P.; Liu, S.; et al. Major types of dietary fat and risk of coronary heart disease: A pooled analysis of 11 cohort studies. *Am. J. Clin. Nutr.* 2009, 89, 1425–1432

¹⁰ Grosso, G.; Pajak, A.; Marventano, S.; Castellano, S.; Galvano, F.; Bucolo, C.; Drago, F.; Caraci, F. Role of ω-3 fatty acids in the treatment of depressive disorders: A comprehensive meta-analysis of randomized clinical trials. *PLoS One* 2014, 9, e96905.

¹¹ Bibbins-Domingo, K.; Chertow, G.M.; Coxson, P.G.; Moran, A.; Lightwood, J.M.; Pletcher, M.J.; Goldman, L. Projected effect of dietary salt reductions on future cardiovascular disease. *N. Engl. J. Med.* 2010, 362, 590–599.

¹² <http://sapermangiare.mobi/>; <http://nut.entecra.it/649/Introduzione.html>

> Mediterranean Diet and health

The Mediterranean Diet has been scientifically proven to improve health by increasing the protection against the most common chronic diseases, such as hypertension, diabetes, obesity and cancer, reducing the occurrence of cardiovascular diseases and preventing neurodegenerative diseases such as Alzheimer’s and Parkinson’s. Now all the most important and influential scientific societies consider it as the ideal style of diet to preserve the status of health and to reduce the occurrence of major chronic diseases

According to the World Health Organization, the Mediterranean Diet is one of the most promising strategies to prevent major diseases and improve the quality of life¹³.

The traditional Mediterranean Diet, as the traditional Asian diets, have had a prominent place in the study that characterises the so called “Blue Zone” regions, where the lifestyle models, including traditional dietary approaches, have been associated with longevity and vitality¹⁴.

A recent study published in the *British Medical Journal*¹⁵ noted that a sample of more than 4,000 middle-aged women, for example, showed a relationship between the Mediterranean Diet and a slowing of the aging process.

Beyond these specific quotes, you can observe how the scientific community is highly cohesive in observing the close correlation between the beneficial effects on health and the Mediterranean Diet. Generally following the Mediterranean Diet means having a significant reduction in tumour mortality and a lower incidence of several types of cancer¹⁶: colorectal in particular, but also of cancer in the upper digestive tracts (pharyngeal or oesophageal cancer) and in the prostate.

In addition, specific food nutrients or micronutrients characteristic of the Mediterranean Diet may play a

role in breast cancer prevention: the intake of foods containing phytochemicals, vitamins C and E, beta carotene and calcium may exert a protective action, including the reduction of cell proliferation.

Substances such as ascorbic acid, carotenoids and other antioxidant vitamins are inversely related to gastric cancer and neoplasm of the upper digestive and respiratory tracts.

The PREDIMED¹⁷ study, an international survey that evaluated the effects of the Mediterranean Diet on the primary prevention of cardiovascular disease, has shown for the first time in a randomised clinical trial that the Mediterranean Diet protects against cardiovascular disease and confirmed the reduction of factors of classic and emerging cardiovascular risks.

One important lesson of the study is that it is never too late to change your eating habits in order to improve personal cardiovascular health, and that part of the study’s positive results could be attributed to extra virgin olive oil and nuts, foods rich in unsaturated fats and rich in antioxidants.

Other potentially beneficial effects of the Mediterranean Diet regard a greater defence against neuro-

¹³ Del Chierico F, Vernocchi P, Dallapiccola B, Putignani L. Mediterranean Diet and health: food effects on gut microbiota and disease control. *Int J Mol Sci.* 2014 Jul 1;15(7):11678–99.

¹⁴ Willcox DC, Scapagnini G, Willcox BJ. Healthy aging diets other than the Mediterranean: a focus on the Okinawan diet. *Mech Ageing Dev.* 2014 Mar-Apr;136-137:148–62.

¹⁵ Crous-Bou M, Fung TT, Prescott J, Julin B, Du M, Sun Q, Rexrode KM, Hu FB, De, Vivo I. Mediterranean Diet and telomere length in Nurses’ Health Study: population based cohort study. *BMJ.* 2014 Dec 2;349:g6674.

¹⁶ Schwingshackl L, Hoffmann G. Adherence to Mediterranean Diet and risk of cancer: an updated systematic review and meta-analysis of observational studies. *Cancer Med.* 2015 Dec;4(12):1933–47.

¹⁷ Ros E, Martínez-González MA, Estruch R, Salas-Salvadó J, Fitó M, Martínez JA, Corella D. Mediterranean Diet and cardiovascular health: Teachings of the PREDIMED study. *Adv Nutr.* 2014 May 14;5(3):330S–6S.

degenerative diseases and preservation of cognitive function, reduced inflammation, improved insulin sensitivity and a possible role in the prevention of the risk of dementia and Alzheimer's disease¹⁸.

In recent years, some authors have indicated that adhering to the Mediterranean Diet reduces the incidence of the onset of diabetes, and the major protective compounds are represented by fibres and vegetable fats such as olive oil; in particular, this protection is guaranteed by the oil consumption of extra virgin olive oil for cooking, seasoning, baking and frying foods. In fact it would appear that diets rich in monounsaturated fats, such as the Mediterranean Diet, improve insulin sensitivity¹⁹.

¹⁸ Del Chierico F, Vernocchi P, Dallapiccola B, Putignani L. Mediterranean Diet and health: food effects on gut microbiota and disease control. *Int J Mol Sci.* 2014 Jul 1;15(7):11678-99.

¹⁹ Martinez-Gonzalez, M.A.; de la Fuente-Arrillaga, C.; Nunez-Cordoba, J.M.; Basterra-Gortari, F.J.; Beunza, J.J.; Vazquez, Z.; Benito, S.; Tortosa, A.; Bes-Rastrollo, M. Adherence to Mediterranean Diet and risk of developing diabetes: Prospective cohort study. *Br. Med. J.* 2008, 336, 1348-1351. - Esposito, K.; Maiorino, M.I.; di Palo, C.; Giugliano, D. Adherence to a Mediterranean Diet and glycaemic control in Type 2 diabetes mellitus. *Diabet. Med. J. Br. Diabet. Assoc.* 2009, 26, 900-907.

> Portions and frequency of consumption

Globalisation, urbanisation, changes in lifestyle and in the food chain have led to a change in eating habits and the loss of traditional food cultures. These changes, along with increased availability and marketing of low nutritional value products, highlight the need for a simple, practical and coherent food guide, to allow people to choose a healthy diet, to prevent disease and to guide countries in developing policies for food, health and agriculture. The guidelines for a healthy diet show how you can follow a healthy and balanced diet, that meets nutritional needs. Claims are often **summarised in graphical form as a pyramid (Spain), a plate (USA) or a wheel, and vary from country to country** de-

pending on their cultural heritage. France has a ladder with nine rules (9 Repères), Sweden has one of the Food Circle (Matcirkeln) accompanied by an ideal diet for men and women, while the United States has the dish (My Plate); but in general the representations try to make the concept of a balanced diet easily understood: One eats in order to meet the daily requirements for **essential nutrients like carbohydrates, proteins, fats, vitamins, minerals, fibre, and water**.

To facilitate the daily task of composing the puzzle of the essential nutrients, foods were divided into groups, according to the substances they contain and bring to the body. The correct consumption from a nutritional point of view is composed of at least one or more foods selected each day from each group, trying to vary the options and adjust the quantity to the specific nutrient and energetic needs, taking special care not to leave out any food group.

Many dietary guidelines have common rules. For example, most promote variety and increased consumption of plant foods, especially vegetables and fruits, as well as reduced intake of saturated fat, salt and sugar. But each set of dietary guidelines contains unique features to meet the food needs of the population of each country.

In fact, the guidelines give indications on portion sizes and their frequency of consumption, but how many keep to these guidelines? It is now clear that the size of food portions in general and those of packed portions in particular have increased over the last 30 years²⁰, so as to suggest that this is one of the factors that has contributed to the increase of obesity.

In 2014 the SINU (Italian Society of Human Nutrition) published the new RDAs²¹ (Recommended Daily Allowance for the Italian population) also containing



²⁰ Benton D. Portion size: what we know and what we need to know. *Crit Rev Food Sci Nutr.* 2015;55(7):988-1004.

²¹ SINU 2012. Italian Society of Human Nutrition. RDA levels of Nutrient Reference intake and energy for the Italian population. Revision 2012

GROUPS OF FOOD	FOODS	STANDARD PORTIONS (g)	PRATICAL UNITS OF MEASUREMENT
MEAT FISH EGGS	meat "red" fresh/frozen (bovine, ovine, pork, equine)	100	1 slice, 1 hamburger, 4-5 pieces of stew, 1 sausage
	meat "white" fresh/frozen (chicken, turkey, other poultry, rabbit)	100	1 slice of chicken or turkey breast, 1 small chicken leg
	cured meats	50	3-4 medium slices of ham, 5-6 medium slices of salami or bresaola, 2 medium slices of mortadella
	fish, shellfish, fresh/frozen shellfish	150	small fish, 1 medium fillet, prawns 3, 20 shrimp, 25 mussels, fish, molluscs, crustaceans
	fish, molluscs, preserved crustaceans	50	1 small tin of oil or brine tuna, 4-5 thin slices of smoked salmon, 1/2 fillet of cod
	egg	50	1 egg
LEGUMES	fresh vegetables or canned	150	half a plate, a small box
	dry legumes	50	3-4 tablespoons
LATTICINI	milk	125	1 small glass, 1/2 medium cup
	yogurt	125	1 cup
	fresh cheese	100	1 small mozzarella cheese
	hard cheese	50	-

Portions of reference for protein foods

the suggestions relating to the portions of each food. The nutritional guidelines INRAN (now CREA - Alimentazione e Nutrizione)²², recommended for the various bands of energy requirements suggest what and how many servings of each food group should be consumed so that the food consumption is varied and balanced.

For the construction of the Environmental Hour-glass, an intermediate energy requirement (2100 kcal) has been considered.

²² Nutritional guidelines developed in 2003 by a working group composed by INRAN (today CREA - Alimentazione e Nutrizione), with the aim of developing a type of diet to suggest to the citizens, recommending the appropriate variations.

MEAT IN THE MEDITERRANEAN DIET

The Mediterranean Diet has always been the consumption of animal proteins. In fact in the Mediterranean Dietary pattern, **meat, fish, eggs and legumes** are considered part of the group of foods that provide protein.

This model invites you to select a variety of protein foods to improve your intake of valuable nutrients for health. What is correct however, is the suggestion to limit their consumption according to **portions and frequencies that depend on age, sex and physical activity levels**. Especially for meat, the fundamental suggestions are to prefer lean cuts and to prepare seasoning using only extra virgin olive oil, limiting sodium intake.



THE NUTRIENTS OF MEAT

Meat and meat derivatives have for centuries been one of the most important foods for human nutrition. The type and amount of meat consumed in the past has been conditioned by several factors (religion, social status and supply), but there is no doubt that the consumption of meat has played a key role in the development of human civilisation. For example, **the development of the brain and its function was only possible thanks to an omnivorous diet**, which provided a lot of energy and specific nutrients²³ typical of meat and fish. The human digestive system is typically omnivorous, and has developed capabilities and enzymes useful for the assimilation of animal and vegetable foods. Precisely the development of the brain and the social relationship with hunting related practices have contributed to the evolution of intelligence, the development of language skills and the ability in planning, cooperation and socialisation.

²³ Pereira PM, Vicente AF. Meat nutritional composition and nutritive role in the human diet. Meat Sci. 2013 Mar;93(3):586-92.

Homo sapiens is thus a perfect example of an **omnivorous species**. Only later did the environmental constraints, such as the need to support a high population density, accompanied by cultural adaptations (dietary restrictions and taboos, usually incorporated in religious commandments), transform meat into a relatively rare commodity for most people in traditional agricultural societies.

A return to a higher consumption of meat in the world began in Europe and North America with the acceleration of industrialisation and urbanisation during the second half of the 19th century: the past 100-150 years, have recorded the fastest form of evolution than in all previous history: **people in a short time grew taller and saw an increase in longevity**. Not only have health care and medical knowledge improved, but also nutrition has played a key role. In the second half of the nineteenth century there was still a widespread Italian dietary problem. A substantial differentiation in weight and height was seen, that depended on the economic and therefore nutritional availability (especially in availability of meat and other noble foods): a 17 year old poor man had the height of a wealthy 14 year old ; at 19 the poor man had the height of a rich 15 year old and the height difference between a poor and a rich 19 year old was in average 12 cm²⁴.

In general, a balanced diet that includes foods both of animal and vegetable origin, fosters harmonious growth, **but removing any one of the forty or fifty essential nutrients makes the body stop growing**: only **iron deficiency** during the first years of life and its development can lead to a reduced linear growth and a **reduction in the IQ of a boy with respect to his potential**.

²⁴ F.S. Nitti. Writings on the Southern question, Vol II, Laterza, Bari 1958, p 180.



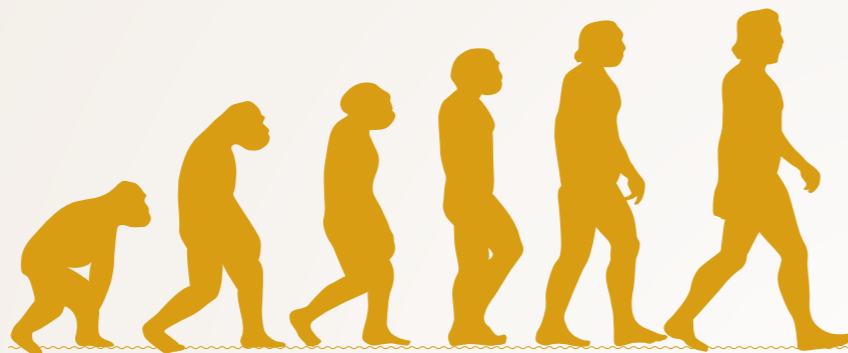
THE ROLE OF MEAT IN THE MEDITERRANEAN DIET

SOCIAL HISTORY OF MEAT IN ITALY

Edited by Silvana Chiesa - University of Parma

The presence of meat in human food is demonstrated by the fossils found in all the archaeological sites, from the Upper Paleolithic to the Neolithic, showing that even the hominids were omnivores, alternating their diet of plant foods with meat consumption. The concomitant presence of finds of broken animal bones and sharp tools to cut the carcasses, however, does not say much about the supply of meat. It appears that *Homo Habilis*, as with *Homo erectus*, consumed both those coming from the carcasses of animals that were already dead (killed by other predators), and by those procured by group hunting. Nothing is known instead of the vegetable consumption of those times, because there are no "remains" to be subjected to chemical/physical analysis.

The arrival of *Homo sapiens* and his settling permanently in temperate areas, seems to have had as an initial result an increase in meat consumption to compensate for the periodic shortage of plant food in adverse seasons of autumn and winter²⁵. Later, with the constant use of fire to cook food and the phasing out of hunting in favour of agricultural harvesting practices, created the foundations for the "birth of ag-



riculture and civilisation" and from the point of view of food consumption, the fundamentals of what we now call the "**Mediterranean Diet**".

By choosing to practice agriculture to produce their own food men gradually changed not only their **lifestyle, which from nomadic became stable**, but also profoundly changed the natural environment in which they decided to settle. To create cultivated areas he practiced systematic deforestation, control and deviation of watercourses, levelling and fencing of the land, artificial seeding, collection and conservation of seeds obtained and ultimately the transformation of the seeds into food.

All this work found its greatest expression in the production and consumption of a novel food, bread, which in nature does not

exist and that symbolises the abandonment of the so called "wild" man.

If bread became a symbol of civilised human beings who no longer consumed only what nature gave him, but also what he had invented, even meat could no longer derive only from hunting, becoming the product of "choice", from the domestication and selection of some animal species. The breeding of sheep, cattle and pigs, in fact, becomes itself a symbol of civilisation and detachment from the "wild" life; **so much so that the men had to build fences and shelters for animals, protect them from wild predators, to ensure that they always had food and water available: in a word, they became farmers.**

²⁵ Perles C., Food strategies in the prehistoric age, essay in Flandrin-Montanari, Food History, 2007, pp. 12-25.

The sinatropia

This "closeness" between humans and animals (*sinatropia*) posed, perhaps for the first time, the problem of "guilt" inevitably resulted by the killing of the animals, in particular the bovine called "Ox plougher", considered a valuable help to mankind. The ritual sacrifices to the gods have been interpreted as a means to justify the violent acts against a *sinatropus* animal, and the subsequent division and consumption of meat as a moment of sharing and social recognition²⁶. In fact, men were divided between "participants" and "outsiders" to the sacrificial feast, and subsequently the distribution of meat distinguished those who were entitled to the first and most abundant portion (*princeps*) and to those who shared the rest (*populus*)²⁷. From all this we can understand

that if on one hand the consumption of meat in ancient Mediterranean cultures was scares and occasional, on the other an ideological and symbolic point of view was strongly marked: "Meat, an exceptional food, which implies the killing of the animal, is the food of important moments, related to the strengthening of the festive commensality among men and the establishment of a relationship between the human world and the gods²⁸".

Naturally in such a significant context, leads to the birth and identification of a movement rejecting the ritual of sacrifice and the consequent decrease in the consumption of meat. Among the first we can identify are the Orphic and Pythagorean movements which, in turn, applied strategies of cohesion and identi-

ty by refusing to participate in the sacrificial rites.

In the Roman world, from the Republican to the late imperial age, we see a gradual increase in the consumption of meat especially in the cities and among the upper classes. This can be justified in part with district procurement policies and in part with the progressive freedom from slaughter by the religious rituals, to be incorporated into a series of standards of "hygiene and protection of public health", as one would

²⁶ Grottanelli C., Parise N.F., Sacrifice and society in the ancient world, Roma-Bari, Laterza 1993

²⁷ Scarpi P., The effect of food, Palermo, Sellerio, 2005, pp.23-27

²⁸ Grottanelli C., Meat and its rituals, essay of Flandrin-Montanari, Food History, 2007, p.83



say today. The gradual emergence of Christianity also freed the consumption of meat from sacrificial rites, but retained (and sometimes strengthened) the use of celebrating the major religious holidays with meat banquets. In Italy the so-called “Mediterranean Diet” was challenged in its principles of identity (bread as the main food, then cereal baby foods, vegetables, dairy products and a little meat) since the onset of the Roman-Barbaric kingdoms (from the fifth century AD), which brought into vogue the cultural, economic and food values of the populations from northern Europe. These, while practicing agriculture (cultivating barley to produce strong drink), are represented as meat eaters, especially pork and/or hunted game.

The barbarian culture, which would become elaborated in the **Italian medieval culture**, considered meat as the **most important source of strength and energy to man and in this logic it became the prerogative of the great warriors, the leaders and the powerful**. Even the conversion of the Barbarians to Christianity in a sense strengthened the symbolic value of the meat, because the “penance” which obliged people to respect the fast days, when the consumption of meat was banned (Lents, Wednesday and Friday of each week), took on great importance and significance only if inserted in a highly carnivorous culture. The same consideration can be made about the food choices of

the origins of monasticism (V-VI century), who considered the abstention from eating meat an obligation for religious men and women who, in this way, marked the “difference in life style” between themselves and those who lived “in the world”.

From the rule that Leandro Sevilla wrote for his sister Fiorentina in 580 A.D. one reads:

“... Who has sufficient strength should abstain from meat. It is a hard condition, in fact, to feed the enemy against whom you fight and to feed one’s flesh in order to feel rebellious. / If the Virgin makes use of the same things as those living in the world, this suggests that she does what all women do in the world. / What can meat fed on meat do, if not abandoning to lust and become an ally to the miserable cruelty of lechery?”

Even the **medieval medical thinking** believed that the consumption of meat was necessary to **restore a “healthy body”** and

was common and widespread knowledge of which there are traces in the dietary rules such as the “Regimen Sanitatis”, but also in the monastic rules:

“... I do not dare neither forbid nor allow the eating of meat because of your weakness... Who has sufficient strength should abstain from meat Those in need of physical force should make use of meat; for example, those who work in the mines, fighting in war, who build tall buildings or those who labour hard in different jobs. The use of meat is capable of regenerating strength²⁹”.

“... One never eats meat. / chickens or any other type of volatile are not be distributed in communities / they are to be obtained only for the sick and for those with delicate health³⁰”.

“But allow the really weak to eat meat, so they may get better; as soon as they feel better, they should abstain from meat as before³¹”.

The period between the IX and XII centuries is the most prestigious for the consumption of meat, also representing the era in which almost the entire population (regardless of class) was able to gain access to this resource through an economy defined **agricultural-forestry-pastoral**, namely where agriculture was (almost entirely absorbed by the production of cereals and legumes) supported by breeding and by the exploitation of uncultivated areas where hunting was practiced to catch large prey (hunting by noble) as well as smaller mammals (by farmers and peasants). The fact that almost everyone could eat meat, though, does not mean that this was the same for everyone: different “quality and quantity” in targeting various social classes signalled, referring to the studies of **J. L. Flandrin**³², what has been **called the meat statute**, meaning by this term all the **social, economic, political and cultural factors that meat consumption represented**. If in fact

from the ninth to the twelfth centuries warriors, nobles and rich ate meat from large mammals (cattle, bears, deer, fallow deer, wild boar), and in larger quantities, or at least at banquets show an abundance of meat, the lower classes ate chickens, geese, rabbits, hares, and especially pig that provided, with **cured meats and sausages, meat reserves for the winter**.

Even the religious, especially the most senior echelons of the monasteries and major dioceses, while respecting scrupulously the abstinence during fast days show impatience towards the prohibition of meat consumption. A fine example is what Peter Abelard writes in the twelfth century: “If the same pontiffs, the leaders of the holy Church and the clerical communities can eat meat without sin, because they are not bound by any vote, who could be blamed for patronising women, especially if they bear a greater need of the rest? ... We, therefore,

considering both possibilities of men and their nature, do not forbid any food, but only excess. We therefore wanted to adopt a measure for the use of meat: not to eat it more than once a day, not to offer the same person several portions, **nor to add other dishes, that it not to be allowed to eat more than three times a week**, i.e. on Sunday, Tuesday and Thursday, even if it interposes holidays³³”.

From the thirteenth century onwards there were a series of political and economic changes where the noblemen, owners of lands and forests, prohibit peasants and farmers access to forests and subsequently therefore had no longer a free and plentiful supply of meat. This led to the radicalisation of two opposing eating patterns: that of the countryside, which consumed very little meat, and that of the city, where all food (including meat) was always available, the only limit being economic wealth.

Gastronomy also became organised on the same basis, developing an urban and “bourgeois”



²⁹ Rule of Leonardo (580 d.C..)

³⁰ Rule of Aureliano FOR VIRGINS (VI century)

³¹ Rule of Benedetto (X century)

³² Flandrin J.L., Chronique de Platine. Pour une gastronomie historique, Parigi, Odile Jacob, 1992.

³³ Rule of Abelardo (1140)



model which focused on cooking meat (especially beef) as a symbol of wealth, refinement and sophistication, while rural gastronomy foresaw very few meat dishes, mainly pork, chicken and rabbit, and above all was characterised by the attention to the use of all the animal parts (muscles and viscera) and an abundance of recipes for “second processing” (from **meatballs and meatloaf to “redone” meat**), in order not to **waste such a rare and much desired food**.

The chronic shortage of meat among the Italian rural populations became a constant that lasted until the early twentieth century, even if the information received unfortunately disregards any qualitative / quantitative figures, relying mostly on narratives or dramatic writings from doctors and nurses.

With the birth of the unified Italian State (1861) and later with the establishment of the Institute of Statistics (ISTAT), we finally had objective data confirming the small amount of meat consumption (about 11 kg / year per person) but without differentiating the quantities between city dwellers and residents of the countryside³⁴.

That meat was still one of the most desired foods, can be seen especially from the testimony of Italians, who due to hunger and misery had to face the migratory adventure starting from Eighteen Eighties, involving Piedmont, Veneto, Calabria, Sicily, etc.. The

destinations were mostly Argentina, United States, Brazil and the news they shared almost always showed amazement for the food consumption in the destination countries, particularly in the abundance of meat and the possibility to eat it every day if so desired (!)

In a letter written in 1878 coming from Rio Grande do Sul (Brazil) is stated:

“... Food was plenty for everyone because we killed a cow a day, had enough soup and bread and plenty of coffee ...”

A Venetian farmer in 1888 in Esperanza (Argentina) said:

“Here, from the richest to the poorest, all live on meat, bread and soup every day³⁵! »

A farmer in Cuneo recalls in an interview:

“My father was born in 1870. He left for adventure embarking for Argentina ... The only thing that was not missing was meat, therefore they did not go hungry. In Argentina meat was like our cornmeal porridge here. They killed a calf and cooked it on the spit. They then cut off pieces of meat with a knife and ate³⁶».

Finally, even the labourers from Calabria that arrived in the United States were surprised by the “equality” of the eating habits, which consisted in the fact that everyone could have access to daily meat consumption:

“When you came home with that great steak, you know, as thick

as this, with all the blood that we are not used to in Italy... And you eat... There is no jealousy in America. We all eat the same, all the same steak, all at the same table, all equal... ”

In 1890 the results of the Inquiry on the hygienic and sanitary conditions of the workers of the land by Mario Panizza were published in Italy (a compendium of the more popular Enquiry Jacini-Bertani) and once again the constant food shortages in rural populations was stigmatised, with a strong focus on the lack of an adequate consumption of meat, which was limited to the religious feasts, weddings, baptisms and little else.

This situation continued until the first third of the twentieth century. What **Ancel Keys saw in central and southern Italy at the end of the Second World War, was in fact, a chronic habit of not eating meat due less to a “lifestyle choice”, but more to the result of centuries of “chronic inability to gain access to the consumption of meat”.**

³⁴ Zamagni V., The evolution of consumption between tradition and innovation, essay in Italian history. Annals 13. The Power, Torino, Einaudi, 1998, pp.175-182.

³⁵ Franzina E., Merica! Merica! Emigration and colonisation in Venetian peasant letters in Latin America (1876-1902), Milan, 1979 pp 90, 176.

³⁶ P. Corti, Emigration and eating habits in the essay of Italian history. Annals 13. Alimentation, Torino, Einaudi, 1998, p.698

The 1960s represented for Italy a period of great economic development, which enabled her country to finally defeat hunger and the areas of undernourishment. The consumer food model became widespread and meat, coveted for centuries, finally became available to everyone. Eating meat was a kind of declaration of freedom from misery and poverty. Doctors and paediatricians continued to suggest the consumption of meat as a factor for improving the growth of children and teenagers. The daily ration of meat for military conscripts was 200 g (even today this is the daily ration as per OG),

the meal canteens always included a meat dish, and throughout the following decade the “main course” in the Italian gastronomic tradition became almost exclusively meat based (steak, sliced, roasted, boiled, cutlet, escalope, ...) making them forget, for a time, the gastronomic variety that traditional nutrition had developed over the centuries.

The attitude towards the consumption of meat from half way through the 1980s began to change: forgotten the initial enthusiasm, the fact that hunger had been reduced and that in Italy certain health disorders be-

gan to be linked to an excessive consumption of meat and animal fats triggered an equal and opposite reaction: the consumption of meat was considered one of the main risk factors of the so-called “diseases of well being”. This led to the elaboration of a new model of Mediterranean Diet that, taking the example of the gastronomic culture of the Mediterranean countries, proposed as a source of food: bread, pasta and the use of the rich heritage of vegetables, fruits and cheeses that characterises precisely the Mediterranean, bringing meat consumption to be the necessary complement for a balanced diet.



> Nutrient basics of meat and cured meats

The positive nutritional value of meat and cured meats can be summarised in two fundamental aspects: on the one hand the presence of **proteins (with complete composition in essential amino acids)**, on the other, the high concentration of trace elements always considered essential for the growth and development of mankind. Many of the micronutrients supplied by meat are involved in the **regulation of energy in the metabolism processes**.

A further very important feature is the simultaneous presence of many of these micronutrients, a factor that can be of great importance: **vitamin A** (present in large quantities in entrails) and **riboflavin** are, for example, both necessary for the **mobilisation of iron**

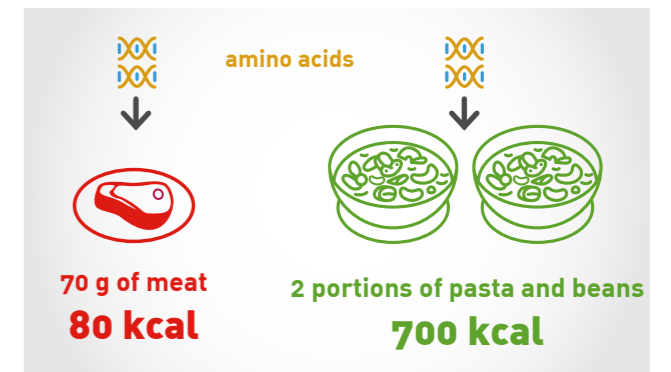
and **haemoglobin** synthesis to the point that the only administration of iron supplements cannot deal successfully with anaemia if these other nutrients are deficient. Protein-energy malnutrition, iron deficiency anaemia and vitamin A deficiency can be avoided if sufficient quantities of meat are consumed.

Many of these nutrients can of course also be found in foods of plant origin, even if in some cases they have a lower bioavailability, i.e. a reduced capacity of absorption by the human body and utilisation by the cells. When comparing the merits and defects of the **vegetarian diet and the consumption of meat**³⁷, it is evident that only the **presence of both in the nutrition** of an individual can effectively contribute to a

³⁷ Pereira PM, Vicente AF. 2013. Meat nutritional composition and nutritive role in the human diet. Meat Science. Mar;93(3):586-92. Review.

healthy and well balanced diet. To obtain, for example, the proper amount of essential amino acids from an exclusively vegetable diet, one is more than likely to introduce at the same time an excessive amount of other nutrients with respect to the needs of your body.

The combination of cereals and legumes is often referred to as an adequate substitute for meat because of its protein content, because the deficiencies of essential amino acids of cereals is covered by those of legumes and vice versa. **But to get the same protein quality of the amino acids contained in 70 grams of meat, a small slice that provides less than 80 kcal, you should consume 2 portions of pasta and beans, with an intake of more than 700 kcal.**



Obviously not all types and cuts of meat have the same characteristics. Muscle portions are richer in essential amino acids (a higher biological value and more digestible) than the connective tissues; the amount of fat (especially saturated) varies from species to species, and so on.

COMPARISON OF DIETS BASED ON MEAT AND VEGETABLES



ADVANTAGES

- High fiber content
- Generally lower energy content
- Major intake of antioxidants
- Less intake of saturated fats

DISADVANTAGES

- Lower iron bioavailability
- Risk of vitamin B12 and zinc deficiency
- Risk of lack of EPA + DHA sources
- Protein with low biological value



ADVANTAGES

- High nutritional density
- Protein with high biological value
- best source of iron, zinc and vitamin complex of group B, especially B12

DISADVANTAGES

- High fat/saturated fat content in some meat cuts
- Sodium content (cured meats)

Source: Pereira and Vicente, 2013

	KCAL	PROTEIN (g)	FATS (g)	CHOLESTEROL (mg)	SAFA (g)	MUFA (g)	PUFA (g)	VITAMIN B12 (µg)	IRON (mg)	ZINC (mg)
Beef Front cuts	145	20.5	7	66	2.20	2.27	1.55	2.00	1.30	4.47
Beef Hind cuts	117	21.5	3.4	60	1.14	1.12	0.68	2.00	1.60	3.30
Veal lean meat	92	20.7	1	70	0.42	0.48	0.04	2.00	1.20	2.80
Pork, lean meat, without fat	268	17.2	22.1	88	7.81	8.64	3.44	1.00	1.40	1.80
Pork, semi-fat meat, without fat	141	19.9	6.8	61	2.17	2.31	1.77	1.00	1.70	1.80
National ham*	235	27.8	13.7	75	4.84	6.35	1.89	0.38	0.80	2.10
Baked ham*	138	15.7	7.6	49	3.20	3.52	0.50	0.09	0.50	1.10
Whole chicken with skin	171	19	10.6	93	3.27	4.12	2.29	TR	0.60	1.10
Whole chicken without skin	110	19.4	3.6	75	1.23	1.08	0.81	1.00	0.70	1.30
Whole turkey with skin	135	18.2	6.9	195	2.22	1.66	2.96	2.00	0.90	2.80
Whole turkey without skin	109	21.9	2.4	63	0.90	0.62	0.60	2.00	1.00	2.70

The nutritional composition of meat and its micronutrients varies depending on the animal species and different types of cut. Data come from the Food Composition Database for Epidemiological Studies (BDA) or * CREA - Alimentazione e Nutrizione (ex-INRAN) food composition tables and refer to 100 g. of food

>> Proteins: the buildings blocks of our body

Proteins are essential nutrients, as they provide the amino acids used by the body to synthesise proteins for several vital roles:

- **structural** (skeleton, skin, fabrics and supporting tissues, cells)
- **protective** (barriers, immune system, anti-inflammatory)
- **transportation and communication** (plasma proteins, hormones, membrane receptors)
- **enzyme** (digestion, metabolism, homeostasis, synthesis)
- **energy** (energy source)

The **amino acids necessary** for the synthesis of proteins useful to man are 20, but they are not all the same: 8 of these are **considered essential** because the body **cannot produce them and they must necessarily be taken with food** (Figure 2).

Furthermore, it is essential to remember that each protein synthesised by the body has a composition of specific amino acids and when it is synthesised it requires the presence of all the amino acids that it is composed of: if even one of these is deficient, the synthesis of the protein is limited. In reality there is no specific dietary requirement for proteins, but these should be taken so as to provide all the amino acids necessary for synthesis by the body. **In children** amino acids such as **cysteine, taurine, tyrosine, histidine** and **arginine** are considered **semi-essential**, in that not all the synthesis mechanisms are fully developed.

On the basis of the characterisation of protein amino acids it is therefore possible to identify which foods have high biological protein value, and are therefore able to provide all essential amino acids.

Among the essential amino acids, **methionine** plays a key role in the growth of the individual. The proteins of plants are in general poor in sulphur amino acids such as methionine, on average 0.6 g/100 g of protein,

while red meat, poultry and fish contain between 1 and 1.26 g of sulphur amino acids/100 g of protein.

More generally, plant proteins are considered to be of lower quality as they are **unbalanced in the relationship between cysteine and methionine** necessary for the growth, which should be in favour of methionine. From the total number of amino acids containing sulphur, red meat, poultry and fish have 30-40% of cysteine and 60-70% of methionine, while soy, beans, peas and lentils have 60% **cysteine** and 40% of **methionine**³⁸.

ESSENTIAL AMINO ACIDS	NON-ESSENTIAL AMINO ACIDS
Phenylalanine	Aspartic acid
Isoleucine	Glutamic acid
Leucine	Alanine
Lysine	Arginine
Methionine	Asparagine
Threonine	Cysteine
Tryptophan	Glycine
Valine	Histidine
	Proline
	Serine
	Tyrosine

Figure 2 - The essential and non-essential amino acids: essential ones have to be assumed by food, because the human organism is not able to produce them.

AMINO ACIDS (mg PER 100g OF EDIBLE PORTION)	HAM*	BEEF FILLET	FARMED BREAM (FILLET)	WHOLE COW'S MILK	WHOLE EGG	FRESH BORLOTTI BEANS	PASTA
Phenylalanine	143	836	1540	176	662	601	542
Isoleucine	194	886	870	192	657	556	455
Leucine	269	1763	1524	355	1041	885	834
Lysine	503	1866	1988	272	880	714	219
Methionine	81	588	780	81	437	120	183
Threonine	174	836	878	164	623	428	314
Tryptophan	32	230	259	50	197	113	105
Valine	183	990	969	233	823	616	544

Figure 3 - Composition of some amino acids in proteins. Source: Data processing of Food Composition Tables - Agg. 2000 - INRAN * agg 2013

Another protein evaluation method recently developed by the scientific world is the DIAAS (Digestible Indispensable Amino Acid Score), which defines with a numeric index the protein quality of certain foods: the higher the value, the better the protein quality (Figure 4).

FOODS OR PROTEIN ISOLATES	DIAAS VALUE
Whole milk	139
Beef	131
Isolated whey protein	125
Soybean isolated	102
Chickpeas	66
Peas	64
Rice	64
Corn	52
Barley	51
Wheat	43

³⁸ Mele M., Nudda A., Pauselli M., Roscini V., Casarosa L., Secchiari P., Pulina G. 2015. Consumption of meat and human health. In: Animal Health and Food origin. Ed. Franco Angeli. Pp.400.

Figure 4 - Protein value index of foods. Source: B. Caballero, Finglas PM, Toldrà F. 2015. Encyclopedia of Food and Health. Academic Press

If it is clear therefore that the nutritional value of animal protein is high, it is also interesting to assess the protein content of food compared to the portion recommended by the new RDAs³⁹ with respect to the caloric intake. **Fish and meat have the highest protein caloric efficiency** (Protein/Kcal*100), i.e. per portion they bring a higher proportion of high quality protein, but with a reduced caloric intake (Figure 5): a **remarkable advantage in terms of overweight and obesity prevention**. The vegetable proteins are often associated with a low content of saturated fat and are therefore recommended as an alternative

to animal proteins. But **if we wanted to cover our protein needs using only plant-based foods**, we would have to assume between **3 to 5 times more calories than the calories obtained from foods of animal origin**, particularly from lean cuts of meat or fish.

³⁹RDA for taking nutrients and energy for the Italian population

FOOD	SERVINGS (g)	PROTEINS (g)	KCAL	PROTEIN ENERGY EFFICIENCY
Fish, molluscs, crustaceans (bream)	150	29.70	141	21
Meat (beef tenderloin)	100	20.70	107	19
Processed meats (ham)	50	13.90	117	12
Eggs	50	6.20	64	10
Ripened cheese (Parmesan cheese)	50	16.75	193	9
Fresh or canned legumes (beans)	150	15.30	199	8
Fresh cheese (mozzarella)	100	18.70	253	7
Dried legumes (borlotti beans)	50	10.10	145	7
Yogurt	125	4.75	82	6
Milk	125 ml	4.12	80	5
Pasta	80	8.72	282	3
Corn	80	7.36	282	3
Bread	50	4.30	144	3
Rice	80	5.36	265	2

Figure 5 - Caloric and protein content of some foods.
Source: Data processing of Food Composition Tables - Agg. 2000 - INRAN * agg 2013

>> Fats: an important source of energy, without exaggerating

According to the principal nutritional indications, fats should cover between **25% and 35%** of total energy intake by an individual because, if ingested in the appropriate quantities, hold a number of important roles: they provide **essential fatty acids (such as linoleic acid and alpha-linolenic acid) and fat-soluble vitamins (A, D, E and K)**; they represent a major source of energy; **promote a sense of satiety** due to the effects on the slowing of gastric emptying and reduce, for the same reason, the bioavailability of carbohydrates (and, therefore, the glycemic response); finally, they improve the flavour, odour, and texture of the foods. But all fats, as well as carbohydrates, are high in calories. And if you consume more calories than you need you gain weight.

The World Health Organization estimated that excess weight is responsible for 21% of cases of ischemic heart disease, 23% of ischemic strokes, 58% of type 2 diabetes and 39% of cases of hypertension. Obesity also increases the risk of certain types of cancer, as well as the risk of non-fatal diseases, such as joint problems and infertility⁴⁰.

Saturated and unsaturated fatty acids: stearic acid, no effect on total cholesterol and LDL

Saturated and unsaturated fats differ in the composition of their molecule: a saturated fat has individual chemical bonds between the atoms that compose it, while an unsaturated fat has at least one double bond. It is this double bond that makes it unsaturated, incomplete, because there would be the possibility of adding hydrogen to the double bond to make it saturated, i.e. devoid of space for new additions. **Liquid fats** are composed mostly of **unsaturated fats, such as olive oil** which is a monounsaturated (i.e. has a single double bond) and **solids** (for example **margarine, butter or palm oil**), are for the **majority saturated**. Fats are found in

both in plant-based foods, and in the food of animal origin. With a few exceptions, such as tropical oils (palm and coconut), vegetable fats are mostly of the unsaturated type, while among animals fats are composed for about half the saturated fatty acids.

For several decades dietary guidelines have recommended reducing the consumption of saturated fats, considered to be responsible for some cardiovascular diseases, thus leading to a significant reduction in the consumption of animal products, especially meat based. It should be remembered that saturated fats are not all the same, because some contribute more than others to cardiovascular risk, in addition to the increasing evidence of the role of carbohydrates for these conditions. Furthermore, the major constituent of the saturated fat content of meat, **stearic acid, has been shown to have a neutral effect on total cholesterol and LDL cholesterol (low density lipoprotein)**.

⁴⁰ World Health Organization. (WHO 2011a). Global status report on non-communicable diseases 2010. Geneva: World Health Organization



FOOD	FAT (g)	OF WHICH SATURATES (g)	OF WHICH SATURATES (%)
Parmesan cheese (50 g)*	14.05	9.27	66%
Salami (50 g)*	19.15	7.24	38%
Milk chocolate (30 g)*	11.28	6.75	60%
Croissants, brioche (50g)*	9.15	5.10	56%
Butter (10 g)	8.34	4.87	58%
Palm oil (10 g)	10.00	4.71	47%
Sponge cake type snacks (50 g)*	11.15	4.70	42%
Margarine (10 g)*	8.28	4.25	51%
Shortbread cookies (40 g)*	8.40	4.18	50%
Pork steak (100 g)	8.00	3.66	46%
Whole chicken with skin (100 g)	10.60	3.27	31%
Cheese crackers (30 g)*	7.65	2.83	37%
Ham (50 g)	6.85	2.42	35%
Cattle front cuts (100 g)	7.00	2.2	31%
Peanut oil (10 g)*	10.00	1.93	19%
Egg (one egg 61 g) *	5.30	1.93	36%
Baked ham (50 g)	3.80	1.60	42%
Extra virgin olive oil (10 g)	10.00	1.44	14%
Whole skinless chicken (100 g)	3.60	1.23	34%
Cattle rear cuts (100 g)	3.40	1.14	34%
Veal tenderloin (100 g)	2.70	1.14	42%
Cocoa and hazelnut cream (10 g)*	3.24	0.99	31%

Figure 6 - Content of fat from some of the main foods - Source Tables of Food Composition - Research Centre for Food and Nutrition;* Source: The Data Bank of Food Composition for Epidemiological Studies in Italy - BDA-IEO. The data refers to a portion according to the amounts suggested (with the exception of palm oil)

The growing attention to the quantity and quality of fats contained in meat has pushed producers and breeders to study production practices (cutting techniques) and breeding (animal diets), in order to generally produce more lean meat and also to favour the composition of more balanced fats. Cooking can have a powerful influence on fat in meat, as well as in the composition of the fatty acids. Some

authors have demonstrated significant reductions in the amount of fat in different cuts of meat cooked on the grill or in the pan without any added fats. In particular, with regard to the fatty acid composition, there was an increase in the polyunsaturated/saturated ratio, probably because polyunsaturated fatty acids are part of the cell membrane and therefore tend to remain in the meat fibres.

MEAT IS INCREASINGLY LEAN

It is estimated that in the US alone the total amount of fat in products derived from cattle has decreased by 44% since 1970⁴¹. Even in Italy the meat has noticeably "lost weight". If you compare the data of food composition tables (INRAN - National Research Institute for Food and Nutrition) for 1996 and 2005, you find that the fat in **beef tenderloin** went from **5% to 2.2% (-56%)**, those of sirloin from 5.2% to 2.9% (-44%). A reduction which affected all cuts of beef, but also pork and cured meats.

The new nutritional values of Italian cured meats emerged from the analyses carried out by INRAN and ASSICA (Experimental Station for the Food Preserve Industry) in 2011, and confirmed


that meats are even more nutritious than ever before and have a better nutritional profile, because of less fat, with less cholesterol, salt and preservatives and larger amounts of proteins, vitamins, minerals and essential fatty acids.


Pork since the 80s has reduced the content of fat by about 30%, also in order to meet consumer preferences.

The loin is the leanest part of both beef and pig, while the chest is typically the leanest part of poultry meat. The skin is the main source of fat in poultry meat. The fat content in major retail cuts of poultry varies from 1 to 17%, and the cuts containing the skin have the highest values. In particular, the energy value of poultry meat

varies between chicken breast and chicken thighs with skin: the presence of skin (due to its fat content) increases the caloric value by about 25-30%. Fats, residing mainly in the skin, can then be easily removed. The lipid content of chicken and turkey is about 1% in the leaner cuts, such as chicken and turkey breast, and about 17% in chicken wings cooked with the skin. However, compared to other types of meat, poultry seems to be relatively low in fat.

⁴¹ McNeill SH, Harris KB, Field TG, Van Elswyk ME. The evolution of lean beef: identifying lean beef in today's U.S. marketplace. Meat Sci. 2012 Jan;90(1):1-8.

BEEF 	FATS (%)		REDUCTION
	1996	2007	
Eye round	2.8	1.1	-61%
Tenderloin	5.0	2.2	-56%
Striploin	5.2	2.9	-44%

PORK 	FATS (%)		REDUCTION
	1993	2011	
Baked ham	14.7	7.6	-49%
Ham- San Daniele IGP	23.0	18.6	-19%
Mortadella	28.1	25.0	-11%

Comparison of lipid content reduction in some Italian cured meats

Cholesterol: new research completely redeem meat

To determine the nutritional value of meat it is best to take into consideration the content of cholesterol, which in red meat is between 49 and 88 mg/100 g, while in poultry is between 63 and 195 mg/100g. The cholesterol content in the liver is the highest. Lean meat has a low energy value which, in a proper diet, also reduces the concentration of plasma lipids, as indicated by several authors.

For example, in one study it was assessed how **lean beef and that of skinless chicken** have similar effects on plasma lipoproteins and how **interchangeable they can be in diets aiming for the reduction of cholesterol levels**. In a similar study, other authors compared the effects of lean red meat and lean white meat. **In the long experiment, which lasted 36 weeks, diets with one of the two types of meat reduced the level of LDL cholesterol and increased the good cholesterol HDL in the plasma**⁴².

The use of meat in diets to lower cholesterol levels in the blood however, only applies to lean meat.

>> Vitamins and Minerals: essential micronutrients for metabolic functions

Meat is an excellent source of several vitamins and minerals, essential micronutrients present in biochemical forms that make them easily assimilated. A 100 grams of red meat will provide around 25% of the recommended daily allowance (RDA) for **riboflavin, niacin, vitamin B6 and pathogenic acid, and two-thirds for vitamin B12**.

The chicken breast is a particularly good source of niacin (100 g will provide 56% of RDA) and vitamin B6 (27%), while 100 g of turkey breast provides 31% of niacin and 29% of vitamin B6. Meat is also one of the best sources of **zinc, selenium, phosphorus and iron**: the lean cuts from cattle provide around 37% of the reference selenium intake, 26% zinc and 20% of potassium in a portion of 100 g.

Lean red meat contains a number of vitamins and minerals that are important for all the stages of life. For some of these nutrients, meat could be defined⁴³ as “**source of**” or “**rich in**”, using the European Union’s assessment, which is based on the recommended daily allowances (RDA). Food can be defined as a “**source of**” if they contain $\geq 15\%$ of RDA per 100g for a particular vitamin or mineral, or as “**rich in**” if they contain $\geq 30\%$ of the RDA.

Figure 7 shows which nutritional indications a slice of red meat of a 100 grams could bring.

⁴² McAfee AJ, McSorley EM, Cuskelly GJ, Moss BW, Wallace JM, Bonham MP, Fearon AM. Red meat consumption: an overview of the risks and benefits. Meat Sci. 2010 Jan;84(1):1-13.

⁴³ REGULATION (EC) No 1924/2006 OF THE EUROPEAN PARLIAMENT AND COUNCIL of 20 December 2006 relative to nutrition and health claims made on foods

NUTRIENTS	RECOMMENDED DAILY ALLOWANCES (RDA) ⁴⁴	CATTLE	VEAL	PORK
Thiamine (mg)	1.1	source of	-	rich in
Niacin (mg)	16	rich in	rich in	rich in
Vitamin B12 (µg)	2.5	rich in	rich in	rich in
Vitamin D (µg)	5	-	source of	-
Iron (mg)	14	-	source of	-
Selenium (mg)	55	-	-	source of
Zinc (mg)	10	rich in	rich in	rich in
Potassium (mg)	2,000	source of	source of	source of

Figure 7 - Content of red meat micronutrients, classified as a source of rich in (REGULATION CEN. 1924/2006) on nutrition and health claims made on foods.

⁴⁴ DIRECTIVE 2008/100/CE



VITAMIN B12

Meat and cured meats bring to our body a significant amount of **vitamin B12**, important for several body functions especially with regards to **red blood cells**. It is in fact involved in haemoglobin synthesis, where it acts in combination with folic acid in the formation of blood cells. The **vitamin B12 deficiency** is the leading cause of megaloblastic anaemia and is strongly associated with high levels of homocystein



in the blood, which is a **risk factor for cardiovascular disease**. It can also **cause neurological disorders**. In children, vitamin B12 deficiency may be a risk factor for **neural tube defects**.

Vitamin B12 is found only in foods of animal origin, mainly in the liver, kidney, meat, fish, eggs, milk, shellfish; but however, can also be found in some types of algae. For **people** who follow **diets devoid of animal foods**, with the complete abolition of meat, fish, eggs and milk, it is essential to **use vitamin B12 supplements** to avoid the development of hypovitaminosis. The situation must also be kept under control for **vegetarians who while eating certain animal products (eggs and dairy), do not consume enough**.

>> An iron mine

Iron has a crucial role in maintaining health, as a deficiency for the body is connected to the malfunction of different biological mechanisms, as well as disorders in a child's growth and during development. Taking into account the physiological losses through skin, intestines, urinary tract, airways and menstruation in women, diet plays a vital role in maintaining the balance of iron.

EME and NON-EME iron

Iron can be found in a wide variety of foods, but it is essential to note that it can take two different forms: **heme-iron and non-heme iron**. The main difference concerns the ease of assimilation of the heme form: **the bioavailability of the heme-iron is greater by 15%** and is absorbed at the enterocyte level as an intact molecule, while the absorption of **non-heme iron** is bound to other components of the diet, which may increase or reduce the absorption, and is estimated at around 5%.

The assimilation of iron by the human body, in fact, can be facilitated or inhibited depending upon what other components are present in food. An example is the role of **meat proteins, which help to increase the absorption of iron and zinc from other dietary sources**.

Vegetable iron sources are particularly **rich in potential iron absorption inhibitors, such as phytates, and some phenolic compounds such as polymerised flavans**, that are found in legumes such as beans and broad beans. Legumes are also an important source of non-digestible carbohydrates, which can impair the absorption of iron. Although **ascorbic acid (vitamin C) can improve the absorption of non heme-iron**.

Heme-iron is present in haemoglobin and myoglobin, so it is only present in some foods of animal origin. In particular **meat is the best source of heme-iron**, because more than half of the iron in meat is the heme type. The adult bovine has the highest heme-iron content, the loin contains about 77%. Iron

both heme and non-heme is present in much lower amounts in poultry meat. The dark parts, such as the leg, contain slightly higher amounts. Pork, defined as a red meat, may contain the same amount or even less iron as a leg of chicken or turkey, therefore falling within the so-called white meats. An examination of Figure 8 also shows that there are differences even between different cuts or parts within the same species, largely due to the more or less intense activity of the muscles that make up the cut in question. It is evident, therefore, that the classification of meat under the colour appearance is of limited importance from a nutritional point of view and it would be much more informative to use the adjective referring to the kind of membership (beef, pork, poultry, sheep, etc.).

Meat and meat products can contribute **up to 18%** of the daily requirement of iron, an important contribution to a healthy, balanced diet and vital in the prevention of one of the most common nutritional deficiencies.

Despite its vital role in the human body, an overdose of iron can be dangerous. High doses of iron can cause damage to the intestinal mucosa and lead to systemic toxicity. This excess can also cause damage by free radicals in different tissues, and recently several studies have associated very high doses of iron with an increased risk of colorectal cancer, cardiovascular disease, infection, neurodegenerative diseases and inflammation. For these reasons there is a tolerable upper intake level, representing the highest intake without causing adverse health effects.

The value is 45 mg/day for adults, that would be achieved by consuming almost three kilos of beef every day.

		RAW MEAT		COOKED MEAT	
		TOTAL IRON	EME-IRON	TOTAL IRON	EME-IRON
CHICKEN	Chest	0.40	0.12	0.58	0.16
	Thigh	0.70	0.20	1.34	0.30
TURKEY	Chest	0.50	0.14	0.70	0.21
	Thigh	0.99	0.49	1.46	0.57
BOVINE	Sirloin	2.07	1.72	3.59	2.64
	Filet	2.35	2.11	3.36	2.86
	Roast beef	2.04	1.77	3.74	3.14
	Topside	1.93	1.68	2.88	1.89
CALF	Filet	0.85	0.71	1.58	1.33
LAMB	Cutlet	2.23	1.68	3.20	2.25
HORSE	Filet	2.21	1.75	3.03	2.16
OSTRICH	Filet	2.43	1.76	3.78	2.85
RABBIT	-	0.45	0.25	0.60	0.31
PIGS	Loin	0.36	0.20	0.46	0.21
	Steak	0.49	0.32	0.79	0.56

Figure 8 - Contents of total iron and heme iron in cooked and uncooked meat (mg / 100 g) (Lombardi-Boccia et al., 2002)

>> Bioactive compounds of meat

In addition to a variety of biologically active phytochemicals present in plants (such as fruits and vegetables), it is good to know that there are several interesting bioactive compounds in meat and cured meats⁴⁵. Such as **carnosine, choline, L-carnitine, conjugated linoleic acid, glutathione, taurine and creatine**, which have been studied for their physiological properties.

Conjugated linoleic acid (CLA): Anti-carcinogenic Properties

In meat there are also trans-fatty acids, which are formed as a result of bio hydrogenation by the bacteria of the rumen. The most common is conjugated linoleic acid (CLA), a trans-fatty acid that has been linked to several health benefits in the prevention of cardiovascular diseases, diabetes and obesity. Already nearly 40 years ago a substance was discov-

ered in extracts of roast meat that was able to inhibit the activity of mutagenic substances.

Subsequently, it was shown that this substance was in fact conjugated **linoleic acid**, which in experimental studies has repeatedly shown **strong anti carcinogenic properties**⁴⁶.

Conjugated linoleic acid already shows its anti-carcinogenic activity at relatively low concentrations, i.e. in less than 1% of food. It is interesting to note that among the other effects of CLAs is to influence the metabolism of fats and that in experimental animals it reduces the amount of body fat.

The conjugated linoleic acid in milk and the meat of ruminants is influenced by diet, especially in the content of polyunsaturated fatty acids and by the

⁴⁵ Schmid, A. Bioactive substances in meat and meat products. Fleischwirtschaft 2009 Vol. 89 No. 7 pp. 83-90

⁴⁶ Dilzer A, Park Y. Implication of conjugated linoleic acid (CLA) in human health. Crit Rev Food Sci Nutr. 2012;52(6):488-513. Tanaka T, Hosokawa M, Yasui Y, Ishigamori R, Miyashita K. Cancer chemopreventive ability of conjugated linolenic acids. Int J Mol Sci. 2011;12(11):7495-509.

conditions of the rumen.

The intake of dietary CLA in our diet is completely dependent on the assumption of meat and milk from ruminants, particularly from the consumption of fats from milk and meat, with higher values present in animals raised on pasture, which in general have even higher levels of polyunsaturated fats.

Coenzyme Q10: an antioxidant to fat levels

Coenzyme Q10 is a component of the transport chain of mitochondria electrons and antioxidant properties on fat levels, proteins and DNA have been attributed to it. Meat is an important source of coenzyme Q10 and its content is closely related to the number of mitochondria in muscle cells. The best sources are meat and fish, but cooking can cause a loss of around 15-32%.

Carnosine: anti aging and cell antioxidant properties

Carnosine is a dipeptide composed of the amino acids B-alanine and histidine. It possesses strong antioxidant and anti-genotoxic activities, even the anti aging of cells. In studies of mice fed on diets supplemented with carnosine, a minor oxidative and inflammatory progression was observed in induced neurodegenerative diseases, from which we can deduce a possible role in the prevention of diseases such as Parkinson's disease. In muscle tissue it functions as a buffer and participates in several biological functions. It is found in meat and fish, but not in plants. The cooking of meat reduces the content by 25-40%.

Taurine: a stimulant of the endocrine and immune systems

Taurine is a sulphur-containing amino acid synthesised from methionine found in the liver both as a free acid or as a constituent of the protein and is present in high quantity in most animal tissues. Tau-

rine plays an essential role in the synthesis of bile acids that are derived from cholesterol and facilitate their elimination. Bile is also essential for the absorption of fat-soluble vitamins.

Together with zinc, taurine is also important for vision. Its critical role was revealed in 1975, when it was discovered that the retinal degeneration occurred in those with taurine deficiency and it was found that the consumption of artificial milk without taurine could cause cardiac and retina dysfunction in preterm infants. Both of these problems can be prevented by the addition of taurine to synthetic artificial milk. It is now recognised that taurine plays an important role in human physiology and nutrition, and that its positive effects are found in the digestive system, and in endocrine, immune, muscular, neurological, reproductive, cardiovascular and eye levels. Studies on rats subjected to intense physical activity have shown that it reduces oxidative stress in the muscle and, therefore, reduces damage of the muscle cells.

Taurine appears to counteract the aging process due to its anti-free radical action. This amino acid is important for the synthesis of nitric oxide, a potent vasodilator; and therefore, appears to stimulate cardiac efficiency and contractility by increasing the blood supply to the myocardium. Taurine is present only in animal foods.

Creatine: for the improvement of muscle performance

Creatine and its derivative creatine-phosphate play an important role in muscle energy metabolism. So much so that, in certain circumstances, the addition of creatine to the diet promotes muscle performance. The muscle creatine is slowly converted to creatinine through the removal of water, with the formation of a ring structure, a phenomenon that is accelerated during the cooking of meat. Not being present in vegetables, those who follow a strict vegetarian diet have lower levels of creatine than non-vegetarians, and this may lower the muscle performance level.



Glutathione: The most powerful antioxidant

It is a tripeptide consisting of cysteine, glycine and glutamic acid. According to many authors it is the most potent endogenous antioxidant: inside the cell, glutathione has the ability to inactivate free radicals such as hydrogen peroxide, thus protecting the cell from lipids or oxidised proteins and prevent DNA damage. Glutathione also acts as a detoxifying activity, blocking heavy metals such as lead, cadmium, mercury, aluminium and other toxics (drugs, alcohol, tobacco, etc.), thereby making them easier and quicker to eliminate, preventing these poisons that bind to -SH groups of tissue proteins and enzymes deteriorating them.

It also promotes the bioavailability of iron. Finally glutathione, carries out pro immune activities and protects the central nervous system. Some fresh vegetables, eggs and meat, especially pork and beef, have a high content of glutathione.

Lipoic acid: antioxidant molecule

Lipoic acid is an antioxidant molecule able to protect both the membranes and the organelles of the cell; it is present in the mitochondria of animal cells, therefore in larger amounts in the muscles of animals that move more. **Lipoic acid is also a powerful chelator**, capable of removing from the blood excess metals such as iron and copper, and toxic metals such as cadmium, lead and mercury.

L-carnitine

L-carnitine is a small molecule derived from lysine which plays an important role in the metabolism of fatty acids, facilitating their penetration into the mitochondria and their subsequent oxidation. The L-carnitine is produced from methionine and lysine and its synthesis is greatly affected by the bioavailability of these elements. After its biosynthesis, L-carnitine passes into the blood and is distributed to organs and tissues, depending on their energy capacity, especially in the muscles and heart. Besides

its endogenous origin, the L-carnitine is provided by foods. With a regular omnivorous diet, at least 80% of L-carnitine present in the body comes from the diet. It declines sharply in vegan diets because most of the L-carnitine is provided by meat, fish and dairy products. It is considered a nutrient like vitamins and the lack or insufficient intake of L-carnitine in the muscles or in the cardiac cells can cause myopathies and cardiac disorders.

Choline: the memory of a lifetime

Choline is an essential nutrient that is found in many food sources and plays a critical role in the development of the central nervous system. Pregnancy and lactation are periods when maternal choline reserves tend to dry up. Animal studies have shown that the state of choline pre- and post-natal can have long lasting effects on the attention and memory of the unborn child. Choline during pregnancy and the early stages of life can alter brain functions, resulting in improved memory for a lifetime. This change in memory function seems to be the cause of changes in the development of the memory centre (hippocampus) in the brain, with long-term effects so that the memory in the elderly may, in part, be determined by what the mother ate during the pregnancy. Foods rich in choline are beef liver, chicken liver and eggs, but also pork.

Choline as a precursor of acetylcholine is involved in regulating sleep, the control of muscle activity, in the regulation of anxiety, learning and can be connected to a slowdown in the loss of cognitive abilities in the elderly.

Bioactive peptides of meat: immune system strengthening with a protection activity



In addition to bioactive compounds, in meat there are peptide derivatives of proteins which are another group of functional compounds with protective activities. When evaluating the quality of a protein, in addition to the composition of amino acids it is also

essential to consider their ability to generate specific bioactive peptides during digestion. Bioactive peptides are sequences of 2-30 amino acids that give a positive effect to the health of the consumer and that play an important role especially in the prevention of diseases associated with the development of metabolic syndrome and mental illness. Meat contains different proteins and peptides with important physiological activities.

Although the activity of these peptides is latent when they are part of the sequence of the protein, during digestion in the gastrointestinal tract they are released and activated. The same happens during fermentation, seasoning or food processing. The peptides modulate the physiological function through the binding interactions to specific receptors on cells that lead to physiological responses.

It has been shown for example that peptides derived from collagen have a positive effect on bone functionality, but in general the beneficial health **effects of the peptides from meat include antihypertensive, antioxidant, antithrombotic, modulation of the immune response and antimicrobial activity**. Bioactive peptides are considered to be very important in the prevention of the metabolic syndrome and in the maintenance of mental health.

> Are there alternatives to meat consumption?

In every part of the world, the Guidelines for Healthy Eating recommends a high consumption of fruits, vegetables, cereals, legumes, foods are rich in essential nutrients and protective substances, which are essential for the body's health⁴⁷. A purely plant-based nutrition must be integrated with a careful selection of foods and supplements⁴⁸. Some nutrients such as minerals, vitamins such as A, D or B12, essential fatty acids (especially omega-3) or the essential amino acids (for example, methionine and threonine in addition to tryptophan and lysine) may not be consumed in optimal amounts, especially in the more restrictive vegetarian diets⁴⁹. Take the

case of iron. In spinach and lentils there is iron. In fact, if we go and see the food composition tables we find that among vegetables, with the exception of chicory and rocket salad, spinach is the one which contains most iron (2.9 mg/100g), while among the legumes, lentils and beans are the most rich in iron (8-9 mg/100 grams of legumes). Unfortunately of these quantities our body is only able to absorb between 2% and 8%. This means that if you were to cover the daily requirement of iron using only **raw spinach** one would have to **eat between 4 and 17 kg per day**, because by boiling them a certain part ends up in the cooking water. Reckoning with iron, like those of other nutrients, should be done according to bioavailability, that is, with its ability to be first absorbed from the intestine and then assimilated by the cells that must use it. There can be so many factors that affect the bioavailability of iron. **Vitamin C makes it grow, so it is a good habit** to season cooked vegetables with lemon or eat



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⁴⁷ Ha V, de Souza RJ. 2015. "Fleshing Out" the Benefits of Adopting a Vegetarian Diet. *J Am Heart Assoc.* Oct 27;4(10).

⁴⁸ Craig WJ. Nutrition concerns and health effects of vegetarian diets. *Nutr Clin Pract.* 2010 Dec;25(6):613-20.

⁴⁹ McEvoy CT, Temple N, Woodside JV. Vegetarian diets, low-meat diets and health: a review. *Public Health Nutr.* 2012Dec;15(12):2287-94.



fruits and vegetables that contain vitamin C, fibres decreases it, as do tannins.

Many scientific studies have focused on the quantity, quality, the type and timing of the consumption of the protein and the consequent effects on health⁵⁰.

Today it is believed that daily intakes of protein moderately higher than the recommendations (recommended intake for the population - 0.9 g/kg × day) for adults⁵¹ may be useful for some people, such as the **elderly**⁵² and physically active individuals⁵³.

Moreover, the moderately high **protein intake in the diet** may help reduce the **risk of chronic diseases such as obesity, cardiovascular disease, type 2 diabetes, osteoporosis and sarcopenia**⁵⁴. But it is essential that the proteins come from various foods, both of animal and vegetable origin. In the group of protein-rich foods, those of animal origin, in addition to providing complete proteins from the point of view of amino acid composition, contribute to the daily intake of nutrients such as iron, zinc, vitamin B12, phosphorus and calcium, while protein foods of vegetable origin contribute mostly to dietary fibre, vitamin E and magnesium. It is these particularities that support the argument to eat a variety of protein food sources, both for health reasons and to help meet the nutritional recommendations⁵⁵⁻⁵⁶.

By comparing the nutritional elements of some recipes, you can see how meat in a balanced diet allows a moderate caloric intake to provide a greater amount of protein than other foods (Source of the recipes: Internal Processing to the working group).

⁵⁰ Moughan PJ. Dietary protein for human health. Br J Nutr 2012;108 (Suppl 2):S1-2.

⁵¹ SINU 2012. Italian Society of Human Nutrition. LARN RDA levels of nutrient intake and energy for the Italian population. Revision 2012

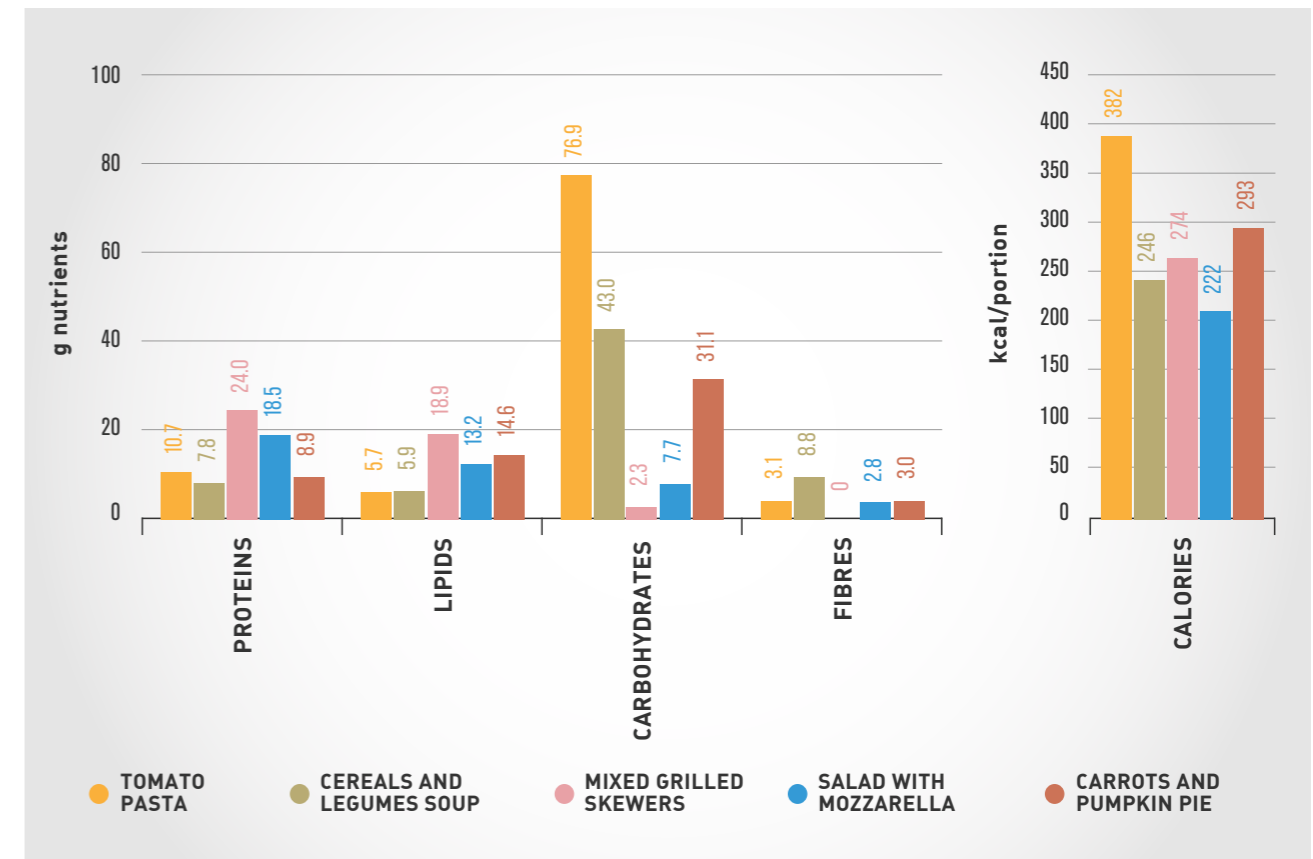
⁵² Bauer J, Biolo G, Cederholm T, Cesari M, Cruz-Jentoft AJ, Morley JE, Phillips S, Sieber C, Stehle P, Teta D, et al. Evidence-based recommendations for optimal dietary protein intake in older people: a position paper from the PROT-AGE Study Group. J Am Med Dir Assoc 2013;14:542-59.

⁵³ Phillips SM. Dietary protein requirements and adaptive advantages in athletes. Br J Nutr 2012;108(Suppl 2):S158-67

⁵⁴ Protein Summit 2.0: evaluating the role of protein on public health. Am J Clin Nutr 2015;101(Suppl):1317S-58S.

⁵⁵ Phillips SM, Fulgoni VL 3rd, Heaney RP, Nicklas TA, Slavin JL, Weaver CM. Commonly consumed protein foods contribute to nutrient intake, diet quality, and nutrient adequacy. Am J Clin Nutr. 2015 Apr 29.

⁵⁶ Nicklas TA, O'Neil CE, Zanovec M, Keast DR, Fulgoni VL III. Contribution of beef consumption to nutrient intake, diet quality, and food patterns in the diets of the US population. Meat Sci 2012;90: 152-8.



The value of a varied and balanced diet is more evident when the contribution of nutrients by the various foods is analysed

RECIPE	INGREDIENTS (PER PORTION)
TOMATO PASTA	Pasta 90g, Peeled Tomato 80g, Oil 5g
CEREALS AND LEGUMES SOUP	Cereals 50g, Legumes 40g, Oil 5g
MIXED GRILLED SKEWERS	Chicken breast 40g, Pork sausage 40g, Veal tenderloin 40g, Peppers 30g, Oil 7g, Wine 10g
SALAD WITH MOZZARELLA	Savoy cabbage 50g, Tomatoes 50g, Mozzarella 80g, Green salad 50g
CARROTS AND PUMPKIN PIE	Eggs 20g, Almond flour 25g, Sugar 25g, Carrot 15g, Pumpkin 10g, Powdered sugar 2g

Comparing the nutritional elements of these recipes, it is possible to see how, in a balanced diet, eating meat allows to reach a discrete calorie intake and, at the same time, the absorption of a greater amount of protein than with other foods. (Source of the recipes: internal processing of the working group)

THE NEEDS DURING THE VARIOUS STAGES OF AN INDIVIDUAL'S LIFE



The need for nutrients begins at the beginning of life and continues through all its phases, with variations due to age and specific needs. All nutrients are **essential**, but each period of life is characterised by a greater or lesser need of some nutrients or energy. Meat provides useful nutrients at all stages in life, but there are some special situations such as pregnancy and lactation, as well as growth and sports training, where it is important not to deprive yourself of this food. For example, if during pregnancy, lactation, growth and aging, the needs for some nutrients or compounds such as proteins, essential fatty acids, chorines, and micronutrients such as iron, zinc, calcium and vitamin B12, increases then you cannot give up the best sources of these nutrients: food of animal origin. Adults can satisfy their needs with limited amounts of meat.



> Pregnancy and breastfeeding

The child in the womb is totally dependent on nutrients that come from the mother. Maternal dietary habits, the nutritional status before conception and during pregnancy and lactation effect the unborn child, its growth and its health. It is therefore important that the foods that a pregnant or nursing woman assumes provide all the nutrients needed to support the growth and development of the child, and this is achievable only through a varied and balanced diet.

Proteins are a primary nutrient, because they provide the building blocks necessary for the construction of the unborn tissues: it goes from two cells at fertilization to about ten thousand billion in the newborn baby! But one must also supply the proteins necessary for the development of the placenta, to that of the breast and uterine tissues of the mother and the growth of the circulating blood volume (more haemoglobin, more plasma proteins), in addition to the amniotic fluid.

Foods that contain proteins of high biological value are milk and derivatives, eggs, meat and fish. The same foods help to replenish the body of other important nutrients during pregnancy and lactation such as calcium, iron, zinc, iodine, the B vitamins, vitamin D and some of the family of omega -6 fats like arachidonic acid (AA).

During pregnancy and breast feeding frequent consumption of **fish to get the valuable long-chain omega-3 fatty acids**, albeit present in smaller quantities in meat, such as **docosahexaenoic acid (DHA)** is highly recommended. DHA is in fact one of the main structural components of cell membranes and is essential for the formation of new tissue, **in particular for the foetal development of the brain, the nervous system and the retina, that continue to develop during the first months of life.**

A good supply of calcium, phosphorus as well as vitamin D, is essential for foetal development in the



first months of life. Not only do the bones and teeth benefit, but so do nerve functions, muscle contraction and blood clotting. During pregnancy you also need to pay close attention to the consumption of sufficient quantities of iron and iodine.

The greater need for iron is due to the greater volume of blood: the baby's cells breathe with the oxygen carried by the iron (haemoglobin) of the mother. An adequate quantity is essential to control the most basic metabolism induced by pregnancy. In addition to eating fish regularly, it is a good thing to replace salt with iodised salt.

During pregnancy, iron deficiency can impair brain function, learning and memory: infants with low iron levels have a retardation in cognitive neurons and motor development, a fact confirmed by a recent research conducted at the Children's hospital of Los Angeles and published in Paediatric Research⁵⁷, one of the most prestigious magazines in the sector.

All vitamins are important during pregnancy, but some are even more important: **vitamin A and vitamin C, necessary for tissue growth, and the vitamins of the B group**, essential for energy and protein metabolism transformation, which are found in ce-

⁵⁷ Monk C, Georgieff MK, Xu D, Hao X, Bansal R, Gustafsson H, Spicer J, Peterson BS. Maternal prenatal iron status and tissue organization in the neonatal brain. *Pediatr Res.* 2015 Nov 24.

reals, legumes and in food of animal origin. Special attention is needed for folic acid, a vitamin essential for the proper development of the spinal cord in the fetus in the first 3 months after conception, to the point that during pregnancy a higher consumption is recommended. It also intervenes in the formation of red blood cells and is able to reduce the risk of heart disease.

During this stage of life the **requirement for vitamin B12 also increases, rising from 2.4 micrograms to 2.6 micrograms a day during pregnancy and 2.8 micrograms during lactation.**

> Growth and development

The nutrition of children and adolescents is based on the same principles of adult nutrition, but with different quantity requirements. The first 2-3 years of a child's life are crucial for his physical and mental development, and in this context the proteins play a key role in the proper functioning of the bones, muscles, blood, skin and hormones.

Animal protein, particularly meat, is therefore a very important food: a portion of 80-100 grams of most types of meat contains about 20 grams of protein, and is a simple way to help your child achieve his protein intake goal. In addition to this, a correct intake of vitamin B12 is essential for neurological development and cell growth. Iron and zinc are important for the growth and development of infants and children.

The child in this period grows more than in all other stages of life, and if you do not eat properly you can get sick more easily, and generally you do not develop in the right way. For example, it is precisely at this stage that you can promote obesity in adulthood. Today it is understood, in fact, that fat cells are formed during childhood: if a child eats too much, he produces a greater number of fat cells that remain virtually unchanged as an adult⁵⁸. So you will have a greater risk of becoming obese.



Some nutrient deficiencies, **such as that of iron, may instead result in low levels of attention and concentration in children, leading to poor school performances**⁵⁹.

The majority of studies that investigated the association between nutrition and cognitive development, have focused on individual micronutrients that are considered essential for the proper development of the brain, namely omega-3 fatty acids, vitamin B12,

⁵⁸ Arner P, Spalding KL. 2010. Fat cell turnover in humans. *Biochem Biophys Res Commun.* May 21;396(1):101-4

⁵⁹ Hermoso M, Vucic V, Vollhardt C, Arsic A, Roman-Viñas B, Iglesia-Altaba I, Gurinovic M, Koletzko B. The effect of iron on cognitive development and function in infants, children and adolescents: a systematic review. *Ann Nutr Metab.* 2011;59(2-4):154-65.

folic acid, zinc, iron and iodine⁶⁰, all nutrients supplied in a special way by food of animal origin.

In children, the association between **vitamin B12 and cognitive development** has been observed especially in children born to vegetarian or vegan mothers who followed a macrobiotic diet. These diets can cause vitamin B12 deficiency, because vitamin B12 is found only in animal foods. Studies of children with vitamin B12 deficiencies showed abnormal clinical and radiological features, including: hypotonic muscles, involuntary muscle movements, apathy, reduced growth and demyelination of nerve cells. After treatment with vitamin B12, there is a rapid improvement of the neurologic symptoms in children with these deficits, but in many the damage is permanent, with a delay in cognitive and language development throughout their lives⁶¹. The long-term effect of vitamin B12 deficiency is supported by the results of some studies⁶² in which researchers examined the cognitive functioning of adolescents who consumed a macrobiotic diet until the age of six, compared to boys who followed an omnivorous diet. Those teenagers who followed a macrobiotic diet up to 6 years of age had lower levels of fluid intelligence, short-term memory and spatial ability compared to controlled subjects.

Zinc **deficiency seems** to be a serious global problem that affects 40% of the population. Recent research suggests that children, adolescents, the elderly and people with diabetes are at high risk of zinc deficiency⁶³. It is believed that zinc is an essential nutrient for the brain, with important structural and functional roles. More specifically, zinc is a cofactor for over 200 enzymes that regulate various metabolic activities of the body including proteins, DNA and RNA synthesis. In addition, zinc plays a neurogenic role, the maturation and migration of neurons and the formation of synapses. Zinc is also found in high concentrations in synaptic vesicles of neurons in the hippocampus (that are involved in the centre for learning and memory). Zinc supplementation has a positive effect on the immune status of infants and can prevent birth defects⁶⁴.

One of the most common nutritional deficiencies both in the developing and developed countries is

iron deficiency. It is believed that iron is involved in several enzyme systems in the brain, including those involved in energy production, in the synthesis of dopamine receptors, in the myelination of nerve cells and in the regulation of brain growth. In addition, iron appears to modify the development processes in hippocampus neurons by altering dendrite growth. Some authors found significantly lower performance in language skills, fine motor skills and attention in children of 5 whose ferrite levels were lower⁶⁵. There is a broad scientific consensus⁶⁶ that iron deficiency has a negative impact on cognitive, behavioural and movement functions and these cognitive deficits can appear at any age. Lack of iron is in fact clearly linked to brain changes in the hippocampus level, the mitochondria of the brain, the metabolism of dopamine, a neurotransmitter, and the myelination of nerve fibres.

One of the most worrying consequences of **iron deficiency in children is the alteration of the behaviour and cognitive performance**, for which there is

⁶⁰ Nyaradi A, Li J, Hickling S, Foster J, Oddy WH. The role of nutrition in children's neurocognitive development, from pregnancy through childhood. *Front Hum Neurosci.* 2013 Mar 26;7:97.

⁶¹ Dror, D.K. e Allen, L.H. Effect of vitamin B12 deficiency on neurodevelopment in infants: current knowledge and possible mechanisms. *Nutr.Rev.* 2008, 66, 250-255.

⁶² Louwman, M.W., VanDusseldorp, M., Van DeVijver, F.J., Thomas, C. M., Schneede, J., Ueland, P.M., et al. Signs of impaired cognitive function in adolescents with marginal cobalamin status. *Am. J. Clin. Nutr.* 2000. 72, 762-769.

⁶³ Gibson, R., and Heath, A.-L. Population groups at risk of zinc deficiency in Australia and New Zealand. *Nutr. Diet.* 2011. 68, 97-108.

⁶⁴ Nyaradi A, Li J, Hickling S, Foster J, Oddy WH. The role of nutrition in children's neurocognitive development, from pregnancy through childhood. *Front Hum Neurosci.* 2013 Mar 26;7:97.

⁶⁵ Nyaradi A, Li J, Hickling S, Foster J, Oddy WH. The role of nutrition in children's neurocognitive development, from pregnancy through childhood. *Front Hum Neurosci.* 2013 Mar 26;7:97.

⁶⁶ Jáuregui-Lobera I. Iron deficiency and cognitive functions. *Neuropsychiatr Dis Treat.* 2014 Nov 10;10:2087-95. doi: 10.2147/NDT.S72491. eCollection 2014.

a large amount of clinical biochemical and neuro-pathological research, showing how iron deficiency can exercise a deleterious effect on learning and brain development, which can also occur with normal levels of haemoglobin⁶⁷.

The iron supplement improves cognitive functions and meat, in particular beef, provides heme-iron, a different iron form that the organism absorbs to a greater extent and that is not found in vegetable or fortified foods. But if iron deficiency occurs very early in life, the damage may be irreversible, and it may not be possible to reverse the brain damage with treatment of iron⁶⁸.

Exclusively breast-fed infants at 9 months of age only get 10 % of iron and zinc that they require, if during weaning there are cereals, fruit and vegetables they receive only 30% of these important nutrients that they require. Introducing meat already from the sixth month is the most effective way to provide the iron and zinc they need⁶⁹.

Meat and other animal products, such as milk, contain nutrients, such as iron, zinc and calcium, that are hard to find elsewhere, or are in a highly absorbable form and used by the body, such as iron. The World Health Organization recommends the intake of animal foods from 6 months of age, showing how diets based only on plants are not able to meet the nutritional needs of the child, unless they use of supplements or fortified products⁷⁰.

> Adult nutrition

During this stage of life it is important not to increase too much in weight, because being overweight and obese are associated with an increased risk to health. Meat, given its high nutritional density, can therefore be of help to limit calories, while ensuring an adequate supply of nutrients.

The prevalence of obesity in Italy has more than doubled over the past 25 years, and several studies sug-

gest that diets with a higher proportion of protein, obtainable for example with lean cuts of meat and cured meats, are effective for the loss and maintenance of weight. Meat, due to its protein intake, may also contribute to satiety and as a consequence reduce food and energy intake.

Like children and adolescents, adults are at risk of iron, zinc and iodine deficiency. Only adequate foods, which also include animal foods, especially meat, can avoid this risk.

A recent study⁷¹ of 127 non-anaemic young women between 18 and 35 years old aimed at evaluating iron status and cognitive performance, highlighted the association between some haematological indicators of iron status (haemoglobin, cell distribution with blood cells, transferring saturation, ferritin, transferrin receptor, and the iron total in the body) with certain measures of brain function (attention, logic, memory, etc.). In practice the better the iron status, the better the performance on tasks of sustained attention and planning skills.

> Meat for sportive people

It is important for those who practice physical activity to eat a healthy balanced diet that provides

⁶⁷ Jáuregui-Lobera I. Iron deficiency and cognitive functions. *Neuropsychiatr Dis Treat.* 2014 Nov 10;10:2087-95.

⁶⁸ Beard, J.L. Why iron deficiency is important in infant development. *J. Nutr.* 2008. 138, 2534-2536.

⁶⁹ Krebs NF, Westcott JE, Butler N, Robinson C, Bell M, Hambidge KM. Meat as a first complementary food for breastfed infants: Feasibility and impact on zinc intake and status. *Journal of Pediatric Gastroenterology and Nutrition* 2006; 42: 207-214.

⁷⁰ WHO (World Health Organization) 2009 b. *Infant and Young Child Feeding: Model Chapter for Textbooks for Medical Students and Allied Health Professionals.* Geneva: World Health Organization; 2009.

⁷¹ Scott SP, Murray-Kolb LE. Iron Status Is Associated with Performance on Executive Functioning Tasks in Nonanemic Young Women. *J Nutr.* 2016 Jan;146(1):30-7.



sufficient calories and nutrients to meet the energy and nutritional needs and that can ensure optimal performance during exercise⁷². Good nutrition in fact helps the athlete to train hard, recover quickly and effectively adapt to environmental conditions, with less risk of illness and injury. It is no coincidence that physical activity creates a higher demand for energy, as well as macronutrients such as carbohydrates, fats and proteins.

Carbohydrates and fats are the primary fuel for exercise, while proteins are necessary for the growth and repair of body tissues: muscles contain about 40% of the total protein of the organism. When the amino acid requirement is not satisfied with the diet, **muscle proteins supply the body with the necessary amino acids, but this also happens after exercise, that is, during the recovery phase, where it is crucial that there is an adequate supply of proteins.**

Numerous studies have shown that consumption of

protein, and in particular of the essential amino acids that constitute them, before, during, but especially immediately after training is capable of stimulating muscle protein synthesis. It is clear that the protein alone is not enough. But studies on the effects of proteins on muscle power have identified the forms that more than others are able to optimise muscle protein synthesis, inhibiting protein breakdown and thus stimulating muscle growth. You must indeed favour the proteins rich in essential amino acids, such as those provided by milk and its by-products, eggs, fish and meat.

Foods or snacks that contain high-quality protein,

⁷² Rodriguez NR, DiMarco NM, Langley S; American Dietetic Association; Dietitians of Canada; American College of Sports Medicine: Nutrition and Athletic Performance. Position of the American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and athletic performance. *J Am Diet Assoc.* 2009 Mar;109(3):509-27.

such as meat and cured meats, fish, eggs or milk should be consumed regularly throughout the day. In particular, immediately after exercise, to maximise protein synthesis to assist muscle maintenance and contribute to repair damaged tissues.

Exercise increases the need for certain vitamins and minerals. A varied diet can balance energy expenditure and is able to meet the higher demand that the athletes have for some micronutrients, but there are some present in a highly absorbable form in animal products which are often deficient in diets of athletes, especially female athletes and vegetarians: calcium, iron, zinc and magnesium, and vitamin B12. Iron is a vital component of haemoglobin and myoglobin, proteins found in red blood cells and muscles, respectively. **Haemoglobin and myoglobin provide oxygen to the tissues during the activity and athletic performance of athletes**, in particular of aerobic sports athletes; who strongly depend on oxygen intake to the muscles so that they can work efficiently. When the iron status is low, less oxygen

is carried to the muscles and sports performance is reduced. Deficiencies of iron, often evident in athletes, can thus impair athletic performance and can be avoided by taking highly absorbable and usable iron, such as that contained in beef.

Zinc is involved in many important functions such as growth, the construction and repair of muscle tissue, and energy transformation. Athletes, particularly women, are at risk of deficiency of this mineral, whose best food source is from meat, but also eggs and fish products.

Some vitamins of the B group (thiamine, riboflavin, vitamin B6, niacin, pantothenic acid and biotin) are involved in the energy transformation process during exercise, while the foliate and vitamin B12 are necessary for the production of red blood cells, protein synthesis, repair and maintenance of tissues. Although the requirements of these vitamins is slightly higher in athletes, it is generally covered by the increased energy intake necessary for athletes to maintain body weight.

adding excessive amounts of salt to foods and condiments. Tooth loss or diminution of taste and smell make even your favourite foods less attractive⁷³.

Meat and cured meats are part of a balanced diet for the elderly⁷⁴ and their consumption is recommended as it provides both high biological value protein and trace elements including iron, vitamin B12, zinc and selenium. Once they reach adulthood, muscle mass begins to decline and the rate at which it reduces accelerates after the age of 50: the muscles **represent about 45% of body weight between the ages of 20 and 30, dropping to only 27% at the age of 70**. This tendency to lose muscle mass is accentuated if you are not taking in sufficient amounts of protein.

A slightly greater amount of protein than individual adults can be useful to the elderly, who can thus increase their reserve capacity and thereby counteract the progressive loss of muscle mass, and also prevent fragility of the skin and the reduction of the

immune function, resulting in better recovery from illness⁷⁵

A deficiency of vitamin B12 in the elderly is associated with decreased memory and hearing. **Another nutrient at risk in the elderly is zinc deficiency, which is involved in the wound healing process, in vision, taste and olfaction**. Most of the nutrient requirements which increase in the elderly are found in foods of animal origin.

⁷³ Van Staveren, W., de Groot, L. & Horwath C. (2012). Nutrition and ageing. In: J. Mann & A.S. Truswell (eds). Essentials of human nutrition, 4th edn. New York: Oxford University Press.

⁷⁴ Kouvari M, Tyrovolas S, Panagiotakos DB. Red meat consumption and healthy ageing: A review. *Maturitas*. 2016 Feb;84:17-24.

⁷⁵ Nowson C, O'Connell S. Protein Requirements and Recommendations for Older People: A Review. *Nutrients*. 2015 Aug 14;7(8):6874-99.

> The importance of animal food for the elderly

After the age of 70 you need fewer calories because you do not move as much as before and the metabolism slows down. But to remain healthy the body still requires the same amount of nutrients, some of which, like proteins, even in higher levels.

Even the stomach and intestines become less efficient. There is a reduction of gastric acid secretion, which may limit the absorption of iron and vitamin B12. Over the years, the body gradually reduces the perception of feeling hunger and thirst; the mechanisms that regulate the carbohydrate and protein synthesis also become less efficient. Even taste fades and you tend to prefer the very tasty food, or



FOOD AND HEALTH

A risk factor is a specific condition that is statistically associated with a disease, and is therefore thought to contribute to its pathogenesis, supporting or accelerating its development. For example, according to the World Health Organization, physical inactivity is the fourth leading risk factor for overall mortality and causes 3.2 million deaths every year.

According to estimates, in particular, physical inactivity would be responsible for about 30% of heart disease, 27% of diabetes and 21-25% of breast cancers and colon.

Eating habits are closely related to various aspects of human life, such as growth, development, disease resistance, and is a consolidated fact that they represent the most influential environmental factor on the duration and quality of life.

To date we have studied many nutritional strategies that are able to prevent or delay the onset of a disease, or also to optimise the therapy. But it is clear that not all individuals respond the same way to dietary changes and some of this variability is due to genetic and epigenetic individual differences, which can in turn affect the absorption, digestion, metabolism, excretion and the action of bioactive food compounds.

Although dietary factors are important in many chronic degenerative diseases, that are major causes of illness and death in affluent societies, it is therefore very difficult to determine with certainty a cause-effect relationship. Chronic diseases have indeed multiple causes and require years to develop: eating habits can therefore be a “**risk factor**”.

The scientific methods to investigate chronic diseases, their causes, treatment and prevention are mostly **epidemiological**, a method that studies the prevalence of frequency with which diseases occur and conditions that favour or hinder the development, looking for the relationship with eating habits. These studies can investigate subjects after the diagnosis of the disease (retrospective studies), or prior to diagnosis (prospective studies).

The influence of the data and the recommendations from developed countries in the field of nutritional guidance has often highlighted and recognised the essential micronutrients and protein intake towards which meat contributes.

The impact of meat on the nutritional quality of the human diet through its contribution of protein and key micronutrients is often underestimated⁷⁶.

⁷⁶ McNeill S, Van Elswyk ME. Red meat in global nutrition. Meat Sci. 2012 Nov;92(3):166-73.

As described previously, the iron content in red meat, for example, is more easily absorbed compared to forms present in plants.

This involves great implications **for cognitive health as there is a clear link between meat and mind**⁷⁷.

The lack of micronutrients that are found in meat has been linked to **brain disorders, including a lower intelligence quotient (IQ), autism, depression and dementia**. Iron is crucial for the growth and the branching of neurons when it is still in the uterus, but also other typical meat nutrients, such as zinc which is found in high **concentrations in the hippocampus**, a crucial area for learning and storage; vitamin B12 which provides for the maintenance of the sheath that protects the nerves; or omega-3, such as docosahexaenoic Acid (DHA fatty acids), which help to keep neurons healthy and **to limit inflammation**.

The key question of meat is thus the amount that you should consume because, being a food with a high nutritional efficiency, it already allows for small amounts included in the Mediterranean Diet to benefit from its valuable effects without having risks to one's health. Because if it is true that too much meat can slow the development and knowledge, excessive consumption is associated with other health problems, such as vascular and neoplastic ones.

Even if there is a possible relationship between an excess of red meat consumption and cancer or cardiovascular disease, the results of the research are not entirely consistent and differ between populations, making it difficult to understand the reasons for this correlation⁷⁸.

According to scientific studies, in fact, the meat-related mortality risk is more pronounced in the US, compared to what occurs in Europe or Asia. This could be due to several factors:

- **Americans consume meat in much higher amounts than the European average and twice as much as in Italy;**
- **Europeans do not grill the meat as much as the Americans;**
- **the type of meat consumed by Americans comes mainly from castrated animals, this involves a much higher fat content than the European average; In addition these fats do not come from the surface but are present in the lean part of the muscle and are therefore difficult to remove;**
- **Americans farms allow the use of natural growth hormones.**

The main diseases associated directly with food are cardiovascular disease, obesity, diabetes and some cancers.

⁷⁷ Neumann CG, Murphy SP, Gewa C, Grillenberger M, Bwibo NO. Meat supplementation improves growth, cognitive, and behavioral outcomes in Kenyan children. J Nutr. 2007 Apr;137(4):1119-23. - Neumann CG, Jiang L, Weiss RE, Grillenberger M, Gewa CA, Siekmann JH, Murphy SP, Bwibo NO. Meat supplementation increases arm muscle area in Kenyan schoolchildren. Br J Nutr. 2013 Apr 14;109(7):1230-40.

⁷⁸ Wang X, Lin X, Ouyang YY, et al. Red and processed meat consumption and mortality: dose-response meta-analysis of prospective cohort studies [published online July 6, 2015]. Public Health Nutr. doi: 10.1017/S1368980015002062. - Kappeler R, Eichholzer M, Rohrmann S. Meat consumption and diet quality and mortality in NHANES III. Eur J Clin Nutr. 2013;67(6):598-606.



PERCENTAGE INCREASE OF DISEASES RELATED TO OVEREATING IN THE ITALIAN POPULATION FROM 1990 TO 2011.

OF OPPOSITE SIGN, THE TREND OF BEEF CONSUMPTION DECREASE

WHILE THE PATHOLOGIES RELATED TO OVEREATING HAVE INCREASED, BEEF CONSUMPTION HAS DECREASED

In recent decades there has been an increase in the prevalence of some chronic diseases related to diet and lifestyles such cases of overweight and obesity, hypertension and diabetes.

While the incidence of these diseases continues to grow over the years, the general increase in food consumption that characterizes the era in which we live has partially reversed the trend, especially for certain foods such as **meat, whose daily intake in time is decreased.** Data collected from 1990 to 2011 show that 1 adult over 3 is overweight, the incidence of hypertension has doubled and 1 person every 20 is diabetic.



OVERWEIGHT
+28%



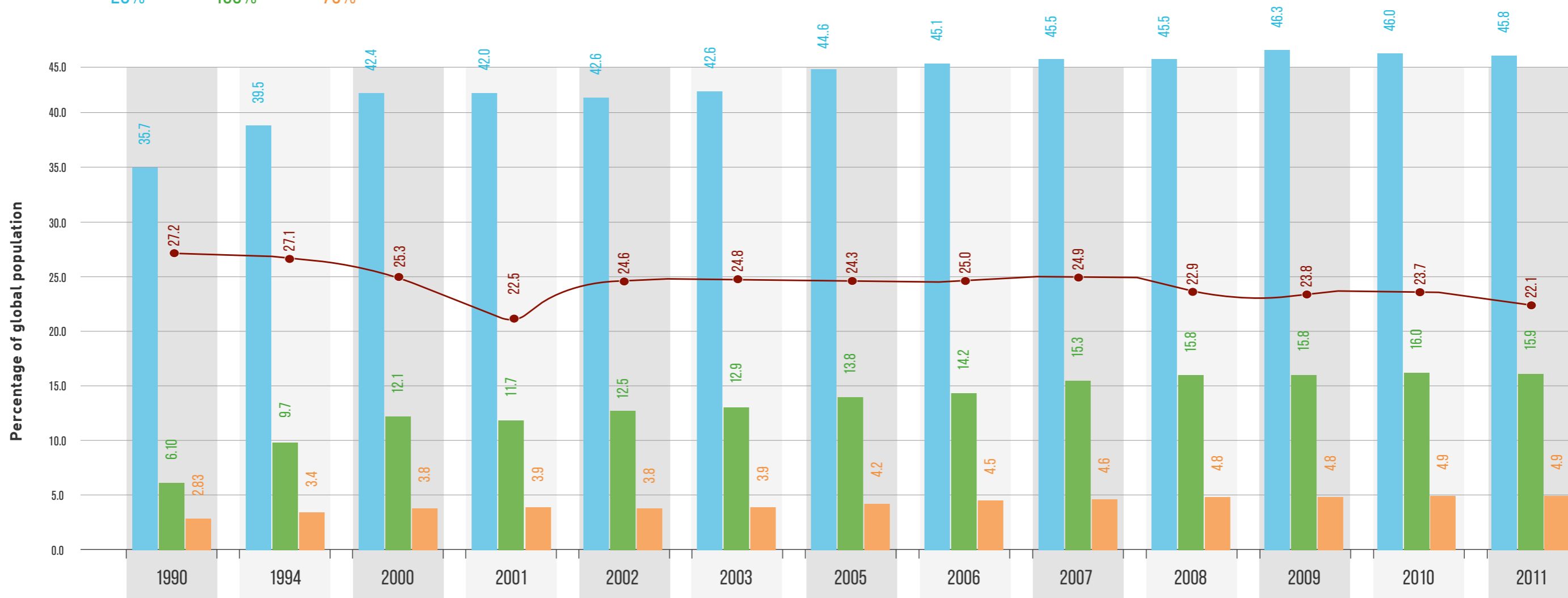
HYPERTENSION
+160%



DIABETES
+73%



APPARENT BEEF CONSUMPTION PER CAPITA IN ITALY
kg of meat per capita / year



Rising rates of diabetes, obesity and overweight, hypertension in Italy in the last twenty years. Elaborations based on Istat data

> Cardiovascular diseases: saturated fat meat is acquitted after 40 years of accusations

Diseases that affect the heart and blood vessels - cardiovascular diseases - include numerous health problems, many of which are related to a process called atherosclerosis, a condition that develops when a substance called plaque is deposited on the walls of the arteries. Its build-up narrows the arteries, making it harder for the blood to flow. If a clot forms inside the arteries, it can stop the flow of blood. This can cause a heart attack or a stroke. Diseases of the circulatory system have caused a number of deaths in 2008 amounting to 224,482 (97,952 men and 126,530 women), i.e. 38.8% of all deaths. Cardiovascular disease is largely preventable by adopting a healthy lifestyle, a particularly healthy diet, **regular physical activity and the elimination of cigarette smoking.**

Meat is often viewed with concern for the **health of the heart, but not all of the scientific studies agree on this point.** A systematic review of 11 epidemiological studies published in 2015 found that in four studies a high intake of red meat posed a significant risk factor for coronary artery disease (CAD), but no significant association was found in the five other studies⁷⁹.

A reasonable amount of lean beef can be included in a healthy diet for the heart, and can have favourable effects on the metabolic syndrome and coronary heart disease. In some studies it was for example observed that adults with high cholesterol, who consumed 100-115 g of lean beef per day but limited their intake of saturated fat to less than 7% of total calories, have had a significant decrease in total cholesterol and LDL cholesterol compared to subjects with a diet low in meat, but with 12% of total calories from saturated fat⁸⁰.

Another study by meta-analysis published in 2010⁸¹ showed a significant increase in the risk of coronary

heart disease with the increasing consumption of processed meats: a 50 g intake of processed meat a day (which is more than double that consumed in Italy) was associated with an average of 42% increased risk, while there was no correlation shown with red meat intake (relative risk [RR] = 1.00).

Even the EPIC study showed a significantly increased risk of death due to cardiovascular diseases linked to the increased consumption of processed meat (HR 1.72 [95% CI 1.29 to 2.30]) comparing the highest consumption and the lowest (> 160 g per person per day compared to 10-19.9 g)⁸². With white and red unprocessed meat there was no significant correlation with cardiovascular death.

In summary, the WHO recommendations to prevent cardiovascular diseases are to reduce the consumption of saturated fat, so as to control the level of "bad cholesterol" in the blood, hence the suggestion to prefer lean cuts of meat. But also to pay attention to other foods: **saturated fats are also present in dairy products, in many baked goods and fried foods.** Some plant foods, such as **palm oil or coconut**, for example contain **large amounts of saturated fat.** Examining the composition food tables of some products already shown in the section relating to nutrients, it turns out that the meat and cured meats are in fact among the least responsible foods of the assumption of saturated fat.

⁷⁹ Lippi G, Mattiuzzi C, Sanchis-Gomar F. Red meat consumption and ischemic heart disease. A systematic literature review. *Meat Sci.* 2015; 108:32-36

⁸⁰ Roussel MA, Hill AM, Gaugler TL, et al. Beef in an Optimal Lean Diet study: effects on lipids, lipoproteins, and apolipoproteins. *Am J Clin Nutr.* 2012;95(1):9-16

⁸¹ Micha R, Wallace SK, Mozaffarian D (2010) Red and processed meat consumption and risk of incident coronary heart disease, stroke, and diabetes mellitus. A systematic review and meta-analysis. *Circulation* 121: 2271 – 2283.

⁸² In Italy people usually consume less than 25 grams per day of processed meat (EPIC 2003)

> Tumoral diseases

Cancer is a leading cause of morbidity and death in the world: on average every year there are about 14 million new cases and 8.2 million cancer-related deaths. Even more important is that it is expected that the number of new cancer cases will grow by almost 70% over the next two decades, up to 22 million new cases per year, probably making cancer the leading cause of mortality in the world⁸³.

The five most common types of cancer are those of the lung, prostate, colorectal, gastric, and liver cancers in men; breast cancers, colorectal, lung, cervix and stomach are the five most common types of cancer in women.

Although there is still a dark side, it has now been established that the **interaction between genetics and environment promotes carcinogenesis.** In particular, certain physical carcinogens (such as **ultra-violet and ionising radiation**) and biological (**viral, bacterial or parasitic infections**) interact with behavioural risk factors like **obesity and food**, insufficient consumption of fruits and vegetables, **lack of physical activity, the use of tobacco and alcohol**, to promote the transformation of a normal cell into a malignant cell. A phenomenon which can be amplified in genetically susceptible individuals⁸⁴.

Among the various factors, **eating habits play an important role in increasing or reducing the risk of various cancers. Although the causal link between diet and cancer is complex and can hardly be revealed due to the fact that diets are characterised by many different foods and nutrients, there is consistent evidence that certain foods can be more harmful than others**⁸⁵.

Despite the rampant progress of scientific knowledge, however, pockets of disinformation caused by prejudice and health simplifications still exist, and are not always correctly spread by some mass media. And therefore food is often classified into **"good" and "bad"**, which confuses consumers even more.

In fact, no product can be considered good or bad for

your health, but should be evaluated for the nutrients that it brings to the daily diet, keeping in mind not to exceed the daily limit for each category of food in a balanced diet. It must in fact always be remembered that cancer diseases are extremely complex as:

- **there are more than 100 types of cancer for which the causes are not always known;**
- **people's diet contains an almost imponderable number of different components, some of which may decrease or increase the risk of developing cancer;**
- **the development of a tumour occurs over a long period of time, making it very difficult to establish a secure and trusted relationship between cause and effect;**
- **many questions about diet and cancer remain unanswered, and studies are often based on tests done on laboratory animals with no direct evidence in humans;**
- **recommendations for a proper diet that reduces the risk of cancer should be based on relevant scientific evidence, and not referred to a single case study.**

Meats are certainly among the most controversial foods because of the excessive consumption, particularly of red and processed meat contributes to the risk of cancer⁸⁶.

⁸³ Stewart, B., Wild, C.P., 2014. World Cancer Report. IARC Press, Lyon, France 2014, ISBN: 9789283204299.

⁸⁴ World Cancer Research Fund, 2007. American Institute for Cancer Research: Food, Nutrition and the Prevention of Cancer: A Global Perspective. The Institute, Washington, DC, USA, ISBN: 978-0-9722522-2-5.

⁸⁵ Bishop, K.S., Ferguson, L.R., 2015. The Interaction between epigenetics, nutrition and the development of cancer. *Nutrients* 7, 922-947.

⁸⁶ Lippi G, Mattiuzzi C, Cervellin G. Meat consumption and cancer risk: a critical review of published meta-analyses. *Crit Rev Oncol Hematol.* 2016 Jan;97:1-14.

The press release of the International Agency for Research on Cancer (IARC) issued on October 26 of 2015 has greatly highlighted the issue, because the consumption of red meat and processed meats has been classified respectively as “probably carcinogenic to man” and “carcinogenic to humans⁸⁷⁻⁸⁸”.

⁸⁷ Bouvard V, Loomis D, Guyton KZ, Grosse Y, Ghissassi FE, Benbrahim-Tallaa L, Guha N, Mattock H, Straif K; International Agency for Research on Cancer Monograph Working Group. Carcinogenicity of consumption of red and processed meat. *Lancet Oncol.* 2015 Dec;16(16):1599-600.

⁸⁸ Links between processed meat and colorectal cancer. World Health Organization website.

>> IARC studies

As seen, the correlation food - cancer is very difficult to study because they are so many elements, real or perceived, that may favour the onset and the development of cancer.

In support of the recommendations of the national authorities, there are the studies developed by the International Agency for Research Studies on Cancer (IARC, International Agency for Research on Cancer) that highlight and classify the **considered agents, certainly or presumably, responsible of cancer onset.**

IARC CLASSIFICATION

Among all the classified agents, **only 6** (red meat, processed meats, coffee, alcohol, maté, China style salted fish) are foods / drinks. The others are substances or molecules that belong to various groups among which the pollutants and the by-products of industrial productions. In GROUP 1, for example, smoking tobacco appears and, since 2012, also the alcohol, that more than a drink shall to be considered as the main component of alcoholic beverages in general. Then there are Arsenic, Asbestos, Plutonium, Air pollution, solar radiation and many other substances. In GROUP 2A the only food / drink is the hot maté (infused), that in addition to the substances that contains, it is pointed out for being consumed very hot and it is known that the thermal stress associated with the consumption of hot drinks is a factor risk for cancer of the esophagus and oral cavity. All other agents are chemicals or work environments potentially at risk (barber / hairdressers, oil refineries, processing and production of glass, wood etc ..).

GROUP 1 CARCINOGENIC TO HUMANS: this category is used when there is sufficient evidence of carcinogenicity in humans. This category includes 113 substances.

GROUP 2A PROBABLY CARCINOGENIC TO HUMANS: this category is used when there is limited evidence of carcinogenicity in humans and sufficient evidence in experimental animals. 66 substances are included in this category

GROUP 2B POSSIBLY CARCINOGENIC TO HUMANS: this category is used for agents for which there is limited evidence of carcinogenicity in humans and less than sufficient evidence of carcinogenicity in experimental animals. This category includes 285 substances.

GROUP 3 NOT CLASSIFIABLE REGARDING CARCINOGENICITY TO HUMANS: this category is usually used for agents for which the evidence of carcinogenicity is inadequate in humans and inadequate or limited in experimental animals. This category is the largest and includes 505 substances.

GROUP 4 PROBABLY NOT CARCINOGENIC TO HUMANS: this category is used for agents for which there is suggestive evidence of the absence of carcinogenicity in humans and in experimental animals. At the moment the only substance included in this category is caprolactam, a precursor in nylon production.

The mere presence of an agent in the classification does not make it immediately dangerous because it is necessary to understand, beyond the level of carcinogenicity, even what **the quantity and the exposure durations** that transform the theoretical risk in real one, as well as what are the real factors of risk. Cigarette smoke is definitely carcinogenic, but those who smoke one cigarette a day, will not face a real risk of tumour development. Chemical compounds that are generated in the high-flame cooking and result in food burning are risky: **changing cooking habits reduces the risk immediately.**

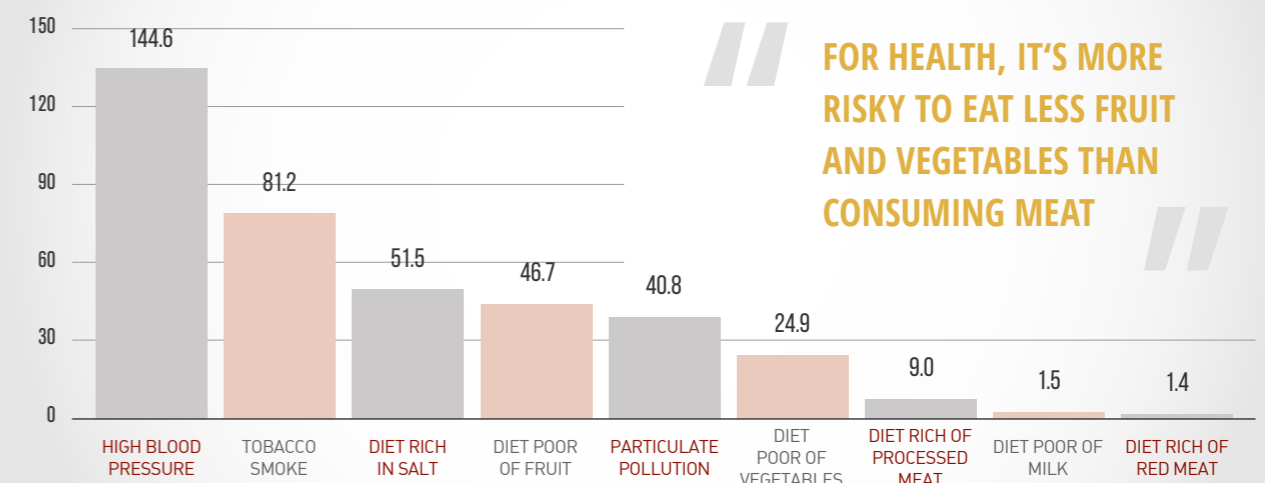
In case of red and processed meats, tumour pathology more likely to develop it is that related to colon and rectum. The IARC studies have associated **the excess of consumption with an increase of about 18% relative risk** for the transformed and 17% for the red. It is crucial, however, not to confuse the absolute risk (for simplicity you could say real) with the relative one, which only **represents the increase of the absolute risk.** If, for example, a person has a family history of colon cancer and cancer in general, healthy habits (not smoking, doing exercise) but it is frequent consumer of cured meats, **increase his/her own risk of getting sick by 17 %:** the absolute risk will anyway remain very low for the reasons expressed above. Another very relevant factor con-

cerns the amount investigated by IARC, which are 50 grams of processed meat or 100 of red meat per day. This consumption **are much higher than those of Italian consumers** and, in general, of the rest of the world.

Going deep, although in a preliminary way, the theme of the risks to people's health, you can use the information posted on the project database **Global Burden of Disease** (<http://www.healthdata.org/gbd9>) that is proposed as a system of measurement of health aimed at estimating the weight of the individual factors (for example, the consumption of tobacco) or groups of factors (the physical environment, accidents) on the development of diseases and therefore able to orient policies and programs. From these data, it emerges, as the colorectal cancer is actually a major cause of death in developed countries, but with a rather low frequency (approximately 3% of deaths in 2013).

If the analysis moves on risk factors, regardless of the type of disease generated, it is rather interesting to observe how in the world the first risk factor is that of high pressure, followed by cigarette smoking. From the point of view of food they are considered sources of risk diets low in fibre much greater proportions than diets rich in meat: **a further confirmation of the importance of following the directions proposed by the Mediterranean Diet.**

HEALTH RISK FACTORS: NUMBER OF DEATHS EVERY 100,000 PERSON



Source: Institute for Health Metrics and Evaluation GBD 2013; GBD 2013; extraction made in June 2016, taking into account all the risk factors in the world

CARCINOGEN RISKS IN MEAT

According to IARC, the risk factors of meat are due to **substances that may be in meat** (e.g. heme-iron), and/or originating during the **processing or cooking at high temperatures** (e.g. nitrous compounds NOC or aromatic amines HAA).

These substances, when introduced into the body, in the long

run may be jointly responsible for the development of cancers due to different biochemical mechanisms. One example is that of aromatic amines (HAA), potentially genotoxic substances that can damage the genetic information within a cell causing mutation and inducing DNA modifications. The suggestion to limit the consumption of red meat is then ac-

companied by that of avoiding open flame cooking, such as the barbecue.

To be fair, it is worth observing that this phenomenon is not just typical of meat, but is the cooking method itself: the same dangerous components, although to a lesser extent, are formed in other foods, such as grilled vegetables or pizza baked in a wood oven.

NITRITES AND NITRATES + HEME-IRON + COOKING

Nitrosamine

are organic compounds containing a nitrous group, $-N=O$, bound to amino nitrogen. They are obtained in very acidic conditions or at high temperatures due to the reaction of nitrite with a secondary amine, which may be present within a protein structure.

Many nitrosamines are carcinogens, which cause genetic mutation, as shown in studies on animals in the laboratory; their intake is linked to the development of cancer in the stomach and oesophagus.

The problem of nitrosamines is linked to the presence of nitrate as a natural component of foods, convertible into nitrite in the mouth due to saliva, and the use of nitrite used as a food

preservative, essential to prevent the development of microorganisms in foods such as the Botox bacterium. The nitrites find the optimum conditions to produce nitrosamines within the stomach or through cooking treatments such as frying or roasting.

Heme-iron

Is found in meat in the form of haemoglobin and myoglobin. The heme-iron is freed from these proteins due to the low pH and the action of proteolytic enzymes in the stomach and small intestine, to be then absorbed by the mucosa and transported in the blood directly to the cells to make heme proteins.

The negative effects of very high amounts are cytotoxicity and increased endogenous formation of N-nitrous compounds (NOC), which can increase the overall rate of mutation in the DNA of colon tissue.

Heterocyclic amines

Are formed in the meat and bread if they are burnt, due to cooking conducted at too high a temperature. In the human population an association between the ingestion of "burned" meat and the risk of cancer has not been identified. Probably it is a limited effect and difficult to identify.

COOKING AND SMOKING OF MEAT

Polycyclic aromatic compounds

Are formed after cooking at high temperatures and smoking food. Although there are over a hundred different IPA, the IARC (International Agency for Research on Cancer) has classified the most dangerous and those capable of causing serious damage to human health. It has been shown that repeated exposure to certain types of IPA involves a significant increase in the onset of cancer.

>> Not all meats are equal





Once clarified what are the substances that characterise the major risk factors, one should study in depth their presence in the various cuts of meat.

A first study concerns the nomenclature: it must be made clear what is meant by red and processed meat.

In traditional cooking terminology, meat is conventionally classified as "red" when characterised by a typical red colour, while "white" usually defines a subtype with a lighter colour. Although the semantic debate is still open, the first type defines the meat of most large mammals (cow, pig, sheep, goat, horse), while the latter is generally used to identify poultry (chicken, turkey) and rabbit.

One of these substances, the heme-iron, is characterised by a marked variability among both red and white meat in the same group of red meat.

Nitrites, another critical substance, are contained mainly in processed meats (where their **role is that of a preservative**), but also in other **foods**. The fresh plant, for example, contain high amounts of nitrates, which can be converted into nitrites. It is to be remembered that most of DOP cured meats are free of these substances⁸⁹.

TYPE OF MEAT	CUT	IRON TOTAL	HEME IRON
 BOVINE	Beef fillet	2.3	2.1
	Roast beef	2.0	1.8
	Topside	1.9	1.7
 LAMB	Thigh sheep	2.2	1.7
	Thigh lamb	0.9	0.4
 PORK	Loin	0.4	0.2
	Steak	0.5	0.3
 CHICKEN	Breast convent.	0.4	0.1
	Thigh convent.	0.7	0.2
	Organic chest	0.6	0.3
	Organic Thigh	1.0	0.5

Presence of iron and heme-iron in meat. Data in mg / 100 grams. Source Lombardi Boccia et al., 2004⁹⁰ - Mele et al., 2015⁹¹

⁸⁹ Mele M., A. Nudda, Pauselli M., V. Roscini, Casarosa L., P. Secchiari, Pulido G. 2015. Consumption of Meat and human health. In: Food of Animal Origin and Health. Ed. Franco Angeli. Pp.400.

⁹⁰ Lombardi-Boccia G, Lanzi S, Lucarini M, Di Lullo G. Meat and meat products consumption in Italy: contribution to trace elements, heme iron and selected B vitamins supply. Int J Vitam Nutr Res. 2004 Jul;74(4):247-51.

⁹¹ Mele M., A. Nudda, Pauselli M., V. Roscini, Casarosa L., P. Secchiari, Pulido G. 2015. Consumption of Meat and human health. In: Food of Animal Origin and Health. Ed. Franco Angeli. Pp.400.

NITRITES AND NITRATES: THE HIGHEST CONCENTRATIONS ARE IN VEGETABLES

mg/100g	NITRATE	NITRITE	mg/100g	NITRATE	NITRITE
Beet	329	0.60	DOP Ham	0	0
Celery	315	0.08	National ham	0	0
Radishes	258	0.48	Chosen Cooked Ham	6	5
Spinach	247	0.38	Bacon	21	0
Lettuce	233	0.06	Pure pork frankfurters	13	0
Beets	203	0.13	Modena Zampone	0	7
			DOP Sausage	1,4	0

Presence of nitrates and nitrites in certain foods. Data in mg/100 grams.
From: food content of potentially carcinogenic substances⁹²

As for the **aromatic amines (HAA)**, their presence is closely related to the cooking mode: the data published in the EPIC study in fact observes the change in the content of the main substance among fresh meat (with a value equal to 0) and cooked meat in various

ways. In this respect, **communication towards consumers should recommend an amendment of meat preparation practices**, rather than a general reduction in its consumption⁹³.

THE DIETARY CONTENT OF POTENTIALLY CARCINOGENIC SUBSTANCES ⁹⁴	PHLP (ng/g)	MELQX (ng/g)	DIMELQX (ng/g)	AC (ng/g)	IQ (ng/g)	MELQ (ng/g)
Fresh beef	0	0	0	0	0	0
Beef grill (with blood)	0-1.2	0-1.1	0	0	0	0
Beef grill (well cooked)	0-15.0	0-2.2	0-4.3	0-4.15	0	0
Beef grill (very well cooked)	5.7-33.3	1.2-5.8	0.4-1.9	0	0	0
Fried beef	0-23.2	0-8.2	0.1-1.3	0	0-2	0-1.7
Hamburger	0.2-18.4	0.2-1.8	0-0.1	0	0	0
Pork (fried or grill)	0-7.8	0-3.8	0-1.1	0	0-0.7	0-0.1
Chicken (fried or grill)	0-270	0-9	0-4	0-170	0	0
Bacon	0-46.2	0-23.7	0-3.4	0-0.1	0-10.5	0-1.7
Frankfurters	0-0.6	0-0.7	0-0.2	0	0-0.2	0-0.1

⁹² Jakszyn P, Agudo A, Ibáñez R, García-Closas R, Pera G, Amiano P, González CA. Development of a food database of nitrosamines, heterocyclic amines, and polycyclic aromatic hydrocarbons. J Nutr. 2004 Aug;134(8):2011-4.

⁹³ Ho V, Peacock S, Massey TE, Ashbury JE, Vanner SJ, King WD. Meat-derived carcinogens, genetic susceptibility and colorectal adenoma risk. Genes Nutr. 2014 Nov;9(6):430.

⁹⁴ Jakszyn P, Agudo A, Ibáñez R, García-Closas R, Pera G, Amiano P, González CA. Development of a food database of nitrosamines, heterocyclic amines, and polycyclic aromatic hydrocarbons. J Nutr. 2004 Aug;134(8):2011-4.

With regards to **polycyclic aromatic hydrocarbons**, finally, the EFSA opinion of 2004 indicates that the two highest contributors to dietary exposure were **cereals, cereal products, seafood and their deriv-**

atives. For these substances it is also important to observe how in **smokers the nutritional contribution is virtually zero compared to that of the smoke**.

FOOD	PREPARATION	TOTAL PAH (µg/kg)
Beetroot	raw	14
Cauliflower	raw	2.8
Lettuce	raw	2.6
Zucchini	raw	8.9
Apple	raw	8.3
Oat bread	oven	64
White bread	oven	3.2
Breakfast cereal	dry	5.7-59.5
Cereal flour	dry	8.6-38
Pizza	oven	13
Bacon	smoked	6.8
Beef	smoked	9.7
Beef	barbecue	5.7-42.1
Chicken	barbecue	0.6-60.2
Ham	smoked	2.6-9.5
Pork meat	barbecue	3.1-13.6
Salmon	smoked	86.6
Kipper	smoked	55-180

Content of polycyclic aromatic hydrocarbons. Data in mg per kg. Source: Food content of potential carcinogens, EPIC, 2004.

>> The protective effect of a balanced diet: vitamin C, vitamin D, folic acid

The analysis of all these data, that does not clearly identify a "good" and a "bad", once again confirms that the diet should be considered as a whole and that **the cause and effect relationship is very difficult, when referring to a single food or food substance**.

For example, a recent epidemiological⁹⁵ survey involving more than 10,000 individuals, studied how a vegetarian or a low-meat consumption diet affects the risk of colorectal cancer with respect to a meat-rich diet.

⁹⁵ Gilsing AM, Schouten LJ, Goldbohm RA, Dagnelie PC, van den Brandt PA, Weijnenberg MP. Vegetarianism, low meat consumption and the risk of colorectal cancer in a population based cohort study. Sci Rep. 2015 Aug 28;5:13484.

The results showed that vegetarians, and those who consume meat, fish eaters and those who ate meat once a week **showed a modest, but significant, reduction in colorectal cancer risk compared to those who consumed meat 6-7 times a week.**

Most of the differences between the groups could be explained by the different consumption of other foods with a protective function, such as fibre. In other studies, other nutrients such as calcium, milk or whole grains, often associated with a lower risk of colorectal cancer, were considered protective⁹⁶, and there is substantial evidence for the potential chemo preventive effects of **vitamin D, folic acid**, fruit and vegetables, also due to their content in **vitamin C**.

>> The suggestions

It is clear that any food, including water, each nutrient or dietary substance poses real, alleged or potential risks, closely related to consumption, to the individual and to lifestyle.

Meat has high nutritional qualities and its consumption in moderate quantities is linked to established and consolidated benefits for thousands of years. It is risky to give credit to information that, based on an assumption of minimal risk of the increased likelihood of a disease (such as cancer) instead lead **to a real risk in nutritional deficiencies and to the known metabolic and cognitive effects that ensue.**

These considerations have even greater value when they concern the diet of growing individuals, persons of old age or with particular health conditions.

The opinion of CNSA

Recently, the National Committee on Food Security (CNSA) has clarified the IARC report in the relationship between meat and cancer, sustaining that:

(...) meat is an important source of high biological value proteins, amino acids, vitamins, mineral salts and metals (in particular iron and zinc) in human food and, especially, in certain age groups and/or physiological states, and in particular health conditions; (...)

and more:

(...) that tumour colorectal cancer, like all cancers, is the result of several factors, and is triggered by the interaction of environment, life style and genetics; that, particularly relevant in this general framework are: being overweight, physical inactivity, poor fibre intake, excess calories in the diet, lifestyle as a whole, including food (...)

and recommends:

(...) following a varied diet, inspired by the Mediterranean model, avoiding the excessive consumption of red meat, both fresh and transformed (...) avoiding the excessive consumption of any food".

⁹⁶ Song M, Garrett WS, Chan AT. Nutrients, foods, and colorectal cancer prevention. *Gastroenterology*. 2015 May;148(6):1244-60.e16. doi: 10.1053/j.gastro.2014.12.035. Epub 2015 Jan 6.

MEAT CONSUMPTION IS SUSTAINABLE



The starting point for assessing whether food consumption of individuals are consistent with the guidelines suggested by nutritionists is to quantify the consumption data per capita per year. The scientific literature provides much information about this, but have limited benefits due to the highly variable level of detail and boundaries of the analysed phenomena. The following is nevertheless an analysis, albeit preliminary, which provides some interesting information about the consumption of meat and cured meats.



> How is people's food consumption estimated

In general, food consumption can be estimated using two different approaches: the calculation of the **availability of food** with **surveys** of real consumption.

>> Food availability: apparent consumption

The first method is to estimate a very general picture of the food resources available for human consumption in a country in a given period of time, to the point that its monitoring is normally accomplished by the major institutional sources (Istat, Eurostat, FAO...) showing the relationship between the availability of food in a country and the number of people who have access to the available resources.

$$\frac{(\text{production} + \text{import} + \text{initial food supply}) - (\text{non-food use} + \text{export} + \text{final food supply})}{\text{number of country's inhabitants}}$$

In the case of meat, the data provided amount to the **equivalent weight of the carcass**, including the non-edible parts (tendons, bones, fat, ligaments),

which tends to overestimate real consumption, In this case we speak about **apparent consumption**. For this reason, this information should not be used to study the relationship between the diet and the health of the consumer, unless one accepts the enormous overestimation in real meat consumption.

>> Real consumption

Real consumption is estimated by the investigation of families or individuals through precise measurements of well-defined samples of the population. Although for simplicity in this paper the two methods are assimilated, in truth surveys on families are usually conducted by analysing the economic cost of a given period of time by means of interviews, while those on individuals regard precisely the consumption of a particular food by a specific sample of people in a given period of time.

These methods are used by organisations specialising in the analysis of statistical data, such as INRAN, Nielsen, Eurisko, or by scientific studies such as *European Prospective Project into Investigation Cancer and Nutrition*. They are ideal for the acquisition of information useful for the study of the relationship between eating habits and the health of people, but have the disadvantage of being very expensive.

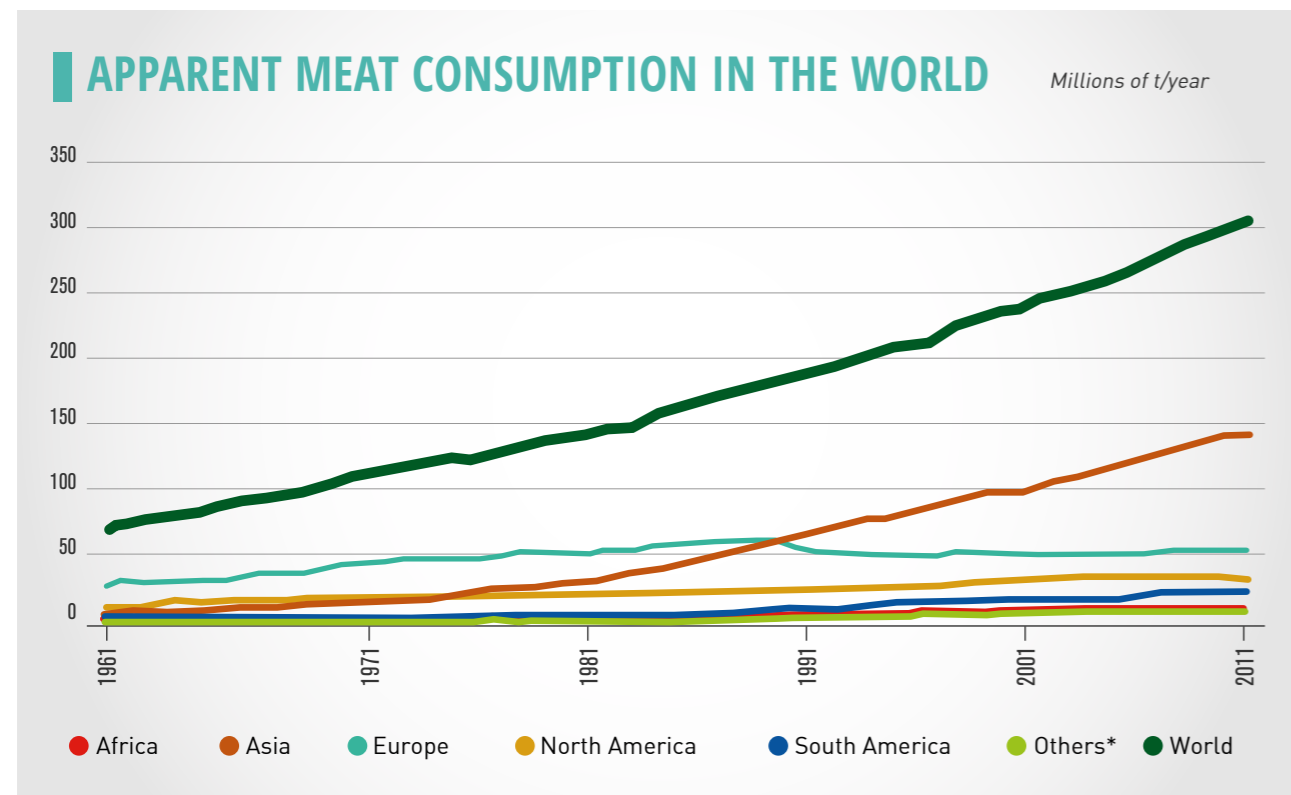
	FOOD AVAILABILITY (APPARENT CONSUMPTION)	REAL CONSUMPTION	
		SURVEYS OF HOUSEHOLD EXPENDITURES	DETECTING INDIVIDUAL CONSUMPTION
MODE	Mathematical ratio between the balance in the availability of food and population	Survey of household spending for the purchase of food and in some cases the quantities purchased	Detection of individual or group consumption in 24 hours or longer periods by means of a diary or interviews
OBJECTIVE	To know the rough amount of food available in a country Compare trends and consumption between different countries Orientate decisions on agricultural and food policies	Analyse spending on food by various samples of people Monitor the consumption of food over time	Assess the per capita food consumption Study the relationship between diet and health
CRITICAL ISSUES	Does not include production for auto consumption It includes non edible items Difficulty in estimating quantities intended for non-food uses Includes losses in the various stages of the supply chain The calculation of person does not take into account the overall number of the flow of tourists, as well as non-resident immigrants	Detects the spending and not the quantity purchased Does not estimate the consumption of meals away from home No distinction is made between the time of purchase and the time of consumption Methodological aspects related to sampling	The detection can consider weights or number of servings, as well as the raw or cooked weight Considers with difficulty the calculation of leftovers Preparations with non-meat ingredients Methodological aspects related to sampling Reliability of participants The cost of the method



> Consumption of meat in the world

In 2011 the theoretical availability of meat in the world reached about 300 million tonnes per year,

of which just under 50% in Asia only. That, since the beginning of the 90s, has contributed more to the growth in volume. Europe and North America contribute in a more limited way, with values that contribute respectively to less than 20 and 15%.



Source: FAOSTAT <http://faostat3.fao.org/home/Ee>
* Oceania and Centre America

SOURCE OF DATA USED

The analysis presented in this part of the document were made taking into account the data published in the FAOSTAT database, available on the website <http://faostat3.fao.org/home/Ee> that refer to **apparent consumption**, having been processed using the food balance sheet method.

Queries were carried out in March 2016 using the following features:

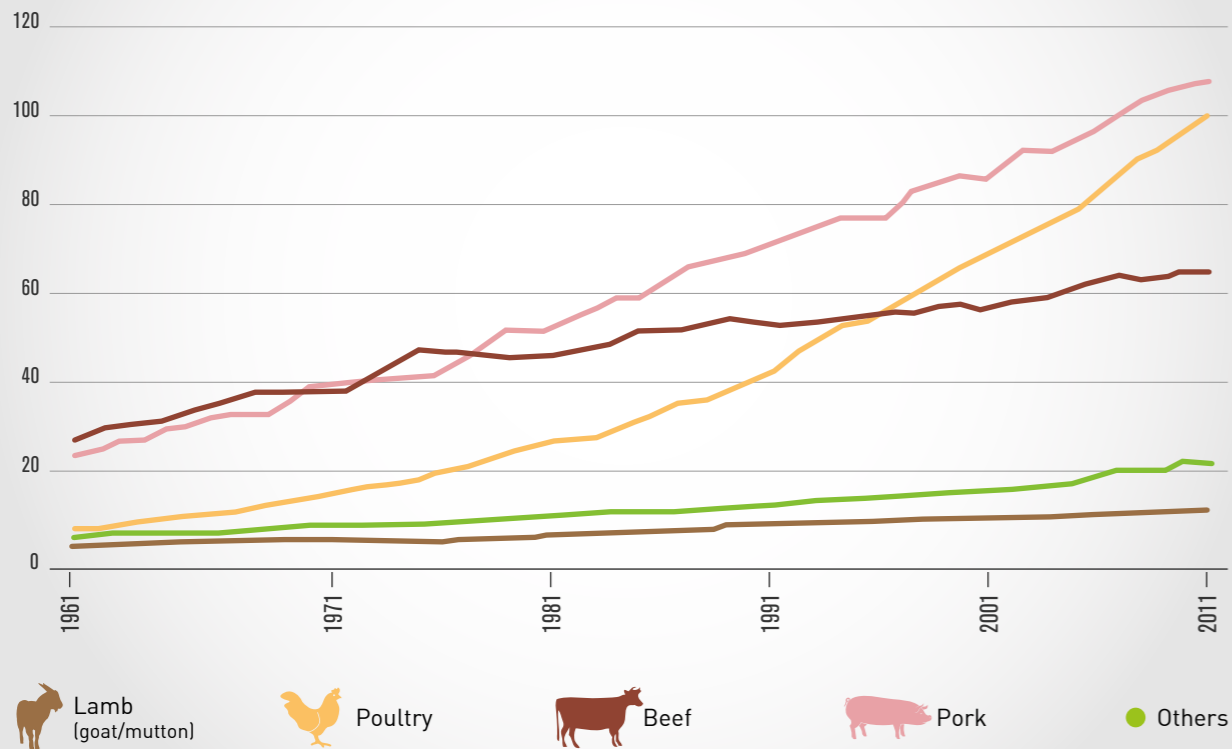
- annual coverage from 1961 until 2011 (there is some data for the years 2012 and 2013, but have been neglected because they are still partial);
- types of products included in the total meat item: Bovine Meat; Meat; Other; Mutton & Goat Meat; Offal; Edible; Pig meat; Poultry Meat;
- in the "other" region, Oceania and Central America are included.



Source: FAOSTAT <http://faostat3.fao.org/home/Ee>
* Oceania and Central America

APPARENT MEAT CONSUMPTION IN THE WORLD PER SPECIES

Millions of t/year



Fonte: FAOSTAT <http://faostat3.fao.org/home/Ee>

The most consumed species are pigs, chicken and bovine, even if with different annual trends: the consumption of beef has largely been stable for over 20 years, while in the same period poultry meat consumption almost doubled.

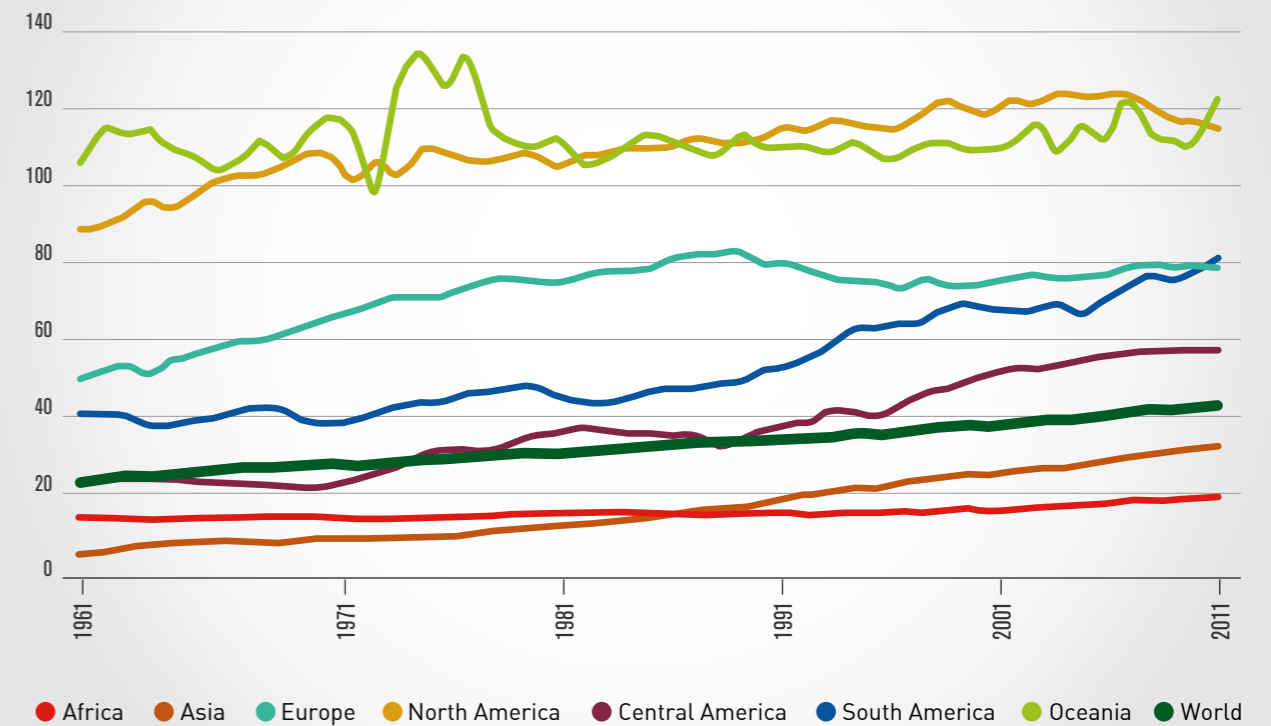
Albeit with some differences among species, there is no doubt that in the last 20 years there has been a net increase in the global consumption of meat. But it is worth dwelling on individual world regions to see how and where the food habits of people changed over time. To do this, one can analyse the theoretical per capita data availability in the same areas already studied.

This case also reveals substantial differences between the various regions of the world: the countries of North America, in fact, recorded an apparent consumption much higher than that of other continents. Asian countries, which have become the first global consumer by volume, are in fact among those with the least per capita value, even though showing a substantial growth since the late 80s.



APPARENT MEAT CONSUMPTION PER CAPITA

kg per capita/year



Fonte: FAOSTAT <http://faostat3.fao.org/home/Ee>

>> Too much meat or too much imbalance between the countries of the world?

The data analysis of world consumption, but above all their variability from region to region, leads to the consideration that the direct correlation between meat consumption and sustainability is always very critical unless it is contextualised. Statements like “you eat too much meat” or “meat consumption is unsustainable” should be contextualised to proven data, to understand whether this is completely true or is more true in some parts of the world.

Obviously, this work provides only a preliminary view of the problem, which could be discussed further with a more detailed analysis.

However, it seems clear enough that:

- meat consumption is on the rise both by virtue of higher per capita consumption in some areas of the world, and (and above all) for the **increase of the global population**;
- there is a strong imbalance between the world's regions: the per capita consumption of meat in North America is more than 4 times higher than the average African states;
- the consumption of **beef in Europe has not shown substantial increases since the late nineties**.

FOOD DIETS IN THE WORLD: A COOP-DOXA DISCOVERY

Among the projects published in the period of EXPO 2015, an interesting one was a study by DOXA for COOP Italy aimed at investigating possible developments in the food sector. From the analysis, available on the DOXA website⁹⁷, also emerged an estimate of average food consumption in some countries. Even if the evaluation is to be considered preliminary because it shows the frequencies of consumption and not the quantity, it is very interesting to observe how Italy has a lower consumption than average with regards to animal proteins, and therefore also to meat, and a higher consumption with regards



to carbohydrates, sweets, fruits and vegetables. The main consumers of meat among the countries surveyed appear to be Russia, China and

Brazil. Italy is the lowest meat consumer after India.

⁹⁷ <http://www.doxa.it/news/cibo-di-oggi-cibo-di-domani-coop-doxa-expo2015/>

The diets of the world

In Italy “Mediterranean Diet”, high meat consumption in Russia, China and Brazil, mainly protein diet for Germany, UK and USA

	Italy	Germany	UK	USA	Russia	China	India	Brazil
Average weekly consumption in days								
4.7 Carbohydrates	5.2	3.8	3.9	3.7	4.1	5.9	5.4	5.8
4.0 Meat	3.4	3.9	3.7	3.9	4.8	4.6	2.6	4.7
1.7 Fish	1.6	1.2	1.5	1.5	1.8	2.6	2.4	1.4
3.6 Cheese and dairy products	3.0	4.4	3.3	4.0	4.0	3.6	2.9	3.9
2.6 Eggs	1.5	2.1	2.1	2.6	2.7	4.2	3.0	2.6
4.6 Fruit	5.1	4.7	4.5	4.0	4.1	4.8	4.9	4.3
4.9 Vegetables	4.9	4.4	4.8	4.5	4.6	5.8	5.5	4.7
4.0 Sweets	4.2	3.5	3.5	3.7	5.3	2.8	4.2	4.8

> Meat consumption in Italy

With regards to consumption in Italy, it was decided to compare the apparent consumption data, available and already consulted in FAO databases with those of actual consumption. To this end, the various public sources cited in the bibliography were analysed. Despite being rather complex to uniquely identify a given real or apparent consumption, the results made it possible to draw some broad

considerations. Studying the details of the data analysed, it can be seen that the apparent consumption value is about 230 g of meat per capita per day, while the real consumption is equal to about 110 grams, which is not far from what is suggested by the nutritional guidelines. This difference is also consistent with the average data yield between edible meat and the carcass of the animals. With regards to actual consumption, according to the Leclerc study of 2009, this is around 20-25 g per day.

SOURCE OF DATA



- **FAOSTAT**
Data base already described for the analysis of world consumption. The data presented is for the year 2011
- **ISMEA**
The figure is part of a time series from 1938 to 2009, prepared by the Milan Chamber of Commerce in 2010. In this analysis the most recent data available was taken into account⁹⁸
- **GIRA**
Data published by the main statistical research institutes.

- **INRAN**
The data presented is the average of 4 scientific studies conducted by CSPO⁹⁹, EPIC¹⁰⁰, INRAN¹⁰¹ (now CREA - Alimentazione e Nutrizione).
- **GfK Eurisko**
The basic data used in this paper are those of the database Ismea-GfK-Eurisko, from periodic surveys on the purchasing behaviour of a sample of 8,000 families. Eating out was included. The study is quoted in the ISMEA document
- **ASPA**
Scientific study of the Association for Science and Animal Production (ASPA)

⁹⁸ ISMEA, Sector Plan, Study on beef consumption in Italy

⁹⁹ CSPO: Centre for the Study and Prevention of Cancer; Pala V. et al., 2003. Diet in the Italian epic cohorts: presentation of data and methodological issues. Tumours 89:594-607

¹⁰⁰ EPIC: European Prospective Investigation into Cancer and Nutrition; Linseisen J, et al, 2002. Meat consumption in the European Prospective Investigation into Cancer and Nutrition (EPIC) cohorts: results from 24-hour dietary recalls - Public Health Nutrition: 5(6B), 1243-1258

¹⁰¹ INRAN (now CREA - Alimentazione e Nutrizione): The Research Centre for Food and Nutrition; Turrini A., et al., 2001. Food consumption patterns in Italy: the INN-CA Study 1994-1996. European Journal of Clinical Nutrition 55, 571-588; Leclercq C., et al., 2008. The Italian National Food Consumption Survey INRAN-SCAI 2005-06: main results in terms of food consumption. Public Health Nutrition 2009; 12(12): 2504 -2532

FROM APPARENT TO REAL CONSUMPTION: THE ASPA STUDY

ASPA, the Association for Science and Animal Production, was founded with the aim of promoting the progress of science and technology affecting livestock production and concerning all the factors of the sustainability that refer to it. Many Italian academic organisations are members, who

for their different skills, have the purpose of carrying out scientific studies useful to this purpose.

One of the projects is aimed at finalising a system for estimating the consumption of meat in Italy: thanks to a thorough study of all livestock production sectors, the

research aims at publishing useful conversion factors to transform data concerning the availability of meat products (form apparent) in real consumption by consumer¹⁰².

The project, which should be completed in 2016, is based on the

practical analysis of surveys in the field, specific surveys and interviews with the operators. The great advantage of the proposed method is to arrive to the estimate of the actual consumption of meat with the same precision of the surveys on individual consumption, but without the high cost of the latter. Starting from the apparent availability of data and using the conversion factors, it is in fact easily possible to calculate the actual consumption.

The first result, published in the course of a conference in June 2015, shows the data relating to the estimates of edible parts of the carcass of each animal species¹⁰³. This is a value to be considered as preliminary, since waste figures are not yet available.

¹⁰² <http://www.aspa2.unitus.it/index.php/it/commissioni-aspa.html>

¹⁰³ Russian and V, Sermoneta C.; statistical data about the agro-food chain. Meat consumption: relevance, limitations, uncertainties and opportunities for improvement of the estimates; Milan, 06/18/2015




¹⁰⁴ ISMEA data

CONVERSION FACTORS FOR THE CARCASSES OF DIFFERENT ANIMAL SPECIES IN SOLDABLE MEAT

SPECIES AND CATEGORY (RED MEAT)	CONVERSION FACTOR (%)	SPECIES AND CATEGORY (WHITE MEAT)	CONVERSION FACTOR (%)
Veal	52.4	Chicken meat <2kg	61.0
Male cattle	59.3	Chicken meat >2kg	62.0
Female cattle	57.5	Turkey	62.0
Cow	50.7	Guinea fowl	58.0
Piglets pig	49.4	Duck	52.0
Light-weight pig	52.8	Goose	52.0
Heavy-weight pig	49.2	Quail	45.0
Lamb (baby)	52.93	Pigeon	50.0
Lamb (adult)	53.6	Rabbit	55.0
Goat	58.0		

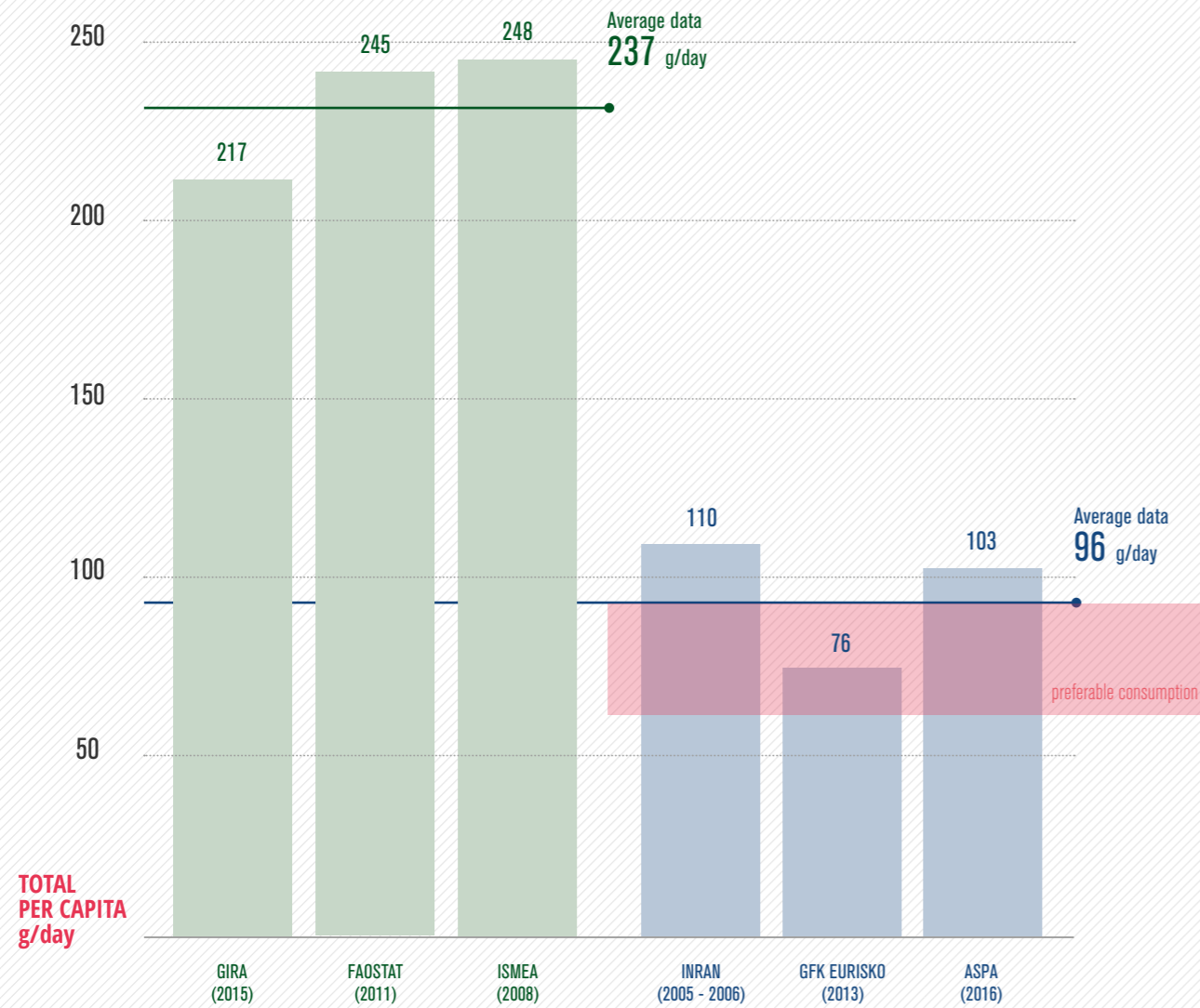
Source: Russo V., Amici A., Cavani C.; Danieli P.P., De Angelis A., Franci O., Gasco L., Lo Fiego D. P., Meluzzi A., Moretti V., Nanni Costa L., Nicastro F.V., Parisi G., Piccolo G., Sermoneta C., Serra A., Trevisi E. (2016) - Stima del consumo reale di carne in Italia. In corso di preparazione per la stampa. Commissione per la stima del consumo pro capite reale di carne in Italia - Associazione per la scienza e le produzioni animali - ASPA

APPARENT AND REAL PER CAPITA YEARLY MEAT CONSUMPTION¹⁰⁴ IN ITALY

MEAT TYPE	2010	2011	2012	2013
BEEF 				
real consumption. kg	12.1	11.2	10.9	10.3
apparent consumption. kg	23.8	22.1	21.3	20.2
real consumption/apparent consumption. %	50.9	50.8	50.9	51.0
PORK 				
real consumption. kg	18.1	17.6	17.2	17.2
apparent consumption. kg	38.4	37.3	36.9	36.7
real consumption/apparent consumption. %	47.2	47.2	46.8	46.8
POULTRY 				
real consumption. kg	9.6	10.2	10.6	10.2
apparent consumption. kg	18.0	18.6	19.4	18.8
real consumption/apparent consumption. %	53.6	54.9	54.8	54.4



MEAT AND CURED MEATS CONSUMPTION IN ITALY



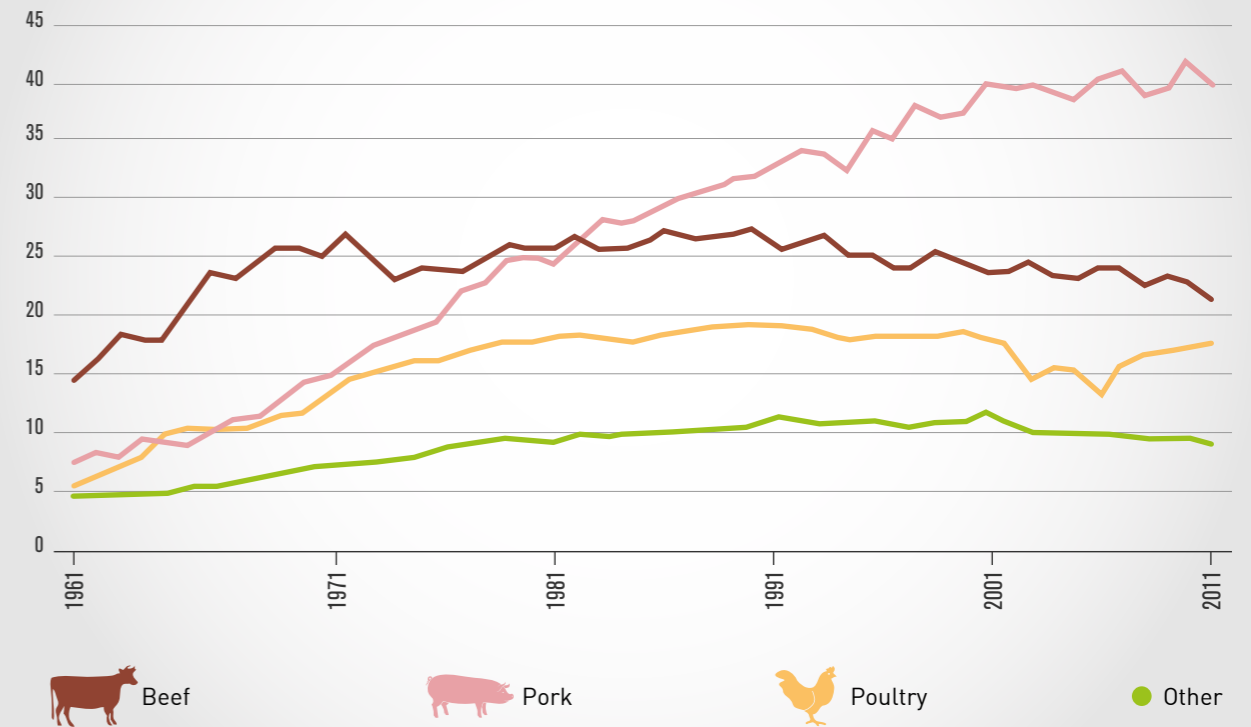
Estimation based on production data for macro-economic assessments. It is not suitable for nutritional considerations.



Based on surveys involving consumers with the aim of assessing the nutritional habits.

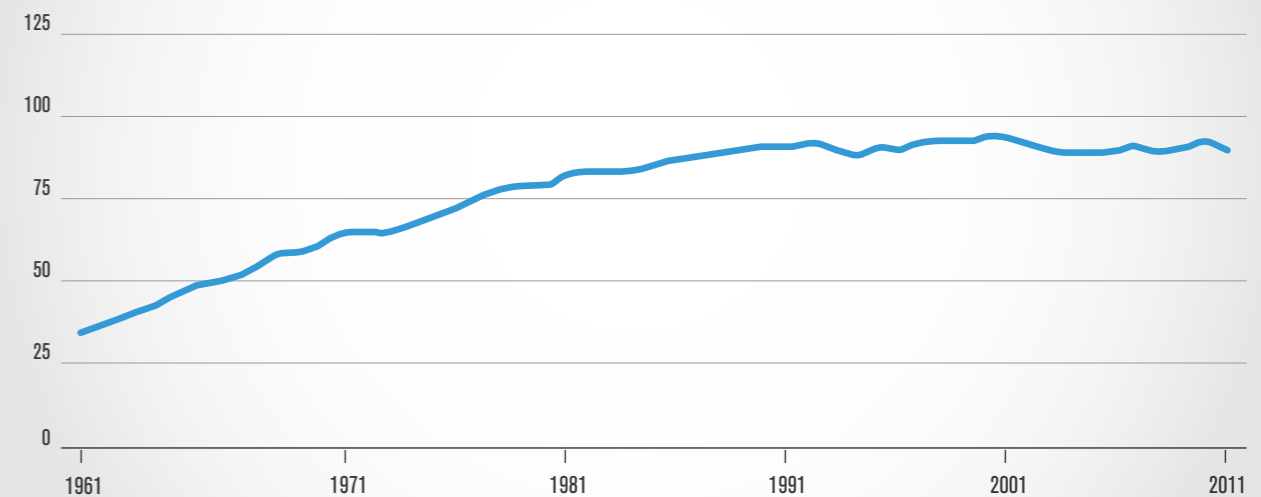
APPARENT MEAT CONSUMPTION PER SPECIES IN ITALY

kg/year per capita



PER CAPITA MEAT CONSUMPTION IN ITALY

kg/year per capita



Source: FAOSTAT <http://faostat3.fao.org/home/Ee>

FREQUENTLY ASKED QUESTIONS

THE NUTRITIONAL VALUE OF MEAT

DOES THE MEDITERRANEAN DIET INCLUDE THE CONSUMPTION OF MEAT?

Yes. The Mediterranean Diet is varied, and includes balanced amounts of each type of food. In general, what emerges from the Mediterranean model is a way of eating with a high consumption of vegetables, legumes, fruits and nuts, olive oil and cereals (preferably wholegrain), and a moderate consumption of fish, meat, dairy products (especially cheese and yogurt) and sweets.

Meat is thus also part of the Mediterranean Diet. In fact, in the past, besides fish and venison, poultry was eaten (chickens, turkeys, rabbits, geese, etc.) and pigs, whose food intake was based on the use of agricultural by-products and on human food waste.

The slaughtering was done by the owners of the animals which, if large in size (especially cattle and pigs), necessitated the preservation of the meat to use in subsequent periods.

This necessity "stimulated the production" of a high number of cured meats, which today have become the pride of our food production, appreciated all over the world. One has only to con-



sider that of the 244 PDO and Italian IGP, 1/3 comes from productions arising from husbandry and 37 are part of the meat category, such as dried beef, ham, salted pork, salami, mortadella, pork sausages, bacon, coppa, bacon etc.

ACCORDING TO MODERN BIOMEDICAL SCIENCE THE MEDITERRANEAN DIET IS THE BEST WAY TO EAT AND REPRESENTS A REAL LIFESTYLE. WHY?

The international scientific community has accepted the role of

the Mediterranean Diet in increasing life expectancy and improving overall health, and has contributed to the spread of this dietary pattern as a central pillar in programs and public health policies in many countries, from the United States to Europe.

But the Mediterranean Diet is not just a diet, it is a lifestyle. The "Mediterranean Diet Foundation" has developed a graph of the Food Pyramid, which includes information closely linked to the Mediterranean way of life, cultural and social order, as well as the importance of exercise and conviviality. The Pyramid emphasises the importance of the Mediterranean lifestyle, including factors not related to the use of particular foods. It is a comprehensive approach, not a single food, not a single behaviour, but a way of life that specifically caters for regular exercise, adequate rest, conviviality and different products to be consumed by following seasonality.

WHY IS THE PRESENCE OF ANIMAL PROTEINS IMPORTANT IN A BALANCED DIET? WHAT BENEFITS DOES THE CONSUMPTION OF MEAT PROVIDE THE BODY WITH?

HOW MUCH CONSUMPTION OF MEAT IS RECOMMENDED?

Just as the Mediterranean Diet shows, you need to follow a varied and balanced diet for health and physical well-being. This "diet" should include not only fruits and vegetables, but also a moderate consumption of meat, a food that can bring numerous benefits to the body.

Proper consumption of meat, especially lean cuts, can be beneficial in different phases of life, such as growth and during adolescence, when boys and more girls have a higher protein requirement and must avoid the risk of iron deficiency anaemia. Even during pregnancy, one of the moments in which the increased need for nutrients is high, the intake of meat (in this case, well cooked) is very important.

Or even during childhood, another period of life in which there is continuous growth, protein requirements are very high, as these are used by the body for building tissues. In old age, protein intake cannot be underestimated. In fact, an inadequate intake of protein in an elderly person contributes to increase skin fragility, reduces the body's

resilience and immune functions, causing difficulty and increasing the time extension for the healing of diseases.

Always accompanied by copious amounts of fruit and vegetables, the right amount of foods of animal origin can at every stage of life increase the intake of vitamin B, A and D and minerals such as calcium, iron and iodine. Compared to a meat diet free, a diet that includes lean cuts of meat contributes to a better intake of protein, selenium, thiamine and vitamin B6, without increasing the intake of total and saturated fat.

Not only that, but unlike foods based on fats and carbohydrates, **have a high satiating effect.** The anti-hunger effect is due to the blocking of ghrelin, the hormone that stimulates hunger, caused by the digestion of proteins.

WHAT ARE THE HEALTH BENEFITS OF THE MEDITERRANEAN DIET?

It reduces the risk of metabolic syndromes, chronic diseases, and the cardiovascular risk.

Scientists have compared the risk of developing heart disease

FREQUENTLY ASKED QUESTIONS

THE NUTRITIONAL VALUE OF MEAT

and other diseases in populations that have not adopted the Mediterranean Diet. The latter is linked to:

- increasing longevity - i.e. a reduced chance of death at any age - mainly because of the reduced ability to develop, have a recurrence of, or from dying,

from heart disease or cancer. The results were confirmed in the populations of the United States and United Kingdom, with a reduction in risk of death by 20% for all ages: a reduced risk of developing diabetes 2, hypertension or increased cholesterol in the blood, each of which is as-

sociated with heart and vascular diseases;

- reducing the chance of becoming obese: the Mediterranean Diet has been the basis for a balanced weight reduction; a reduced risk of developing Parkinson's and Alzheimer's disease.



IS EATING MEAT DANGEROUS FOR HUMAN HEALTH?

A moderate consumption of animal protein is not dangerous to human health, on the contrary. Conversely, excessive consumption of red meat, more than 500 g per week is associated with a greater risk of developing diabetes, cardiovascular diseases and cancer. According to the Italian Association for Cancer Research study, "no disease is caused only by the consumption of meat, and there is no relationship of cause and effect between direct and absolute animal protein consumption and the development of a given disease. [...] There are not yet studies suggesting a convincing relationship between the risk of disease and the modest consumption of animal protein; indeed, in certain cases a limited intake of animal protein has beneficial effects, because it provides important micronutrients".

The 500 grams figure is still higher than recommended in the nutrition claims when referring to the Mediterranean Diet.

IF THERE IS NO HEALTH HAZARD, WHY HAS IARC (INTERNATIONAL AGENCY FOR CANCER RESEARCH, THE RESEARCH AGENCY OF THE WORLD HEALTH ORGANIZATION) CLASSIFIED RED MEAT AND PROCESSED MEAT RESPECTIVELY, AS PROBABLY CARCINOGENIC AND CARCINOGENIC TO HUMANS?

IARC in 2015, based on many scientific studies, whose results were known long ago, anticipated the decision to include red and processed meats in Group 1 (carcinogenic) and red meat in Group 2A (probably carcinogenic), on the basis. "In the studies reviewed, the consumption of processed meat was associated with a small increased risk of cancer. In these studies, the risk generally increases with the amount of meat consumed. The analysis of data from 10 studies estimate that every portion of 50 g of processed meat, consumed each day, increases the risk of cancer of the colon-rectum by

about 18%. The risk of cancer related to the consumption of red meat is more difficult to estimate, because the evidence that red meat causes cancer is not as strong. However, if the association between red meat and colorectal cancer has been shown to be causal, the data of these studies suggest that the risk of colorectal cancer could increase by 17% for each portion of 100 g of red meat eaten every day" (source: Q & A site IARC). As you see, the IARC refers to high daily portions, very far from real consumption.

WHAT IS IN RED AND PROCESSED MEAT THAT INCREASES THE RISK?

According to IARC studies, the risk factors of meat are due to substances that may be in meat (e.g. heme-iron), and/or originating during the processing or cooking at high temperatures (e.g. nitrous compounds NOC or aromatic amines HAA). The suggestion to limit the consumption of red meat is accompanied by that one of avoiding open flame cooking, such as barbecue, and of adding foods that contain C vitamin, such as lemon, that

helps the absorption of the free iron present in red meat and that neutralizes almost completely the risks connected to potential unhealthy substances. The presence of nitrous compounds NOC or aromatic amines HAA is considered responsible for the activation of carcinogenic mechanisms when the consumption of meat and cured meats is very high: for red meat this is considered to be more than 100 grams a day, which is a value very far from the actual Italian consumption. To be fair, it is worth observing that this phenomenon is not just typical of meat, but is the cooking method itself: the same caution should in fact be used for other foods, such as grilled vegetables or pizza baked in a wood oven.

CAN YOU AVOID ADDING NITRATES AND NITRITES TO CURED MEATS?

These additives are used, in the quantities authorized by the health authorities, to prevent the development of Clostridium botulinum spores that develop a very dangerous toxin, deadly to humans. In any case, one must remember that these substanc-

FREQUENTLY ASKED QUESTIONS

THE NUTRITIONAL VALUE OF MEAT

es are not added when is strictly necessary: the process of conservation by long seasoning, typical of Italians products, it is also enough to eliminate any risk. For some products, such as the DOP hams, the use of these substances it is prohibited. For products in which are used, the nutritional analysis of 2011, compared to those of 1993, have shown declines between 50 and 90% of nitrates (present in any case in few parts per million).

CAN THE COOKING METHODS OF MEAT CHANGE THE RISK?

The high temperature cooking methods can generate compounds that could contribute to the risk of cancer, but their role is not yet fully understood. In particular, baking at elevated temperatures or with the food in direct contact with a flame or a hot surface, such as barbecuing or frying, produces different types of chemical carcinogens, such as polycyclic aromatic hydrocarbons and heterocyclic aromatic amines. However, it should be noted that this phenomenon is independent of the type of food and also includes the charring of other foods such as fish, vegetables, pizza, etc.

SINCE TOBACCO SMOKE, ASBESTOS, AND ALCOHOL ARE CLASSIFIED AS CARCINOGENIC TO HUMANS, DOES IT MEAN THAT PROCESSED MEATS ARE CARCINOGENIC SUBSTANCES AS WELL?

No. Even if included in the same category as tobacco smoke or asbestos as a cause of cancer, this does not mean that they are all equally dangerous. IARC classifications describe the scientific strength of evidence of an agent to be a cause of cancer, rather than evaluate its risk level. In other words, it is important to know not only in which list a certain substance is, but what are the dosages and durations of exposure beyond which the risk becomes real and not just therefore theoretical.

As explained by the IARC, "according to the most recent estimates of the Global Burden of Disease Project, an organisation of independent academic research, about 34,000 cancer deaths worldwide each year are attributed to diets high in processed meats.

Eating red meat it is not yet defined as a cause of cancer. However, if the reported associations were demonstrated to be causal,



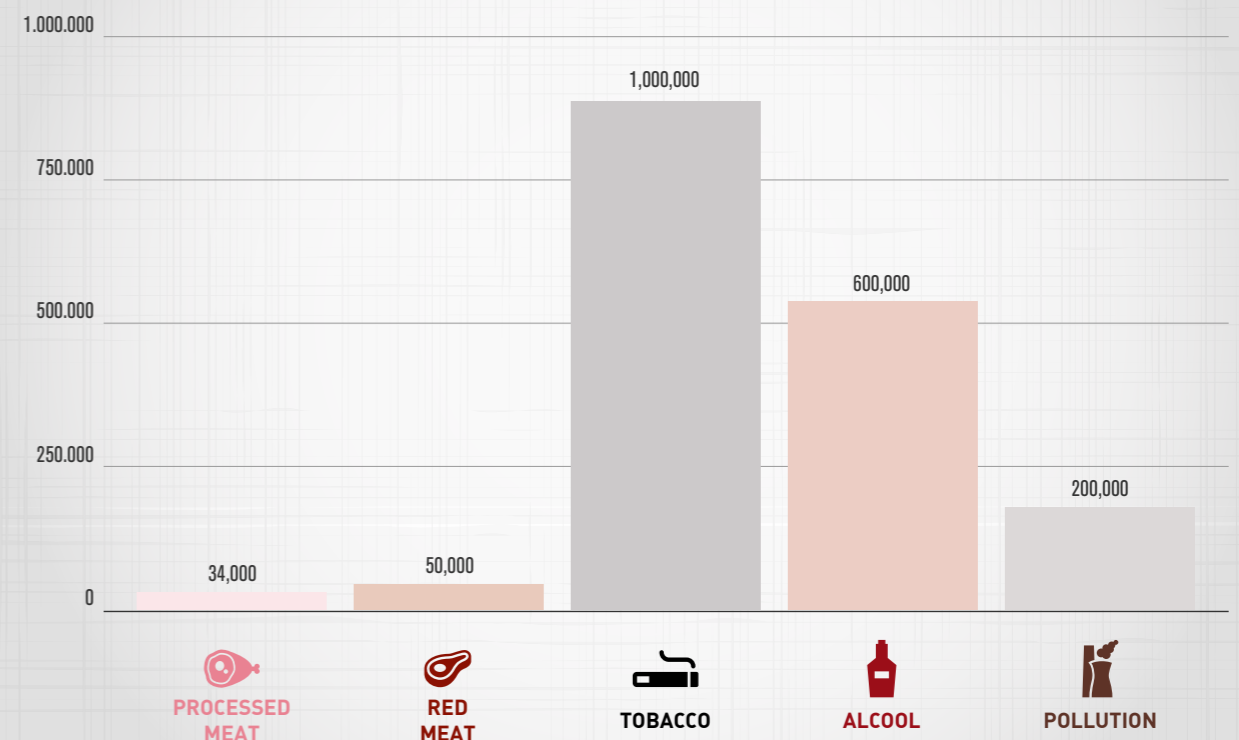
the Global Burden of Disease Project has estimated that diets high in red meat may be responsible for 50,000 cancer deaths each year worldwide.

These numbers contrast with about 1 million cancer deaths every year worldwide due to tobacco smoke, 600,000 per year due to alcohol consumption and more than 200,000 a year because of air pollution "(Source: Q & A site IARC).

ARE THE IARC CONCLUSIONS DEFINITIVE?

No, because the matter is highly controversial: the decision to insert meat among the dangerous substances was not taken unanimously and there has been a recent authoritative study (Oostin-

CANCER DEATHS PER YEAR AND RISK FACTORS



Source: Global Burden of disease project (citati dall'OMS)

dijer et al., 2014) whose findings revealed that the relationship between the consumption of processed meat, fresh red meat and colorectal cancer are inconsistent: It therefore needs a lot more scientific evidence. In addition, as highlighted in the chart above, the level of risk related

to the consumption of red and processed meat are much lower than that associated with other risk factors such as smoking, alcohol and pollution.

Finally, the study in question does not consider other foods: many kinds of fresh vegetables

(carrots, spinach, cabbage, salad, etc.) are significant sources of nitrates, nitrites and polycyclic aromatic hydrocarbons.

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MEAT AND ENVIRONMENT

- 🌱 HOW TO CALCULATE THE ENVIRONMENTAL SUSTAINABILITY OF FOOD
- 🌱 THE ENVIRONMENTAL IMPACTS OF DIET: THE ENVIRONMENTAL HOURGLASS
- 🌱 WHAT THE IMPACTS OF MEAT AND CURED MEATS ARE

THE LIFE CYCLE ASSESSMENT (LCA) METHODOLOGY IS USED TO CALCULATE THE ENVIRONMENTAL IMPACTS OF THE ENTIRE FOOD CHAIN

THE EUROPEAN PRODUCTION SYSTEM HAS A LOWER IMPACT PER KG OF PROTEIN

IF CONSUMED ACCORDING TO THE MEDITERRANEAN DIET, MEAT HAS AN ENVIRONMENTAL IMPACT SIMILAR TO OTHER FOODS

The growing interest in food sustainability also translates into an increased focus on the environmental impacts generated by food chains along all the stages from the cultivation of raw materials, to the distribution of products to consumers. To report and communicate the impacts, synthetic indicators such as **carbon** and **water footprint** are used, which on the one hand have the advantage of being easy to communicate and understand, but on the other can often lead to misleading results, because the values are communicated without an analysis of the actual local repercussions.

The consumption of a certain amount of water, for example, does not provide information about the **real impact if the value is not put in relation to the availability of water in the area in which the production is actually carried out.**

In general, meats and cured meats are among the foods characterised by major environmental impacts if

the analysis is performed considering one kg of product. "Classifying" foods based on their impact per kg is not a significant exercise, both because the **nutritional intake of foods is different**, and because proper nutrition should include a **balanced consumption** of all foods available. Comparing the impact to the frequency of consumption and the **portions suggested by the public recommendations**, the average weekly impact of the meat is aligned with other foods, for which the **unit impacts are less**, but the **amounts generally consumed are higher**. This concept is well represented by the **Environmental Hourglass**, obtained by multiplying the environmental impact of food for the weekly amount recommended. According to this representation, **eating the correct amount of meat does not significantly increase the environmental impact of an individual.**

Beyond the evaluations of the gen-

eral context, operators of meat and cured meats production sector are constantly looking for **actions of improvement** towards the efficiency of production processes, and the reduction of environmental impacts. The **availability of skills and modern technologies**, allows the livestock operators to have a wide choice for the possible actions suitable for the environmental improvement.

Some of the most relevant are the **precision farming practises** as well as the use of manure for the production of **biogas**. Especially the second alternative allows a **double advantage**: beside the reduction of the environmental impacts due to the manure management, a large amount of energy is produced **without using fossil resources**.

In this regard the results of a FAO research are interesting, according to which the European production systems are those characterised by lower **environmental impact per kg of protein**.

HOW TO CALCULATE THE ENVIRONMENTAL SUSTAINABILITY OF FOODS¹



There are various methods for assessing the environmental impacts of foodstuffs. The difference lies in the fact that some analyse the entire supply chain, while others only examine a part of it, some use all of the available impact indicators, while others focus on the most relevant. In fact, there is no single research method that is capable of measuring all of the aspects simultaneously with equal accuracy, or of comparing them in an overall assessment and the skills involved may be different and complementary.

The life cycle assessment analysis (LCA) is one of the most “innovative” of all the methods used as it allows for a rather **broad view of the supply chain**, while admittedly compromising the detailed analysis of the local context at the same time. Basically all trade between the system and the environment are quantified in order to develop numerical summary indicators².

¹ Taken from Marino, Pratesi; “Il cibo perfetto”; Edizioni Ambiente 2015

² G. L. Baldo, M. Marino, S. Rossi, Analisi del ciclo di vita LCA



Due to the infinite amount of information required, the analysts’ expertise and the available databases³ are essential and enable us to use the resources for studying the most important stages of the production chain.

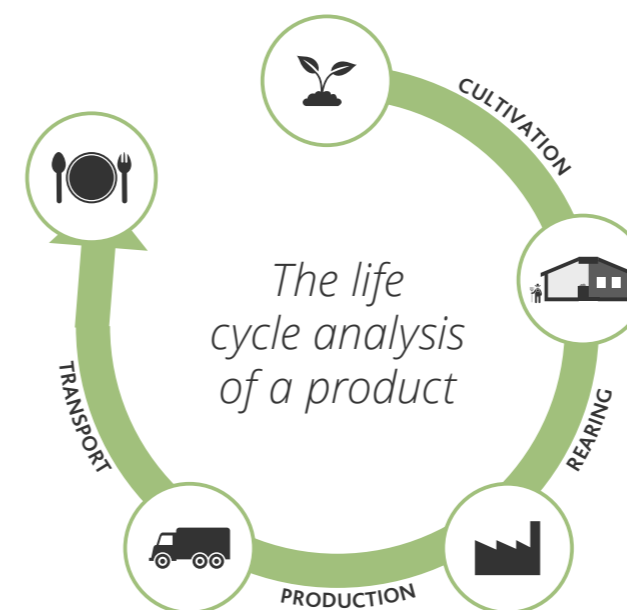


Figure 1 – The life cycle analysis of a product belonging to the food supply chain. The environmental impacts were assessed by means of the life cycle analysis (LCA), which is regulated at international level by the ISO 14040 standard.

> Are all impacts the same? The importance of the context

Very often the term “environmental impact” confuses two phenomena that are actually quite distinct: environmental aspects and environmental impacts. An environmental aspect is any kind of interaction between human activity (e.g. a production process) and the environment, while environmental impact refers to an alteration (either positive or negative) that the environment undergoes⁴. The discharge of pollutants into a river is an environmental aspect, but the damage to aquatic organisms caused by the discharge of pollutants is an environmental impact. This cause and effect might seem a purely academic distinction, but it is ac-

tually quite useful for better describing the following concepts. However, it is important to note that there is not always an obvious relationship between environmental aspects and environmental impacts and that various issues can affect it.

One is **time**: under certain conditions the environment is able to eliminate the effects of pollution immediately and (almost) return to its initial state. However, this natural phenomenon, which can be defined as resilience, has its limits: when environmental aspects are serious and pressing, the environment’s “self-healing” capacity decreases and an environmental impact occurs⁵. This situation can be compared to what happens when one consumes alcohol, which does not harm you if the doses and consumption frequencies are such that the body is able to eliminate this form of “pollution” but when one overdoes it by drinking too often or too much (like in the case of too frequent or too serious environmental aspects) we get drunk (high impact) which can sometimes cause irreversible damage.

The other aspect is the **context**, namely the local conditions in which environmental aspects occur, which is essential for quantifying the damage (impact) caused: if a production process repeatedly discharges 10 grams of pollutants into water, the relative impact will differ greatly depending on whether it flows into a small mountain lake or the Atlantic Ocean.

Other phenomena that influence the differences between aspects and impacts are the **chemical, physical and biological mechanisms** that occur in the environment following the discharge of a pollutant. An example of this is the use of nitrogen fertilizers: after adding nitrogen to the soil, the biochemical reactions of the soil lead to the formation of nitrous oxide (N₂O), which has a much greater environmental impact than basic nitrogen.

³ To date, one of the most popular databases of the scientific community is Ecoinvent (www.ecoinvent.org), which is imported automatically from the main software used in the LCA sector.

⁴ UNI EN ISO 14001: 2004 “Sistemi di gestione ambientale – Requisiti e guida per l’uso”.

⁵ Holling, C. S., 1973. “Resilience and Stability of Ecological Systems”, Annual Review of Ecology and Systematics, Vol. 4: 1-23.



GLOBAL AND LOCAL IMPACTS CAUSE AND EFFECT

Source: elaborated by the authors



> Global and local impacts

Space is another variable to be considered in the analysis: the effects can differ depending on where the environmental aspects are generated.

For example, if the machinery of a large production plant generated noise in places far from one another, the environmental aspects would be unlikely to aggregate, which would otherwise occur if the machinery were near to one another. Moreover, an environmental aspect can cause little harm to the environment in the immediate vicinity of the place it was generated and cannot affect the whole world.

Let us reconsider the noisy factory, “the inconvenience” generated is limited to the local population. Yet if we consider a company that uses a natural resource and wastes it, the damage affects the whole world population either directly or indirectly. The first case concerns **local** impacts while the second case concerns **global** impacts.

> How to interpret environmental indicators

These methodological premises can prove to be useful when carrying out the next in-depth analyses during which we will try to understand how in some cases, especially concerning the water footprint, **data impact evaluation, if not accompanied by an adequate assessment of the conditions of context, can lead to partial or even erroneous conclusions.**

Theoretically, there are many significant environmental impacts caused by food chains and scientifically robust analysis should place many indicators on the **same level**. However, for the purpose of communication and company policies, we will focus on a few values that are considered sufficiently repre-

sentative of the total impacts that generally take into account greenhouse gas emissions, land use and water use, by means of the so-called “footprints”.

Although with some limitations, by combining these indicators we obtain a balanced set in terms of simplicity and scientific rigor, at least regards to the global type of impacts. Yet when analysing local impacts, such as the use of water or agricultural phytosanitary products, it is advisable to find more specific and targeted methods, which take the local aspects into account.

> The impact of meat

The previous edition of the report explored the “Carbon Footprint”. Currently the most popular indicator is used due to the fact that it is easily communicable and understandable.

However, in this edition we report on another hotly debated environmental indicator in the food sector: the water footprint. Using water leads to two types of impact: one linked to the consumption of water as such, and one related to the deterioration of its quality due to the presence of pollutants.

From a technical standpoint, these two impacts are represented by various indicators which take into account, both separately and specifically, all of the aspects that enable us to report on the phenomenon accurately (e.g. the index of eutrophication).

ENVIRONMENTAL IMPACT	DESCRIPTION	LOCAL OR GLOBAL IMPACT?	COMPANY/PROTOCOL REFERENCE
CLIMATE CHANGE [kg CO ₂ eq]	The greenhouse effect is a natural phenomenon resulting in the presence of some atmospheric gases. The main substances responsible for this phenomenon in the food industry are carbon dioxide deriving from fossil fuels, methane from enteric fermentation, nitrous oxide from agricultural soils fertilized with nitrogen.	GLOBAL	Intergovernmental panel on climate change, 2007 www.ipcc.ch
USE AND POLLUTION OF WATER [litri]	The use of water in the food sector is relevant for both the water volume consumed and the possible pollution of the aquifers.	LOCAL	Water Footprint Network www.waterfootprint.org ISO 14046
SOIL OCCUPATION [global m ²]	Food supply chains occupy the soil with raw materials and livestock during the cultivation phase.	LOCAL	Global Footprint Network www.globalfootprint.org
EUTROPHICATION [g PO ₄ ³⁻]	Eutrophication is the impact that a large quantity of nitrogen has on the environment (generally in water) causing damage to fauna and flora. The main causes are nitrogen-based fertilizers (natural or chemical).	REGIONAL	The most popular evaluation method is based on the stoichiometric procedure of Heijungs (1992).
CONSUMPTION OF NON-RENEWABLE RESOURCES [MJ]	This impact is mainly caused by fossil fuels such as gas and oil used for producing electricity and vehicle fuels.	GLOBAL	Frischknecht, 2002
ECOTOSSICITY [CTU, Comparative Toxic Unit]	This impact is caused by the emission of chemical substances that can pollute air, water or soil that damage the ecosystem and the flora and fauna. The substances responsible for this impact are mainly agricultural chemicals.	LOCAL	UNEP-SETAC Life Cycle Initiative www.usetox.org

Table 1 - The main environmental impacts of food supply chains

THE IMPACTS OF THE MAIN TYPES OF MEAT

PORK MEAT



	TOTAL	SOW MANAGEMENT	BREEDING FARM	TRANSFORMATION
CARBON FOOTPRINT <small>kg CO₂eq</small>	7.4	0.6	6.4	0.5
<small>Source: BCFN, 2015</small>				
EUTROPHICATION <small>g PO₄³⁻</small>	63.7	4.9	58.6	0.2
<small>Source: confidential LCA study</small>				
ECOLOGICAL FOOTPRINT <small>global m²</small>	31.0	2.0	27.7	1.3
<small>Source: confidential LCA study</small>				
WATER FOOTPRINT <small>litres</small>	6,093	2,400	3,048	645
<small>Source: WFN,2010 - Report 48</small>				

CURED MEATS

	TOTAL	BREEDING FARM	SLAUGHTERING	CURED MEATS FACTORY AND PACKAGING
CARBON FOOTPRINT <small>kg CO₂eq</small>	15,1	12.0	0.7	2.5
<small>Source: BCFN, 2015</small>				
EUTROPHICATION <small>g PO₄³⁻</small>	108,8	107.1	0.3	1.3
<small>Source: confidential LCA study</small>				
ECOLOGICAL FOOTPRINT <small>global m²</small>	60,3	50.1	1.8	8.4
<small>Source: confidential LCA study</small>				
WATER FOOTPRINT <small>litres</small>	9,256	9,213	7	36
<small>Source: WFN,2010 - Report 48</small>				

BEEF MEAT



	TOTAL	HEIFER/COW MANAGEMENT	BREEDING FARM	TRANSFORMATION
CARBON FOOTPRINT <small>kg CO₂eq</small>	22.9	9.7	10.1	3.1
<small>Source: EPD Coop, 2015</small>				
EUTROPHICATION <small>g PO₄³⁻</small>	134.8	66.3	66.8	1.8
<small>Source: EPD Coop, 2015</small>				
ECOLOGICAL FOOTPRINT <small>global m²</small>	86.7	37.6	40.3	8.9
<small>Source: EPD Coop, 2015</small>				
WATER FOOTPRINT <small>litres</small>	11,500	6,100	4,710	690
<small>Source: WFN,2010 - Report 48</small>				

POULTRY MEAT



	TOTAL	CROP CULTIVATION	BREEDING FARM	TRANSFORMATION
CARBON FOOTPRINT <small>kg CO₂eq</small>	5.2	1.9	1.7	1.6
<small>Source: BCFN, 2015</small>				
EUTROPHICATION <small>g PO₄³⁻</small>	46.1	18.6	26.1	1.3
<small>Source: confidential LCA study</small>				
ECOLOGICAL FOOTPRINT <small>global m²</small>	27.7	22.1	0.9	4.6
<small>Source: confidential LCA study</small>				
WATER FOOTPRINT <small>litres</small>	2,638	1,400	1,080	162
<small>Source: WFN,2010 - Report 48</small>				

> Water footprint of food products

One of the most significant environmental aspects of meat production and of agriculture in general concerns water management. It is essential to analyse this aspect from two different perspectives: firstly, one must consider the **volumes used**, secondly the **level of pollutants** emitted.

Each of these two aspects, which should always be analysed together, is controlled and measured with different evaluation parameters. It is important to note that while water quality has historically been subjected to more stringent controls, while researchers have only recently shown interest in the amount of water used, especially following periods of drought that compromise the management of agronomic practices.

The attention paid towards the water issue has led us to analyse the data and technical evaluations also for communication purposes. The need to transmit synthetic and understandable information to the consumer has led to the definition of protocols aimed at calculating aggregate indicators.

An example of this is the reporting protocol developed by the Water Footprint Network⁶ whose data are among the most widely used and should therefore be carefully analysed.

>> The three colours of the water footprint

The aim of the **water footprint** concept was to refine the idea of virtual water developed in the 1990s by Professor Tony Allan. Both terms express “hidden” volumes of water, that is the total amount of water used along the production chain.

Therefore, this does not only mean the water

contained in the product, but all the water that was required for manufacturing it. The water footprint distinguishes three different types of water: **green, blue and grey**.



Green Water

The **green water** footprint refers to agricultural or forestry products and represents the amount of rainwater that crops need to live and grow throughout their production cycle. In more detail, one might add that this refers to the amount of “evapotranspirated” water, i.e. from the evaporation of ground moisture or the transpiration of plants into the atmosphere.

Obviously not all rainwater is exploited for reasons relating to soil peculiarities, plant requirements and rooting characteristics therefore the green water footprint only includes rainwater volumes that are retained by the soil and are available for meeting crop needs. In practical terms, this is calculated according to the type of crop, the weather conditions in the area and average annual rainfall.



Blue Water

Blue water refers to the amount of water drawn from a body of water (rivers, lakes, aquifers), which is actually used in the production process and is not recovered down line of the process for which it was used or at the source from which it was drawn.

For example, if the water is then taken to a refrigeration plant and later re-introduced into the environment, the blue water footprint is only composed of the part which may have evaporated during the process.

⁶Water Footprint Network: www.waterfootprint.org



Grey Water

Lastly, **grey water** refers to the volume of water **theoretically required** to dilute the contaminants present in the water exiting the system (such as the water that leaches from a cultivated field or exits from an industrial process) and restore the water to its initial quality. Basically, the higher the level of pollution, the higher the value of virtual water.

>> The meaning of green water

The green component in food products accounts for over 50% of the overall water footprint. It assumes a particularly important value when observing virtual water flows at global level rather than when com-

paring different product categories.

In fact, when purchasing goods, there is a “virtual” trade of the water required for producing them. Globally it is advantageous when a product is exchanged between a country with a high level of water productivity and one with a low level. In this case virtual water can be considered as an alternative water source, which allows for the preservation of local resources.

Trading goods from countries that can produce with a high ratio between green and blue water to countries that must impinge on its reserves of blue water in order to produce the same commodity is an advantage at global level. In fact, as already mentioned using green water has a very different social, economical and environmental cost compared to blue water.

Green water is not consumed exclusively for cultivation: in fact, there is often very little difference



GREEN WATER: SOME EXAMPLES

- A PET bottle of Coca Cola has a water footprint of 5.3 litres, without even a drop of green water! In fact, it is composed exclusively of blue (2%) and grey (98%)⁷ water.
- Approximately 300 litres of green water are required for cultivating one kilogram of wild raspberries, but if they are grown in Italy, blue and grey water is also needed. Clearly, in the Aosta Valley, where rainfall is abundant, the blue water footprint will be much lower than in Sicily (80 times less)⁸.
- A houseplant does not have a green water footprint; it only needs blue water.

⁷ The Coca Cola Company, 2010. Product Water Footprint Assessments- Practical Application in corporate water stewardship.

⁸ Mekonnen, M.M. and Hoekstra, A.Y., 2010. The green, blue and grey water footprint of crops and derived crop products, Value of Water Research Report Series No.47, UNESCO-IHE.

between the evapotranspiration of farmland and fallow land. For example, the water demand of a multi-grass lawn or a wood are much greater than those of a corn or tomato field, as clearly shown by the Kc values⁹!

>> Mean features of water footprint

The value is calculated according to the specific conditions of the cultivated area (climate, temperature and average rainfall) and the quantitative yields obtained. The extreme variability of local conditions affects the green water footprint value.

Water footprint comparisons were made on the same agricultural product, corn, grown in different countries.

As you can see, the value varies considerably depending on the area of cultivation; the green water

footprint is high in equatorial/tropical climates with high rainfall, while it is much lower in arid climates with low rainfall.

The blue water footprint trend presents an opposite trend: the greater the quantity of "natural" water "natural" used by the crop, the less the amount of irrigation water required. The differences observed between the overall values are due to quantitative

⁹ FAO, Crop Evapotranspiration (guidelines for computing crop water requirements), Irrigation and Drainage Paper No.56. In particular, this concept is easily demonstrated by analyzing Kc crop coefficient values, determined by proper experimental tests. It is a multiplicative correction factor of the evapotranspiration differences between the crop itself and that used as reference. The coefficient Kc, while being specific to crop cultivation, varies in the course of the season or from year to another due to modification in the morphological and physiological characteristics of the crop itself.

¹⁰ Mekonnen, M.M. and Hoekstra, A.Y., 2010. The green, blue and grey water footprint of crops and derived crop products, Value of Water Research Report Series No. 47, UNESCO-IHE, Delft, the Netherlands.

yields: highly efficient production systems reduce the overall water footprint. It is evident that when a greater quantity of corn is obtained from the same surface area of farmland, the overall water footprint will be lower: in fact, the amounts of green, blue and grey water used will be spread across a larger quantity of crops.

>> How to interpret water footprint values

The colours distinguish the three different kinds of water, each of which has a different social and economic environmental impact. Therefore, it is essential to evaluate the data by correlating the various components with one another, while bearing in mind local conditions. A first important observation **concerns the green/blue ratio**: the higher this value,

the greater the ability of the crop to be grown in the region of reference, as there it only needs rainwater to grow.

Therefore, some precautions should be taken when using the water **footprint indicator**:

- **Avoid making comparisons based only on the overall values** of the water footprint. In the case of corn mentioned above, the data relating to Malaysia is much higher than those of Egypt where the blue component is predominant;
- Always express the **division in green, blue e grey**;
- Focus on the **green/blue ratio**;
- Whenever possible, **correlate the consumption value with the availability** of water in the areas in which the processes are carried out. This aspect will be analysed more deeply in the following pages with the water footprint of meat produced worldwide.

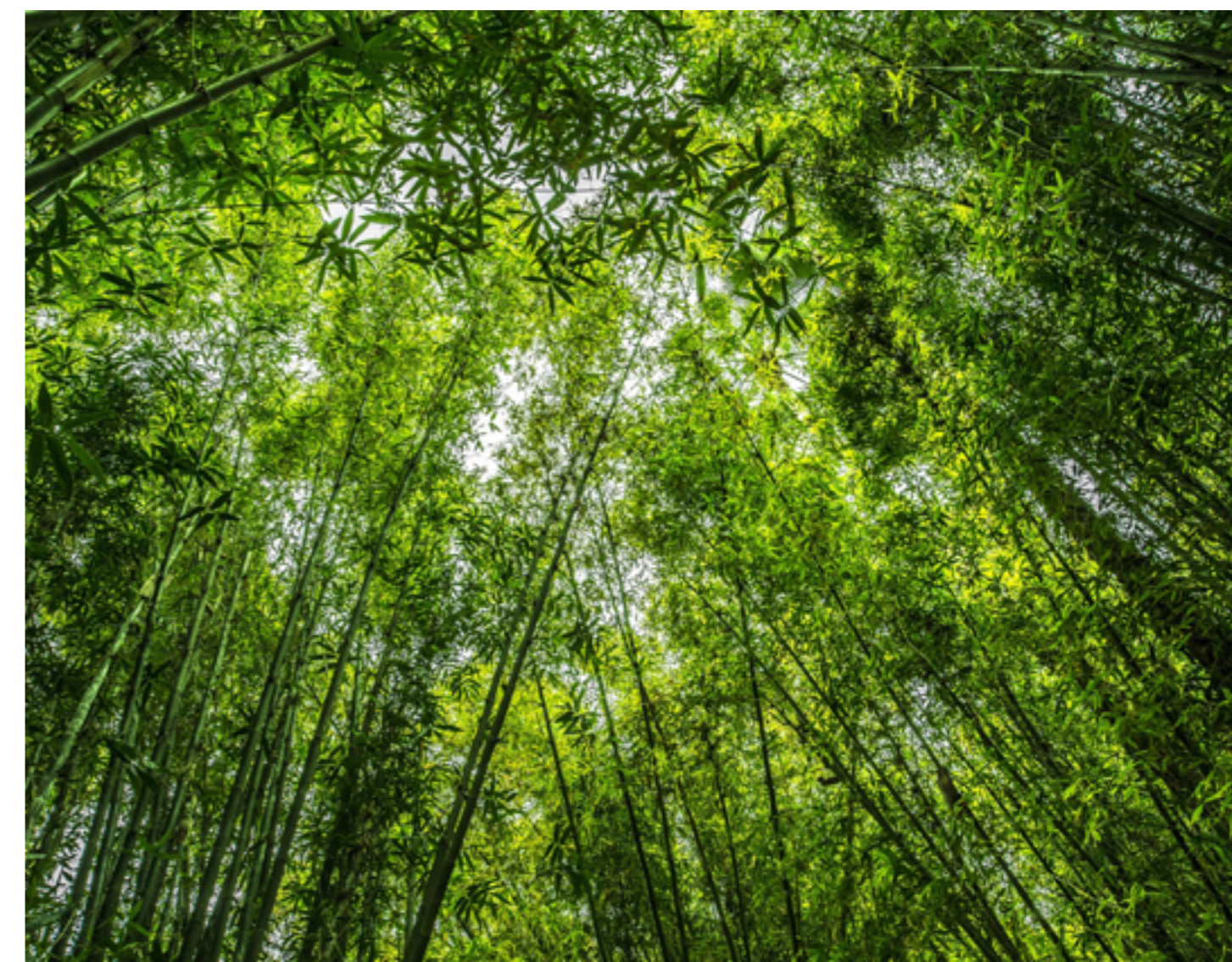
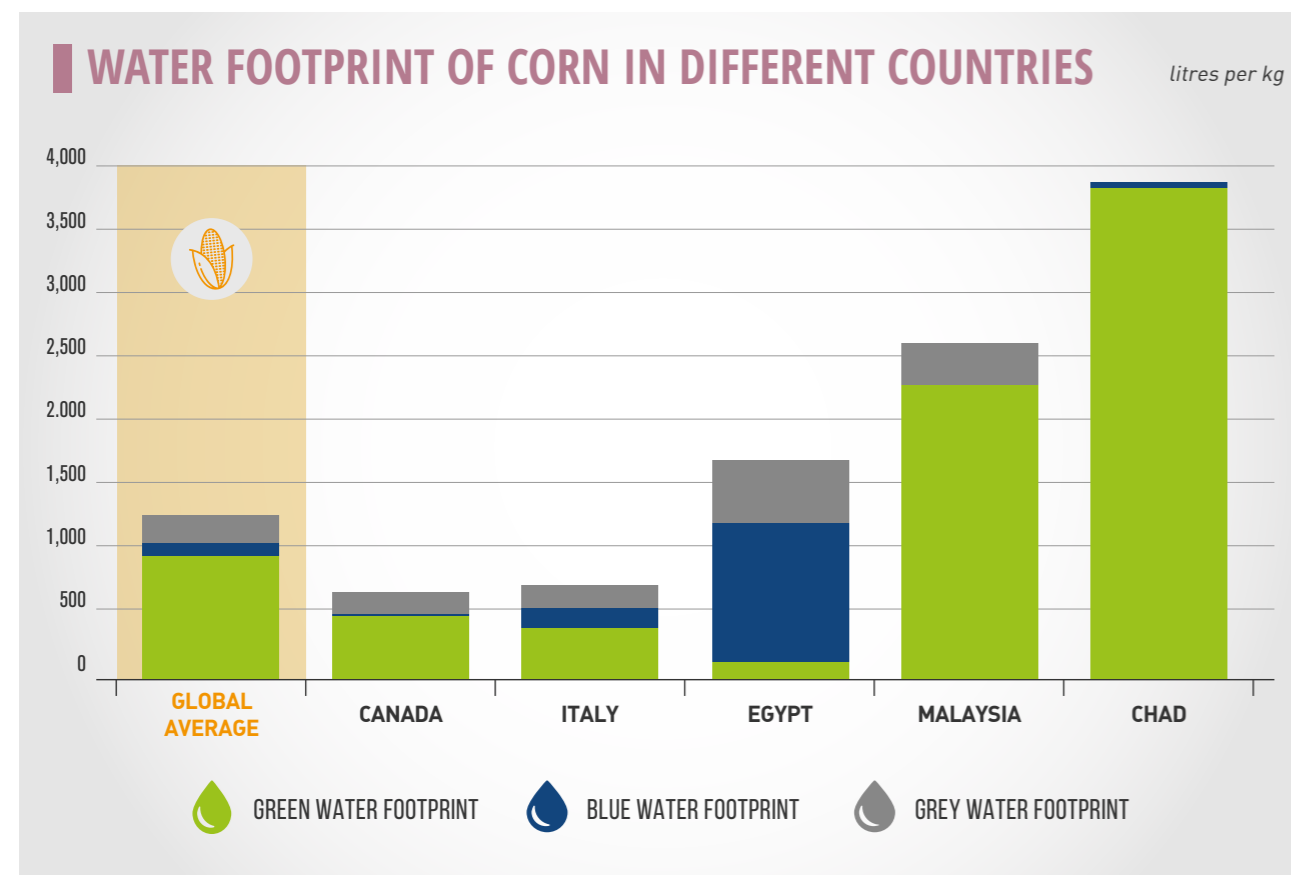
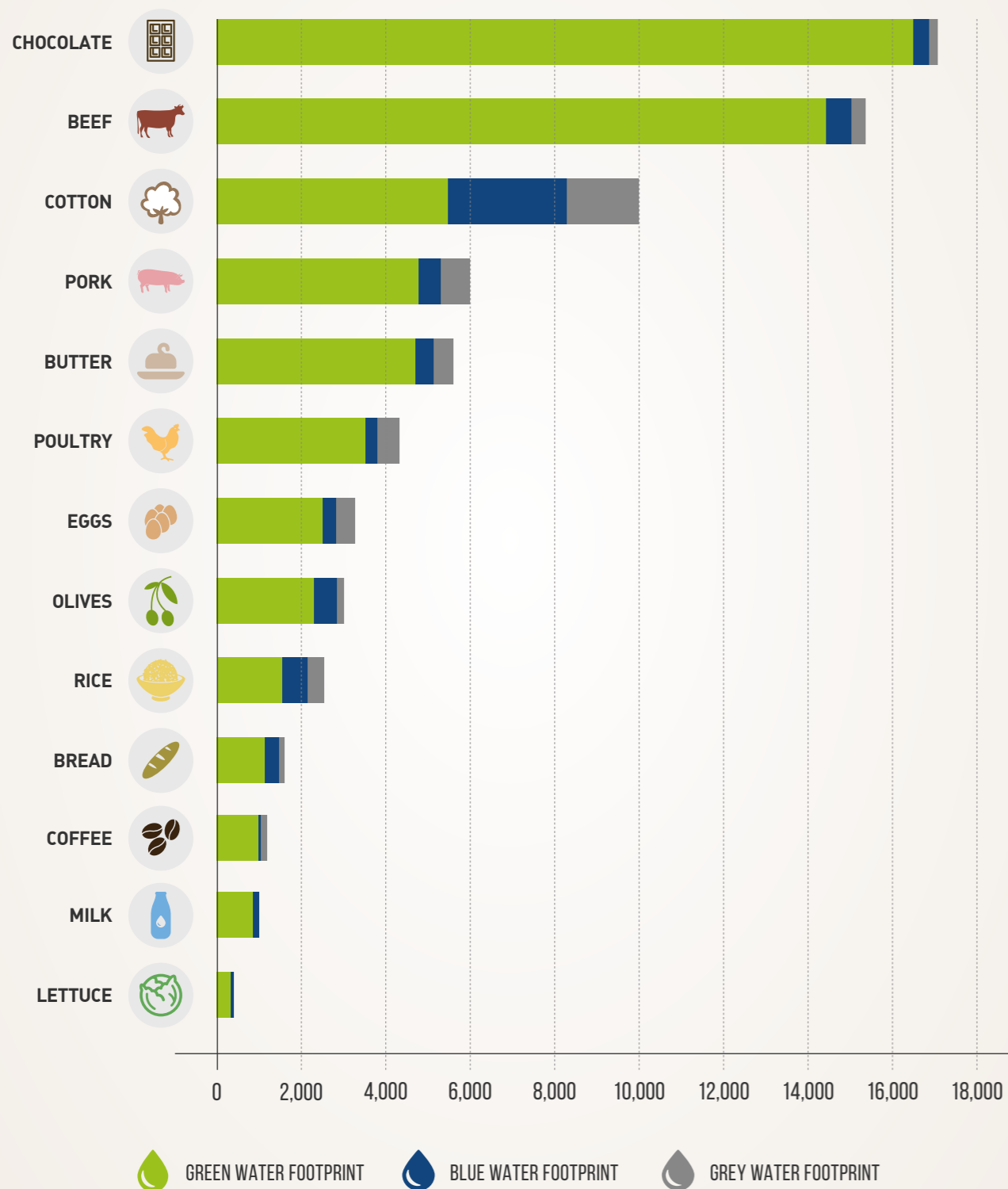


Figure 1 - Values of the water footprint of corn (l/kg) relative to its production in different countries¹⁰

WATER FOOTPRINT (litres per kilo of product)

THE WATER FOOTPRINT OF SOME FOOD PRODUCTS



The majority of the available data are published on the WFN web site. Water footprint average data of some products expressed in litres / kg of product. In spite of being a non-food product, cotton has been added to the group since it comes from agricultural production.

> The water footprint of meat

Almost all of the data in literature related to the water footprint of food products which are not currently available or used for communication were published by the Water Footprint Network (WFN) or by various authors in scientific journals when referring to the calculation methodology developed by this network. This was in fact the most widely used protocol at international level until the publication of the ISO 14046 standard.

Since high water footprint values are one of the main issues concerning meat and cured meats production, this indicator should be analysed in depth as well as the precautions to be taken in the trial stage.

As regards to beef, available data report a total water footprint value of approximately 15,400 litres/kg, of which 94% is green water, 4% is blue water and only 2% is grey. This value refers to a kilogram of meat produced at **global level** by averaging the values of the various rearing systems (pasture, industrial, mixed) in different regions of the world. Therefore, the figure is obtained **by comparing the various types of production systems and extremely different climatic regions between one another**: which ranges between over 26,000 litres per kg from cattle grazing in India, to the 3,000 litres used by Argentine or US industrial systems.

As well as this great variability in the overall value there is also a high variability in the composition: 99% of the water required for grazing livestock is green, yet this value may drop to under 90% in the

case of an industrial system. **For Italy the data indicate an average value of 11,500 litres of water per kg of meat produced, of which 87% green, 5% blue and 8% grey.**

By applying the methodological considerations to the newly presented data, one can comprehend how making hasty use of the indicators can lead to misunderstandings. One example is that the overall water footprint (the sum of the green, blue and grey waters) for industrial systems is much lower than for mixed and extensive systems (cattle reared mainly by grazing).

Industrial systems are generally more efficient¹¹: in fact, using concentrates leads to a reduction in the feed conversion index, which correlates the amount of food consumed by the cattle with the increase in meat. However, a lower overall water footprint corresponds to larger quantities of blue and grey water, due to the need for feed whose cultivation requires blue water for irrigation and grey water to eliminate the contamination caused by using fertilizers.

¹¹ The data reported in these infographics were obtained from Mekonnen's publication cited in literature. Other studies such as "Gerbens-Leenes P. W., et al. The water footprint of poultry, pork and beef: A comparative study in different countries and production systems, Water Resources and Industry 1-2 (2013), 25-36", confirm the magnitude of the values published. Additional data in agreement with those published, were obtained from other publications available in literature.

THE ISO 14046 STANDARD

The term Water Footprint was also used in the ISO 14046 standard published in 2014 with the aim of defining the guidelines for evaluating the water consumption of a system with an LCA-type analysis. In short, the purpose of the ISO standard is to evaluate the effects that the use of water resources has on the environment in order to improve the management of water resources at local, regional and global level. The ISO standard does not refer to the concept of virtual water or to the distinction between green, blue and grey water; however, it is advisable to take into account the amount of pollutants present in the flows and to bear them in mind when presenting the impacts with environmental indicators.

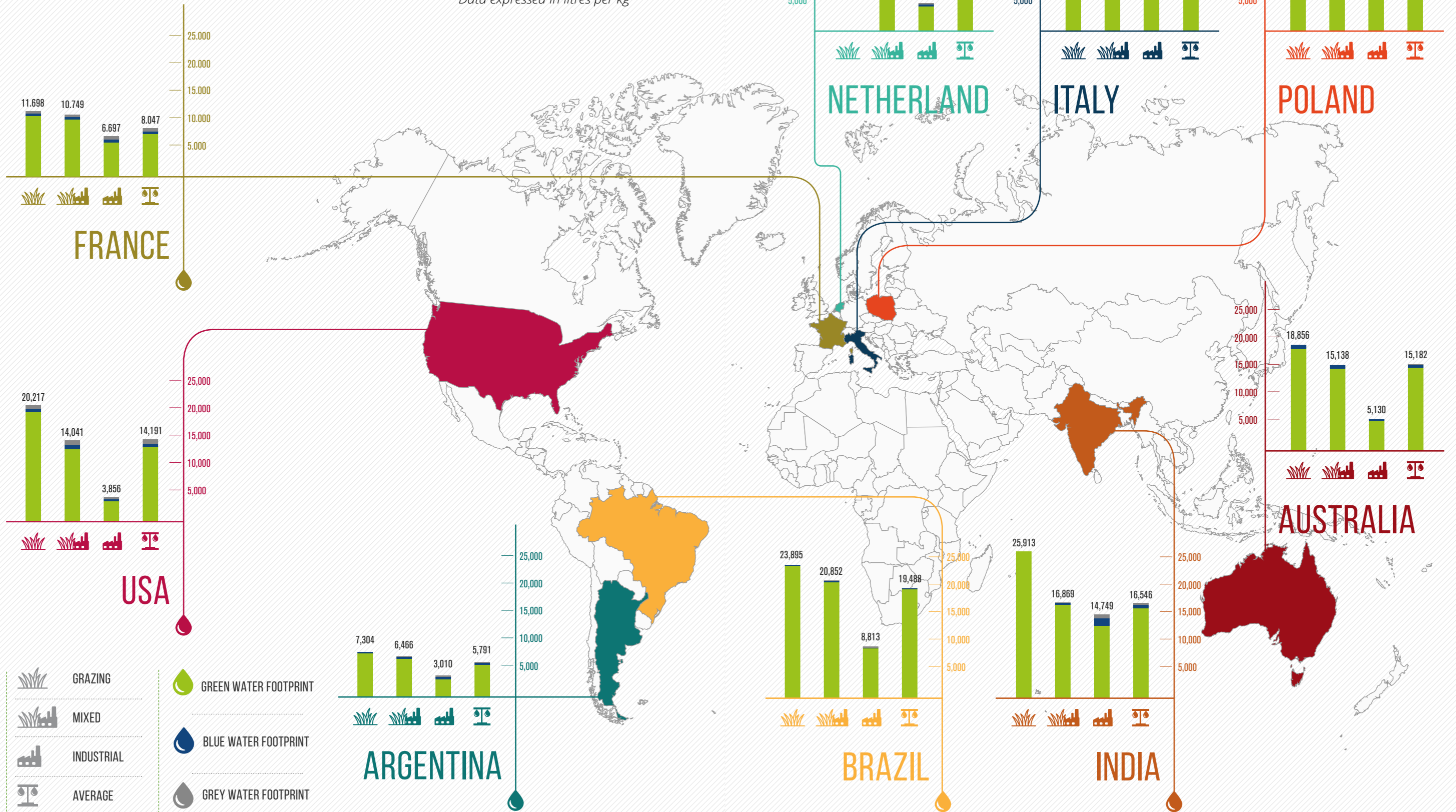


THE WATER FOOTPRINT OF BEEF MEAT IN VARIOUS COUNTRIES



(Source: Mekonnen & altri (2010); Data related to Bovine cuts boneless, fresh or chilled)

Data expressed in litres per kg



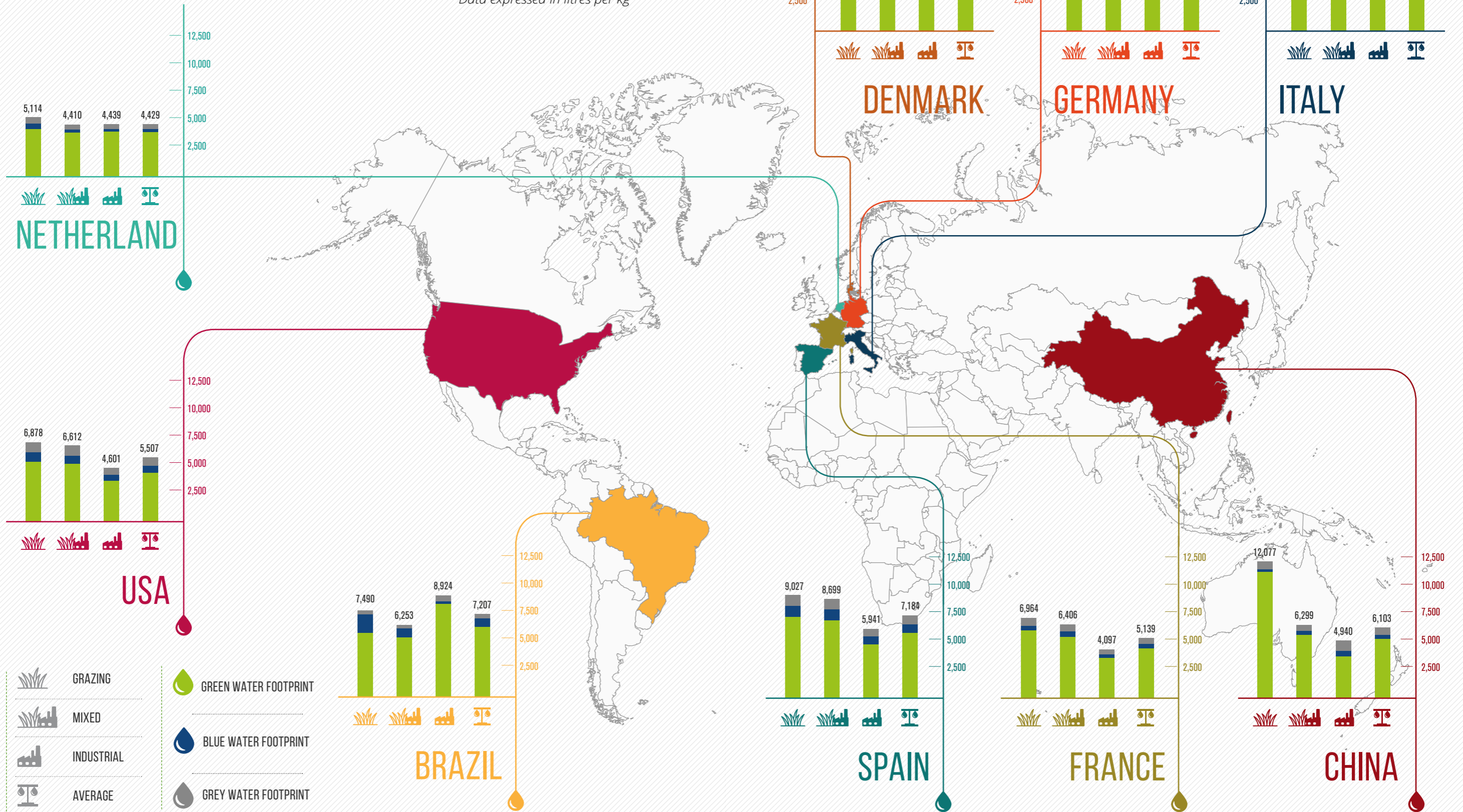
- GRAZING
- MIXED
- INDUSTRIAL
- AVERAGE
- GREEN WATER FOOTPRINT
- BLUE WATER FOOTPRINT
- GREY WATER FOOTPRINT



THE WATER FOOTPRINT OF PORK MEAT IN VARIOUS COUNTRIES



(Source: Mekonnen & altri (2010); Data related to Swine cuts, fresh or chilled, nes)
Data expressed in litres per kg



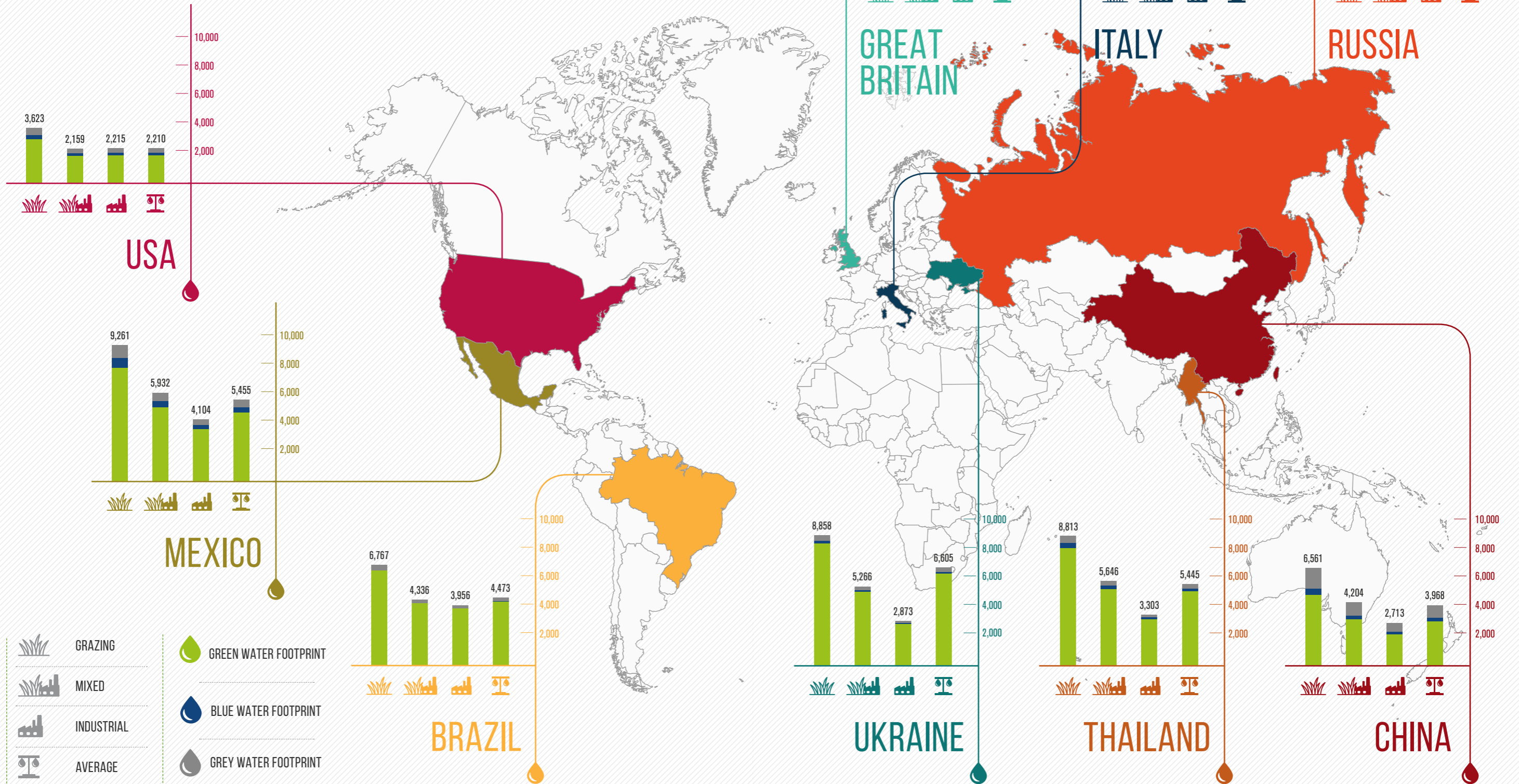
THE WATER FOOTPRINT OF POULTRY MEAT IN VARIOUS COUNTRIES



(Source: Mekonnen & altri (2010); Data related to Poultry, live except domestic fowls, weighing more than 185 g)

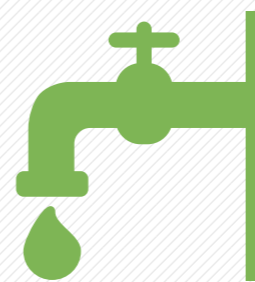
Data expressed in litres per kg

The values were reported to meat available for consumption with a conversion factor of 75%. Although other more updated data could be chosen, it was decided to use this source for consistency with other sectors' studied.





THE WATER FOOTPRINT OF MEAT IN ITALY AND WORLDWIDE



The **water footprint** is the sum of three contributions partly real and partly virtual: transpiration water from plants used to live (**green water**), the water actually used by processes or to irrigate fields (**blue water**) and the water virtually needed to dilute and purify the waste water (**grey water**).

For meat and cured meats the component of green water is by far the most significant of the three, coming to constitute almost the totality of the impact and demonstrating how the actually consumed value is **much lower** than the common figure.

**The figure refers to heavy pigs (160 kg, 9.11 months of age) while the most common pigs abroad weigh 80/100 kg (7.5 months)*

DATA in litres/kg



GREEN W. FOOTPRINT



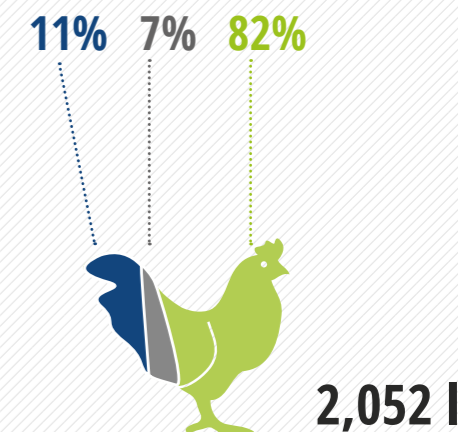
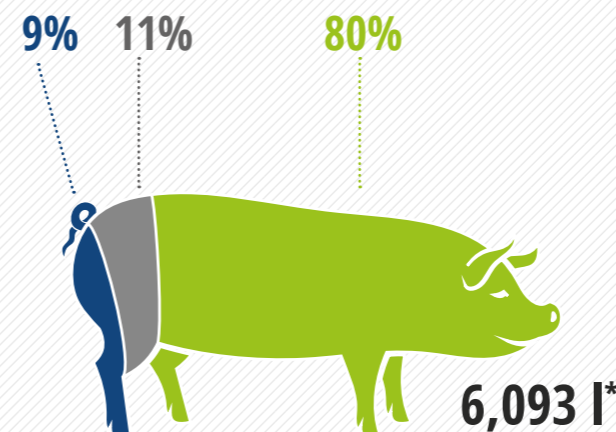
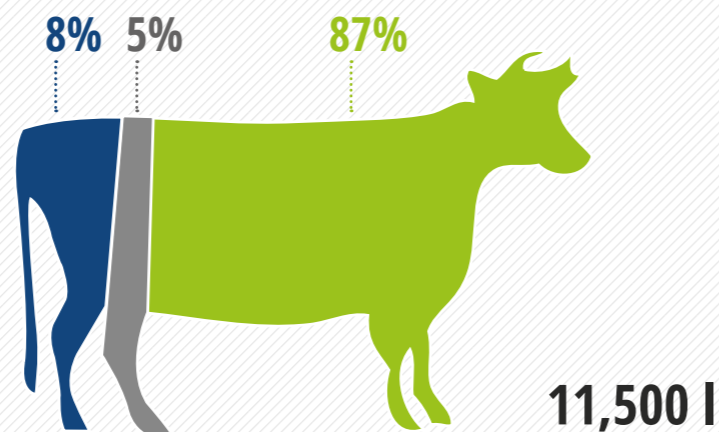
BLUE W. FOOTPRINT



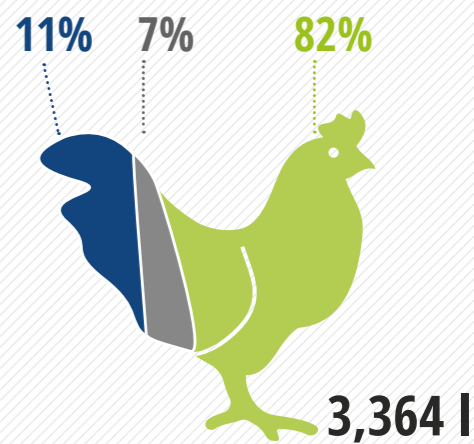
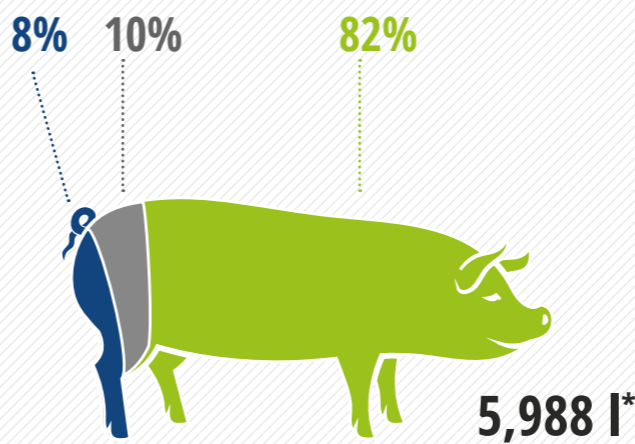
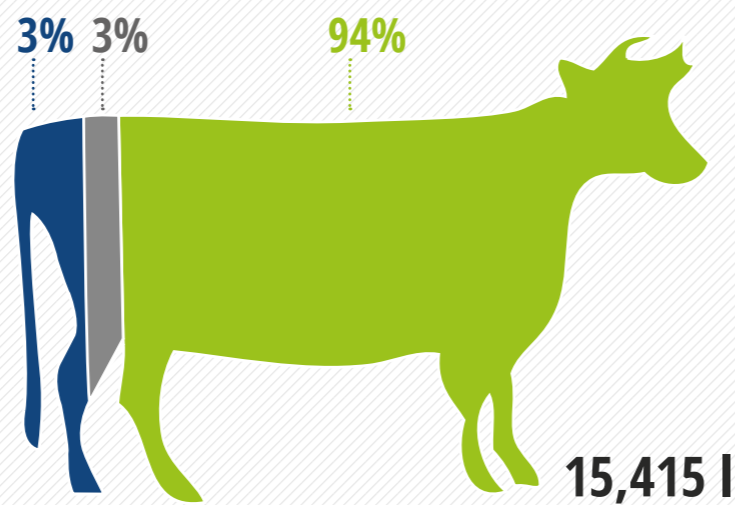
GREY W. FOOTPRINT



ITALY



WORLD



Source: Mekonnen, M.M., Hoekstra, A.Y. The Green, Blue and Grey Water Footprint of Farm Animals and Animal Products. Value of Water Research Report Series no.48, UNESCO-IHE, Delft, the Netherlands, 2010

>> How can the water footprint analysis be improved

As we have seen so far, there are two main issues regarding the water footprint analysis:

- the large amount of green water in the total value does not necessarily mean that it causes an equally high environmental impact. Although the overall water footprint value is composed mainly of green water it actually indicates a high level of compatibility between culture and meteorological area and very little is used as irrigation water;
- the blue component should be correlated with local scarcity in order to assess the sustainability of the product under investigation. In fact, the impact of drawing blue water from a specific area depends on the availability of blue water in that area.

One way of overcoming the second issue would be to correlate the values of blue water with water avail-

ability in the regions involved in the process under analysis. This is obviously much more complex since it requires in-depth knowledge and the elaboration of a large amount of information.

There are various methods for doing this which all originate from the concept of **water scarcity** (defined as the inability to obtain adequate amounts of water in respect to the needs) and **water availability** (that is the actual availability of water accessible both from a qualitative and quantitative perspective). Among the most widespread methods of calculation there is one relating to **water resource depletion**, developed by the Joint Research Centre (JRC) of the European Commission, which is responsible for assessing to what extent water consumption in a particular geographic area actually effects the exhaustion of water resources in that area.

¹² Fonte: <http://www.unep.org/dewa/vitalwater/jpg/0222-waterstress-overuse-EN.jpg>

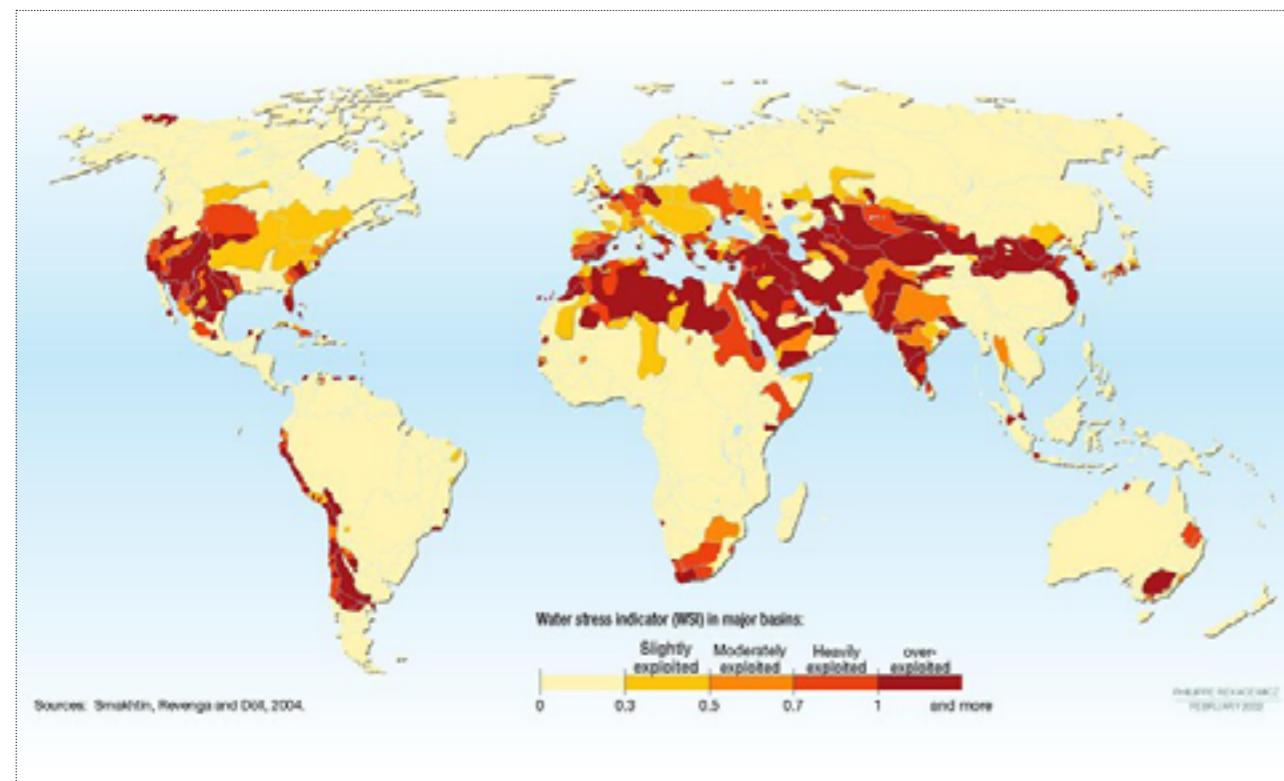


Figure 2 - Map of the areas subjected to lower or higher water stress. A value close to zero indicates an area that is not subject to water stress; similar numbers or numbers greater than 1 indicate areas where the actual availability of water - usable at affordable costs - is an issue. Source: UNEP (Smakhtin, Revenga and Doll, 2004)¹².

The European Commission promotes this method as part of its initiatives for the environmental footprinting of products (PEF, Product Environmental Footprint) and organizations (OEF, Organization Environmental Footprint).

The calculation is based on factors provided by the "Ecological Scarcity"¹³ method and is expected to multiply the consumption of water of the process under study (in our case blue water) by a characterization factor obtained from the ratio between total consumption and availability in the reference area (low, medium and high). The indicator is expressed in terms of equivalent volumes of water and is based on the factors listed in the study by Frischknecht et al 2008¹⁴⁻¹⁵.

For this study we decided to use the method suggested by the JRC¹⁶ with the aim of "weighing" the blue water footprint values. The analysis is to be considered preliminary as it is based on **the assumption, not always correct**, that the entire supply chain (cultivation, livestock breeding and processing) is developed in the area under study and that therefore all of the blue water of the final product is consumed in the same nation.

This "weighing" enables us to correlate the withdrawal of blue water with the actual "damage" caused to the water availability of a given geographical area. In regions with water shortage issues such

as India, the meat supply chains actually impact to the extent that the "weighted" water footprint is actually greater than calculated. Whereas when the supply chain is located in areas with abundant water availability, there is less environmental damage such as in Argentina or Ireland which both produce large quantities of meat.

¹³ Un ulteriore approfondimento su questo metodo di calcolo è disponibile nel seguente Report: European Commission, Joint Research Centre, Institute for Environment and Sustainability. Characterization factors of the ILCD Recommended Life Cycle Impact Assessment methods. Database and Supporting Information. First edition. February 2012, pag. 15-16.

¹⁴ Frischknecht, R., Steiner, R., Jungbluth, N. (2008). The Ecological Scarcity Method - Eco-Factors 2006. A method for impact assessment in LCA. Environmental studies no. 0906. Federal Office for the Environment (FOEN), Bern: 188 pp.

¹⁵ There are other similar methods such as that proposed by Pfister et al. (2009) (Pfister S, Koehler A, Hellweg S., 2009. Assessing the Environmental Impacts of Freshwater Consumption in LCA, Environmental Science & Technology (43) 4098-4104) which adopts a water scarcity indicator (WSI) and is calculated with a system of characterization factors based on the ratio between consumption rates and water availability in the various countries.

¹⁶ This is the ILCD 2011 Midpoint+ V1.07 calculation method used in SimaPro® software; the calculation factors that are specific to each country are reported in the section entitled water resource depletion.





BLUE WATER FOOTPRINT OF BEEF WEIGHED WITH THE SCARCITY INDEX

(Source: Mekonnen et al (2010); data relative to boneless (fresh or chilled) bovine cuts)

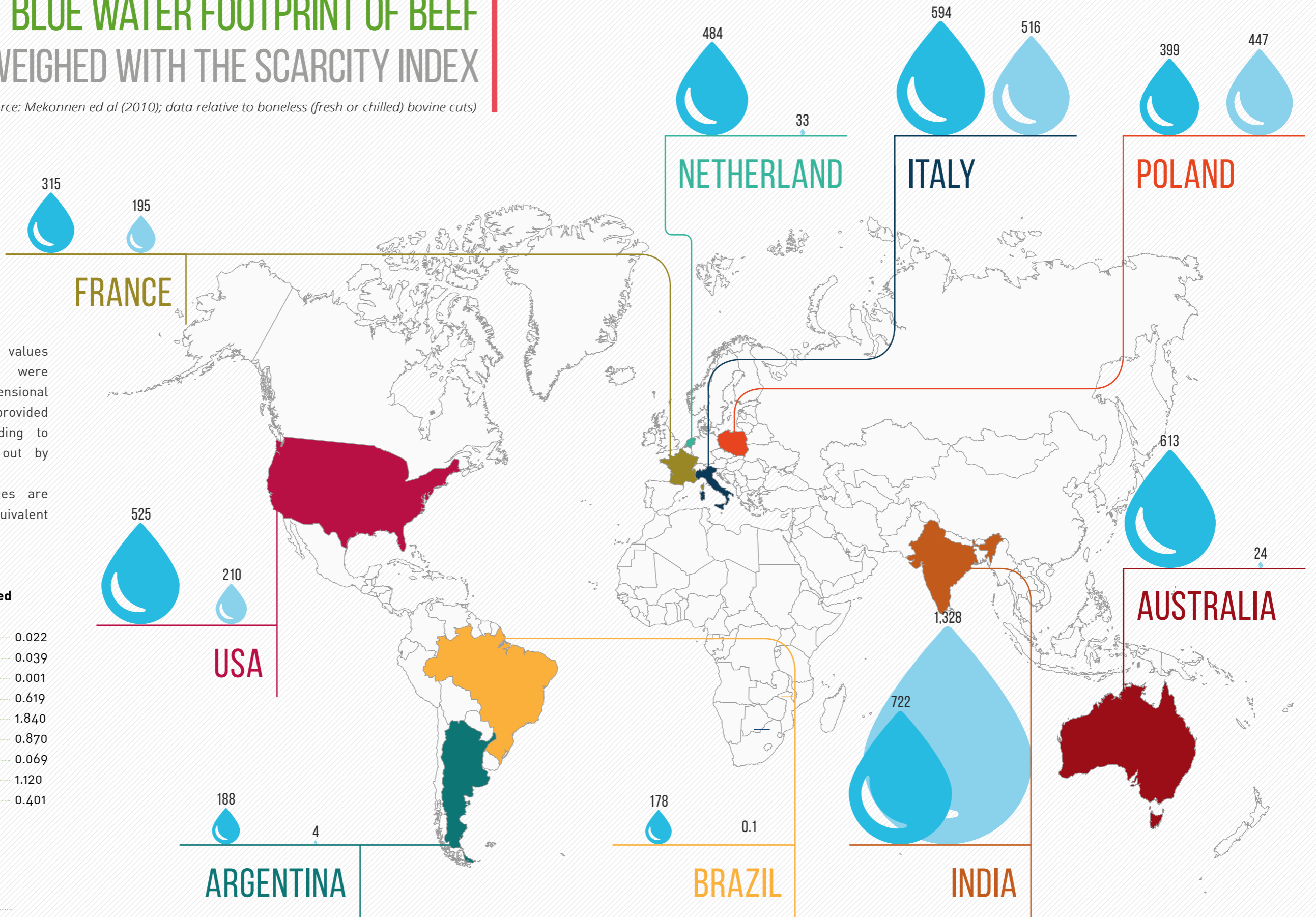
The water footprint values already presented were corrected with a dimensional conversion factors provided by the JRC according to the study carried out by Frischknecht at 2008. The corrected values are expressed in m³ of equivalent water.

Conversion factor used

Argentine	0.022
Australia	0.039
Brazil	0.001
France	0.619
India	1.840
Italy	0.870
Netherland	0.069
Poland	1.120
USA	0.401

PUBLISHED DATA
(LITRES /KG)

NORMALIZED DATA
(EQUIVALENT LITRES/KG)



THE ENVIRONMENTAL IMPACTS OF DIET: THE ENVIRONMENTAL HOURGLASS

Numerous Italian and international publications support the concept that it is preferable to follow a well-balanced diet both for its health-promoting effects and for the recent attention paid towards the environment. It is a well-known fact that foods based on animal protein generally impact more per kilogram than those obtained from plants, **but the classification and the comparison per unit mass is not significant** since the nutritional intake of food differs and because a healthy diet should be based on the balanced consumption of all available foods.

The Italian publication of the Double Pyramid developed by the Barilla Centre for Food & Nutrition (BCFN) in 2010 is worth mentioning as it provides an annual reorganization of available literature accompanied by a graphical representation. The traditional food pyramid, which illustrates the weekly amounts of food recommended for a well-balanced diet, has been juxtaposed by an inverted pyramid that shows the environmental impacts associated with each kilogram of these foods; the foods with a high environmental impact are at the top of the environmental pyramid while those with a low environmental impact are placed at the bottom. Graphically you get an inverted pyramid, which shows how the foods with the greatest environmental impact are those that should be consumed less for a well-balanced diet.

> From impacts per kilogram to weekly impacts

However, a direct comparison, which is extremely clear when using unit values, becomes much less clear when correlated with a correct weekly diet and recommended portions. When graphically representing this concept starting from the recommended weekly consumption proposed in the nutritional guidelines and multiplying them by the average environmental impacts of the various food categories, one obtains an innovative graphical representation that resembles an hourglass. The first edition of this representation was published in a book on the sustainability of branded beef in 2013 by Coop Italy¹⁷: the hourglass, whose purpose was to propose a different interpretation of the relationship between diet and environmental impact, was reviewed and updated in the Sustainable Meat Project.

The most important aspect that emerges from this representation is that, in a balanced weekly diet, the environmental impact of foods rich in proteins (meat, fish, eggs, legumes, cured meats) is comparable with the impact generated by foods of vegetable origin (fruit, vegetables). In fact, if consumed in the right amounts, the various food categories have a very similar "environmental burden" which is evenly distributed along the hourglass. Therefore, it is reasonable to say that **a balanced diet is not only beneficial to the health, but also to the environment.**

> How to construct the hourglass

Conceptually the construction of the hourglass is quite simple: **one must multiply the environmental impact (per kg) of foods by the amount consumed in a week, thus obtaining the environmental impact.** The criticality of the calculation depends

on the data, relating to both the impact and quantity of food, that are selected. For example, people's fruit preferences can vary greatly (from pineapples to apple) and their relative environmental impacts vary accordingly. The same applies to the amount of food consumed, which cannot be accounted for with accuracy, since people's choices can differ greatly even if they are part of a balanced diet.

For these reasons, the hourglass was created considering various types of foods with the awareness that the representation presented in this document is not the only one as there are countless combinations of consumption frequencies and favourite foods.

¹⁷ Coop, La Sostenibilità delle carni bovine a marchio Coop – Gli impatti economici, sociali ed ambientali della filiera delle carni, pubblicato a Novembre 2013 e disponibile su www.e-coop.it.



>> Environmental impact data

The first version of the Environmental Hourglass was developed solely with data regarding the Carbon Footprint of food; in this new edition the perspective has been broadened to include water footprint values in order to “test” the applicability of the model with other environmental indicators.

Most of the **Carbon Footprint** data were obtained from the BCFN¹⁸ database and are related to both food production and cooking methods when required. In the case of meat and cured meats, in-depth sectorial knowledge has led to a more representative use of information related to Italian production.

The information on **water footprint** data were obtained from the publications available on the Water Footprint Network website. In particular, Reports 47 (agricultural products) and 48 (products of animal origin) were used which were published by Mekonnen, M. M. et al. in 2010¹⁹.

In all cases, the approach used was to exploit public data while privileging the traceability of the calculations, rather than the accuracy of the results.

¹⁸ The BCFN source is the technical support document to the Double Pyramid, version 2015 (BCFN, Double Pyramid 2015: recommendations for sustainable food) except for vegetables whose impact data were obtained from the technical document, 2014 (BCFN, double Pyramid: dietary habits and environmental impact).

¹⁹ In accessing values, the Italian average (Italy, country average) was chosen; for further details, refer to the bibliography at the end of the chapter.

²⁰ The data reported above is the average Carbon Footprint data of the two types of meat, including cooking. The reference documents are the two environmental product declarations, published by Coop that are available on the website (www.environdec.com). For further details please see the bibliography at the end of the report.

²¹ Environmental product declaration of frozen hamburgers produced by Montana, rev. 2, year 2016. Available online at www.environdec.com.

²² Confidential LCA studies (source: LCE).

²³ The same impact was assumed for both fresh and preserved fish.

²⁴ By assumption, fresh, canned and dried legumes have the same impact.



		CARBON FOOTPRINT	WATER FOOTPRINT	
		DATA (kg CO ₂ /kg of food)	DATA (litres/kg of food)	Entry of selected database
MEAT, FISH, EGGS, LEGUMES	Fresh meat poultry and pork	4.6	4,365	Report 48 - WFN (Poultry, live except domestic fowls, weighing more than 185 g; Swine cuts, fresh or chilled, nes), dato medio
	Fresh beef	23.4 ²⁰	11,500	Report 48 - WFN (Bovine cuts boneless, fresh or chilled)
	Fresh beef hamburger	10.5 ²¹	11,500	Report 48 - WFN (Bovine cuts boneless, fresh or chilled)
	Cured meats	15.1 ²²	6,569	Report 48 - WFN (Hams and cuts thereof of swine prepared or preserved)
	Fish and shellfish	4.4	-	Data not available
	Preserved fish ²³	4.4	-	Data not available
	Eggs	3.8	1,341	Report 48 - WFN (Eggs, bird, in shell, fresh, preserved or cooked)
	Legumes ²⁴ (Fresh or in cans)	1.7	2,620	Report 48 - WFN (Vetches, Lupines, Lentils, Chickpeas), average value
	Dry legumes	1.7	2,620	Report 48 - WFN (Vetches, Lupines, Lentils, Chickpeas), average value
MILK, YOGHURT, CHEESE	Milk and yoghurt	1.5	1,053	Report 48 - WFN (Milk not concentrated & unsweetened 1%-6% fat, > 6%; Yoghurt)
	Fresh cheese	9.3	2,426	Report 48 - WFN - (Cheese, fresh - including whey cheese - unfermented, and curd); data on mozzarella from two EPD Granarolo), average value
	Matured cheese	9.3	3,867	Report 48 - WFN (Cheese, blue-veined)
CONDIMENT	Butter	8.3	4,240	Report 48 - WFN (Butter)
	Oil	3.1	9,102	Report 47 - WFN (Virgin olive, oil)
CEREALS	Bread	1.1	1,059	Report 47 - WFN (Wheat bread)
	Bakery products	1.6	2,303	12 EPD bakery products, average value
	Pasta	1.9	1,218	Report 47 - WFN (Dry pasta)
	Rice	3.8	2,280	Report 47 - WFN (Rice, broken)
	Potatoes	1.2	326	Report 47 - WFN (Potatoes, fresh or chilled nes and frozen), average value
FRUIT, VEGETABLES	Vegetables	1.7	339	Report 47 - WFN (Vegetables, fresh or chilled nes and frozen), average value
	Salad	0.6	216	Report 47 - WFN (Cabbage lettuce (head lettuce) fresh or chilled and Lettuce), average value
	Fruit	0.5	750	Report 47 - WFN (Various fruits), average value

>> How to calculate weekly consumption: portions and consumption frequency

The amount of food consumed weekly can be calculated with two pieces of information: the **portions** (amount of food) and **frequency** (the number of servings).

Regarding the portions, we decided to use the amounts recommended by the Italian Society of Human Nutrition (SINU) in the RDAs published in 2012²⁵. The aim is to provide the operators of the nutritional surveillance sector with useful information for defining diets for various age groups or groups with specific nutritional needs (pregnant or nursing mothers etc.).

Under the hypothesis of maintaining the portions constant, the frequency of consumption can vary according to food preferences and also according to people's personal characteristics (sex, age, job etc.).

In order to evaluate the variability of these options, three scenarios based on a different methodological approaches were analysed: two of them (Scenario B and C) are based on the nutritional guidelines proposed by INRAN (now CREA - Alimentazione e Nutrizione)²⁶; the third one was based on the Mediterranean Diet (Scenario A) proposed by the Interna-

tional Mediterranean Diet Foundation)²⁷. In calculations relating to INRAN (now CREA - Alimentazione e Nutrizione) guidelines, foods belonging to the first category (meat, fish, eggs, legumes) were organized in various ways, while keeping the recommended frequency of 14 weekly portions constant.

Regardless of the assumptions adopted, it is important to note that a balanced diet should not exclude any type of food; for this reason, alternative dietary patterns such as the vegetarian diet were not taken into account as they are not relevant for the study and would require medical skills that surpass those of the authors involved.

²⁵ SINU 2012. Società Italiana di Nutrizione Umana. LARN Livelli di Assunzione di Riferimento di Nutrienti ed energia per la popolazione italiana. Revision 2012 (Portion quantitative standards, pag. 50).

²⁶ Nutritional Guidelines developed in 2003 by a workgroup made by experts from INRAN (become CREA - Alimentazione e Nutrizione), the Ministry of Health and the Institute of Food Science, University "La Sapienza" of Rome, with the aim to produce a typology of diet to which easily address the citizens, recommending the appropriate changes. Creating the average diet, the recommendation of 2,100 kcal per day was considered.

²⁷ Bach-Faig A., et al., 2011. Mediterranean Diet Foundation Expert Group. Mediterranean Diet pyramid today. Science and cultural updates. Public Health Nutr. 14(12A), pp. 2274-2284.

SCENARIO A LOW

The Mediterranean Diet scenario foresees a very low consumption of meat and cured meats (350 grams per week) in favour of a high fruit and vegetable consumption.

SCENARIO B INTERMEDIATE

The intermediate scenario foresees a moderate consumption of meat and cured meats amounting to 450 grams per week.

SCENARIO C HIGH

While respecting nutritional indications, this scenario foresees a more frequent consumption of foods of animal origin amounting to 550 grams of meat and cured meats per week.


			WEEKLY CONSUMPTION RATES		
	FOOD	g per portion (from LARN 2012)	A	B	C
MEAT, FISH, EGGS, LEGUMES	Fresh meat poultry and pork	100	2	3	3
	Fresh beef	100	1	1	1
	Fresh beef hamburger	100	0	0	1
	Cured meats	50	1	1	1
	Fish and shellfish	150	3	2	2
	Preserved fish	50	0	0	0
	Eggs	50	3	3	3
	Legumes (Fresh or in cans)	150	0	0	0
	Dry legumes	50	4	4	3
MILK, YOGURT, CHEESE	Milk and yoghurt	125	10	21	21
	Fresh cheese	100	2	1	1
	Matured cheese	50	2	2	2
CONDIMENT	Butter	10	7	7	10
	Oil	10	14	14	11
CEREALS	Bread	50	35	35	35
	Bakery products	30	7	7	7
	Pasta	80	5	3	4
	Rice	80	2	4	3
	Potatoes	200	2	2	2
FRUIT, VEGETABLES	Vegetables	200	14	13	12
	Salad	80	7	1	2
	Fruit	150	21	21	21
Total meat and cured meats			350	450	550


>> The various environmental hourglasses

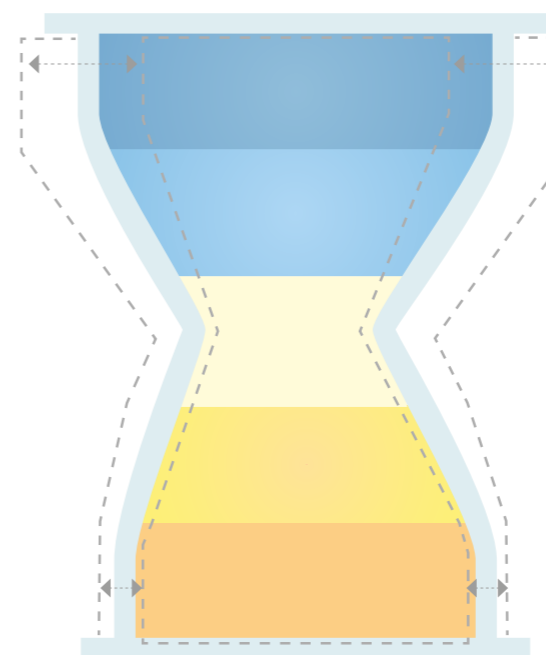
The analysis on the variability of food choices shows us how the hourglass does not vary significantly despite the different levels of consumption: in fact, in the case of the Mediterranean Diet it seems almost paradoxical that low impact foods such fruits and vegetables become more impactful than meat.

There are some differences in the results compared to last year partly due to constant updating of environmental data and partly to the revision of the weight of the portions that have been modified in order to use a more current source.

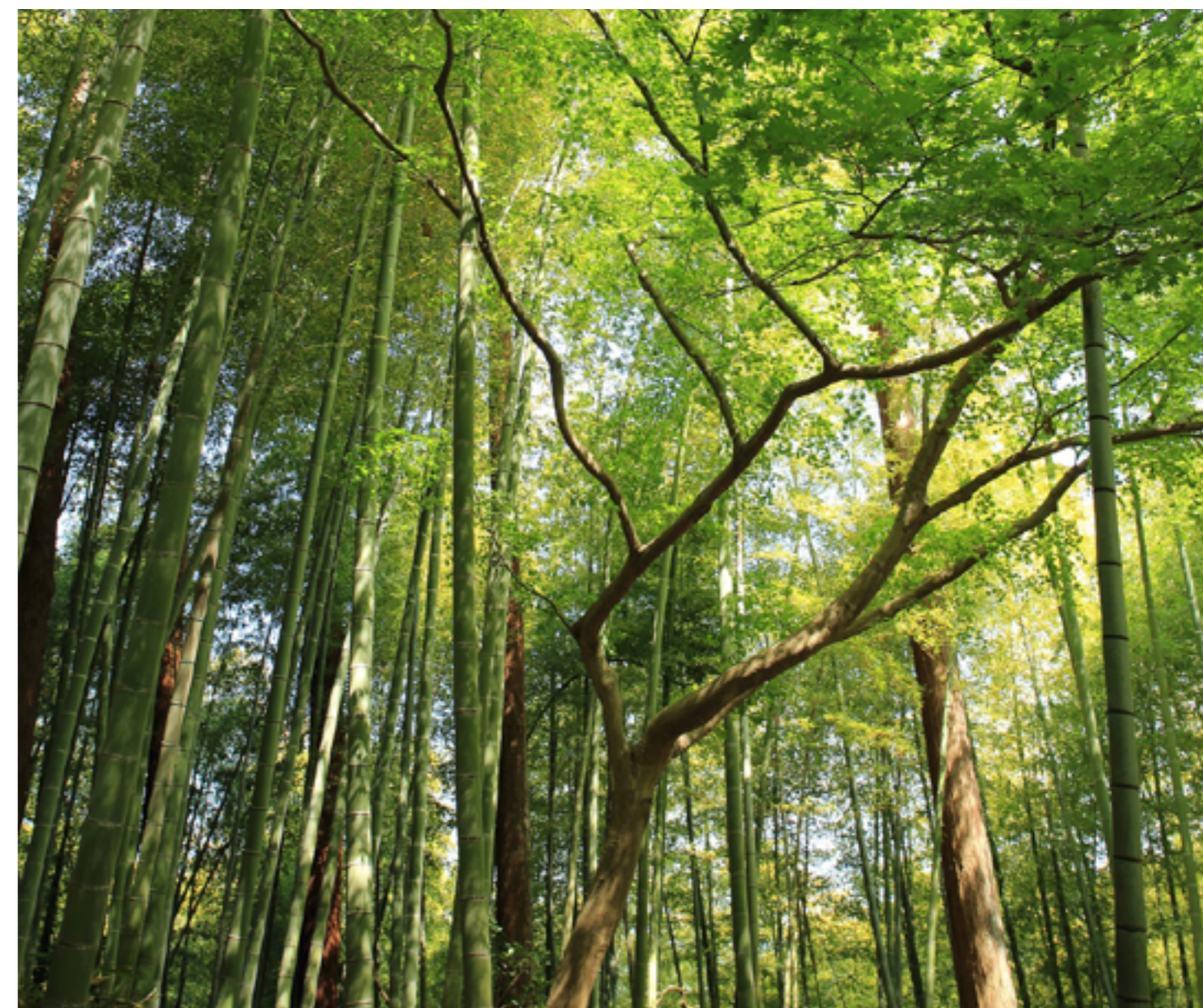
Scenario B was used as reference for the construction of environmental hourglasses (related to carbon footprint and water footprint).

CARBON FOOTPRINT HOURGLASS  CARBON FOOTPRINT THE THREE SCENARIOS kg CO ₂ person/week	CATEGORY	A	B	C
	MEAT, FISH, EGGS, LEGUMES	6.9	6.7	7.7
	MILK, YOGURT, CHEESE	4.6	5.8	5.8
	CONDIMENT	1.0	1.0	1.2
	CEREALS	4.2	4.5	4.3
	FRUIT, VEGETABLES	6.6	6.0	5.7
	TOTAL	23.3	24.0	24.6

WATER FOOTPRINT HOURGLASS  WATER FOOTPRINT THE THREE SCENARIOS litres person/week	CATEGORY	A	B	C
	MEAT, FISH, EGGS, LEGUMES	3,100	3,500	4,500
	MILK, YOGURT, CHEESE	2,200	3,400	3,400
	CONDIMENT	1,600	1,600	1,400
	CEREALS	3,300	3,500	3,400
	FRUIT, VEGETABLES	3,400	3,200	3,200
	TOTAL	13,600	15,200	15,900



ALTHOUGH MEAT IS AMONG THE FOODS WITH THE GREATEST IMPACT PER UNIT OF WEIGHT, A BALANCED CONSUMPTION DOES NOT SUBSTANTIALLY AFFECT THE WEEKLY IMPACTS

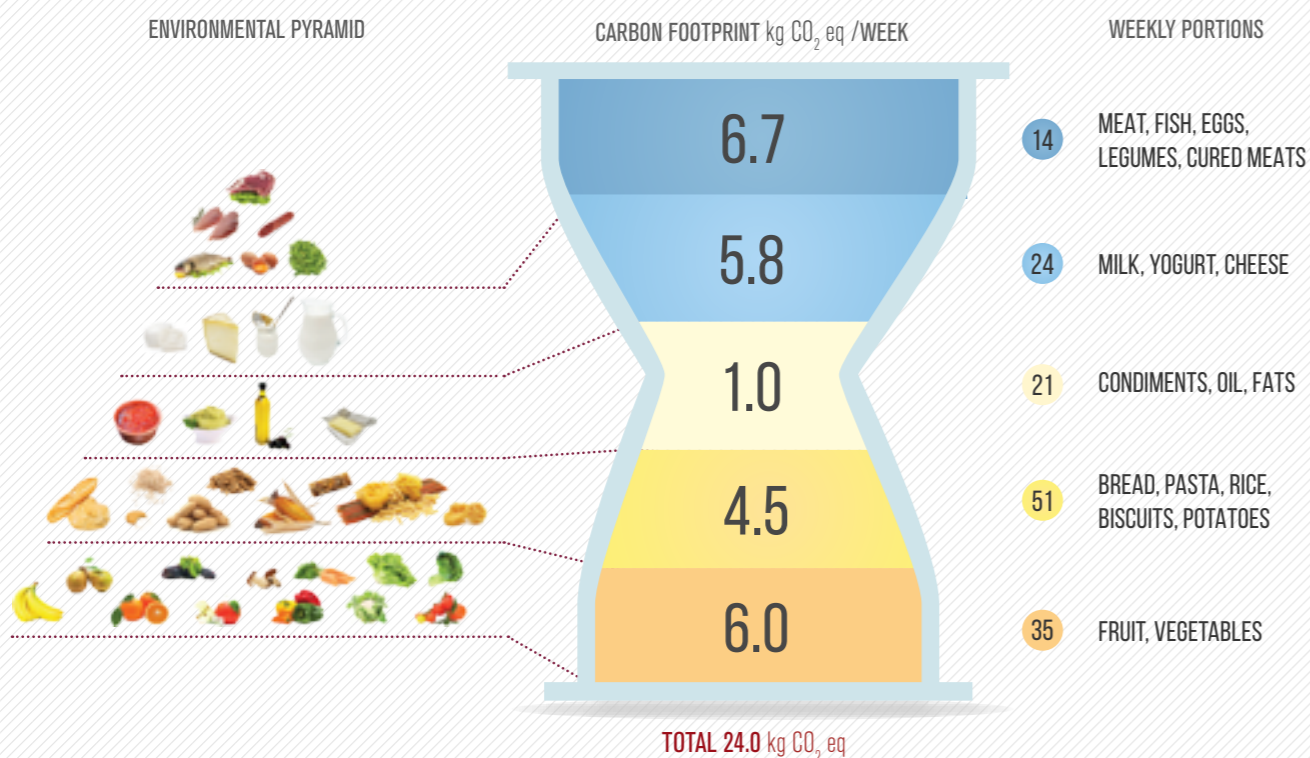




THE ENVIRONMENTAL HOURGLASS OF CARBON FOOTPRINT

The Environmental Hourglass represents the carbon footprint of the foods consumed in a week following **scenario B**.

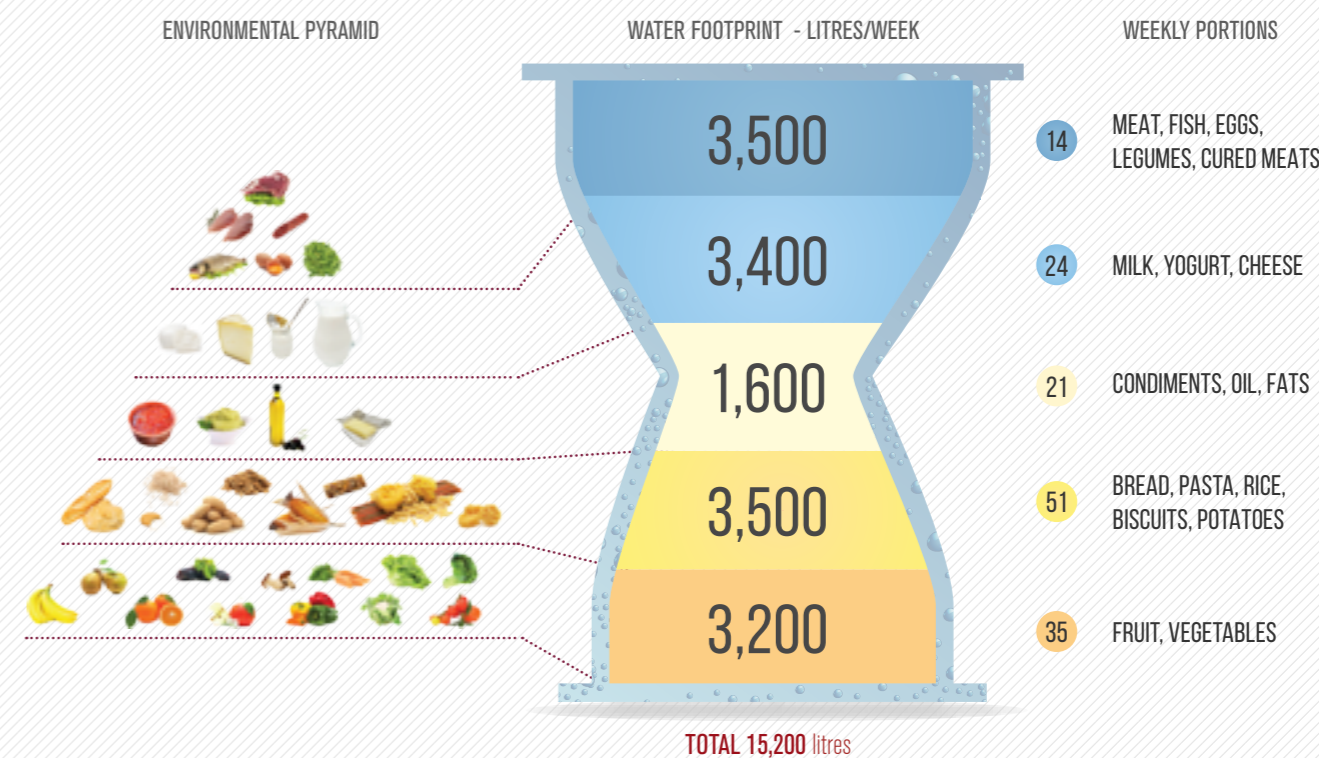
ENVIRONMENTAL HOURGLASS®



THE ENVIRONMENTAL HOURGLASS OF WATER FOOTPRINT

The Environmental hourglass represents the water footprint of the foods consumed in a week following **scenario B**.

ENVIRONMENTAL HOURGLASS®



The Environmental Hourglass is built considering the consumption frequency suggested by INRAN (now CREA - Alimentazione e Nutrizione) in the guidelines 2003 for an adult who needs 2,100 kcal per day, and the portions suggested by SINU in the guidelines published in 2012.

ENVIRONMENTAL IMPACT CALCULATORS

There are several calculators available on the Internet with which we can roughly assess the environmental impact of our lifestyles. Some enable one to calculate the user's environmental impact by assessing his/her entire lifestyle, while others focus on nutrition. They are quick and simple calculators, which are catch the attention of users due to their ease of compilation and interpretation, while bearing in mind the essential aspects of everyday life.

The official calculator of the Footprint Network, *Calculate your footprint*²⁸, enables one to calculate one's "ecological footprint", that is how much biologically productive land is required to sustain one's lifestyle.

The questions asked concern nutrition (consumption of meat, fish, eggs and dairy products, local products), lifestyle and clothing habits, the home (with related energy costs and household waste management) and means of transport used. The results are expressed as "planets" and divided into the various components of the Ecological Footprint.

The WWF Italian calculator, *Make*

a difference!²⁹, evaluates the user's environmental burden and expresses it in CO₂ equivalent, therefore in terms of Carbon Footprint.

The overall impact of an individual is calculated from primary emissions (home and transport/travel) and secondary emissions (nutrition, purchase of goods and services, entertainment etc.). The calculator asks the user about his/her habits regarding home management, transportation, food and services, and provides a final result in terms of tonnes of CO₂ equivalent per year.

Firstly, the Coop calculator, the expenditure footprint³⁰, calculates the environmental impact of the user's eating habits based on his/her weekly shopping. With the calculator it is possible to simulate shopping, by referring to the main products that end up in the shopping cart and then calculating their environmental impact in terms of carbon footprint. By multiplying the recommended amount of each food consumed in a balanced diet (proposed by the INRAN nutritional guidelines (now CREA - Alimentazione e Nutrizione) by its environmental im-

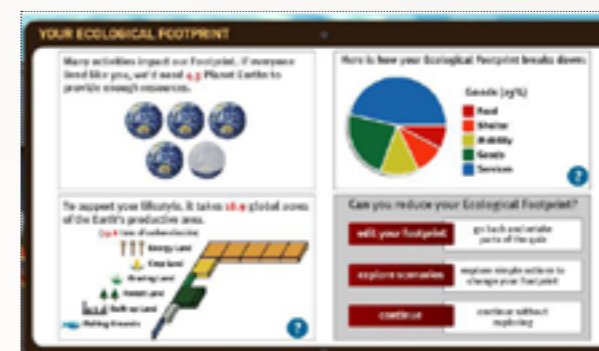
pact, we can obtain the average impact of the weekly diet. After specifying the number of family members and the number of shopping days, the user chooses his/her food and indicates the respective amounts.

The calculator compares the average impact of the weekly diet with that obtained by the user-entered input and provides advice and tips for following a healthier diet emphasizing how important it is to consume all of the food categories in a balanced way.

²⁸ http://www.footprintnetwork.org/it/index.php/gfn/page/personal_footprint/

²⁹ <http://racconta.repubblica.it/wwf-calcolatore-co2/main.php>

³⁰ <http://www.e-coop.it/coopco2/>



"CALCULATE YOUR FOOTPRINT"



"MAKE THE DIFFERENCE !"

WWF Italian edition



"LA SPESA ALL'IMPRONTA"



WHAT THE IMPACTS OF MEAT AND CURED MEATS ARE

The aim of this part of the document is to present an overview of the main environmental impacts caused by the production of meat and cured meats with details of the available techniques and technologies for operators who want to improve performance. One of the aspects that emerges from the analysis is certainly the fact that when farmers and processors **organize themselves in industrial entities and structured supply chains**, they are able to gain access to more resources and therefore have a better chance of achieving the economic efficiency required for sustainability over time. A large industry that achieves a small improvement leads to great advantages from a global point of view.



> Animals and plants: two interdependent systems

The agro-food sector is the most complex industrial field because the study of the impacts must always take into account the numerous interactions of the various supply chains.

This is even more important when producing meat and cured meats: the farms often use organic fertilizers such as manure from the breeding farms

which are then used for producing feed from agricultural waste or processing industrial by-products.

Beef comes from one of the most complex systems, since it must take into account meat, milk and skin simultaneously: the impact calculation of each of them must comply with the allocation rules of environmental loads among the various systems.

In order to make studies comparable and repeatable, it is essential that these rules are transparent and possibly made according to a public and international

AGRICULTURAL PRODUCTION AND BREEDING

- agricultural waste:
 - compost production
 - co-generation energy
- manure:
 - organic fertiliser production
 - biogas

“CIRCULAR ECONOMY” REGENERATING RESOURCES, CREATE ZERO WASTE

DISTRIBUTION AND CONSUMPTION

- reducing packaging at product's expiry date
- recyclability of packaging through recycling

INDUSTRIAL PRODUCTION

- recycling of industrial waste
- co-generation energy from biomass derived from waste products
- compost production from production waste
- transformation of by-products, bones and skins for food, pharmaceutical, animal feed and fertiliser industries



al path validation and international such as that initiated by the International EPD System³¹, which has been operating in this field for many years and was first to publish the Product Category Rules (PCR)³² for meat. In fact, the rules for allocation rules for distributing the impacts between the various products of the supply chain under study are described in detail in the PCR.

As regards to the adult cattle supply chain, the total environmental impact is divided between the brood cow, bred only for reproductive purposes, and all the products and by-products that are obtained from her: the brood cow (her meat, skin and fat) and the calves born during her years of activity.

The availability of common calculation rules has made it possible to certify and publish the results of LCA studies with environmental product declarations (EPD) as Coop Italy did in 2013³³ and Inalca³⁴ did in 2015. The need to create common rules and

to integrate the different sectors also prompted the European Union to promote the PEF (Product Environmental Footprint) method in 2013 with the aim of defining a common methodology for calculating the environmental impacts of a product at European level. The project is currently in the pilot phase and the first results are expected by the end of 2016.

³¹ www.environdec.com

³² International EPD® System, PCR 2012:11 CPC 2111-2113: Meat of Mammals fresh, chilled or frozen; ver. 2.0 del 2013/07/22

³³ Coop, environmental product declarations (EPD) of adult branded beef and white veal, rev. 2015.

³⁴ Inalca, environmental product declarations (EPD) of frozen Montana hamburgers, rev. 2015.



LIFE+ CLIMATE CHANGE-R PROJECT



The LIFE+ Climate changeE-R is a LIFE project promoted and coordinated by the Region of Emilia Romagna whose aim is to develop cultivation and breeding techniques reduce the production of greenhouse gases while maintaining the same product quality and production yields. Some of the most important national and international agribusiness groups and large retailers participate in the project: Coop, Granarolo, Barilla, Parmareggio, fruit and center services, Apo Conerpo and Unipeg.

The scientific partners of the project are the Regional Agency for Prevention and Environment

(ARPA), the Plant Production Research Centre (CRPV) and Animal Production Research Centre (CRPA).

The project is based on an integrated approach concerning agricultural, industrial and distribution factors and on the development of an information system created from the experience of the partners involved. The goal is to develop new agricultural and zoo technic guidelines using the most advanced techniques identified by researchers at international level starting from the experience of integrated pest control which is well established in Emilia-Romagna.

These practices may also lead to the reduction of fertilizers and pesticides, a more rational management of water resources,

lighter land processing techniques, different manure management methods and new types of animal feed.

An important point will be testing the practices in the factory (thanks the availability of a few agricultural enterprises), but the ultimate goal is to introduce new regulations for regional supply chains, using the resources of the new rural development program 2014-2020, and by promoting and enhancing them with consumers.

The application of new methodologies will reduce greenhouse gas emissions of agricultural origin in Emilia-Romagna by 200 thousand tons of CO₂-equivalent in three years in compliance with the European objectives established in Europe 2020.





IMPACTS ALONG THE SUPPLY CHAIN



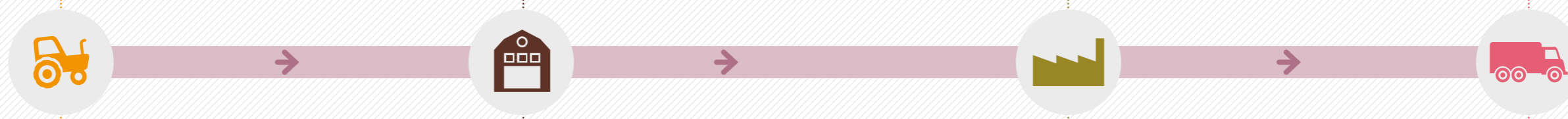
Although it is often believed that the most significant phases are those related to industrial processing or distribution, the steps that most contribute to the overall meats and cured meats environmental burdens are **farm management** and **feed cultivation**. Agricultural and livestock farms are therefore the phases where the major effort is needed, in order to control and reduce, where possible, the overall environmental impact.

There are dieticians for animals as well as for people. They establish the appropriate rations for the various animal species for the various phases of their lives. Soya, corn, sunflowers, alfalfa and hay are the main raw materials grown for making feed for livestock.

Breeding farms can be managed according to the production area in which they are located and the type of animals bred.

The transformation phase begins with the slaughtering of the animals and includes the production of more elaborate products such as cured meats and cured meats.

Distribution involves all of the production phases up to the retail store or the consumption of the meat.






PRODUCTION OF FEED

The main aspects of this phase are typical of agricultural practices:

-  use of fertilizers and agrochemicals
-  use of diesel fuel
-  land occupation
-  use of water




BREEDING FARMS

The main aspects are related to:

-  the management of animal excrement
-  energy consumption
-  use of water

TRANSFORMATION



Significant environmental aspects are typical of industrial production:

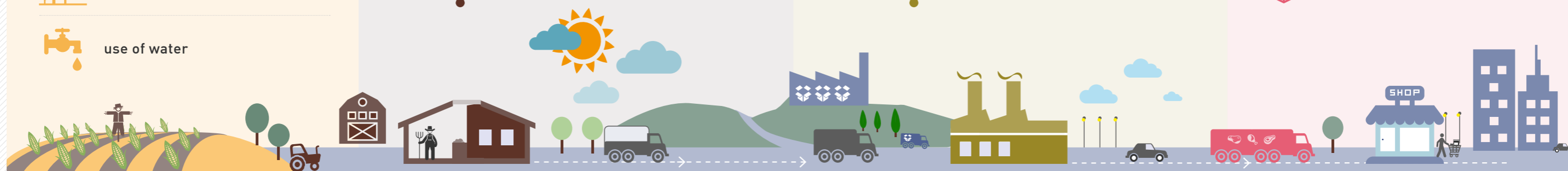
-  energy consumption
-  waste production
-  use of water

DISTRIBUTION

In most cases meat and cured meats are very fresh products which must be distributed rapidly.

The most important aspects are:

-  transportation
-  use of packaging



> Reducing the impacts in order to achieve efficiency

As in the case of other foods, the impact of the meat is calculated by correlating the environmental aspects of the system with the amount of product produced: the lowest environmental impact is obtained when the animal reaches slaughter weight as quickly as possible, with the smallest amounts of food and excreta.

One of the most debated issues regarding meat is whether it is better to raise the animals in barns –

intensive livestock farming or in fields – grazing. This is a topic which should be examined from different viewpoints: animal welfare, safety, the quality and taste of the meat, environmental impacts.

By focusing solely on the environmental issue, agricultural intensification produces lower impacts as the animals reach slaughter weight rapidly with ad hoc rations and **maximum efficiency**. However in order to achieve sustainability, not only the environmental aspects must be taken into account since there must be a balance between extreme models. It is not easy to find a solution, as there are many factors to consider such as the animal species in question.



THE FAO'S ROLE IN SUSTAINABLE CATTLE FARMING³⁵

by Susanna Bramante³⁶

Livestock farming is essential for the livelihood of much of the world's population, especially in areas where people live in poverty. The global demand for animal products is increasing especially in developing countries, thanks to progressive urbanization, population growth and the rising incomes of the population: it is estimated that this demand will increase by 70% in order to feed a world population that is expected to reach 9.6 billion people by 2050.

In this context it is believed that the global production of meat will more than double from 229 million tonnes in 1999/2001 to 465 million tonnes by 2050, and that the global production of milk will increase from 580 to over 1,000 million tons. The increase in demand for these products is a great opportunity for approximately 1 billion poor people who depend on cattle raising as a source of sustenance and income.

The growing demand for animal products is met mainly due to the rapid expansion of "intensive" livestock farming as well as traditional systems.

This reality should be examined in the light of limited natural resources, as the livestock sector

puts significant pressure on several ecosystems, on biodiversity, water and soil quality and on global environmental impact. Livestock farming accounts for 14.5% of greenhouse gas emissions, which influences climate change significantly. Therefore, although this sector provides highly nutritious food, with important positive social and economic implications, and promotes food security and poverty reduction, it requires a large amount of resources.

The livestock sector uses most of the world's agricultural land for pasture and crop production. The natural resources required for agricultural purposes such as water and land, are becoming increasingly scarce and are continually threatened by pollution and climate change.

In this context, the United Nations Food and Agriculture Organization (FAO) supports the sustainable development of livestock farming, with the aim of reducing their environmental impact and resource utilization while increasing production efficiency at the same time. Producers, society and governments are aware of these impacts and are implementing concrete risk-reduction measures in order to improve



the use of natural resources.

In particular, two partnerships were formed in which the FAO is actively involved, which brings together various stakeholders (governments, the public and private sector, producers, civil society, international community organizations, research centres and academia, and donors who agree to finance the various FAO projects):

³⁵ <http://www.fao.org/livestock-environment/en/>; <http://www.fao.org/ag/againfo/themes/en/Environment.html>; <http://www.fao.org/partnerships/leap/overview/background/en/>; <https://www.youtube.com/watch?v=3NmL8DjMOXQ>

³⁶ Susanna Bramante is an agronomist, scientific popularizer and biotechnologist. She is the author and co-author of 11 scientific publications and numerous articles on human nutrition and its impact on health and the environment. In 2010 she was granted the title of Doctor Europaeus and Ph. Doctor in Animal Production, Health and Food Hygiene in countries with a Mediterranean climate. She edits GenBioAgroNutrition, "a blog in support of Italian agribusiness, the Mediterranean Diet and Biomedical Research, against pseudoscientific misinformation", which she updates daily.

• **The Global Agenda for Sustainable Livestock** aims to catalyse the actions of interested parties in order to:

Increase production efficiency: by improving animal health and nutrition in the dairy industry it is possible to increase production, reduce the amount of resources required, protect the environment and ensure food safety.

Give value to pasture land: in the case of extensive farming, proper pasture management increases production, enhances soil carbon sequestration and protects biodiversity and water quality. By reducing the number of animals raised and the use of fertilizers, it is possible to increase the quantity and quality of forage.

Improve manure management: in intensive farming, appropriate manure management leads

to the reduction of air and water pollution, thanks to biogas production and using manure as fertilizer. The energy and the nutrients obtained can replace fuel and synthetic fertilizers.

• **The Livestock Environmental Assessment and Performance Partnership (LEAP)** which was founded in 2012, focuses on the development of sector-specific guidelines, in order to quantify and monitor the environmental impact and performance of the livestock sector. The initiative is the result of a consultation process launched in 2010 between the Department of Animal Production and Health of the FAO and a group of representatives of the food and farming industry. Thanks to the on-going dialogue between the interested parties (governments, private sector and civil society) focused on objectives to be accomplished and team commitment, the pro-

ject was developed with the aim of creating a partnership between the various stakeholders for benchmarking purposes and for monitoring and improving the environmental performance of the entire meat supply chain, bearing in mind the positive social and economic outcomes.

Thanks to technical, analytical and research skills and by exchanging data and information kept in collective databases, we will get a better understanding of the key factors influencing the performance of the livestock sector and its environmental impact. The FAO is committed to providing comprehensive and reliable assessments of the environmental impacts of the livestock sector, their mitigation potential and the concomitant effects on food security and poverty reduction. This is essential for enhancing policy dialogue and for establishing the right strategic direction to follow.

GLOBAL LIVESTOCK ENVIRONMENTAL ASSESSMENT MODEL: THE FAO PROJECT

Among the FAO's many activities, the GLEAM project (Global Livestock Environmental Assessment Model) is certainly noteworthy, which assesses the environmental impacts of worldwide meat production by means of the life cycle analysis with the aim of

identifying possible improvement strategies. It provides in-depth information and official documents on the GLEAM project website (<http://www.fao.org/gleam/resources/en/>), in order to present the data and relevant conclusions especially regarding

greenhouse gas emissions.

A first consideration concerns the overall emissions of the livestock sector, estimated at 7,000 million tonnes per year (7 Gt), which is equal to approximately 14% of human-generated greenhouse

gas emissions. This value also includes emissions associated with land-use change, which occurs when forests are replaced with pastures or fields for cultivating the raw materials required for producing animal feed.

As regards to the various types of meat, a high level of environmental impact is generated by bovines (beef cattle and dairy cows), due to the methane emissions from enteric fermentation, which alone account for approximately 40% of the total. The most significant areas in terms of emissions are South America and Southeast Asia (25% each), Europe and North America (10% each).

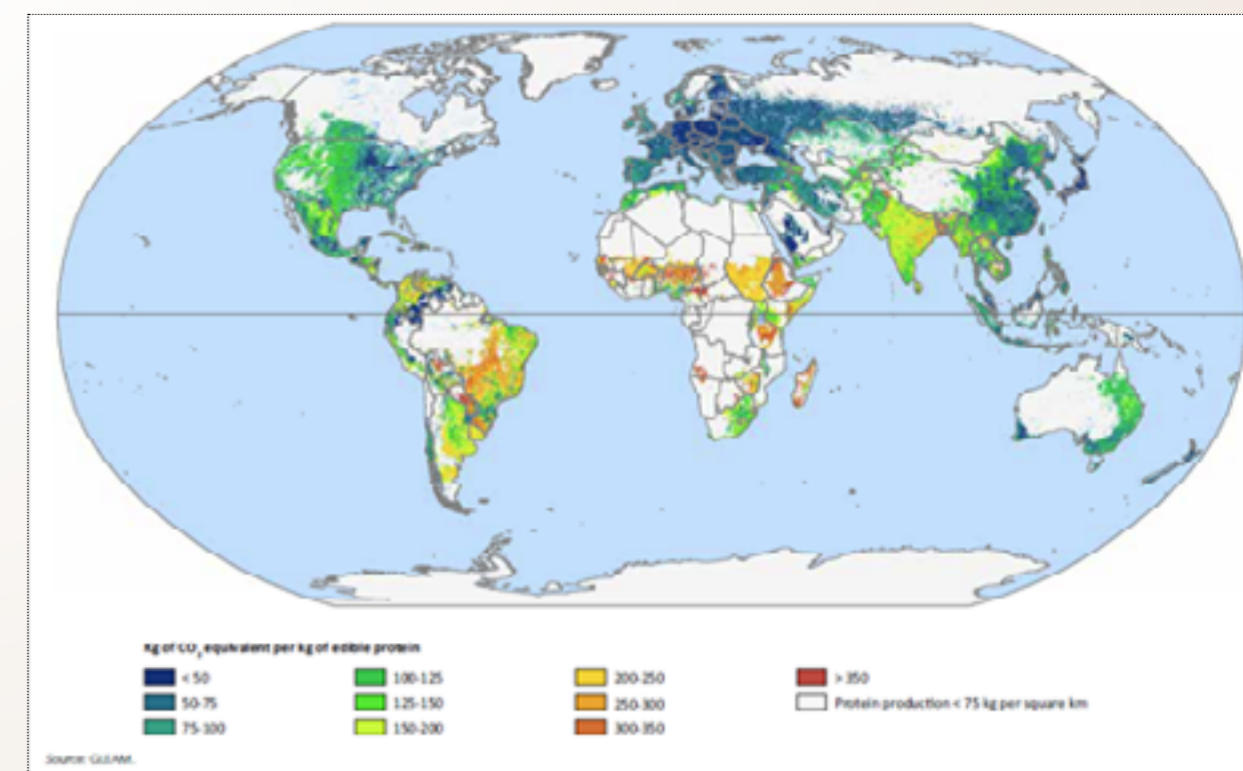
An important aspect concerns the differences in production of the various geographic are-

as, both in terms of the species reared and breeding systems adopted: the main breed raised in South America is beef cattle, that are mostly reared with extensive farming; in Asia the production focuses on dairy cattle and pigs; North America is a major producer of beef cattle by means of "industrial" livestock production systems, while production in Europe is semi-intensive and is quite evenly distributed amongst the species, with a slight predominance towards pig farming.

These variations in terms of production obviously correspond to differences in terms of emissions. One can see in the figure below that the emissions per unit of production are higher in countries in which extensive farming prevails than in countries that adopt more "industrial" live-

stock production systems. However it is important to note that excessive production efficiency research may compromise the safety of meat products (use of illicit substances) or animal welfare.

An agricultural policy for improving the sustainability of the livestock sector must be regulated to meet the needs of the areas in question. For example, a reduction of consumption per capita is advisable in areas with high overall consumption levels (i.e. North America); while in areas with low environmental impacts and that comply with nutritional recommendations such as Europe, the most important aspect is animal welfare, for which improvement measures are certainly possible.



> Feed production

Feed production is the first phase of a livestock production chain. Therefore, the first step is to understand what feed is made of, which raw materials are required for producing it and how the impacts of the various sectors vary. The main impacts are caused by the agricultural phase: for poultry and pork this phase is responsible for 60-80% of the emissions released by the entire production systems (farm to gate); while the percentages are slightly lower for beef, approximately 35-45%, due to the fact that most of the emissions are related to enteric fermentation³⁷.

Therefore, the only sustainable way forward in livestock production is to involve farms in a far-sighted and systematic way.

>> Is there competition between animal feed and human consumption?

Feed intended for farmed animals is mainly composed of a mixture which mainly includes cereals (maize, wheat, barley), legumes (such as soybeans), vitamins and trace elements according to a diet that is established on the basis of the needs related to the type of farming and its productive specialization.

In Italy there are farms that produce their own feed, which are part of integrated supply chains. This

³⁷ Sonesson, et al., 2009. Greenhouse gas emissions in animal feed production – Decision support for climate declaration. Report 2009: 2.

BREEDING TYPE	BEEF CATTLE	DAIRY COWS	POULTRY	PORK
OVERALL RATION	15-20 KG/DAY	25-30 KG/DAY	0.15 KG/DAY	1.35 KG/DAY
CORN IN VARIOUS FORMS	65-70%	60%	25-30%	45-50%
SUNFLOWER	8-10%	< 5%	-	-
BEETROOT	5-10%	< 5%	-	-
WHEAT AND OTHER CEREALS	5-10%	10%	20%	30-35%
SOY	< 5%	< 5%	40%	15-20%
GRASS AND HAY	< 5%	20%	15%	-
SUPPLEMENTS	< 5%	< 5%	-	< 5%

Average feed rations used for livestock breeding for different species in Italy

practice, which is an undeniable asset for breeding farms, is mostly used for cattle rearing and enables farmers to adapt their agricultural production to specific nutritional breeding strategies, and provides them with strong control capabilities and good agricultural practices, including “**precision farming**” techniques that can positively affect the overall sustainability of their agricultural production.

In the case of pig and poultry livestock production, the correlation between self-production of raw materials and livestock production is less strict. In these cases, integrated supply chains, that comprise farms and feed mills, are developed in order to be able to specialize feed production to the specific livestock production typology. Compared to the free market between feed producer and farmer, **the integrated supply chain allows more consistent quality of production and, above all, a greater ability to control**, both food safety and sustainability aspects. The vegetable raw materials used for processing animal feed are generally purchased from foreign and domestic markets. Depending on the type of agricultural raw material, there is a **variable degree of self-sufficiency in domestic production**.

For example, Italy is not self-sufficient in soya beans and must obtain them from soya-producing countries such as some South American nations. In this case community legislation provides a comprehensive system of safety laws regarding health and traceability along the entire the food supply chain. It is important to note that from a safety perspective **feed is treated in the same way as food for human consumption and must therefore comply with the same regulations**.

Although it is more complex to implement projects for improving sustainability in the context of international trade, it is important to note that voluntary sustainability and certification systems are available even in the case of agricultural commodities for global markets. An example of this is represented by the production and certification systems of sustainable soya, the most important of which is the RTRS - Round Table on Responsible Soy (www.responsiblesoy.org).



In order to reduce our dependence on vegetable productions from other continents, **the EU promotes and supports the use of waste and by-products from food chains** for raising livestock according to the principles of circular economy. There are in fact numerous on-going avenues of research aimed at broadening the technologies required and the portfolio of animal feed made from food waste.

The diet of the animals has always been supplemented with **waste or by-products obtained from the various stages of the industrial food**, processing of foodstuffs such as fruit and vegetables that cannot be put on sale, the by-products obtained from cereal milling, not in compliance pasta and bakery products, and milk, beer and tomato residues.

The environmental advantage for using these materials is twofold: it reduces dependence on foreign raw materials for producing feed as well as the agricultural land required for **growing feed** which can be used for producing food for human consumption and **eliminates the problem of waste disposal**; it is furthermore the use of food residues to be allocated to livestock is in fact an efficient way to transform human “waste” in feed for livestock³⁸.

³⁸ Elferink E. V. et al., 2008. Feeding livestock food residue and the consequences for the environmental impact of meat, *Journ. of Clean Prod.* 16 (2008) 1227-1233.

FROM CELLULOSE TO PROTEIN

The complex nature of the metabolism of cattle is due to the conversion that only they are capable of performing. In fact ruminants have a natural system of bio-fermentation which occurs in four compartments of the stomach: the rumen, reticulum, omasum and abomasum, that correspond to the stomach, correct in the strictest sense of the word.

These organs allow for the transformation of the cellulose contained in plants, i.e. the indigestible part for humans. The digestion of cellulose in ruminants is carried out by a complex, little-known microbial flora which only develops in cattle prestomachs. It is thanks to this system that cattle **are able to convert plant products (otherwise indigestible) into proteins such as milk and meat.**

In fact, the biological process of rumination determines the transition from the vegetable world to

the animal world. This is the reason why ever since prehistoric times ruminants have coexisted with human beings thus guaranteeing a supply of high biological value proteins, starting from vegetables lacking in bioavailability for humans.



FOOD	EXAMPLES	EDIBLE FOR HUMANS?
FORAGE CROPS	Pasture grasses, alfalfa, clovers, hay and silage.	No
CEREALS	Corn, wheat, barley, millet, sorghum, triticale, oats.	Yes
VEGETABLE PROTEINS	Soya (mash and flour), cotton (seeds and flour), rapeseed and peanut meal.	Partially
CEREAL BYPRODUCTS	Cereals from the distilling industry, corn gluten, wheat bran, straw, agricultural residues.	No
VEGETABLE BYPRODUCTS	Apple peel, citrus pulp, almond shells, fruit/vegetable waste.	No or partially
FOOD INDUSTRY BYPRODUCTS	Bakery waste, canned, from restaurants etc.	Partially
SUGAR BYPRODUCTS	Molasses and beetroot pulp.	Partially
ANIMAL BYPRODUCTS	Meat waste and bones, tallow, feathers, blood and flour, poultry litter.	Partially
CHEESE BYPRODUCTS	Milk, whey, casein.	Partially
FISH BYPRODUCTS	Fish waste, fish oil, seaweed.	Partially
OTHER	Vitamins, minerals, probiotics, antibiotics, yeasts, enzymes, preservatives.	Partially

Examples of foods commonly used in livestock production systems (data USA: Capper et. al, 2013)

The crucial point is the ratio between the amount of edible proteins to be used as animal feed and the amount of (edible) protein obtainable from the rearing of animals.

In order to increase efficiency and reduce the amount of edible protein used as animal feed as much as possible, it is essential that breeding farms exploit crop residues and by-products more efficiently, by trying new combinations that maintain a high level of conversion efficiency³⁹.

Since the world population continues to grow, so does the demand for food, therefore farm animals will play important roles in converting inedible food into high quality proteins.

³⁹ Wilkinson, J. M. 2011. Re-defining efficiency of feed use by livestock. *Animal* 5 (7): 1014-1022.

GFLI, GLOBAL PROJECT FOR MEASURING THE IMPACT OF ANIMAL FEED

The aim of the *Global Feed LCA Institute (Gfli)* is to measure the environmental impact of animal feed production. The project was launched in the USA in 2015 and is supported by several international organisations such as *Fefac* (European feed manufacturers' federation), *Ifif* (International Feed Industry Federation), *Afia* (American feed industry association) and *Anac* (Animal Nutrition Association of Canada), as well as by a consortium of international companies.

The objectives of Gfli are:

- To adopt a standard method at international level for ana-

lysing and evaluating the environmental impact related to feed production;

- To ensure the development and use of a free and transparent database that gathers all information related to the lifecycle of the ingredients used in animal feed production;
- To create a comparative analysis method for determining the effects of feed production on the environment.

The Gfli has also established a partnership with the *Fao* and the *Leap* (Livestock environmental

assessment and performance partnership) in order to ensure that its activities are consistent with the methodological requirements defined by the two organisations. The technical program of the Gfli was designed to comply with the *Pef project* (Product environmental footprint project), which is aimed at determining the environmental impact of all products, which is coordinated by the European Commission⁴⁰.

⁴⁰ <http://www.bovinodalatte.it/2016/02/18/al-via-il-gfli-progetto-mondiale-per-misurare-limpatto-ambientale-dei-mangimi/>

>> Land use and deforestation

As regards to territory, one of the most debated environmental issues concerns **land use** which leads to contrasting issues depending to the country of reference: in some cases, the main risk is the **abandonment** of agricultural land, in other cases the problem concerns the impact of aggressive human activities on the natural environment (**deforestation**).

For example, in Italy the main problem is the transition from agricultural land to urbanized land, resulting in general abandonment of farmland by agriculturalists. According to the latest data published by ISPRA⁴¹, between 2008 and 2013 approximately 60% of the land used for cultivating crops or other types of produce (such as fruit orchards) have been urbanized or used for other purposes. Moreover, renewable energy incentives have been implemented, which have often prompted farmers to convert their land into "solar power plants" or to grow crops that can be used for producing energy (biofuels).

This phenomenon has various economic and social impacts; productivity is reduced to the need to purchase raw materials from abroad. While the continuous maintenance required by farms helps to protect the territory, especially in areas at high landslide risk.

Therefore, it is essential to provide support, especially economic, to agriculture and animal husbandry in order to prevent the progressive impoverishment "of the countryside."

However, in other countries the problem is that agriculture occupies areas to the detriment of other habitats. Just think of the uncontrolled **deforestation** of tropical forests in favour of plantations producing agricultural commodities (mainly palm oil and/or soybean oil) for food or energy purposes, or of pastureland for grazing cattle. Besides causing the loss (sometimes permanent and irreversible) of fertile soil, these transitions also cause other nega-

tive impacts such as land fragmentation, reduction in biodiversity, variations in the hydrological cycle and microclimate changes.

Although Europe is not directly affected by deforestation and in fact forested areas are in expansion, there is a **phenomenon induced (embodied)** by the continuous and growing demand for raw materials. All over the world global phenomena are reducing and increasing forests: the countries in which the net balance is strongly negative are South America (33% of total global deforestation), sub-Saharan Africa (31%) and Southeast Asia (19%).

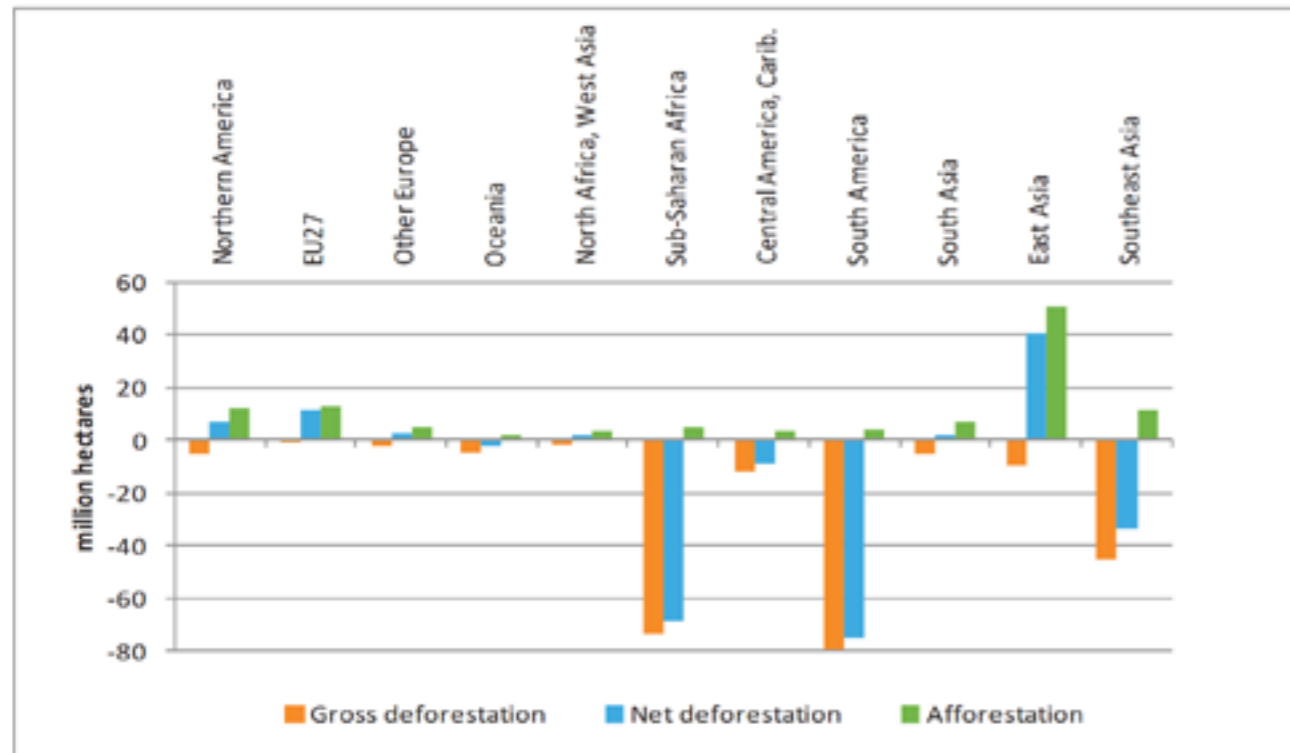
From 1990 to 2008, **worldwide net deforestation** was estimated at 239 million hectares (Mha). The agricultural sector was responsible for the deforestation of approximately 128 Mha: 49% is land for producing animal feed or pastures for grazing cattle, 8% is used for growing vegetable products for feeding pigs and poultry, 43% is used for cultivating plant-based foods, and producing bio-fuels and textile fibres. The main five crops in the period of reference that contributed to deforestation were soybeans (19%), corn (11%), palm oil (8%), rice (6%), and sugar cane (5%).

In **Europe** it was estimated that **embodied deforestation** amounts to approximately 8.7 M ha (7% of the global total) for which the largest contribution is due to the demand for animal feed, followed by raw materials for human consumption (soybean and palm oil).

These data show a very complex phenomenon that is difficult to manage, which must take into account the growing demand for food by the world's population. A possible solution is to reduce the amount of meat consumed in countries with high consumption rates; however, production efficiency must also be considered. As already mentioned in the case of greenhouse gas emissions, it is evident that grazing livestock is not always the most sustainable solution, also as regards to deforestation. A possible

⁴¹ ISPRA, Il consumo di suolo in Italia, edizione 2015, Rapporti 218/2015.





Source: FAO, 2010a, FAO, 2011 and own estimates based thereon

Changes in areas covered by forests between 1990 and 2008 in various parts of the world. In Europe (EU27) wooded areas are in expansion (afforestation), yet this contributes indirectly to net deforestation. Source: EC Study, Technical Report 2013-063.

solution would be to make farmers adopt specific policies when purchasing raw materials, in order to allow for the control of the supply chain and the traceability of raw materials.

>> The impact on agriculture

Fertilizers, irrigation and tillage systems, and the use of agricultural pharmaceuticals: generally speaking, the agricultural stage is the phase that causes the main impacts of the entire food chain.

Fertilizers are substances that provide nitrogen, phosphorus and potassium to the soil, which are the nutrients required for growing plants, yet **they are also the primary source of environmental impact of agricultural production**, both for the way they are used and for the production processes, especially those used for producing synthetic fertilizers. The greatest impact is caused by nitrogen due to the production of **nitrous oxide**, which contributes significantly to the greenhouse effect.

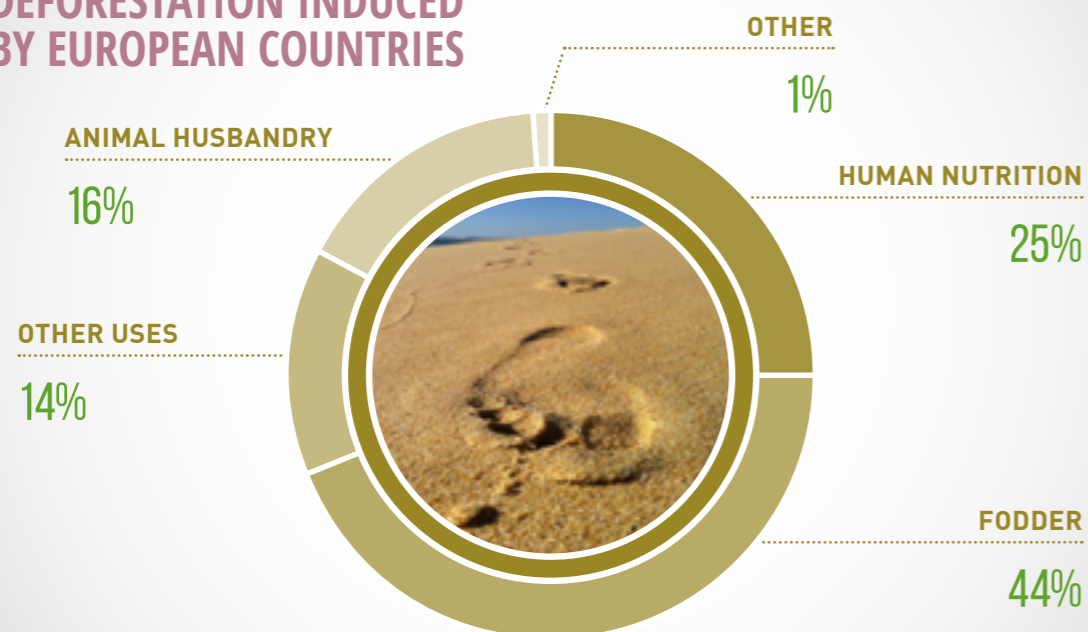
that either the plant or its products are used in food production. The plants can be protected by administering (curatively or preventively) chemicals (natural or, if available) in the various stages of plant growth, as well as through “smart” field management: for example, the fusarium infection, which affects wheat and cereals, is more frequent when corn was previously grown in the soil. If farmers bear this in mind when planning crop rotation, they could reduce their use of chemicals and cut their operating costs.

There are also operational decisions that must be made quickly in certain situations: adverse weather conditions, risk of infection etc. Since they can have major environmental and economic impacts, these decisions must be based on tools and information that “traditional” farmers often do not have. For this reason, decision support systems (DSS) are becoming more and more widespread as they gather, organize, interpret and automatically integrate the information required for deciding on the most appropriate actions to take in order to meet the various cultivation requirements, whether they are long-term strategic decisions or operational decisions to be taken quickly.

Furthermore, when excess fertilizer is applied, the residues that are not consumed by the plants can flow into both surface water and underground aquifers, resulting in an abnormal increase in the concentration of nitrogen that leads to an increased growth of flora: the so-called eutrophication phenomenon. **Natural fertilizers that are widely used in organic farming**, can reduce these impacts, especially for the smaller loads in the production phase, yet they have the same effects when applied to the soil: in fact, in some cases natural fertilizers (such as manure) make “advanced” agricultural techniques difficult to employ since they are aimed at reducing impacts by means of innovative techniques and technologies.

In addition to nutrients, the plants need to be **protected from disease**, insects, and weeds, which can negatively affect plant health and consequently production yields as well as food safety in the event

DEFORESTATION INDUCED BY EUROPEAN COUNTRIES



Embodied deforestation generated by European countries between 1990 and 2008. Source LANDFLOW; FAOSTAT 2011.



OGM YES OR NO?

One of the most controversial and recurrent aspects concerns GMOs (Genetically Modified Organisms), which are often held accountable for endangering human health and the environment and for representing the highly mechanized agro-food model focused on monocultures.

Although many studies have been carried out on this scientifically unsound topic from different viewpoints, the issues surrounding GMOs never fail to trigger disputes between supporters and detractors of this form of innovation. Please see below some of the main points of the debate, beginning with the definition of GMO.

The term "Genetically modified organism" refers to any "organism whose genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination"⁴². In fact, it is well known that the genetic characteristics of an animal or plant species can be modified and improved.

Therefore, it is important to note that the GMO techniques "on trial" are those that have been developed over the past 40 years⁴³ and that enable one to change some of the features of living

species "in the laboratory": for example, it is possible to increase the resistance of a plant to pesticides or certain pests, improve its nutritional profile and its ability to adapt to adverse weather conditions (e.g. by increasing its resistance to drought).

For many years, the WHO (World Health Organization) has declared that the GMOs currently on the market do not present risks to human health⁴⁴. However, a large percentage of general public is opposed to using GMOs in the agro-food sector, especially because people cannot benefit directly from this new technology due to the risks involved.

In order to help the average consumer to distinguish between scientific evidence, opinions and ideologies, the FAO provides an easily comprehensible summary of the possible positive and negative impacts of GM crops, and a brief analysis of their verifiability⁴⁵.

In Italy the Barilla Centre of Food & Nutrition has published annual reports since 2010 aimed at deepening people's understanding on biotechnological issues in order to identify the most controversial issues concerning genetically modified organisms⁴⁶.

There are certainly significant environmental and ethical issues. Crop simplification appears to be one of the most important issues concerning the environment, which could probably lead to biodiversity loss. This concern is aggravated by the lack of knowledge of whether these species are more invasive than traditional ones, which could lead to changes in the ecosystems in adjacent areas to those in which GMOs are introduced.

However ethically the main issue concerns the patentability of GM seeds and the possible economic repercussions that the development of an oligopolistic market in the hands of few companies could have on small farmers.

But where and why are GMOs used? The varieties of GM plants on the market today were developed to be resistant to agricultural pests (*Bacillus thuringiensis* BT), tolerant to herbicides (Herbicide tolerant, HT) and resistant to viruses. Recently European farmers have been authorised to grow in Amflora potatoes (EH 92-527-1) that are rich in starch for the paper industry, with the aim of increasing the level of productivity of the supply chain in question.

In the near future, genetically modified plants will be commercialized for their resistance to pests and herbicides, even if it is essential to develop plant varieties that can adapt to adverse environmental and climatic conditions: in fact studies are being carried out to develop plants that can adapt to drought or significant changes in temperature, or are able to grow in soils rich in certain minerals or metals.

Worldwide the main GM crops are soybeans, corn and cotton.



⁴² Article 2 directive 2001/18/CE of March, 12 2001

⁴³ GMO techniques use genetic engineering to modify genes through a transgenesis process, that is the insertion of a foreign gene (transgene) within the genome of a living organism

⁴⁴ World Health Organization, Food safety: 20 questions on genetically modified foods (http://www.who.int/foodsafety/areas_work/food-technology/faq-genetically-modified-food/en/)

⁴⁵ FAO, Weighing the OGM arguments: against, 2003 (<http://www.fao.org/english/newsroom/focus/2003/gmo8.htm>)

⁴⁶ Barilla Center for Food & Nutrition (www.barillacfn.com)

> Animal breeding

Most of the environmental impacts of meat and cured meats production systems are generated in farms; the most important aspects are **enteric fermentation** (for cattle) and **manure management**.

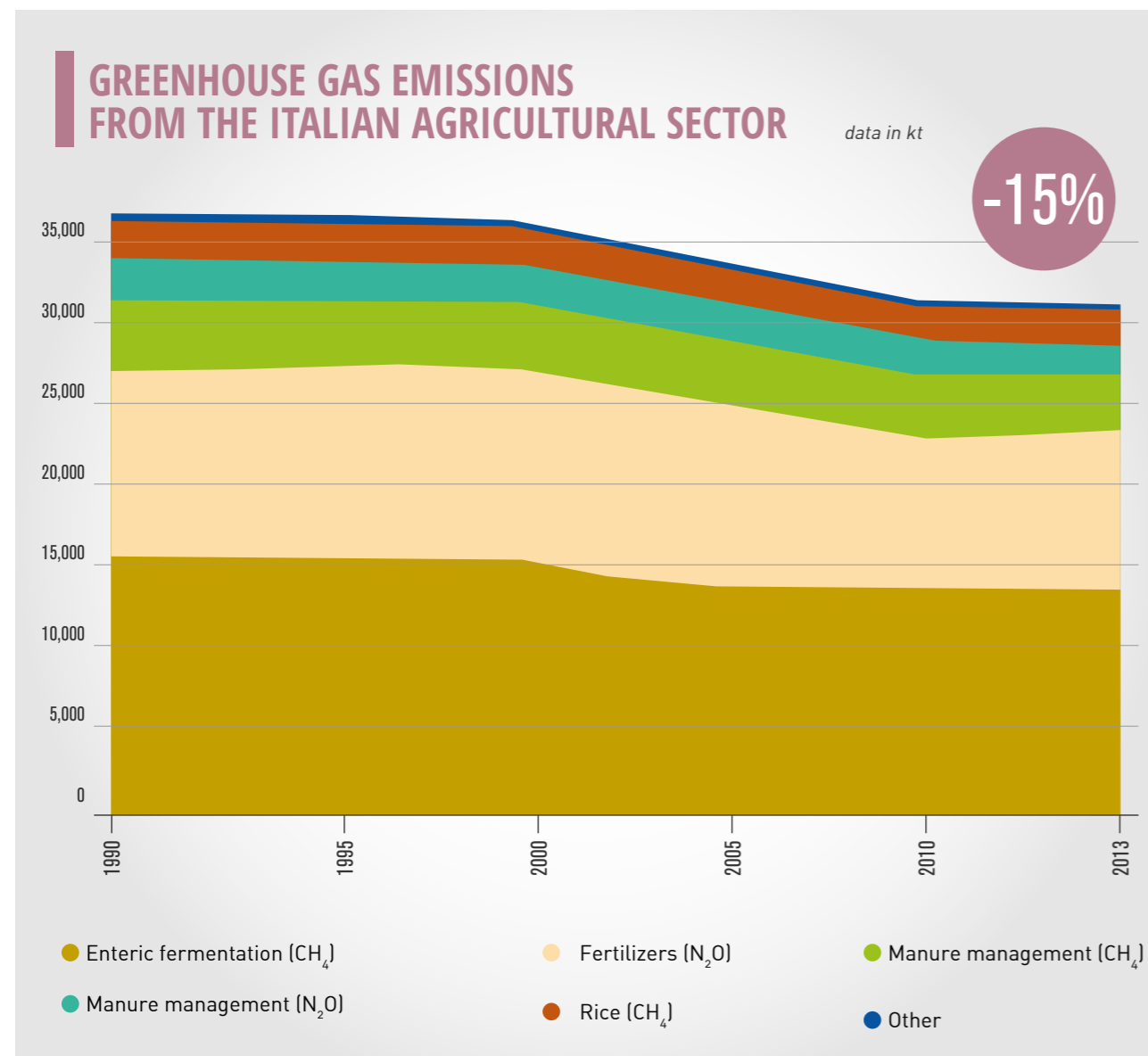
These statements are supported by data published by ISPRA⁴⁷ from which one can see a 15% of overall greenhouse gases reduction compared to 1990.

⁴⁷ ISPRA, Italian Greenhouse Gas Inventory 1990- 2013, National Inventory Report 2015, Report 231/2015.

>> Enteric fermentation

Enteric fermentation is one of the results of the food digestion process; It is particularly important in the case of ruminant animals (cattle, sheep, buffalo etc.), as it produces a large amount of methane (CH₄), which, if released into the atmosphere, the comparative impact of CH₄ on climate change is 28 times greater than carbon dioxide CO₂.

The amount of methane produced mainly depends on the characteristics of the animal (breed, age, weight), but also on the type and quantity of feed administered.



How are enteric emissions calculated

The IPCC organization dealt with the calculation of enteric emissions in its guidelines published in 2006⁴⁹, and defined three approaches for estimating them with different detail and depth.

The **Tier 1** method is simpler but less accurate, as it provides an emission estimate based solely on the type of animal (e.g. beef cattle or dairy cows) and their geographical location.

The **Tier 2** method is more complex to calculate and requires a deeper knowledge of the livestock in question; this method should be used for calculating large quantities of enteric emissions such as those produced by cattle.

Lastly the most accurate approach is the **Tier 3** method but it also requires a thorough understanding of the livestock and a considerable amount of primary information such as the composition of rations, seasonal variations in the animal population, the quality and quantity of the feed administered and possible mitigation strategies of the impacts generated which is often information generated via direct experimental measurement.

How emissions vary: an example calculation

The Tier 2 approach is the most widely used as it illustrates how emissions can vary significantly depending on the amount of food administered as well as the type. The calculation is based on specific emission factors that are a function of the diet administered according to the following formula:

$$EF = \left[\frac{GE * \left(\frac{Y_m}{100} \right)}{55,65} \right] * d$$

where:

- EF (emission factor) = emission factor expressed

in kg di CH₄ per head per year;

- GE (gross energy intake) = gross energy intake per head per year depending on the type and amount of feed;
- Y_m (methane conversion factor) = energy conversion factor of the energy contained in feed into methane gas depending on the type of livestock;
- The 55.65 factor (MJ/kg CH₄) is the energy content of methane;
- d is the number of days the ration is administered.

The value of the YM factor mainly depends on where and how the cattle are kept: the IPCC values for cattle are 3% for barn animals and 65% for pasture-raised animals (or dairy cows). With the same amount of energy (GE constant), **pasture-raised animals generate twice as much methane gas as barn animals**. This statement does not lead to a conclusion as it is essential to bear in mind the total amount of feed administered as already mentioned above.

With the aim of illustrating the method of calculation, below is an example that compares the diets of pasture-raised cattle and cattle raised according to the Italian productive system which foresees a grazing period with a period during which the cattle are kept in the barn. The comparison should be considered **preliminary** since there are many assumptions and implications: the first issue is to consider the rations as being constant throughout the animal's lifetime, which is actually not the case. The hypotheses made are reasonable for the purpose of this report which analyse the calculation in depth and to demonstrate why livestock reared in barns generates fewer overall emissions overall than pasture-fed livestock.

⁴⁹ IPCC 2013, fattore di caratterizzazione per il metano (Methane, land transformation: 28 kg CO₂ eq/kg CH₄).

ENTERIC FERMENTATION: CALCULATION EXAMPLE

PASTURE RAISED CATTLE

- diet of 25 kg of grass per day;
- time required for reaching weight of 650 kg: 25 months

CATTLE HOUSED IN BARN

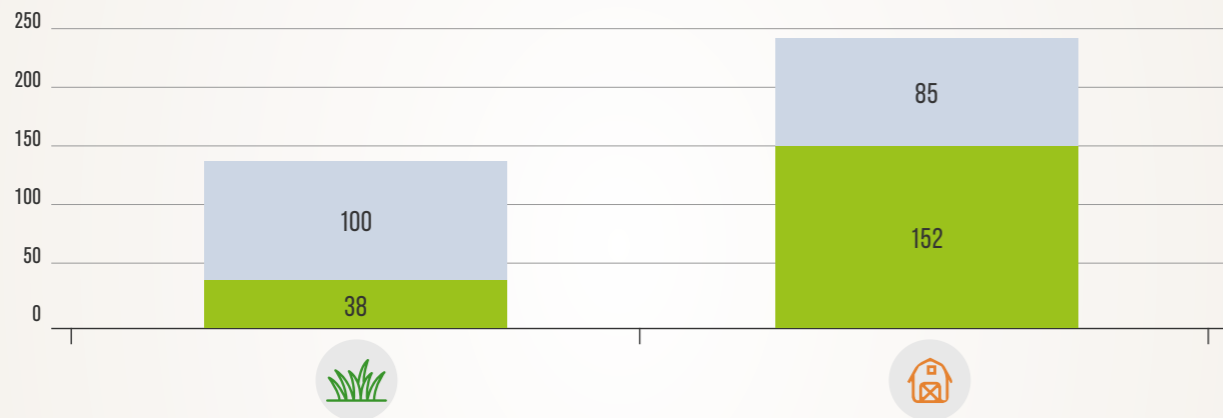
- Breeding times - 10 months in pasture land; 8 months in barns

- Diet in pasture land: 25kg of grass per day
- Diet in barns: 16.5kg of feed composed of corn mash (60%); straw and hay (21%); beetroot (6%); soya (5%); sunflowers (4%); wheat (4%).

The values also include the enteric emissions relative to the agricultural production of raw

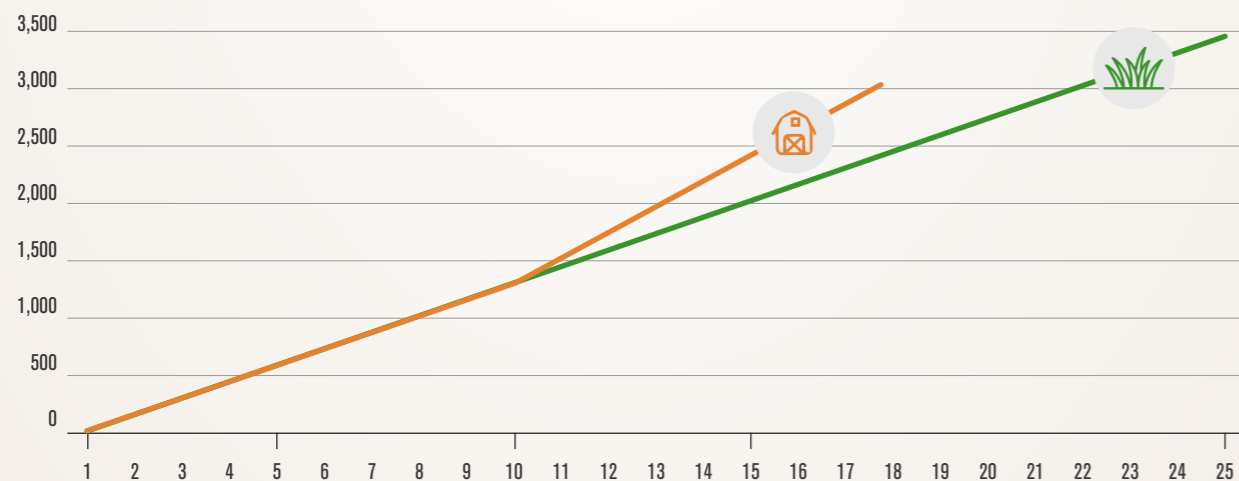
materials used during the period in barns.

The diet of the livestock kept in barns is overall more impactful because although there are fewer enteric emissions, the cultivation of the feed must be taken into account. However overall there is less impact due to the shorter times are required for reaching slaughter weight.



Monthly GHG emissions - kg CO₂ eq

● CULTIVATION ● ENTERIC FERMENTATION



Overall GHG emissions - kg CO₂ eq

>> Manure management

The two-fold impact of animal manure management is caused by the **emissions of volatile organic compounds (ammonia, methane and nitrous oxide) into the air** and the release of **nitrogen into the soil**. In the case of barn animals these environmental aspects concern two different moments of manure management: the **collection and storage** phase and the **final manure disposal phase**. However since in the case of pasture-fed cattle it is impossible to collect the manure, the impact depends on the extent to which it is spread across the meadows which is almost impossible to control.

Collection and storage of manure in barns

The first aspect to consider concerns farm management methods, which in the case of deep straw bedding or other absorbent material may result in manure (cattle) or chicken manure (poultry), and slurry manure when livestock is housed on slatted flooring (cows or pigs). As it is almost solid, cattle and poultry manure are more easily managed than slurry manure. Therefore, it is preferable, since there are various alternatives for the subsequent stages of storage and disposal. Moreover, manure is produced by herds housed on deep straw bedding, which is better for animal welfare

After collection, manure is stored to ensure that it is treated in the most appropriate times, places and ways possible. There are several types of storage systems, but an important aspect is coverage: especially as slurry manure can be kept in either open or **closed** tanks that generate very different impacts from an environmental viewpoint. Uncovered tanks release larger amounts of volatile organic compounds that are generated by spontaneous fermentation phenomena, which further lead to the emission of methane gas, CO₂ and other substances.

As in the case of enteric fermentation, by following the indications in the IPCC⁵⁰ Guidelines it is possi-

ble to estimate the emissions of the three main substances generated during storage: methane, carbon dioxide and ammonia. There are three possible approaches among which the tabular approach and the experimental approach; the intermediate scenario, Tier 2, is the one used for calculating environmental impact since it is quite accurate when used with known data.

It is possible to make elaborations that enable us to understand the different impacts of the various modes of storage. However, the formulas are more complex than those used for enteric emissions; please refer to the IPCC documents for further details. The emissions depend on the quantity and type of manure, and especially on how and where it is stored (the geographical area) as climate exerts a strong influence on the biological degradation processes responsible for the emissions.

In order to improve sustainability, the livestock sector should invest in more rational manure management systems and **wherever possible opt for solid manure and therefore deep litter farming systems**. In fact by observing the data in the environmental product declaration published by COOP Italy we can see that nearly half of the manure produced by beef cattle derives from deep litter farming systems.

⁵⁰ IPCC, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, chapter 10, paragraph 10.4-10.5 CH₄ and N₂O emissions from manure management.

THE POTENTIAL IMPACTS OF THE DIFFERENT TYPES OF MANURE STORAGE

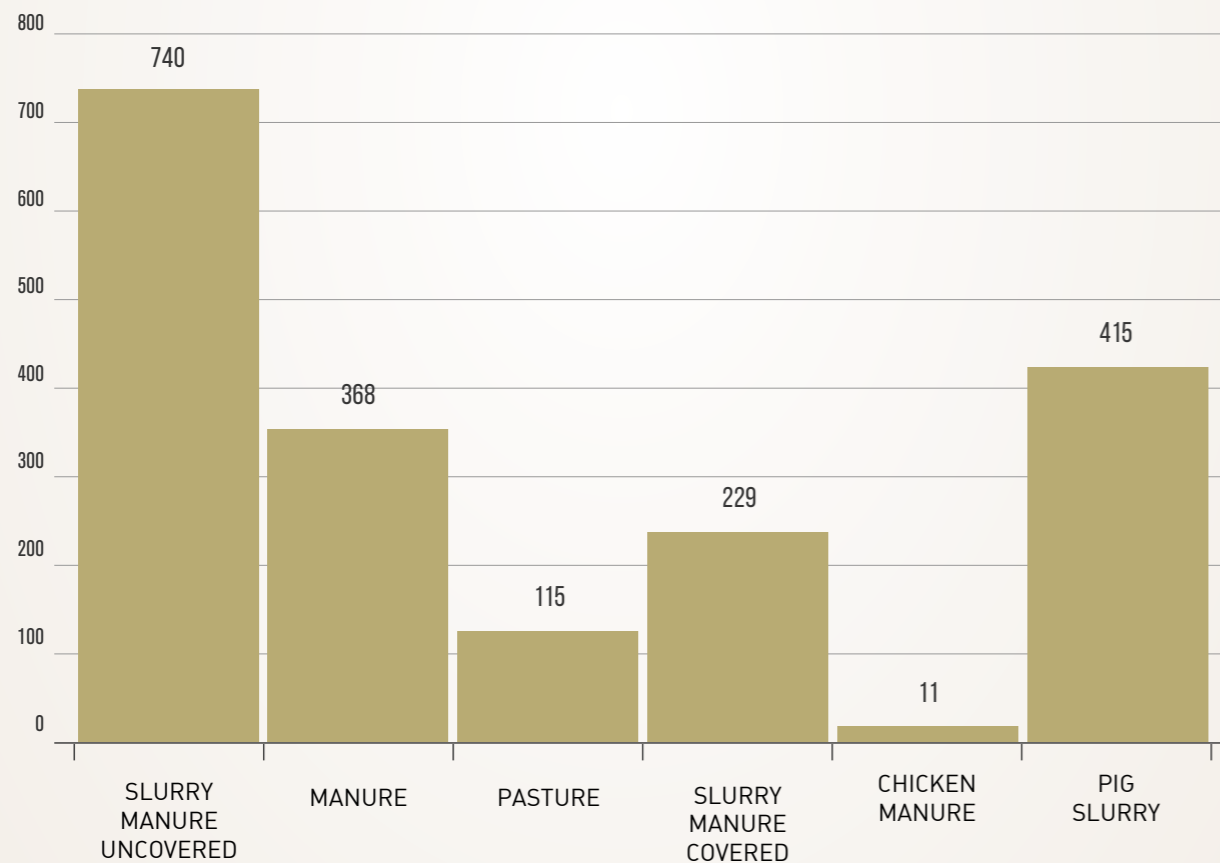
In order to provide a preliminary estimate of the emissions associated with the main manure storage technologies, a calculation was made keeping all the characteristics (climate, type of manure, amount) constant and by only modifying the storage technology used. The annual CH₄ and N₂O emis-

sions per head regarding sewage management for both cattle and poultry were estimated with the data and using the methods provided in the IPCC Guidelines⁵¹.

As regards to the emissions related to pig manure management reference was made to the study by Fabbri et al⁵².

⁵¹ 2006 IPCC Guidelines for National Greenhouse Gas Inventories, chapters 10 and 11.

⁵² Fabbri, et al 2014. Emissions of ammonia, methane and nitrous oxide and concentration of dust in two different herds of fattening pigs.



Greenhouse gas emissions - Impact per head (kg CO₂/head/year)

MANURE MANAGEMENT IN ITALIAN BEEF CATTLE FARMS

SLURRY MANURE UNCOVERED TANK

20%

SLURRY MANURE COVERED TANK

33%



Figure 4 - Percentage distribution of the manure management methods used by Italian beef cattle farms which raise cattle for COOP⁵³ Italy. This figure is representative of approximately 125,000 heads, accounting for approximately 2% of the cattle raised in Italy (5.7 million heads of cattle bred in 2014, a decrease of approximately 8% compared with 2005, Istat-SIEV data⁵⁴).

Manure spreading in agriculture

Following storage, the manure must be utilized. There are various possibilities depending on the animal species from which it is derived (as it may contain different substances) and on how it is stored.

In principle, spreading manure can be seen as a "closed loop", as it is possible to supply nutrients to crops (mainly nitrogen and phosphorus) without resorting to chemical fertilizers. In this case proper manure management is essential, since excessive amounts of manure may result in the release of pollutants, especially nitrogen.

For this reason, besides the quantity, it is also important to consider the quality of the manure, since

the organoleptic characteristics can vary greatly. For example, the low moisture content of chicken manure (30% versus 90% for beef or pig manure) makes it very rich in nitrogen therefore it must be spread with extreme caution.

⁵³ Primary data gathered in farms that raised adult cattle for Coop Italy in 2014. These data were used for the environmental product declaration, updated in 2015.

⁵⁴ Official statistics on cattle and pig farms (<http://mangimiealimenti.it/articoli/1330-le-statistiche-ufficiali-sugli-allevamenti-di-bovini-e-suini>).

	DAIRY COWS	BEEF CATTLE	POULTRY	PIGS
Total solids (ST) [kg]	12	8.5	22	11
Volatile solids (SV) [kg]	10	7.2	17	8.5
TKN⁵⁶ [kg]	0.45	0.34	1.1	0.52
NH₃N [kg]	0.079	0.086	NP	0.29
P [kg]	0.094	0.092	0.3	0.18

Main characteristics of different types of manure – the data refer to 1000 kg p.v.⁵⁵
(Agricultural manual, 1997 - chapters 6.7 "Animal waste management" pag. E-343)

In order to limit the impacts, the agricultural use of livestock manure is governed by specific programs (such as the **Nitrates Directive**) that vary from region to region, with the aim of safeguarding vulnerable areas from nitrates of agricultural origin. The main principle is a **have a surface area of land at one's disposal that is proportional to the number of animals bred**, in order to be able to manage the manure in situ.

On animal factory farms this is seldom possible. Therefore, it is necessary to transport the material, in particular nitrogen, to other farmers in need of fertilizers. Transporting manure is rather complex, although technological innovation has led to the development of various procedures to make economically viable their use as, for example, the drying of digestate, using heat obtained from the combustion of the biogas produced by the digestion anaerobic.

⁵⁵ Average values referring to 1000 kg live weight of the animal; actual values may vary considerably due to differences in feed, age distribution and farm management.

⁵⁶ TKN = nitrogen Kjeldahl; total nitrogen Kjeldahl (TKN, Total Kjeldahl Nitrogen) is defined as the sum of ammoniacal and organic nitrogen.



THE NITRATES DIRECTIVE

The nitrates directive (91/676/CEE⁵⁷) The nitrates directive (91/676/CEE) promotes the use of nitrogen compounds in agriculture provided that the fertilizers distributed do not exceed crop requirements in the case of both synthetic and organic fertilizers namely manure.

Member States are obliged to:

- Identify the Nitrate Vulnerable Zones (NVZ) of agro-livestock origin; areas with already contaminated water or that could become contaminated in the absence of appropriate interventions. In these areas, the measures must ensure that, for each cattle farm, the total annual amount of livestock manure applied on the holding, including that deposited by the animals themselves, does not exceed 170 kg of nitrogen per hectare. The annual limit for non-vulnerable areas is 340 kg of nitrogen per hectare;
- Implement and adhere to programs in Nitrate Vulnerable Zones that regulate the agronomic use of livestock manure and use of mineral and organic fertilizers containing nitrogen.

Member States may apply to the European Commission, which may grant a derogation concerning the maximum limit of 170kg/ha/year of nitrogen from livestock manure in Nitrate Vulnerable Zones. The request must be supported with detailed livestock and environmental information obtained from previous and current monitoring data, which proves that the soil nitrogen levels (typically up to 250 kg/ha/year) do not compromise the quality of ground and surface water.

⁵⁷ http://www.ersaf.lombardia.it/upload/ersaf/gestionedocumentale/91_676_IT_2008_784_7532.pdf

The treatment of manure: transforming it from problem into resource

Manure treatment systems are generally aimed at concentrating the nutrients (nitrogen and phosphorus), in order to facilitate transportation and the use of soil improvers or manure by farmers or hobbyists.

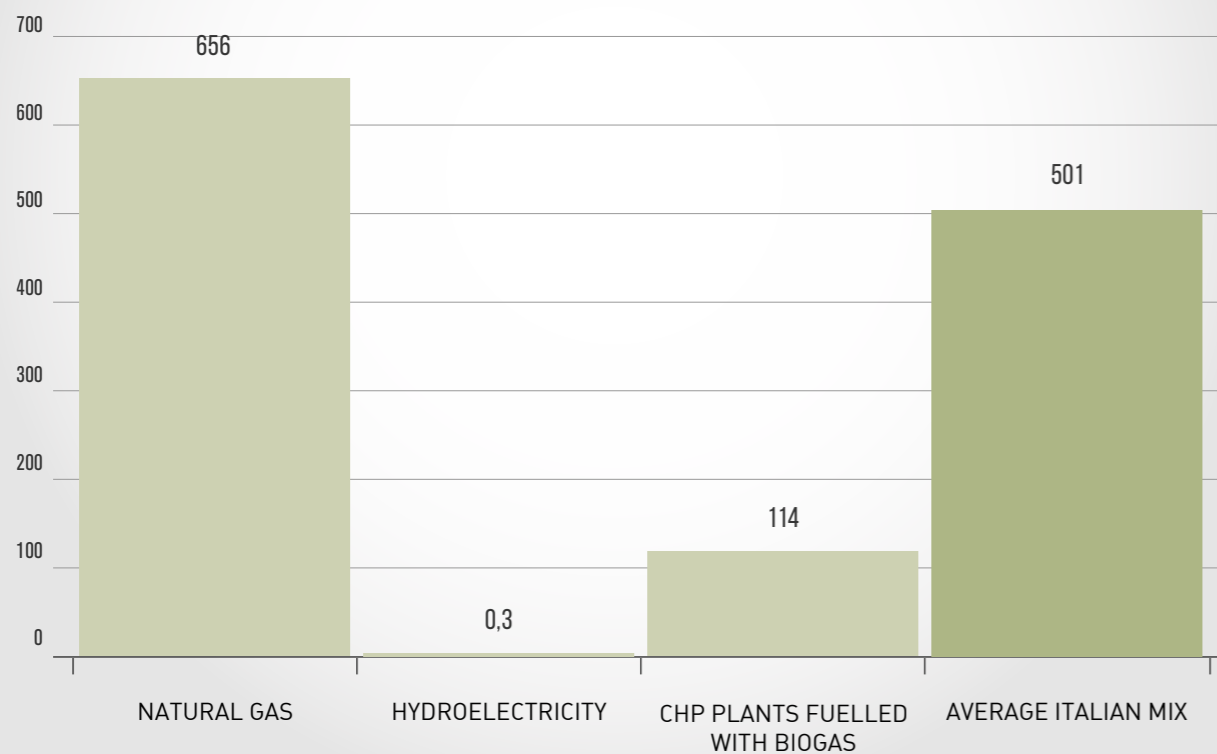
One of the most widely used procedures is composting which, through a controlled process of aerobic degradation, transforms the material (usually manure or chicken manure) into soil conditioner. The process takes place by mixing different types of organic material, to provide a constant substrate to microorganisms involved in the biological process: the manure can then be mixed with sewage sludge, cuttings and prunings, organic waste deriving from the differentiated collection of municipal waste. It is

interesting to note that when dried, chicken manure becomes an excellent fertilizer used in organic crop production.

One of the most noteworthy processes is anaerobic digestion which offers a manure treatment solution as well as the production of energy from non-fossil sources. The process generates biogas, a mixture of CH₄ and CO₂ deriving from the anaerobic degradation processes of mixtures of organic compounds (manure, plant remains, whey etc.). In this case, the biological process is rather delicate: the material treated should be composed of equal amounts of dry materials (manure, food waste, plant residues) and liquids (slurry, whey, blood etc.), and a well-organized farm management is required.

BIOGAS A RENEWABLE ENERGY SOURCE

When farms are well organized and a decent size, the investments required for building a biogas production plant can be sustained. There are significant environmental benefits in energy conversion, when compared to traditional energy production. The operations selected for comparison were obtained from the Ecoinvent database⁵⁸.



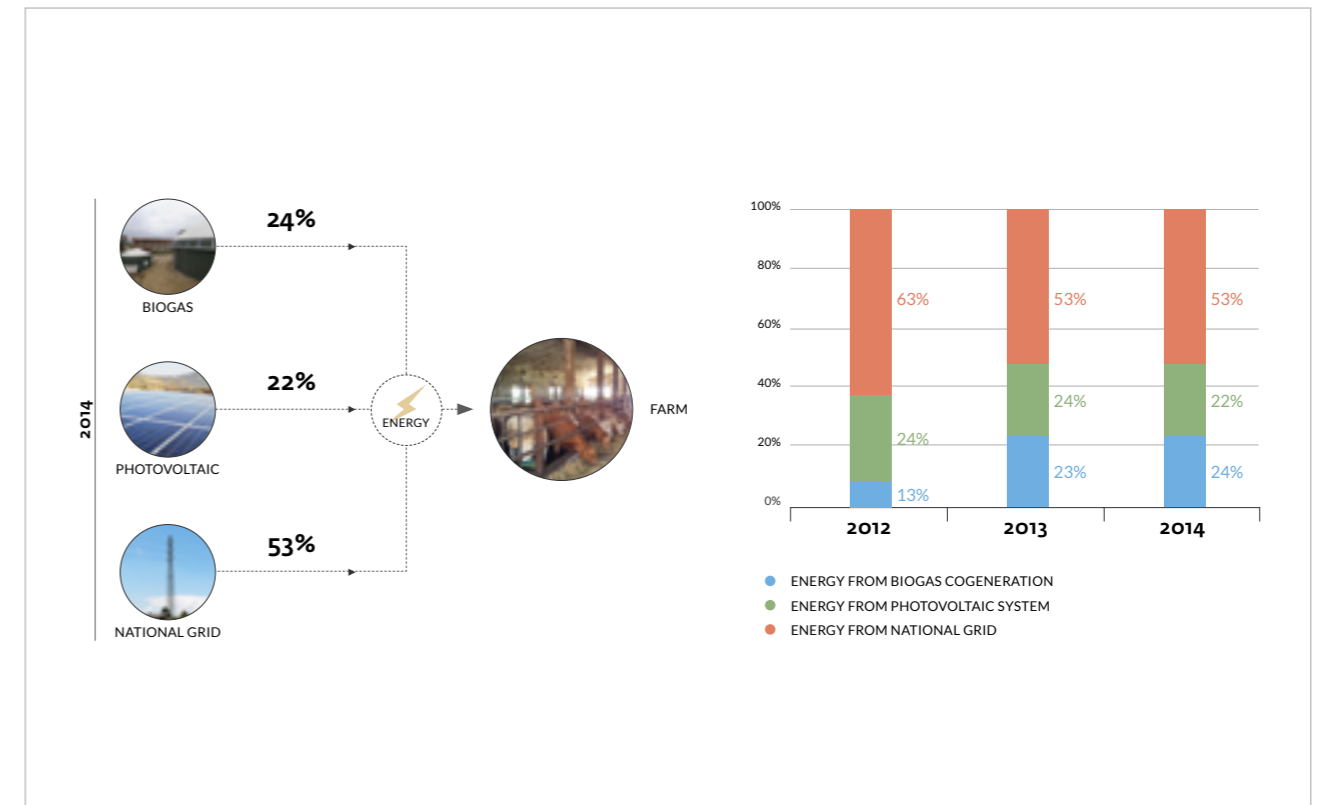
Comparison of 1 kWh of electricity produced with different systems - g CO₂/kWh

>> Farm energy consumption of farms and use of solar energy

The electrical energy consumed on livestock farms is required for supplying energy to farm machinery and for producing thermal energy to heat the stables, feed and water for washing. In order to reduce the impacts related to energy use, apart from the normal practices for limiting consumption, it is essential to produce energy from **renewable sources**.

es. Besides the biogas mentioned above, due to the availability of space (barn roofs etc.) there is a growing interest in solar energy.

⁵⁸ It is possible to choose between the following options: Natural gas: Electricity, natural gas, at power plant/IT U; Hydroelectricity: Electricity, hydropower, at power plant/IT U; CHP plants fuelled with biogas: Electricity, biogas, at Mini CHP plant, allocation energy/CH U; Average Italian energy mix: Electricity, low voltage, at grid/IT (energy mix according to IEA OECD 2014).



Average energy mix used in the Italian stables analysed in 2015 for the environmental declaration of adult COOP beef meat⁵⁹.

The improvement in solar panel efficiency, as well as their duration and low maintenance, has led to their application in the livestock/agriculture sector (i.e. on the roofs of the shelters, barns and sheds). Solar energy is mainly exploited for thermal power and for producing electricity.

These systems, as well as producing biogas through anaerobic digestion, allow for the reduction of direct energy consumption related to the rearing phase (which is generally moderate).

These systems are quite widely used thanks to the financial support provided over the years by the Italian government.

One example is the case presented in the EPD of Coop beef meat, in which the energy mix “virtually” used in the stables of the supply chain is highlighted.

>> Water consumption on livestock farms

The water consumption of livestock is largely influenced by water used for washing: in order to **reduce the amount of water wasted**, it is essential to implement procedures that prevent the generation of dirt.

One consumer voice is therefore linked to drinking troughs, whose volumes depend on various factors such as health status, weather conditions, the type of feed administered and watering system.

Also in this case technology can help to limit consumption, by reducing water waste to a minimum without affecting the animal welfare.

⁵⁹ Coop, Environmental declaration of Coop branded beef, rev. 3, approval date 30-10-2013 / registration number: S-P-00495 – three-year validity.

> Slaughtering and processing

The “industrial” phase of the meat production chain starts with slaughtering of the animals and ends with the production of products that are placed on the market. As for all processes, the environmental aspects concern the use of energy and water, as well as waste generation.

However, it is important to note that throughout the life cycle of food products this phase is **less problematic** from an environmental point of view, as it has fewer impacts than the other phases and because they are concentrated in points of high technological concentration which allows one to maximize efficiency: reducing consumption and adopting the best waste management techniques is essential for reducing operational costs.



>> Waste or by-products?

Meat processing involves the production of a large quantity of products which, **although not intended for human consumption, are useful secondary resources for other processes**. The management of the waste products is rather complex, because it is necessary to distinguish between by-products, co-products and waste, in a context in which practices that pose a risk to human health are carefully regulated.

Meat by-products are divided into three categories⁶⁰:

- category 1 - parts of slaughtered cattle such as skulls, offal or carcasses of sick animals etc. that must be incinerated;
- category 2, which includes manure and the stomach contents of ruminants or dead animals in general;
- category 3, which includes materials with characteristics that could be suitable for human consumption (e.g. fat or bones) but are intended for other purposes (such as the production of pet food).

Subject to compliance with legislation and by focusing on reusing by-products in other production systems, the meat industry is trying to exploit the information and innovations achieved by scientific research **to give added value to animal by-products**, going beyond profitability. There are in fact numerous possible uses: human or animal nutrition, feed, pharmaceuticals, fertilizers and by-products for producing biodiesel⁶¹.

It is also important to note that organic materials that cannot be used for other purposes can be converted into biogas by means of **anaerobic digestion**, with the environmental and economic advantages already discussed in the section on manure processing.

⁶⁰ Regulation (EC) No. 1069/2009 laying down health rules concerning animal by-products (classified in categories I, II, III) and derived products not intended for human consumption.

⁶¹ Toldrà et. al., 2012. Innovations in value-addition of edible meat by-products, Meat Science (92) 290–296.

> Distribution

The life cycle analysis approach is useful for analysing processes through a life cycle logic, sometimes leading to unexpected results and considerations.

An example of this is represented by kilometre zero products and why they are “sustainable” from an environmental point of view, which is due to the fact that they cover the shortest possible distances to travel from the place of production to the place of sale and consumption. The idea is to reduce the environmental impact of transportation thus reducing carbon dioxide emissions.

Yet it is not necessarily the case that consuming local products leads to a reduction in the overall CO₂ emissions of a food product since transportation is

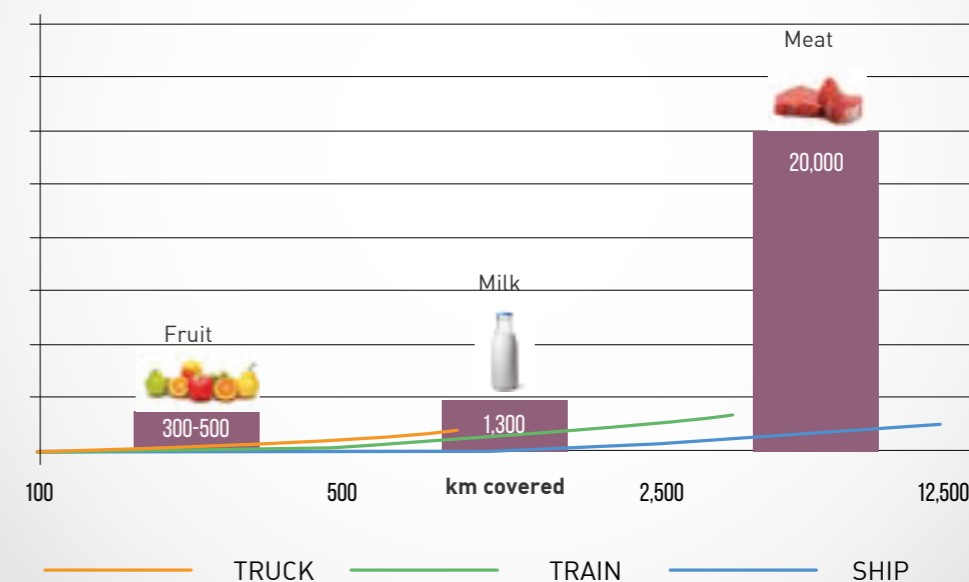
known to have a negligible impact compared to the overall production cycle.

On comparing the environmental impacts of production and distribution of various food products, it is obvious that transportation only affects products belonging to “simple” supply chains, such as fruit and vegetables.

While the environmental burden associated with distribution is almost irrelevant in the case of more complex products like meat or cheese considering the overall impact of the entire supply chain. Therefore, for complex supply chains it is essential to focus on efficient and less impactful processes rather than “neighbouring” products. There are other advantages of “km 0” such as preserving and promoting local food heritage and rediscovering territorial and cultural identity.

CARBON FOOTPRINT grams of CO₂ per kilo

Transportation via truck, train or ship: the CO₂ emissions of the transportation phase are always very low compared to those related to production with the exception of fruit for which long-distance transportation (5,010,000 km) can have a significant impact.

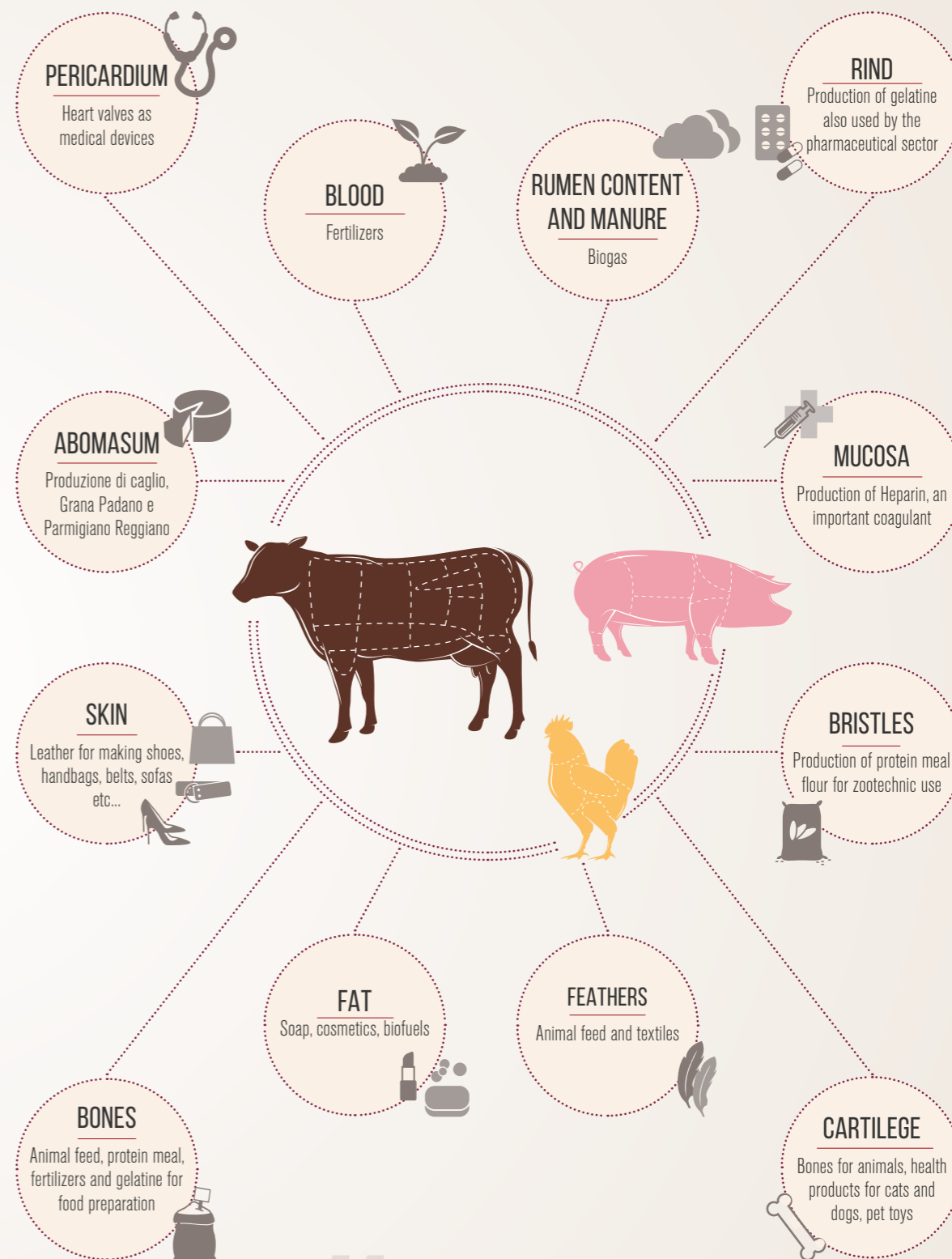


Source – Marino, Pratesi; “Il cibo Perfetto”.



THE MAIN USES OF SLAUGHTERING BY-PRODUCTS

 <p>BONES</p> <p>They are used for producing animal fodder, protein meal, fertilizers and gelatine used for food preparation</p>	 <p>CATTLE AND PIG SKIN</p> <p>They are used for producing leather products: veal leather is used for luxury articles (shoes, handbags, belts etc.), steer leather is used in the automotive sector (car seats), cow leather is used for making sofas and leather goods while pig leather is used to line shoes</p>	 <p>FAT</p> <p>It is used in the cosmetic industry as well as in the zootechnic sector (for producing animal feed)</p>	 <p>PORK RIND AND CARTILIGE</p> <p>They are used for producing food thickening agents and pet food</p>
 <p>PORK RIND AND BOVINE FAT</p> <p>They are used for producing both gelatine for food preparation (mainly pork) and pharmaceuticals (mainly bovine) for preparing films required for encapsulating medicines</p>	 <p>BLOOD AND ENTRAILS</p> <p>The pig entrails are used for producing cured meats and salami, while bovine blood is used for producing fertilizers and chicken blood is used for pet food</p>	 <p>TISSUE VALVES</p> <p>They are used for making medical devices (heart valves)</p>	 <p>FAT LIQUIDS AND RUMEN CONTENT</p> <p>And other wastes are used as well as other animal waste products for producing green energy (biogas cogeneration)</p>
 <p>ABOMASUM</p> <p>It is the last cavity of the four stomach chambers of ruminants and it is used for making rennet (in fact it is the only coagulant that can be used for making DOP cheeses such as Grana Padana or Parmigiano Reggiano)</p>	 <p>PORK BRISTLES</p> <p>Once used for making paintbrushes and brushes, today they are mainly used for making protein meal for feed production</p>	 <p>PORK MUCOSA</p> <p>Extracted during the preparation of pork intestines, it is used by pharmaceutical companies for making Heparin, which is an important coagulant medicine</p>	 <p>THE FEATHERS</p> <p>They are used for producing animal feed and in the textile industry</p>



“ NOT ONLY MEAT IS OBTAINED FROM ANIMALS ”

FREQUENTLY ASKED QUESTIONS

MEAT AND ENVIRONMENT

ARE SEVERAL KILOGRAMS OF VEGETABLE FOOD FOR HUMAN USE SUBTRACTED?

Feed intended for farmed animals is composed of a mixture of cereals (corn, wheat, barley) but also legumes (such as soybeans) in a diet designed to meet livestock nutritional requirements according to the type of breed and the breeding purpose.

Therefore, animal feed may contain cereals eaten by people, but it is also true that protein and fibre are often provided by crops that are not intended for human consumption (e.g. maize silage, forage peas, pasture grass, alfalfa, clovers or hay). It is important to not forget that in cattle farms the 80% of the plants (stem), inedible for humans, is used.

Meanwhile we are trying to avoid using edible protein for human consumption as zoo technical feed. In order to achieve these objectives, farms and feed producers must work closely together with the aim of optimising the use of crop residues and by-products, by trying new combinations that maintain high conversion efficiency.

IS IT TRUE THAT MEAT PRODUCTION HAS A HIGHER ENVIRONMENTAL IMPACT THAN OTHER FOOD PRODUCTION CHAINS?

Meat is generally considered to be one of the foods with the highest environmental impact per kilogram. This is due to the fact that it has quite a complex production chain.

Unlike agricultural products, two phases are required for producing meat: firstly, it is necessary to produce feed for the animals, then the protein conversion process begins with the rearing of livestock.

A second important aspect in the case of the beef supply chains mainly, concerns the impacts induced by brood cows that are reared solely for the purpose of giving birth to calves at a rate of one a year.

The last aspect is related to manure management and enteric fermentation, which both have significant impacts, especially regarding the production of greenhouse gases. These are undeniable issues that are typical of meat supply chains.

However according to Paracelsus, it is "the dose that makes the poison". In other words, it does not make much sense to compare (to judge) the impact of differ-

ent foods, especially bearing in mind that production chains are often integrated and depend on one other. For this reason, the model proposed by the Environmental Hourglass promotes the consumption of all foods in a balanced way in accordance with the Mediterranean Diet: in this way the weekly impact of meat consumption is in line with that of foods which have less environmental impact but are consumed in greater quantities.

ACCORDING TO SEVERAL STUDIES THE WATER FOOTPRINT OF FARM BREEDING IS MUCH HIGHER THAN GRAZING. IS THIS CORRECT?

The available data on the water footprint of meat production (15,000 litres per kg of beef) were published by the Water Footprint Network (www.waterfootprint.org), and includes three different types of water: **blue water** which derives from groundwater or surface water bodies, **green water**, which is rainwater that evaporates from the soil during crop growth, and **grey water**, the volume of water required to dilute and purify wastewater. However, there are some is-

ssues concerning the accounting method used, especially when observing the total amount of data: since the "green" water footprint is generally the highest, it appears that **pasture raised herds** are those characterized by a **higher water footprint**.

Another criticism is that by considering the overall value and ignoring the local context in which production and breeding take place, the water used is not correlated with the water available in the area.

FARM BREEDING IS ACCUSED OF CAUSING WATER POLLUTION. IS THIS TRUE?

Animal manure is rich in nitrogen and the excess spreading of manure on soils may result in the contamination of the aquifers. However, the Nitrates Directive establishes limits by defining pollutant thresholds for the land depending on whether it is in a vulnerable area or not.

To overcome this problem animal manure livestock slurry and animal manure are often being used for producing biogas and therefore heat and electricity. Biogas is produced in anaerobic digestion plants that are capable of treat-



ing livestock manure and slaughterhouse waste such as rumen and blood as well as the sludge produced by sewage treatment plants.

The biogas produced is normally used in the cogeneration plants of the companies for the simultaneous production of electricity and heat with two advantages: the possibility of producing **energy without resorting to fossil fuels**, and reducing the amount of waste to be treated. The result of anaerobic digestion (digestate) is suitable for agricultural use.

APART FROM MEAT, WHAT OTHER PRODUCTS ARE OBTAINED FROM BREEDING FARMS?

As well as meat, there are many other products that are produced

from farm animals. In fact, bags, shoes, medical devices, heart valves, soaps or cosmetics, fertilizers, natural rennet and biogas are just a few examples of the huge amount of products and by-products that are obtained from the livestock sector. The amount of meat obtained from an animal for human food consumption varies according to the type of animal. In the case of cattle, it is about 33-35%, while for pigs the percentage decreases to 18%. But considering that nothing is thrown away, many ways have been found to give value to farm waste over the centuries.

Beef and lamb skin is used for making durable goods like leather, which is then used to produce shoes, handbags, belts, or to cover sofas and car seats. Cattle and pig fat is mainly used by the cosmetic industry to make soap

FREQUENTLY ASKED QUESTIONS

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while smaller amounts are used in the field of medicine. Cattle and pigs provide the pericardial tissue used for making medical devices such as heart valves, while skin and bones and pork can be used for encapsulating drugs or medicines such as heparin by the pharmaceutical sector. Natural rennet (the only coagulant allowed for producing DOP cheeses such as Grana Padano and Parmigiano Reggiano) is extracted from the inner mucosa of the fourth stomach chamber (the abomasum) of calves. Apart from their meat, chickens also provide important products such as fat which is used in feed and biodiesel production.

IT IS TRUE THAT DIETS WITH HIGH MEAT CONTENT PRODUCE MORE GREENHOUSE GASES THAN VEGETARIAN DIETS?

There is no doubt that meat has greater impacts than plant foods per kilogram therefore a dish based on animal protein has a greater environmental impact than a vegetarian dish. However, impact should not be calculated on a single dish but on the life cycle of the product, which is very different between plant and

animal (bovine: 18-14 months, chicken: 1-2 months, pork: 9-11 months, salad: 1 month, tomatoes: 2 months). In a balanced diet which foresees the consumption of all foods, a moderate consumption of meat does not significantly increase the environmental impacts over a certain period of time, for example a week.

WHAT IS THE ENVIRONMENTAL HOURGLASS?

A well balanced diet should be based on a balanced consumption of all available foods. By following the dietary recommendations of the Mediterranean Diet the average weekly impact of meat is aligned with that of other foods, for which there are fewer unitary impacts while the amounts consumed are generally larger.

This is the concept represented by the Environmental Hourglass, obtained by multiplying the environmental impact of food (for simplicity the Carbon Footprint) by the weekly amounts proposed in current nutritional guidelines INRAN, now CREA - Alimentazione e Nutrizione. According to this representation, eating reason-

able amounts of the meat does not significantly increase the environmental impact of an individual. Moreover, a sustainable lifestyle should also be measured according to other factors such as mobility, energy consumption, clothing, and leisure habits.

WILL NON-MEAT EATERS SAVE OUR PLANET?

Since the correlation between dietary habits and environmental impacts has now been proved by many scientific and popular publications, the question that arises is whether it is sufficient to control and reduce one's food impacts in order to consider oneself "sustainable."

In fact, it would be interesting to extend the concept of sustainability to one's overall lifestyle, of which nutrition is an important but not unique variable. It is said that the only way to save the planet is to become vegetarian and in fact often people who choose not to eat meat usually do so for environmental reasons rather than ethical reasons.

Yet, eating reasonable amounts of meat right or none at all does not substantially improve its

overall environmental impact. There are other factors causing the overall environmental impact of an individual.

Cars can have significant environmental impacts: the differences in impact between car with a powerful engine and a car with an average engine can be greater than 500 tons of CO₂ per year, a much higher value than the potential benefit associated with food choices. From these data it is evident that we must have an overall eco-friendly attitude in order

"to be sustainable".

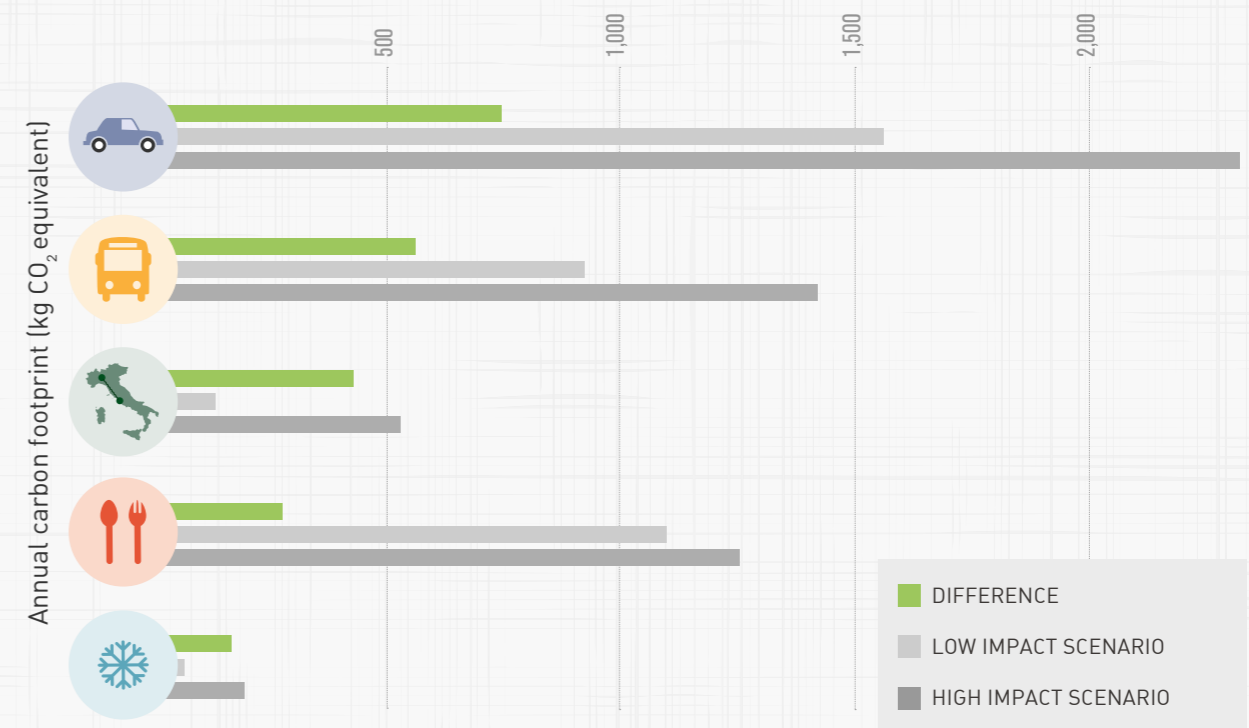
There are also many simple things we can do to be eco-friendly that are based on immediate choice (like buying a car), while others are more complex as they are linked to external factors or habits that require more time such as dietary changes.

We should therefore follow a 360° sustainable way of life through simple actions, such as reducing household consumption (by reducing winter heating

and summer air conditioning), or by wearing clothing that is appropriate to the season.

ARE KILOMETRE ZERO PRODUCTS THE MOST SUSTAINABLE?

The topic of food distribution is interesting both for the social implications related to the safeguarding of the community and the environmental implications related to local traditions. In





FREQUENTLY ASKED QUESTIONS

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fact, the kilometre zero food concept is becoming more and more widespread, since it is associated with the equation "kilometre zero = product with a low environmental impact."






Yet a simplistic view of the issue can lead to misleading interpretations. By only considering the environmental issues, for example the Carbon Footprint, it is evident that food distribution is only impactful in certain cases. In fact, even if it is true that truck transportation causes high levels of CO₂ per kilometre covered, it is also true that trucks transport large quantities of goods, in this case the impact per kilogram of

product is low.

Therefore, given the low importance of transport, it is not always true that zero kilometre production systems have less environmental impact than conventional production systems. A "distant" system is more efficient from an environmental point of view than a "close" system, therefore the impacts caused by transportation are largely offset by lower production costs.

This is the case of some agricultural commodities which, when grown in areas dedicated to their production, make cultivation very efficient: strawberries culti-

vated Sweden would have higher energy costs for the greenhouses which would not make them less impactful than those grown in Romagna that must be transported by truck. This does not mean that local production is not preferable, but it is important to note that decisions should be made bearing in mind other (important) benefits, such as cultural, economic and territorial enhancement.

CHOICES AND BEHAVIOUR	LOW IMPACT SCENARIO	HIGH IMPACT SCENARIO
 Selection of car with which you travel 15,000 km per year	Car 100 g CO ₂ /km 1,500 kg CO₂	Car 150 g CO ₂ /km 2,250 kg CO₂
 Moving around town: 40 km a day, 5 days a week, 48 weeks a year	Using the bus 890 kg CO₂	Using own car 1,440 kg CO₂
 Business Trips Rome - Milan	6 trips by train 120 kg CO₂	6 trips by plane 540 kg CO₂
 Food choices	Diet of 23 kg CO₂ eq per week	Diet of 25 kg CO₂ eq per week
 Cooling an office	Use of a fan 12 kg CO₂	Use of air conditioning 200 kg CO₂

Environmental impact per person, associated with certain situations of "common life."
Figures have been calculated on the basis of indicative assumptions.



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FOOD SAFETY AND ANIMAL WELFARE

- ANTIBIOTICS: LET'S CLARIFY
- CONTROLS AND INFORMATION FOR CONSUMERS
- THE COMMUNITY FOOD ALERT SYSTEM
- ANIMAL WELFARE

Introduction

MEAT AND CURED MEATS ARE COMPLETELY TRACEABLE, A GUARANTEE OF THEIR ORIGIN AND QUALITY

THE ITALIAN HEALTH CARE SYSTEM IS ONE OF THE MOST STRUCTURED IN THE WORLD HAVING 4,500 OFFICIAL VETERINARIANS

ANIMAL WELFARE IS IMPORTANT FOR ETHICAL REASONS, BUT ALSO TO ENSURE THE DEFENCE OF FOOD SECURITY AND IMPROVE MEAT QUALITY

When it comes to the safety of meat (and food in general), one often refers to a series of aspects, complex and integrated with each other, which may have an impact on people's health.

A first point to clarify is the fundamental difference between the **effects of the contamination** of food on people's health that can be **certain or assumed**. The precautionary measures taken in relation to the alleged risks are sometimes misinterpreted as management of cases of real danger, creating unjustified alarmism.

A second element is the use of drugs on farms which have to be divided among those prohibited and those regulated by national and international protocols, more or less severe. This observation is useful to eliminate **some false stereotypes**, such as those relating systematic use of **hormones in livestock, banned throughout Europe**.

The use of **antibiotics** in animal husbandry falls under the practices subject to very strict rules and controlled by the Health Authorities: these substances can in fact be used only for

animal care through medical treatments prescribed by veterinarians. Their use should be limited in time and in no instance can the meat of animals treated be placed under any circumstances for consumption without having respected the "**suspension period**", which guarantees the absence of residues in meat.

The quality and food safety, in Italy as well as throughout the European Union, are not only an EU regulatory stronghold, but the real fundamental element of the Community consumer protection policy. The European Employment Strategy provides for the **prevention of any risk to food safety throughout the production chain** and is based on the so-called "**One Health**¹": an integrated approach which considers as **essential the link between animal health, the health of products derived from them and human health**, to guarantee the latter a high level of quality of life while protecting the health and welfare of animals.

The effectiveness of controls is further enhanced by **traceability**, which allows the tracing and following of a

food from the consumer to the primary agricultural production. **The Italian health care system is one of the most structured worldwide**, recognised in Europe as a example of excellence thanks to the approximately **4,500 official veterinaries** involved in numerous tests and analysis in the field of safety and meat quality. The issue of security is closely linked to **animal welfare**. Maintaining a state of good physical and mental health in animals is a prerequisite to ensure their sustainable livelihoods, but it is also a crucial element in ensuring the safety and the quality of foods derived from them. The evolution of public awareness has meant that since the 80s this issue has been widely covered by EU and national legislation, comprehensively monitored by the legislation that lays down the minimum wellbeing conditions to be met, and **in many cases a violation of these rules is considered in Italy a criminal offense**.

¹ For more information see the website of the organization One Health Initiative: <http://www.onehealthinitiative.com/>

ANTIBIOTICS: LET'S CLARIFY



When it comes to the safety of meat (and food in general) one often refers to a number of aspects, complex and integrated with each other, which might **affect the health of people**: in particular, the various forms of food contamination, the control and prevention systems, the proper management of the distribution phase and so on. Often these subjects are treated superficially, sometimes detrimentally, which highlights the need to bring clarity with a transparent and objective perspective, starting with some basic explanations on the fundamental aspects of food security.



A first point to clarify is the difference among the various **effects of the contamination** on people's health: these can be certain and acute, certain and chronic or not certain, and so the contamination is considered risky at a precautionary level.

Cases of certain contamination include, for example, the bacterial contaminations, which in some cases may even be fatal, or chemical, which may lead to medium-term health damage (chronic) when assumptions are prolonged in time. When instead the correlations between a substance and health damages are not certain, as in the case of GMO foods, any limitation is to be considered precautionary.

A second element concerns the **administration of drugs**, which may be prohibited or regulated by more or less strict protocols. The first case includes for example hormones; the second includes all those drug treatments permitted (and sometimes necessary) to be carried out however only under strict veterinary supervision. The differentiation between the two phenomena is important to distinguish between illegal cases of "fraudulence" (If it is forbidden, it should not occur), to be punished rigorously, and the possible situations of mishandling of a medical protocol that could evidence an illegal case, but also the simple necessity of breeder formation.

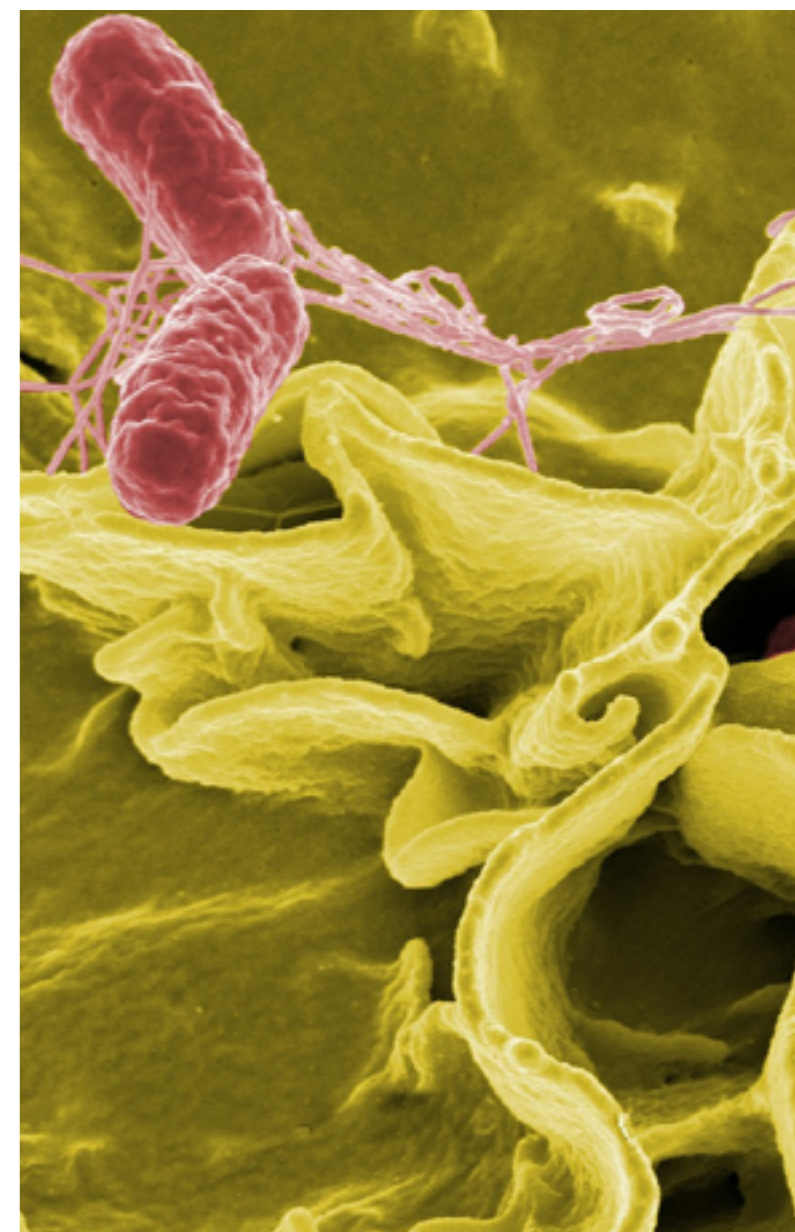
> Antibiotic drugs

Antibiotics (from ancient Greek: anti, "against" and bios, "life") are chemical substances that kill bacteria or inhibit their growth. They belong to the broader group of antimicrobial compounds, used to treat infections caused by microorganisms, including fungi and protozoa.

In the veterinary field, since the 50s, they represent a fundamental means for the control of infectious diseases, thus contributing to the improvement of animal welfare and the safety of food products of animal origin.

The advantages of using antibiotics are innumerable, even to human medicine, and many bacterial infections, that up to 50 years ago could kill a person, such as pneumonia, are no longer a danger.

When however the use of these drugs is excessive or uncontrolled, they are likely to trigger phenomena of resistance.



> > The phenomenon of antimicrobial resistance

The development of resistance is in itself a normal evolutionary process, a result of genetic evolution which applies to microorganisms: with an excessive and inappropriate use of antibiotics, however, the resistance phenomenon accelerates the natural tendency of microorganisms to “defend” the active ingredients contained in drugs. The “resistant” bacteria, although harmless, move from one organism to another transmitting the resistance to a pathogenic organism of the new host.

Since the 90s, the phenomenon has become increasingly widespread, to the point that in the first Global Report on antimicrobial resistance published by WHO in April 2014, the antibiotic resistance is identified as a “**serious and potential threat to public health**”. The development of resistant strains of bacteria makes it difficult to treat an increasingly wide range of infections quite common and easy to contract, with the result that even the most common and easy to cure diseases may potentially constitute serious risks to health.

To reduce this danger, in 2006, the European Commission has **banned the use of antibiotics** in livestock for non-therapeutic purposes (i.e. as growth promoters)² and has recently drafted guidelines for their proper use.³ Assuming that resorting to veterinary drugs is a prerequisite for animal welfare, their use must therefore be complementary to a good barn management practice and appropriate vaccination programs, making it possible to maintain the state of health of the animals and minimise the conditions that favour the emergence of diseases.

The antibiotic resistance issue is also at the centre of many **information campaigns for consumers** by the various governments and the WHO itself, as well as the subject of institutional strategies aimed at the promotion of the appropriate use of antimicrobial drugs protocols⁴.

² EU Regulation 1831/2003.

³ Communication from the Commission 2015/C 299/04 “Guidelines on the prudent use of antimicrobials in veterinary medicine”.

⁴ For more information, see the following box.



THE AWARENESS CAMPAIGN IN EUROPE

A number of initiatives that aim to spread the messages about the risks associated with the inappropriate use of antibiotics, as well as information on the prudent use of antibiotics in the first place for human therapies have already been pursued in Europe. Among these, the main ones being the “World of Antibiotics Week” sponsored by WHO and the European Day of Antibiotics of the European Union, but also national campaigns developed by individual Member States.

Some of these are:

- **AUSTRIA NAP AMR:** The Austrian national action plan on antimicrobial resistance.
- **BELGIUM** Antibiotics: use them properly and only when you need them!
- **DENMARK** Antibiotics: yes or no?
- **FRANCE** National Information Day on antibiotics
- **GERMANY** RKI: Antibiotic resistance
- **IRELAND** Under the Weather

• ITALY

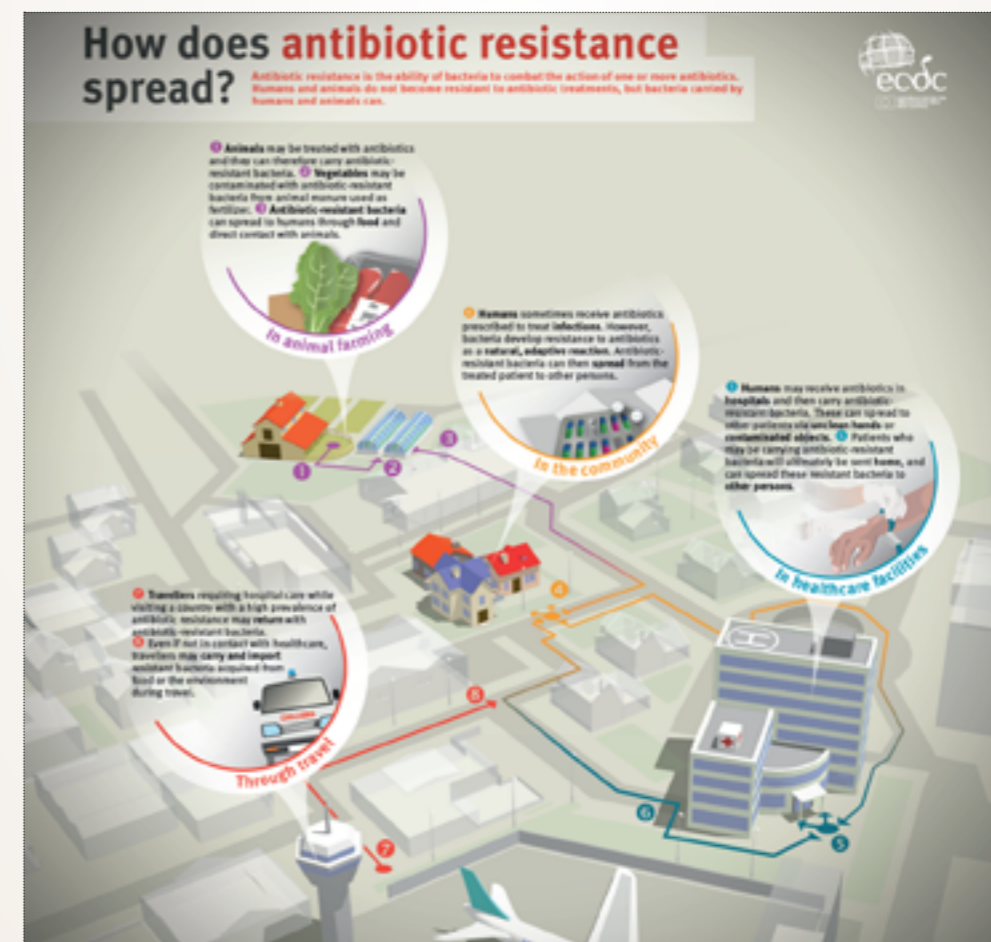
AIFA (Italian Drug Agency): Campaign “Without rules antibiotics do not work”
ISS (National Institute of Health): Seventh Day of antibiotics: more resistant bacteria in Europe

• ENGLAND

Campaign “Antibiotic Guardian”
Public Health England: toolkit and information materials on antibiotics

• HOLLAND

Antibiotic-resistant



Not only food: the different channels of dissemination of antibiotic resistance.
Source: European Antibiotics Awareness Day

>> How much it is used

At the moment there are no sources available that give precise information on the quantities of antibiotics administered every year in Europe. To make a preliminary analysis one can, however, resort to the data provided by ESVA project (European Surveillance on Veterinary Antimicrobial Consumption), launched in April 2010 with the aim of finding information throughout the European Union on the sales of antimicrobial drugs to animals.

In the Report data are collected from the sale of antibiotics, pharmaceutical formulations and medicated feed used in animal husbandry collected in 26 countries, including about 95% of the population of animals for food production in the EU/EEA area. But before studying the analysis, it is appropriate to make two assumptions. The first is that **the amount of active ingredients sold does not corre-**

spond precisely to the actual quantities supplied to the animals. The second concerns the management of medication: while in Italy veterinarians who prescribe the drugs are not allowed to sell them, in other European countries this practice is permitted, causing some uncertainty on the real need of some of the treatments carried out.

In order to make the data comparable between the different Member States, the figures for the amount of antimicrobials sold were normalised by using a species-specific index called PCU (Population Correction Unit)⁵.

⁵ The Population Correction Unit is a theoretical value determined on the base of the average weight of cattle to which treatments are given and the number of animals slaughtered in the year in question, taking into account the animals imported and exported to be fattened and slaughtered.



Map of the total sales of all antimicrobials for animals intended for food production, in mg / Pcu, for 26 countries in 2013.

The final report presents the sales data of 2013, and includes a chapter on the changes in the use of drugs that occurred between 2010 and 2013. In 2013 a total of 8,122 t of antimicrobial active ingredients were sold for veterinary use in the 26 countries in question, showing in general a drop in sales of around 8% compared to 2010. An analysis of the proportion between the antibiotics sold and the weight of the national herd (mg drug / Pcu), we see that the highest sales are registered in Cyprus, followed by Spain and Italy.

In Italy, although appearing among the first member states selling antibiotics members, is the one in which there is the highest reduction (equal to 29%) between 2010 and 2013, going from 427 to 302 mg / Pcu. This decrease in sales is the result of ongoing information and awareness activities carried out by national and local authorities and by producers' associations to encourage the responsible use of veterinary medicines.

>> How to reduce risks: the maximum tolerable levels of residue and prevention strategies

The description of practices and dangers helps to understand what are the correct methods for risk reduction: the principles or key for the use of antibiotics, especially in human therapies, can be summarised as **"use them as less possible, only when necessary and in the correct amounts"**.⁶

The administration of antibiotics in animal husbandry is always subject to a veterinary prescription and, where possible, should be based on susceptibility testing performed on bacteria isolated from the animal who is being treated: this test permits to verify the susceptibility of bacteria to specific antibiotics, thus finding the most appropriate therapy. Furthermore, in Italy since 2006, the use of antimicrobials for prevention has been banned, in accordance with Regulation (EC) 1831/2003. In the other cases, active

ingredients that have previously obtained marketing authorization can be used,

In addition to the practices relating to the proper use of drugs in farming, it is of fundamental importance the control of the **maximum residue limits (MRL)**, which represent the highest concentration of active ingredients acceptable legally in food so as **to not pose a risk to human health**. To ensure compliance with the MRL, the law establishes **a period of medicine suspension** before slaughter or the marketing of foods such as milk and eggs. The controls for the presence of antibiotic residues in food is entrusted to the National Plan of Residues, which are discussed in greater detail in the section on controls and information for the consumer.

The Ministry of Health, which is responsible, together with regions and local health services, for supervising the administration of antibiotics to animals for breeding, has recently drafted **guidelines for the proper use of antimicrobial drugs** along with Italian Breeders Association (AIA), Federchimica, Assalzoo and the National Federation of Italian Veterinary Orders (FNOVI). The document also introduces the importance of **bio-security**, meaning all those useful devices to prevent the introduction into the industry of pathogenic microorganisms (such as attention during the purchase of animals, compliance with hygiene rules, control of supply, etc.).

The initiative supports the use of vaccination programs and interaction between veterinary and breeder, with provision of solid health programs and constant communication between the two categories.

⁶ AIA, AISAM ASSALZOO, FNOVI. Best practices for the use of antimicrobial drugs in animals intended for food production.

HOW ARE THE MAXIMUM RESIDUE LIMITS ESTABLISHED?

The definition of the maximum residue limits is the result of a process based on 4 successive stages:

- 1 For each substance, the values of NOEL (No Observed Effect Level) are calculated through laboratory tests, the maximum quantity of a given active ingredient which does not give rise to biological effects when administered in the diet to laboratory animals sensitive to that substance
- 2 Starting from the NOEL value the Acceptable Daily Intake (ADI), i.e. the amount of the substance that can be taken throughout the animal's life without the appearance of effects is established.
- 3 On the basis of the ADI for animals, one calculates the ADI for the man, that is the amount of a substance that can be taken daily for life by a person without the appearance of any effects. The human ADI is obtained by dividing the animal ADI by a safety factor that varies from 100 to 100,000: in practice it is assumed that the man is at least 10 times more sensitive than the animal species on which the analysis was conducted, and that in the same human species sensitivity can vary up to 10 times.
- 4 Finally, on the basis of the human ADI and assuming that an individual eats for his whole life exclusively a particular food, it calculates the MRL for that specific substance in that particular food.

EU GUIDELINES ON THE PRUDENT USE OF ANTIBIOTICS

In September 2015, the European Commission published a Communication relative to the Guidelines on the prudent use of antimicrobials in veterinary medicine. These guidelines, which are non-binding, are intended to define the principles for their prudent use in order to combat antibiotic resistance, indicating the measures that Member States must consid-

er when developing and implementing national strategies. To turn the guidelines into practice, the document was accompanied by a series of practical examples of their use in the various Member States for the implementation of each ingredient.

The Commission highlights the fact that any use of antimicrobi-

als (both in human and veterinary medicine) may result in the development of antibiotic resistance phenomena. The risk increases if antibiotics are used improperly, for example in a non-targeted (collective preventive treatments or to use non-susceptible organisms), at doses below-therapeutic, repeatedly or for time periods of inadequate.

The guidelines provide some general guidelines, and other more specific depending on the various animals. In general, the goal of a prudent administration is to reduce to a minimum the use of antimicrobials, delineating the use in cases of real necessity. In such situations, the prescription and administration of these medicines must be justified by an animal's diagnosis by the veterinarian, and possibly supported by specific tests to determine the most appropriate choice of the antimicrobials.

Prophylaxis should not be taken in a systematic way, but must be reserved for specific indications

in exceptional cases. Where possible, an individual treatment of infected animals should be preferred (for example, by administering injections) to collective or group treatments.

The narrow-spectrum antimicrobials are, in general, to be preferred to those with a broad spectrum. If an animal or group of animals suffer from recurrent infections that require antimicrobial treatment, one needs to take action to eradicate the strains of microorganisms, establishing why the disease is recurrent and changing the conditions of production, animal husbandry and/or management.

Finally, the use of antimicrobial agents that tend to favour the propagation of transmissible resistance should be avoided.



PARTECIPANTS IN THE CHAIN OF CONTROL

The Ministry of Health is responsible for collecting the sales figures of veterinary medicinal products from those responsible for their commerce (AIC).

The Experimental Animal Disease Prevention institutions are involved in monitoring resistance to antibiotics on farms, even offering diagnosis on diseases and zoonoses.⁷

The ASL, within their institutional competencies, constantly monitor compliance with the provisions concerning the prescription

of veterinary medicinal products, place the controls provided by the relevant regional medicine surveillance plans and perform inspections of final operators to monitor the records of shipping and delivery and of the stocks.

Finally, in all the Member States of the EU the companies must compulsorily keep for at least five years - regardless of whether the animal is still in the farm or not - the records of all medicines used in animals intended for food production, including the treatments with antibiotics.

The records are used to verify the use of antimicrobials in the farm, to observe trends and analyse changes.

⁷ Zoonoses are infections or diseases that can be transmitted directly or indirectly between animals and humans, for example, through the consumption of contaminated food or contact with infected animals. In humans these diseases can have different levels of gravity, depending on the pathogen and the health condition of the infected individual, with medical cases characterised by mild symptoms to life-threatening conditions.

PREVENTION IS BETTER THAN CURE: THE “SUSTAINABLE BARN” PROJECT OF THE EXPERIMENTAL ANIMAL DISEASE PREVENTION INSTITUTE OF TURIN

Design a barn to ensure the welfare and health of animals, while respecting the environment: this was the goal that brought the Polytechnic of Turin and the Piedmont Institute to realise the model of “Sustainable Barn”.

The project is a collaboration of architects, farmers, veterinarians and agronomists who have combined their expertise in order to identify a structure for cattle that would reconcile the functional characteristics with environmental sustainability, health care and wellness criteria and the insertion in the local agronomic reality.

The design stems from the need to find more efficient solutions to make sustainable modern farming practices, while reducing the stress factors and poor welfare. The project has permitted the creation of an interactive and virtual mock-up model of a sustainable cattle shed.

Among the various aspects considered in the project, the reduced use of veterinary drugs stands out, thanks to a preventive approach towards animal diseases. The ventilation system has been studied in order to ensure the maintenance of an ade-

quate and constant microclimate inside the barn, through the control of movement, temperature, air humidity and gas concentrations produced by the litter: these attentions permit the alleviating of respiratory diseases in animals, and consequently lower the share of administered antibiotics. Even the flooring and the litter are specially chosen so as to reduce the risk of foot injuries, with consequent reduction of the administration of anti-inflammatory drugs.



THE NATIONAL PLAN FOR THE RESPONSIBLE USE OF VETERINARY MEDICINE AND THE FIGHT AGAINST ANTIBIOTIC RESISTANCE IN POULTRY FARMING

Unaitalia, the association of reference for operators in the poultry sector, initiated with the Italian Society of Avian Pathology a voluntary plan aimed at promoting responsible use of antibiotics in poultry farming.

Specifically, the program aims to reduce the total consumption of antibiotics by 15% in 2015 and by 40% by 2018 compared to the 2011 consumption monitoring, with particular attention to the most problematic antibiotics such as fluoroquinolones, macrolides and polymyxins. The strategy is based on the one hand

on the promotion of prevention protocols, on the other hand by the continuously updated training of operators.

From a practical point of view, the first step taken was the monitoring of the actual consumption of active ingredients in the period 2011-2013, which was possible thanks to the involvement of the chicken and turkey sectors. Completed this first survey phase, which made possible to acquire a precise figure, the writing and adoption of the Plan kept on going with the monitoring activities of veterinary drugs, in order to

measure progress towards the goals established.

The operational aspects of the reduction scheme are divided into several stages, which include the promotion of best animal husbandry practices, the development of complementary and/or alternative systems that enable the reduction of operations with antimicrobials, the constant monitoring of actual consumption, the exchange of information between operators and their training.



> Microbiological and chemical contaminants¹⁰

A feasible threat to consumer safety regards the possible contamination with microorganisms or chemical substances, which may come into contact with food (or with the raw materials such as animal feed) in many stages of the processes. In truth, these types of contamination are not specific to meat, but all fresh food. For this reason it is essential to have a good management of all distribution phases that occur from the exit of manufacturing sites onwards, including domestic conservation. One risky situation is the poor upkeep of household refrigerators which, if not perfectly clean and not kept at appropriate temperatures, can be a source of contamination.

>> Microbiological contamination

Microbiological contamination is by far the most frequent cause of food alert. In this category belong contaminations by bacteria (such as salmonella), parasites (Trichinella), viruses and fungi.

European legislation has intervened to safeguard consumer safety with Regulation (EC) No. 2073/2005, which establishes the microbiological criteria applicable to many foods, including all types of meat. It is the basis of the microbiological tests conducted by both official controls and by self-control: in fact, it not only obliges food operators to ensure that food complies with the safety and processing hygiene criteria, but also establishes that the authorities will monitor compliance, also through sampling and food analysis in the context of the supervision activities.

The goal of self-control of quality management systems and systems developed by the agribusiness companies is that of minimising the risk of microbiological contamination through widespread control of the processes and, in particular, of preservative systems. Among the microbiological risks are also

mycotoxins, toxins produced by certain fungi or moulds in plant foods such as peanuts, walnuts or hazelnuts, corn, grain or soybeans that can enter the food chain through meat or other animal products such as eggs, milk and cheese from cattle that have consumed contaminated feed.

In addition to the controls implemented throughout the supply chain, consumer behaviour plays a key role: the best domestic conservation practices and proper cooking of food are fundamental to reduce risks.

>> Chemical contamination

The chemical contaminants include chemicals in the environment (such as pesticides), heavy metals, and other debris that may accidentally enter the food chain during the food production process. Chemicals such as pesticides or medicines used for Animal Health are subject to strict regulations, and must pass strict toxicity tests for humans and the environment, before being admitted to registration with the European or National Authorities. Also for industrial substances, such as dioxins and heavy metals, there are strict controls, designed to avoid contamination of the environment and to ensure the protection of public health.

¹⁰ <http://www.eufic.org/article/it/page/barchive/expid/basics-sicurezza-alimentare/>

THE IMPORTANCE OF THE COLD CHAIN

Most of the microorganisms that cause food contamination belongs to the category of mesophilic bacteria, that is capable of multiplying at a temperature comprised between 20° and 40° C.

Amongst these are both pathogenic microorganisms and toxin producers, both spoilage microorganisms, that use for their metabolism specific substances present in the food modifying them, or during their metabolic processes synthesize and release compounds that modify the appearance of the food.

At a temperature different from the one for optimal growth, and

in particular at refrigeration temperature (0-4 ° C), all metabolic processes are slowed down.

This means that:

- 1) cell multiplication is reduced and consequently the bacteria load will find it difficult to reach concentrations that will cause symptoms in the consumer;*
- 2) the concentration of microorganisms will not be enough to start the toxin formation processes;*
- 3) the metabolic processes that lead to an alteration of the food will be very slow.*

For this reason, the maintenance of the cold chain is critical at all stages, from the storage of raw

materials up to the single sale, both for perishable products, that is, with high water concentrations (essential substrate for the multiplication of nearly all microorganisms in question), and both for those products whose production process does not reset to zero the microbial load.

For other products the cold chain is not crucial: in fact they do not have a microbial population that can multiply and cause diseases or organoleptic alterations.



WHY CURED MEATS CONTAIN SALT

The practice of adding substances to foods for easy storage is not a chemical or industrial invention, but is an ancient tradition. Some examples are the addition of an acid juice (such as lemon) to prevent the blackening of a vegetable, as well as the use of the smoke from wood, especially ones rich in resin. And, in the specific case of the meat, the use of salt. In fact, the ancient Romans already had observed that saltpetre was improving the production of cured meats and sausages, avoiding the browning of the meat and especially preventing the proliferation of unwanted bacteria.

Precisely for this reason, in the production of some cured meats are added, in controlled quantities, nitrates and nitrites that, *inter alia*, have the property of maintaining the colour of meat. In 2003, the EFSA - European Food Safety Authority explicitly stated in an important counsel to the European Commission that "in most processed meat products the addition of nitrite (or nitrate) is necessary to prevent the development and production of toxins for *C. botulinum*".¹¹

Thanks to the use of the refrigerator and microbiological knowledge, in addition to compliance

with the hygiene rules and to the exploitation of the bacteriostatic properties of spices and herbs such as garlic, pepper and chilli, you can nowadays produce safe cured meat using few preservatives. In the DOP hams, for example, the prolonged maturing process makes unnecessary the use of salts, which in fact are no longer used in these products. As for all substances, also in the case of these compounds an excess consumption can lead to negative consequences for health. Although it should be noted that nitrates are a component of many plant foods (lettuce contains 3 grams per kg¹²), the nutritional balance, repeatedly emphasised with the promotion of the Mediterranean Diet, is the way to valorise the benefits of each individual food reducing health risks.

¹¹Opinion of the Scientific Panel on Biological Hazards on a request from the Commission related to the effects of Nitrites/Nitrates on the Microbiological Safety of Meat Products, The EFSA Journal (2003) 14, 1-34

¹²Cantoni C. - Professor at the University of Milan - Faculty of Veterinary Medicine - Department of Veterinary Sciences and Technologies for Food Safety. Nitrates and nitrites in meat products - Eurocarni June 2004.

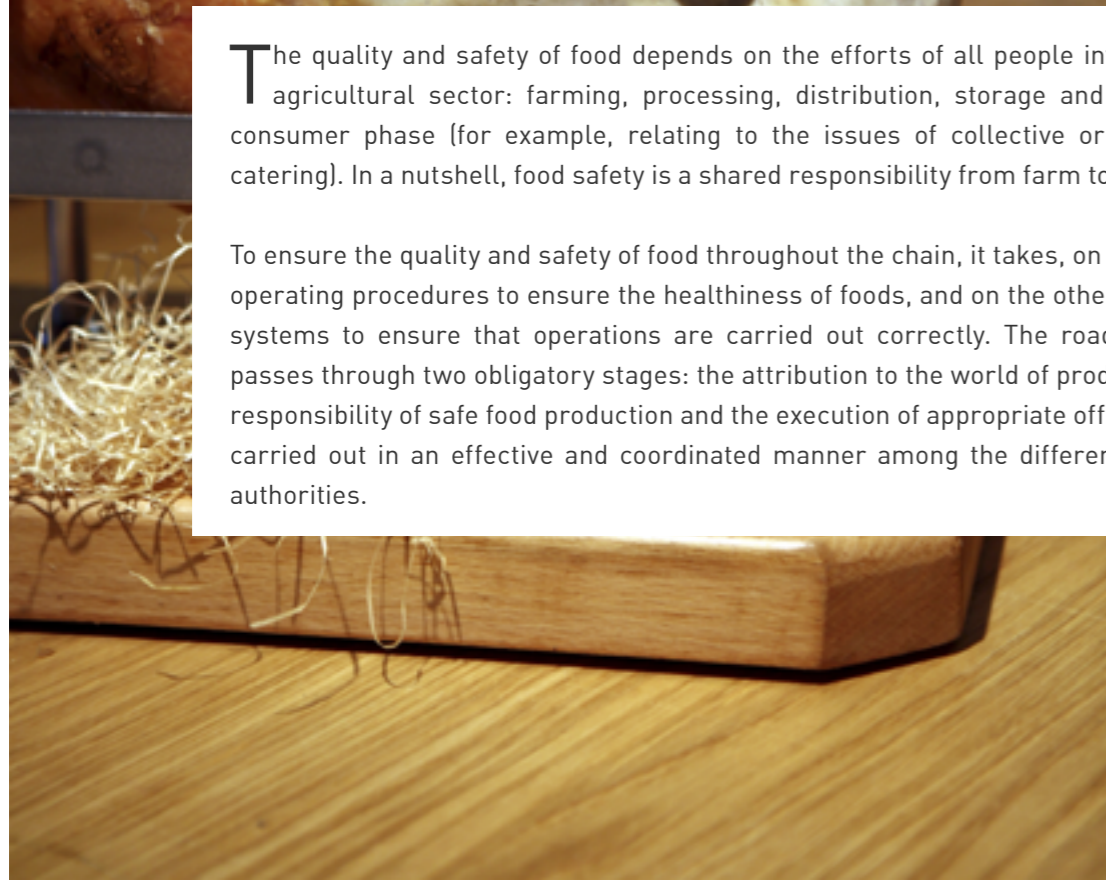


CONTROLS AND INFORMATION FOR CONSUMERS



The quality and safety of food depends on the efforts of all people involved in the agricultural sector: farming, processing, distribution, storage and even in the consumer phase (for example, relating to the issues of collective or commercial catering). In a nutshell, food safety is a shared responsibility from farm to fork.

To ensure the quality and safety of food throughout the chain, it takes, on the one side, operating procedures to ensure the healthiness of foods, and on the other, monitoring systems to ensure that operations are carried out correctly. The road to security passes through two obligatory stages: the attribution to the world of production of the responsibility of safe food production and the execution of appropriate official controls carried out in an effective and coordinated manner among the different competent authorities.



> Traceability and tracking

Often the two terms are used interchangeably, but they are not exactly synonymous, although they represent two sides of the same coin:

- **Traceability** means the ability to describe the path of a raw material or a quantity of production through the passageways from one business entity to another, within the production chain: from production, to processing, up to distribution. In essence, the flow of goods is accompanied by a flow of information, which are adequately recorded and retained at each step.
- **Tracking**, however, implies the possibility to reconstruct backward the entire path of a product, from its final state to the starting raw materials.

These approaches are essential elements in the management of food security, because they allow

the reconstruction of the characteristics and history of a food along the production chain, as well as ensuring a timely withdrawal from the market, when issues appear related to the quality or safety that pose a risk to the consumer.

Since 2005, the legislation requires that all food products are properly tracked, involving in this process all the players in the food chain. The obligation of traceability also applies to products of foreign origin (in whole or in part), and permits finding the origins of the raw materials.

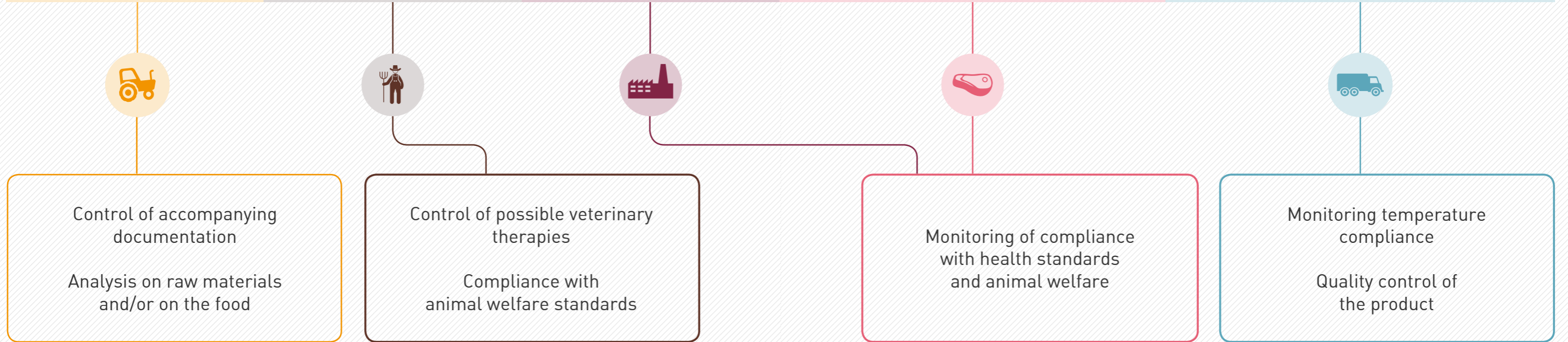
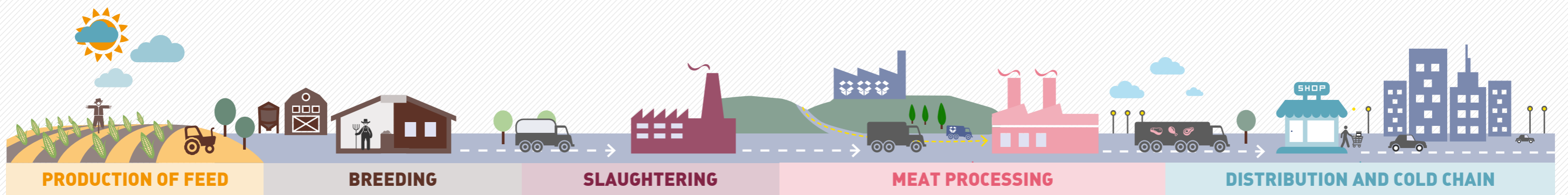
In addition to being a fundamental prerequisite for the management of safety and food emergencies, traceability has an important role ensuring the quality of the product: by a careful system of documentation, in fact, all the checks carried out on processes and products can be traced in every production stage.





TRACEABILITY OF MEATS

MAIN PERFORMED CHECKS



EUROPEAN AND ITALIAN RULES ON FOOD SAFETY

To guarantee the safety of food to consumers and safeguard the agrifood sector from recurring crises, the European Union, and Italy as a member country, have adopted the strategy of "safety from farm to table". This formula contains the spirit of regulatory intervention and control: the challenge of ensuring safe food all along the production chain, setting up an integrated control system between the various actors involved to ensure the safeguard of the requirements of food products and the welfare of animals and plants, whether produced within the EU or imported.

The general principles on which the legislation concerns are¹³:

- integrated controls throughout

the food chain;

- interventions based on the Analysis of Risk;
- primary responsibility of the industry for each product created, processed, imported, marketed or administered;
- traceability of products throughout the supply chain;
- consumer as an active part of food security.

In addition, to ensure a scientific approach to issues related to food, the European Authority for Food Safety was established (EFSA¹⁴) in 2012, which, in collaboration with national authorities and in consultation with stakeholders, since then provides independent scientific advice and clear communication on existing

and emerging risks. EFSA elaborates scientific and expert advice to provide a solid foundation for legislative work and to facilitate timely and effective decisions in risk management.

Especially for meat, the legislation is very detailed, both in the definition of the requirements of the production facilities and for product specifications and related control systems.

¹³ http://www.salute.gov.it/portale/temi/p2_6.jsp?lingua=italiano&id=1136&area=sicurezzaAlimentare&menu=sicurezza

¹⁴ European Food Safety Authority, EFSA: <http://www.efsa.europa.eu/it>

> Institutional controls

In Italy, the protection of food security is entrusted mainly to **official control** activities carried out by the **Ministry of Health**, in compliance with the food safety model introduced in the European Union by Regulation 178/2002¹⁵, Regulation no. 882/2004¹⁶ and subsequent regulations of the so-called "Hygiene Package"¹⁷. The Ministry operates at central level, with the General Directorate for hygiene and food safety and nutrition and, at regional level, with its Regional Offices. To these are added the controls of the Regions and Autonomous Provinces of Trento and Bolzano, through their territorial structures, Departments of Prevention of Local Health and public Laboratories of Official Control, such as the Animal Disease Prevention Institutes.

The controls are designed to ensure that food and feed on the market comply with the regulations aimed at protecting **consumers health, animal welfare** and prevent **food fraud**. In the first two cases one intervenes to ensure the safety of the consumer, avoiding contamination and preventing situations that could lead to the development of bacterial contamination. In the case of commercial fraud, however, controls verify the conformity of the product with the characteristics declared by the manufacturer about the amount or source, and determine any tampering that could cause danger to human health.¹⁸ In both cases, non-compliant or products considered dangerous are blocked before their arrival on the market, or withdrawn from the market.

The controls, which take place throughout the supply chain, cover both Italian or foreign products to be marketed domestically and Italian products destined for export. In general, the surveys provide a fully investigated product through inspections, sampling and laboratory analysis, inspections, or in production processes with controls that may include also the staff assigned to processing.

As for the meat sector, the controls are focused on farms, with regard to health and animal welfare, as well as slaughterhouses in the processing industries. Continuing along the chain of distribution, at-

tention is drawn to the rules for labelling and compliance with consumer information requirements.

According to the provisions of Regulation no. 882/2004, the controls are programmed on the basis of a risk assessment (and thus, targeting the sectors/activities/operators that can be associated with a greater risk for the health of the consumer) and integrated, that are managed in a coordinated manner among the various authorities involved in the control along the supply chain. The objective is to enable more efficient action and avoid duplication.

Complementing the official controls provided by the legislation, businesses in the food industries have to implement self-control plans in accordance with the principles of HACCP (Hazard Analysis Critical Control Points), to ensure the hygiene of processes, prevent risks to consumer health, define the procedures of intervention in cases of non-compliance and monitor the effectiveness of the program.

¹⁵ The Regulation 178/2002 introduced the current food security model, marking the beginning of a real process of reorganization of the Community legislation.

¹⁶ Regulation (EC) 882/2004 is the norm framework for the organisation of official controls on food, feed, animal health and animal welfare.

¹⁷ For more information on the Hygiene Package regulations, see the website of the Ministry of Health: http://www.salute.gov.it/portale/temi/p2_6.jsp?id=1136&area=sicurezzaAlimentare&menu=sicurezza

¹⁸ <http://www.izsalimento.izsto.it/palimenti/index.php/laspesa/frodi-alimentari>



SUPERVISION AND CONTROL ACTIVITIES ON FOOD AND DRINKS IN ITALY

Each year, the Ministry of Health prepares a report describing the results of the supervisory activities and control of food and beverages made during the year, both at the inspection and analytical level. The last available reports, referring to 2014, show that during the year there have been a total of 472,856 inspections and 28, 823 controls on operating units (plants and local equipment, facilities and means

of transport).

With regards to the analytical controls on foods, a total of 64,921 product samples were analysed, of which 1,521 resulted non regular. Sampling was carried out on a broad spectrum, including all food categories: from animal products (dairy products, eggs and egg products, meat and meat products, animal fats, fish, crustaceans and molluscs) to vegetable products (fruit and vege-

tables, herbs and spices, vegetable fats and oils), also including ready meals, herbs, spices and alcoholic and non-alcoholic drinks.

In the meat sector 11,130 samples were analysed, of which 364 (3.2%) showed irregular results due to microbiological or chemical contamination.

IS IMPORTED MEAT LESS SAFE THAN ITALIAN MEAT?

If we were to draw up a list of topics that generate most concern for consumers in relation to food security, the origin of the meat they eat would certainly appear up at the top. It is in fact a quite widespread belief that imported meat is "less safe" than home-made, a hypotheses which in reality is not confirmed by the facts: lets to make things clear.

Within the EU, the control system is harmonised by Community law and follows the principle of safety "from farm to fork": this means

that the cattle are traced at every stage of the supply chain, regardless of the country in which it is bred, and can not be treated with substances prohibited by the Union (such as, for example, anabolic hormones).

Meat coming from other Member States, therefore must meet the same requirements as Italy, and thanks to the obligation of traceability, can be traced back at any time to information about specific phases of the supply chain. As for the non-EU countries, how-

ever, the question becomes more complex.

In some countries, in fact, the national legislation does not impose the obligation of traceability along the supply chain, giving priority to analytical controls on the product to be placed on the market, rather than supervising pre-slaughter.

This does not mean that the products are less safe or controlled, because to obtain the import authorisation in Europe, the

companies must comply with the same requirements in force in the EU market.

Either way, in Italy there are various control points located in places of commercial trade, borders or at ports and airports: the so-called PIF (Border Inspection

Posts) in which are placed the controls on food imported from other countries and the UVAC (Veterinary Offices for Community Compliance) involved in trade between Member States.

P.I.F. are directly connected to the European food alert system:

this allows, in the presence of a non-compliant product, to take swift action to prevent the placing on the Community market or eventually its removal.

THE COST OF FRAUD AND FOOD EMERGENCIES

The budget costs to the national economy caused by food emergencies is very high.

According to data from Censis at the end of 2013, fraud in the agri-food sector subtracted from Italy a production of over 13 billion Euro and a missed increase in employment of 0.4%. To confirm this, calculations presented in the dossier by Legambiente "Italy at the table - 10th Report on Food Security", published at the end of 2013, indicate some significant numbers: 500.000 inspections and over 28 thousand tons of products confiscated, for an economic value, only in 2012, of over 500 million Euro.

To counter this, regulatory changes have been developed, until finally the offense of infringing geographical indications or controlled designation of products was intro-

duced into the Penal Code.

Apart from food fraud, health emergencies also affect the food industry, and cause much damage to the national economy.

According to an Eurobarometer survey*, consumers are very sensitive to these issues: every emergency involves great economic losses within the affected areas. For this reason it is important that a real or perceived food emergency does not become a media issue.

* <http://www.foodweb.it/2011/03/le-emergenze-alimentari-costano-5-miliardi-euro/>

** Coldiretti elaborations based on 2011 Eurobarometer data

HOW ITALIANS BEHAVE IN FOOD EMERGENCIES**

- 1) 43% avoid the food only for a certain period of time
- 2) 30% is concerned but do not change their purchases
- 3) 13% excludes the food from their diet definitively
- 4) 12% ignores the information
- 5) 2% does not respond

NRP AND CONTROLS FOR THE DETECTION OF PROHIBITED SUBSTANCES

EU and national legislation lays down control measures for the presence of undesirable substances in food. In particular, each Member State must annually perform the National Plan for the detection of Residues (NRP), a structured program which aims at overseeing and monitoring the presence of residues of substances for livestock use, both illicit and authorised, and environmental contaminants in live animals and the feed from which they originate. The NRP consists in a series of samples prepared at national level adapted to the regional situation and carried out by the National Health Service, both on farms (primary production) and in the establishment of initial processing (slaughterhouses or the milk collection centres). The analyses to reveal the presence of illegal substances are carried out by the laboratories of the Institutes of Experimental Animal Disease Prevention.

The substances to be searched fall into two categories:

- **Category A:** includes substances with anabolic effect and unauthorised substances for the treatment of farm animals. To this category belong therefore substances that are used in a fraudulent manner, for example, anabolic effects that in-



duce an increase in weight of the animal treated.

- **Category B:** includes the veterinary medicinal products, for which the EU defines a maximum residue limit that can not be exceeded in consumer products; and environmental contaminants such as heavy metals.

In the event that the administration of prohibited substances is detected, or the content of residues of authorised substances or environmental contaminants were higher than the established limits, the application of sanctions would be implemented to protect the consumer such as the recall of dangerous products, the application of administrative and criminal sanctions, the conducting of epidemiological investigations to determine responsi-

bilities and uncover any further treatment. For some substances, such as growth promoters, the NRP also adds other specific controls.

The use of low concentrations means that the residues of these substances present in animal tissues are difficult to reveal by laboratory analysis. In this case, we resort to specific histological examination, i.e. inherent tissue analysis, carried out directly on the carcass after slaughter operations: the use of growth promoters, in addition to increased accretion of the animal, in fact also determines the alteration of some organs (sex glands, gonads, thymus etc.) whose analysis can highlight situations that deviate from the norm and, accordingly, permits the use of illicit substances to be suspected.

THE RESULTS OF THE NRP 2014

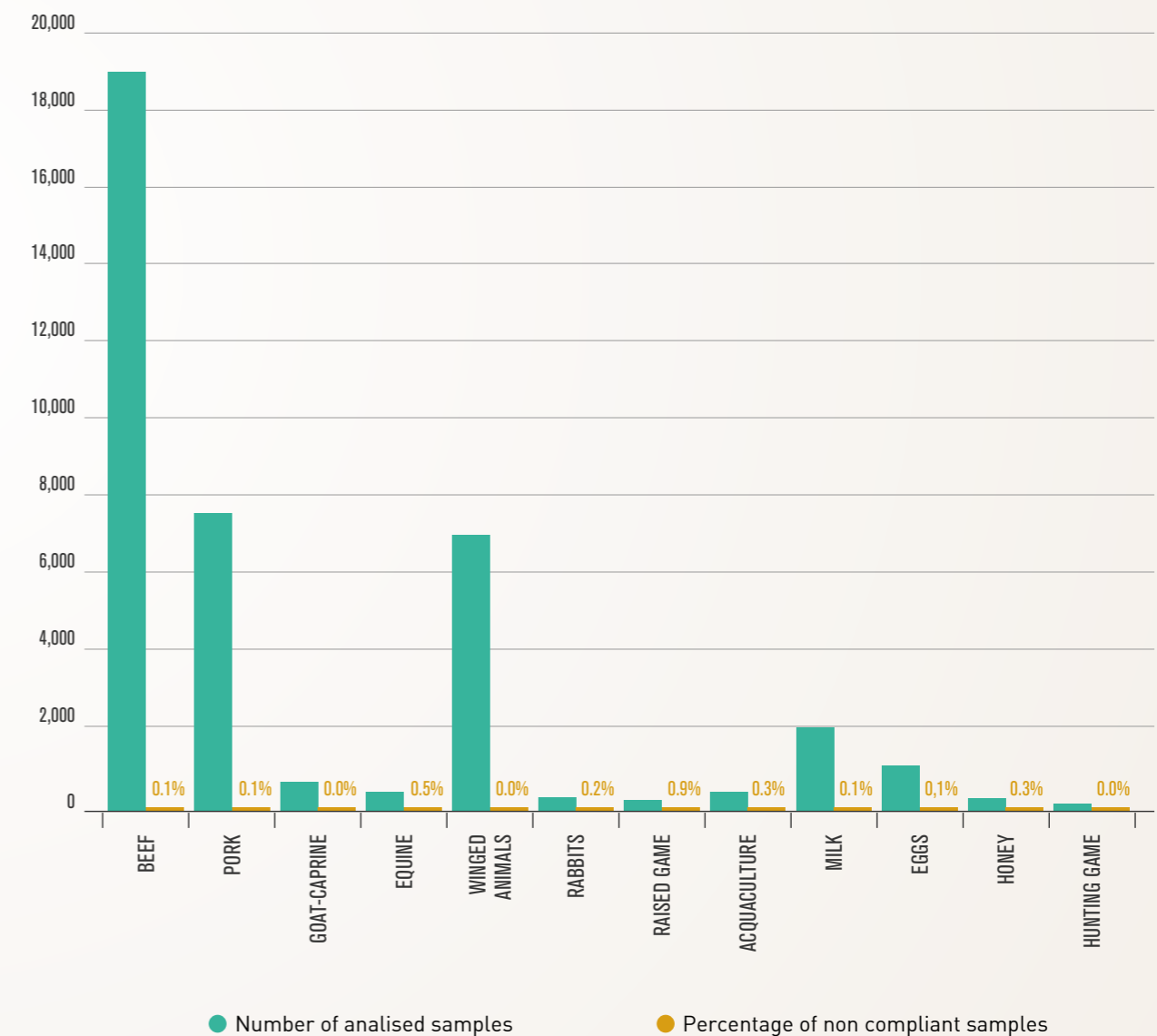
In 2014, the implementation of the NRP has led to the analysis of 40,806 samples, of which 16,276 for the detection of residues of substances in Category A (equal to 39.9% of total analysis) and 24,530 for the detection of residues of substances in category B (equal to 60.1%). The samples

that have provided irregular results for the presence of residues were a total of 44, equal to 0.11% of the total of the samples analysed.

Of these, 15 were found not to conform due to the presence of residues belonging to category A

(34.1%) and 29 due to the detection of residues of substances in Category B (65.9%).

The chart below shows the percentage of compliant samples in each single production department, respect to the total samples analysed for each same sector.



> The self-control system of companies

Food companies apply a series of strict measures to ensure that all activities of production, processing, packaging and sales are managed in an optimal manner, in order to control and prevent risks that may arise in the different phases of each production process.

All these measures can be regarded as a “self-control” system, and are applied to the complete and constant control of the productive activity.

According to European regulations¹⁹, any activity that operates in the food industry has an obligation to prepare a plan of self-control according to the HACCP (Hazard Analysis and Critical Control Points).

This method provides that each operator performs an analysis of potential risk factors for health resulting from its operations, and define one or more measures for the control and prevention of the risks. The HACCP Manual must be validated by the Health Authority (ASL) which oversees its implementation.

The HACCP self-control plan is based on seven principles:

1. Identify any hazard to be prevented, eliminated or reduced.
2. Identify the critical control points (CCP - Critical Control Points) in the phases in which it is possible to prevent, eliminate or reduce a risk.
3. Establish, for these critical control points, critical limits which separate acceptability from unacceptability.
4. Establish and implement effective monitoring procedures at critical control points.
5. Establish corrective actions if a critical control point is not under verification (exceeding the established critical limits).
6. Establish the procedures to be regularly applied to verify the effective functioning of the measures taken.
7. Prepare documents and records commensurate with the nature and size of the food business.

¹⁹ Regulation (EC) No. 852/2004

The plan must be applicable and applied, finalised at preventing the causes of occurrence of non-compliance before they occur and must provide for appropriate corrective actions to minimise risks when, despite the application of preventive measures, there is a non-compliance.

The plan includes general and specific measures. Those “**general**” are represented by common rules that apply to all processing areas and are inherent to the hygiene of operators, premises, equipment, processes and products, as well as the application of verification measures of those rules.

Those “**specific**”, defined for each type of production process, aiming at the identification, evaluation and control of the specific risks of a biological, chemical and physical nature which could affect the safety of food products.

The dangers are evaluated according to the principles outlined in the “Codex Alimentarius” and the national and international legislation²⁰.

> An all Italian safety: supply chain and the protection consortium

The Italian food system presents some peculiarities that, in addition to determining a strength in terms of quality and value, permits excellent safety levels to be guaranteed.

A first aspect concerns the presence of effective and well coordinated **supply chains**. A product is made “in the food chain” when all the actors involved in the production process are integrated and coordinated with each other: in this way an additional control, direct and complete, of agricultural and industrial production systems is possible on behalf of those who have product liability towards the market.

The purpose of the chain is to make transparent the

²⁰ INALCA. Sustainability Balance Sheet 2014, chapter 9

INFORMING THE CONSUMER WITH THE PRODUCT LABELS



The labelling of meat, which has become mandatory the last 10 years, even though at different times for different products, is a system that requires the manufacturer to provide information to the consumer about the product they are about to purchase.

At European level, the matter is currently governed by Regulation 1169/2011, which establishes common rules for the labelling of the various species and serves as a coordination between the various sectors, ensuring consistency of the information contained in the different labelling systems.

Although there are subtle differences between the various species, in general the information concerns the country of breeding, slaughtering and, if applicable, processing of the product. This information can help the conscious choice of consumers during the purchase.

DOP & IGP IN ITALY



Italy holds the European record for the number of DOP and IGP awards, with more than 261 quality products recognised²¹. Due to the international importance of these designations, the awarded products are subject to strict and specific controls, in addition to the routine checks laid down by European and national legislation. In our country, the DOP and IGP products of the pig production chain are subject, as well as inspections of the national health system, to the annual inspections at farms, slaughterhouses, processing plants, ham and cured meats companies, carried out by two independent institutions designated by the Ministry of Agriculture, Food and Forestry.

These organisations certify the quality of raw materials and in particular compliance with the rules of production materials: a system which guarantees the acquisition of high quality products, made according to traditional recipes. About a third of European DOP and IGP meat based products are Italian. In addition, the first 4 DOP Italian products for export volumes and market share belong to husbandry sectors: Parma ham, San Daniele ham, Grana Padano and Parmigiano Reggiano cheese.

²¹ Istat 2014. “High quality food products” <http://www.istat.it/it/archivio/131519>

relationship between the subjects involved in the production and processing of the final product, by developing a relationship of trust, with shared objectives between the parties involved. A added value to the chain is to minimise risk by simplifying the control plans. Products relating to controlled supply chains allow a better comparison of data quality and food safety, generally more detailed than the minimum requirements of the law, better control of product standards with respect to the expectations of the consumer and greater recognition through dedicated brands. In Italy it is estimated that about half the beef and the pork are produced in the supply chain, while for poultry meat in the production chain is almost complete.

A second aspect concerns the presence of numerous products identified internationally as gastronomic excellences such as those protected by the geographical indication trademarks.

The European Union protects the typicality of some food products through the recognition of **DOP (Designation of Protected Origin)** and **IGP (Typical**

Geographic Indications). These designations, recognised throughout Europe, are awarded only to those high quality products whose production takes place in defined geographical area, and for which there is a causal link between the geographical area and the quality or characteristics of the product and the characterising aspects of the production process²².

In other words, the product should show a strong link to the territory, to whose name must be traced certain characteristics of the product itself. The function of these trademarks is threefold: to protect quality products from misuse and imitation; give consumers reliable information about the products they purchase; contribute to the protection of rural areas, whose socio-economic system often depends on the development of typical agricultural food production and quality.

²² For more information see: AICIG, Italian Association of Geographical Indications Consortia. <http://www.aicig.it/index.php?page=dop>

VOLUNTARY LABELLING IN THE AGRICULTURAL SECTOR

Italian legislation foresees the possibility, for operators who wish to do so, to provide voluntary and additional information on the label other than required by law. To achieve this, however, a particular set of voluntary labelling procedures must be followed, which are recognised by the Ministry of Agriculture: in the poultry sector, the first and most comprehensive is the one developed by UNAITALIA, representative of 99.98% of the producers who use voluntary labelling.

In addition to the information prescribed by the law, the guidelines state that you can enter specific information relative to:

- the food: for example a no GMO, free of animal flour and/or added animal fat, vegetable food etc.),
- the kind of farming adopted: raised on the ground, outdoor, extensive covering, etc.,
- the genetic type,
- animal welfare measures: more space in breeding areas respect to the legal limits, the presence of natural light in infrastructure dedicated to breeding, presence of straw bales or perches to encourage natural behaviour, etc.

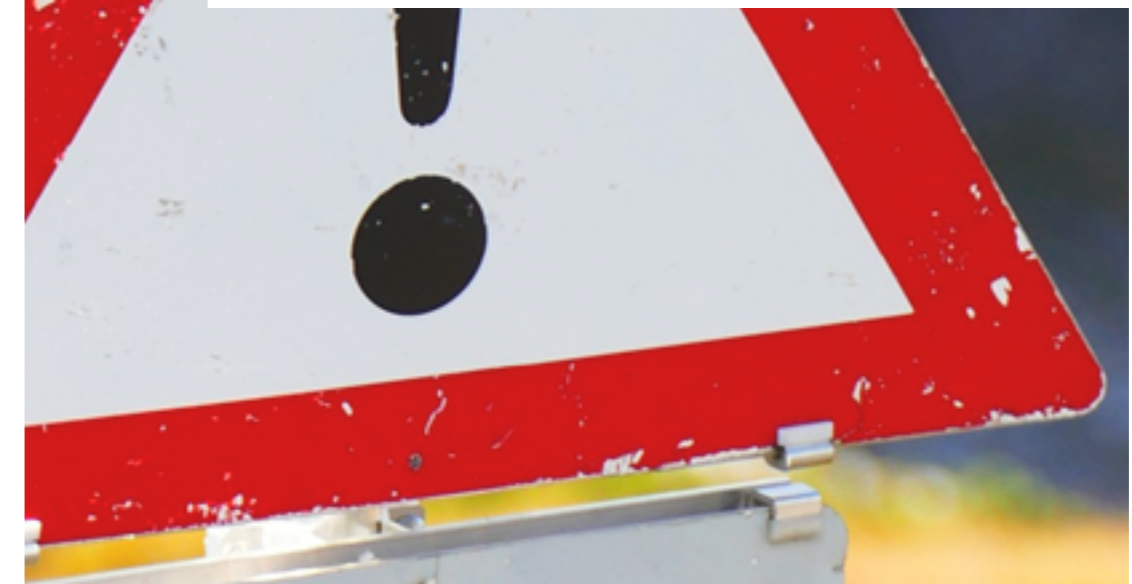


THE COMMUNITY FOOD ALERT SYSTEM



To notify in real time risks (real or potential) for the health of consumers a system of Community rapid alert (**RASFF**) was established, which, through a network of spreading information, permits a rapid and coordinated action. In practice, the RASFF constitutes a network of “contact points”, identified in the European Commission, in the EFSA (European Food Safety Authority), the ESA (Supervisory Authority of the European Free Trade Association) and at national level, identified by the authorities in individual member countries. All parties involved exchange information in a clear and structured way by means of protocols that ensure the homogeneity of the reports: the Ministry of Health is the Italian point of contact.

In case of **serious and immediate risk** (for example, of a toxin such as botulinum), further to providing immediate seizure of the products, the emergency procedure can be supplemented with press releases to inform the public on the risks linked to the consumption of a particular product and the mode of delivery of the food to the competent local Health Authority.





EUROPEAN UNION



MINISTER OF HEALTH

REGIONS

LOCAL HEALTH AUTHORITIES, ASL

ANIMAL DISEASE PREVENTION INSTITUTES



> Different levels of alert: when is it right to worry?

The Alert System foresees **four types** of communications that are sent to the Member States depending on the severity of the situation:

- The **Alert Communications**: are sent when food or feed which present a serious risk are on the market and where action is needed quickly for their withdrawal or recall. The RASFF member that identifies the problem and takes proper action (e.g. product recall) starts the alert with the objective of giving all members the information to verify whether the product in question is on their markets, so that they can take the necessary measures.
- **Informational Communications**: are used when a

risk is identified in respect of a food or feed on the market, but other Member States are not required to take rapid action. This is because the product has not arrived or is no longer present on their market or because the nature of the risk simply does not require such action.

- The **rejections at the border**: concern consignments of food and feed undergoing an exam and rejected outside the EU borders (and the EEA, the European Economic Area) when a health risk is detected. Notifications are sent to all EEA border posts in order to strengthen the controls and ensure that the rejected product does not re-enter the EU through another border.
- The **News**: all information relating to safety of food and animal feed that have not been sent as a warning, but which also contain useful news for the purpose of controls that countries can plan.

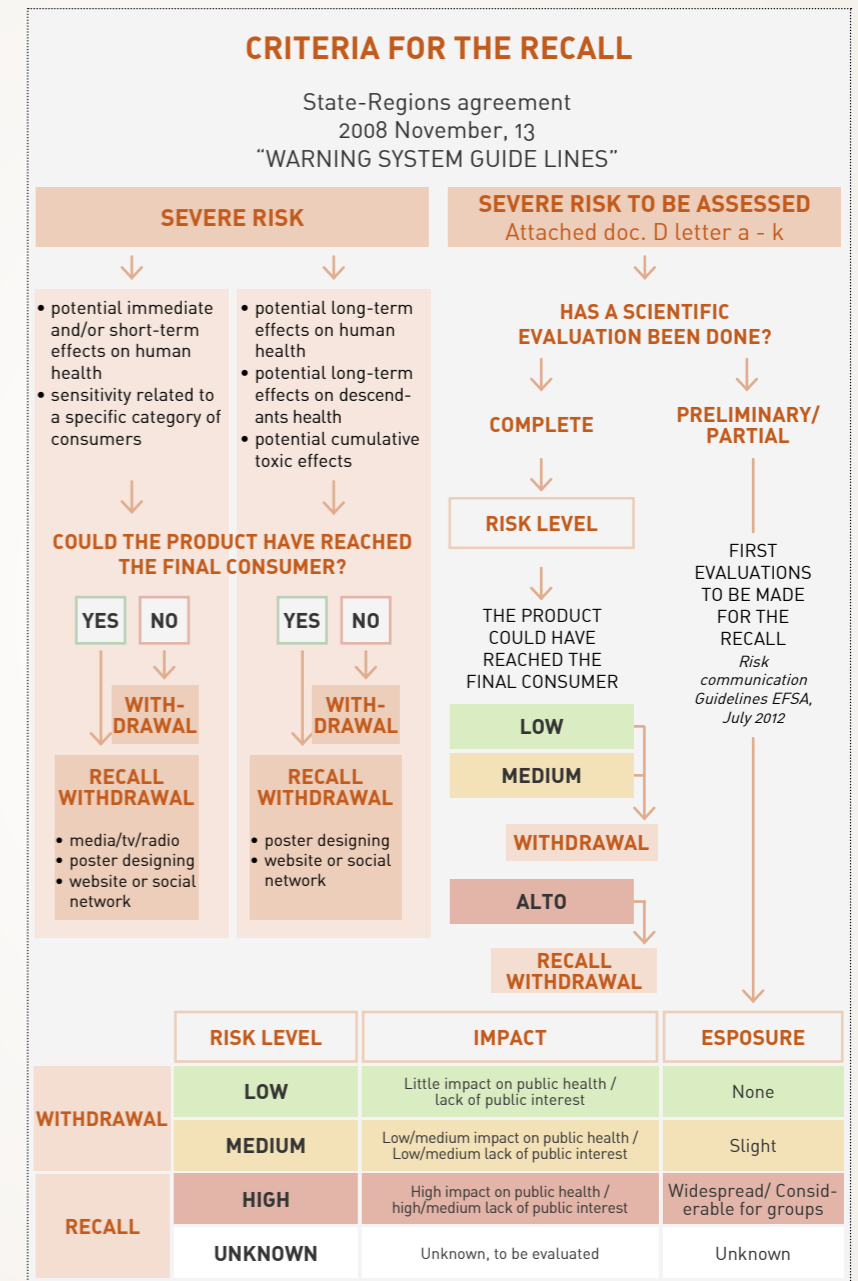
NOTIFICATIONS TO CONSUMERS

Next to prevention, control and warning systems, there is the strategic role of communicating to consumers, who must be kept informed, about the activities of the bodies which guarantee the wholesomeness of food, new concerns about food safety, the risks that certain foods may present for certain groups of people, and on the impact on health of an inappropriate diet.

In particular, consumers are explicitly warned (with direct and multi-channel communications) if a dangerous product which has already been sold to consumers through the distribution network, is to be recalled from the market.

In these situations, the food business operators are required to use all the necessary means of communication to inform, in an effective and accurate way, potential buyers of the risk that the product may pose to health.

In these cases, the distributors are required to stop selling the product in question, to segregate it to avoid possible contamination and to cooperate in its recall and follow the information prepared by the food producer.



However, there is no obligation to an explicit communication in case of withdrawal of the product, i.e. actions to prevent a potentially dangerous product being placed on the market.

> What are the risks that generate alerts?

Each year the results of the notifications to the RASFF system are collected in a report published by the European Commission and then translated by the various Member States. The annual report represents an extremely useful tool for getting immediate information on which food categories were most subjected to criticism during the course of the year, as well as the type of risk detected. From

the analysis of the report dated 2015²³, it emerges that notifications are gradually decreasing, while most warnings concerned the contamination by microbiological pathogens such as Salmonella and Escherichia coli (total 782 notifications in 2014), and the presence of residues of plant protection (435), of mycotoxins (383) and heavy metals (285).

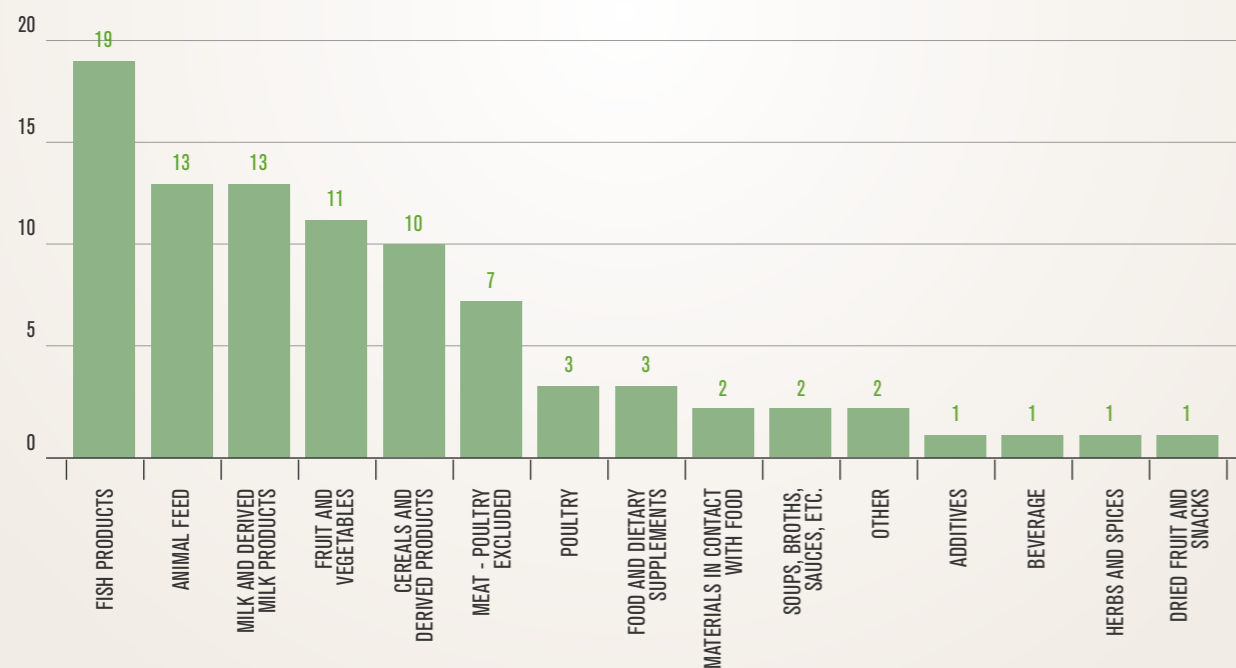
²³ Ministry of Health. "Report on the European warning system - year 2015".

NOTIFICATIONS IN ITALY

Overall in 2014 there were 3,097 notifications, compared to 3,136 the previous year. The comparison with previous years reveals a decrease in alerts: in 2012 received notifications were 3,436, and 3,721 in 2011. The country more subject to notifications turns out to be China (469), followed by Turkey and India.

Looking at the situation in our country, Italy has proven to be **the first member state for the number of notifications** sent to the European Commission, thereby demonstrating intense and thorough monitoring activities throughout the country, with a total of 506 notifications (equal to 16.3%), while in 2013 the notifications issued by Italy were 534 (17%).

Italy is the thirteenth in the ranking for the number of notifications received, with a total of 89 national products reported as irregular (compared with 97 notifications in 2013). The type of irregular products are heterogeneous: the highest number of notifications concerned fishery products, followed by animal and dairy products.



ANIMAL WELFARE



Animal welfare is an element of sustainability that affects both the ethical aspects linked to the respect of the animals and the quality and safety of food products derived from them.



> Fundamentals of animal welfare: the five freedoms

The interest for animal welfare, as we understand it today, can be traced to **1965**, the year the **Brambell's report** was published, the first scientific paper on the subject commissioned directly by the British government.

The document is specifically related to farm animals and sets out the "five freedoms" to be protected to ensure animal well-being, not only as absence of disease, but as a state of good overall physical and mental health. These conditions, taken and "institutionalised" in 1979 by the Farm Animal Welfare Council (FAWC), are still the base of the international legislation on animal welfare.

The five freedoms recall the respect for the fundamental and basic needs of each animal, the protection of which is vital especially in captive conditions that do not allow the individual pursuit and satisfaction of needs. Although these requirements are still the basis of Community legislation, in reality the debate on this topic has not yet found a clear definition.

THE FIVE FREEDOMS



1. FROM HUNGER, THIRST AND MALNUTRITION

by ensuring to the animal access to fresh water and a diet that maintains full health



2. TO HAVE AN ADEQUATE PHYSICAL ENVIRONMENT

giving the animal an environment including shelter and a comfortable resting area



3. FROM PAIN, INJURY, DISEASE

foreseeing them or diagnosing and treating them quickly



4. TO EXPRESS THEIR SPECIFIC BEHAVIOURAL CHARACTERISTICS

of their species providing the animal with sufficient space, proper facilities and the company of animals of their own species



5. FROM FEAR AND DISTRESS

ensuring the animal conditions and care that do not involve psychological suffering

Most experts agree to see animal welfare as **a balance between the individual and the environment that surrounds it**, where "environment" refers to a heterogeneous group of factors including the physical environment (facilities, density, microclimate etc.), interaction with other animals and humans, the absence of disease or predators.²⁴

The adaptation to these factors can vary in intensity from case to case: the animal can be, for example, in a good level of wellness compared to some factors such as the breeding structure, but in a low level for others, such as the health status. From this consideration emerges that one cannot talk about health only in terms of presence or absence, but also the wellbeing varies **from very bad to very good**.²⁵

To testimony the strong interest on the subject in recent years various projects have started to measure the level of animal welfare, based on specific and objective indicators that can reflect the psychophysical condition and the level of stress of animal health: some of these are the Quality Welfare and the RIBECA project.

Also in the Rural Development Programmes animal welfare has found ample space. In particular, Measure 215, relative to payments for animal well-being, financially supports the dissemination of methodologies and farming conditions with high animal welfare content, more than the minimum limits imposed by specific regulations, with the aim of increasing the competitiveness and profitability of livestock farms

Although the scientific community has established the characteristics of animal welfare and its measurement mode, in the public opinion the perception of well-being is far from unique and maintains a strong characteristic of subjectivity, due to ethical considerations. In other words, if for science there is a substantial agreement on how to define the state of animal welfare, in common understanding the conditions considered "adequate" vary according to the conception of the animal itself and the adopted perspective.

²⁴ INEA 2012

²⁵ INEA 2012



WELFARE QUALITY

Welfare Quality® (www.welfarequality.net) is a research project funded by the European Union to thoroughly examine the studies on animal welfare, and identify measuring parameters. Launched in 2004, the project was attended by forty-four institutes and universities, representing thirteen European countries and four Latin American countries that have co-operated in an integrated manner in order to implement monitoring systems in

breeding to improve animal welfare on the farm. Welfare Quality® ended in 2009 with the presentation of the first protocols for measurement and classification of animal welfare on the farm, addressed respectively to cattle, swine and poultry. The identified systems are based on a combination of scientific methods of detection of well-being with the classification criteria of the farms into four categories, from "poor" to "excellent".

The assessment of animal welfare is based on four principles: adequate housing, proper nutrition, good health and appropriate behaviour. Within these principles, twelve welfare criteria, distinct but complementary, have been highlighted.



MEASURING WELL-BEING: THE RIBECA PROJECT

RIBECA, "Application of an innovative system of relief of animal welfare in beef cattle farms", is a two-year project, funded by MipAAF and coordinated by the CRPA Foundation, involving 7 Piedmont and Veneto beef cattle farms run by young farmers and their associations, and Asprocarne Unicarve. The project, which ended in November 2015, was aimed at developing an innovative system of relief and welfare assessment in cattle for fattening, taking into account the recommendations of the EFSA Scientific Opinion (2012) on the welfare of beef cattle: the indications provided in this Opinion concern structural and managerial aspects, such as the types of housing, unit surfaces to be assigned to each item, the heads per box, floors and bedding materials, control of the microclimate inside the stables, distribution

of food and drinking water, human-animal interactions, mutilation and disease control.

The evaluation system perfected as part of the project involves both the assessments carried out directly on animals based on the Welfare Quality Protocol®, and the assessments of the farm environment and management procedures based on the IBA Protocol (Wellbeing Index of the Farm), a methodology developed by the CRPA in collaboration with the Department of Agricultural Management Systems, Food and Forestry (GESAAF) of the University of Florence.

The project led to the development of a checklist for the detection of animal welfare and an input program, calculation and verification of the requirements

of current legislation and the EFSA recommendations, used directly by farmers on their own farms.

The evaluation system involves the compilation of a specific company checklist at the livestock farm, the inclusion of data collected in a special software, the calculation (automatic) of the obtained scores and the positioning of the company in a wellbeing classification (1 = company with poor level of welfare to 6 = company with high level of welfare), the identification of critical points, possible improvements and assessments also of their economic viability.

Recently, the CRPA has developed a system of animal welfare evaluation similar to RIBECA, used in pig breeding and fattening.

> Animal welfare in modern livestock

As with all food products, also livestock production is constantly increasing and this involves, on the part of the operators a constant search for efficiency. This, one should admit, has over the years resulted in some critical situations as some aspects of sustainability, such as the one for animal welfare, have been put into the second place compared to the economic one, which has always been the main driver of a productive enterprise.

It is also necessary to observe, however, even though not always at the same speed among the various industrial sectors, that things are changing and many entrepreneurs have started considering animal health among the subjects relevant to the sustainability of their business, especially when the vision is far-sighted: it is only in medium or long-term horizons that investment without immediate return, such as those of animal welfare, give their fruits.

In the case of livestock, the principles laid down by the five freedoms should be guaranteed mainly by paying attention to the rearing phase, but also to transport and slaughter.

To regulate these and other factors the legislation, first Community and then National, intervened establishing specific criteria that represent minimum thresholds to be respected.

Intervention in legislature was joined, with a remarkable growth in recent years, by the development of a large number of standards and voluntary initiatives, brands and certifications to ensure compliance with certain characteristics in breeding permitting, among other things, a higher level of well-being.

It is for example the case of awards for animal welfare and standards for breeding proposed by non-governmental organisations such as Compassion in



World Farming and the RSPCA, or product standards such as organic, for the attainment of which are provided stringent requirements for farming conditions.

>> The types of farming

Today the issue of animal welfare is directed especially towards intensive farming, generally accused of offering lower conditions of animal welfare and respect in comparison to more "traditional" and extensive forms.

Behind this statement there is a complex issue, namely the inability to objectively define what are the characteristics of an "intensive" or "industrial" farm. Although the term "intensive" is commonly used both in legislation and in common language, there is actually not a unique and precise definition. One of the few references is in the **European Convention for the Protection of Animal Husbandry of 10th March 1976**, which defines intensive farms, "that primarily employ technical installations managed principally by means of automatic devices". A definition both broad and vague.

A second suggestion, more specifically, is provided by **INEA** (National Institute of Agricultural Economics) in a report from 2012, in which it

identifies the intensive rearing livestock as a way in which man has the control of both of space available and of animal resources. However, even in this case, there is some ambiguity: as in the case of “pasture grazing” farms when the animals are sheltered in warehouses when there is intense cold or snow: in this case one necessarily turns to food rations, thus the “resources” available to the cattle, and the space to be assigned to each of them are controlled.

When the judgment is based on the well-being, the conditions and the place of farming, one tends to look favourably on pasture grazing in preference to those in the barn, considered more “industrial” and less respectful of standards of animal welfare. In reality, **both methods have advantages and weaknesses**, and it is important to remember that they refer to different breeding requirements, which are derived from the characteristics of the territory and the fertility of the soil, but also the economic sustainability of companies.

In the case of livestock in the **barn**, which obviously provides less space, the management of the animal is more **precise** and **accurate**: the animals are checked daily, with the possibility of a timely detection of problems of various associated nature, for example, in diseases or nutritional problems. In this case, also, it is easier to prevent any harmful infectious diseases for livestock or humans, important especially in highly humanised environments.

In **pasture** grazing, typical of northern European countries or America, which have large agricultural areas, the animal is left in the wild for most of its life. In this case there is certainly more freedom of movement, but you must consider that the production cycles are getting longer and the degree of control in the event of illness, bad weather or predator attack is less.

It is therefore clear that the choice **between extensive and intensive is not so distinct**, both because there are no fixed definitions, and because both breeding models have advantages and disadvantages that need **to be judged with a global vision** that takes into account many aspects. In

general, therefore, the stocking density is not the only criterion on which to base the measurement of well-being: it is not the case that a structure with high densities, but handled scrupulously, providing an environmental enrichment and innovative infrastructures, necessarily offers conditions of wellness worse than one with a lower density, but handled with less care.

>> What the law says: minimum criteria to be respected

In recent decades, the respect and protection of animals have become of ever increasing interest in our society. Such thinking has also influenced the EU legislation, leading not only to enact many laws aimed at the protection of animals, but also to integrate the needs dictated by the welfare of animals in the formulation of EU policies.

A key step is represented by the Amsterdam Treaty of 1997, in which animals are defined as “**sentient**

beings” and are no longer considered only food.

Subsequently, in the White Paper on Food Safety published in 2000, the Commission proposed a set of standards by highlighting the close relationship between animal welfare and food safety.

The significance of the issue of animal welfare at legislative level, finally, is also found in the Common Agricultural Policy (CAP), which has included since 2007 animal welfare among the criteria required to be met in the context of so-called “**conditionality**”, subordinating the economic support for farmers with compliance to a series of sustainable requirements that specifically concern animal welfare²⁶.

Within the complex **body of legislation** currently in **force**, it is possible to distinguish horizontal and vertical legislation. The first dictates the lines of appropriate behaviour in all species of food-producing animals, while the second enters into the specifics of certain animal species.

With regards to **horizontal legislation**, amongst the acts developed by the European Commission these

should be remembered:






- **Directive 98/58/CE** disposes the minimum standards for the protection of all animals on farms, containing provisions regarding animal control, freedom of movement, livestock buildings, automatic systems, feed and mutilation;
- **Regulation (EC) No 1/2005** on the protection of animals during transport, which lays down the provisions concerning the liability of operators and the training of animal handling personnel, and the controls based also on the use of new technologies, space during transport, the duration of the journey and the pauses, the rules for long journeys and for animal handling operations during their loading and unloading;
- **Regulation (EC) No 1099/2009** on the protection of animals during slaughter, which instructs on the provisions on the responsibilities of the slaughter house, staff training, tagging modes in the waiting room and animal movement, innovative systems of stunning and killing the animals and the verification of their efficiency.

The **vertical legislation** concerns the **different species of animals for income** and, in particular, the following categories of production: breeding and fattening pigs, calves (i.e. bovine from 0 to six months of life), laying hens and broiler chickens. These rules aim to establish criteria relating to the management and structural aspects finalised at protecting the animals, setting minimum requirements for the elements that affect the welfare conditions of the different species, such as housing density, environmental control, paving, supply of food and water, etc.

Following can be found the details of the current European legislation on the welfare of farm animals, divided according to the different stages of the process (farming, transport and slaughter).



²⁶ Regulation (EC) No. 1782/03.

	BREEDING	TRANSPORT	SLAUGHTER
 EGG LAYING HENS	DIRECTIVE 98/58 / EC, concerning the protection of animals on farms. DIRECTIVE 1999/74 / EC and DIRECTIVE 2002/4 / EC, laying down minimum standards for the protection of laying hens.	REGULATION (EC) No. 1/2005 of 22 December 2004 on the protection of animals during transport and related operations.	1099/2009 of 24 September 2009 on the protection of animals at slaughter.
 CHICKENS FOR MEAT	DIRECTIVE 98/58 / EC, concerning the protection of animals on farms. DIRECTIVE 2007/43 / EEC laying down minimum standards for the protection of chickens kept for meat production.	REGULATION (EC) No. 1/2005 of 22 December 2004 on the protection of animals during transport and related operations.	REGULATION (EC) No 1099/2009 of 24 September 2009 on the protection of animals at slaughter.
 PIGS	DIRECTIVE 98/58 / EC, concerning the protection of animals on farms. DIRECTIVE 120/2008 / EEC laying down minimum standards for the protection of pigs confined for rearing and fattening,	REGULATION (EC) No. 1/2005 of 22 December 2004 on the protection of animals during transport and related operations.	REGULATION (EC) No 1099/2009 of 24 September 2009 on the protection of animals at slaughter.
 CALVES	DIRECTIVE 98/58 / EC, concerning the protection of animals on farms. DIRECTIVE 119/2008 / EEC laying down minimum standards to protect calves confined for rearing and slaughter.	REGULATION (EC) No. 1/2005 of 22 December 2004 on the protection of animals during transport and related operations.	REGULATION (EC) No 1099/2009 of 24 September 2009 on the protection of animals at slaughter.
 BOVINE	DIRECTIVE 98/58 / EC, concerning the protection of animals on farms.	REGULATION (EC) No. 1/2005 of 22 December 2004 on the protection of animals during transport and related operations.	REGULATION (EC) No 1099/2009 of 24 September 2009 on the protection of animals at slaughter.

>> Animal welfare in Italy: non-compliance is an offence

The acknowledgement of the Community indications means that Italy is in line with other European countries in terms of safeguarding the minimum conditions of animal welfare. A peculiar aspect of our country, however, is made up of the larger number of controls resulting from the presence in the Criminal Code of the **offense of cruelty to animals**. Article 544-ter of Law 198 of 2004, amended by Law 201 of 2010, states that there is a crime when an animal

is subjected to injury, abuse, unbearable conduct or hardships, or to treatments from which derive damage to its health or moreover when it is subjected to the administration of prohibited substances. The offense is connected with the **exercise of the profession**, and all persons who come into contact with the animal in the breeding, transport and slaughter are punishable.

The inclusion in the Criminal Code leads to a widening of the prohibitions with respect to the provisions of the Community legislation (any act involving unjustified suffering to the animal is potentially

punishable), but also to a widening of the spectrum of the persons responsible for monitoring. Any supervisory body active in the sector of food business operators (from the traffic corps to the NAS – Italian Food Anti-sophistication police) can in fact carry out controls and file a complaint.

It should also be remembered that in Italy a “National Plan for Animal Welfare” has been active since 2010; it defines the criteria and monitoring programs by the competent Sanitary Authority with the aim not only to verify the application of national and Community legislation concerning the protection of animals on farms, but also to provide information, explanations and guidelines for the breeding of various species.

>> The pursuit of excellence: standard and voluntary criteria

For more virtuous operators maintaining animal welfare is not a “plus” accessory, but the daily modus operandi, and results in a number of specific practices well-integrated into the business management system. Not only, in addition to the practices established by law, the most sustainability-conscious organisations have **voluntarily** decided to implement action protocols or to adopt additional protections on the welfare of farm animals.

In this context, in Italy, there are many initiatives, promoted both by institutional entities and associations, to improve farming conditions further: obviously these excellences **only** represent the “**best practices**” to which the industry is leaning towards (or should lean), with time scales and effectiveness which vary from case to case.

Among the notable initiatives there are certainly those of a few international non-governmental organisations, who have rallied to ask producers to ensure additional measures of animal protection than those provided by law. One of these is **Compassion in World Farming (CIWF)**, an NGO present at

global level since 1967 that promotes more respectful animal wellbeing farming systems. Since 2007, Italy has started a **Animal Welfare Award** program, through which promotes the use of voluntary measures to protect specific-species animal welfare. The measures vary from award to award, but can be attributed in general to the following main areas: a **density** of less breeding within the limits of the law, the absence of systematic **mutilations**, the presence of **environmental enrichments** and adequate space so that the animals behave naturally. For certain categories, such as pigs, among the criteria is also the absence of antibiotic use.

Another case is represented by brands and voluntary certifications, such as **organic**, for the attainment of which certain animal welfare criteria must be met. In general, **organic livestock production is closely tied to the land**, and the number of heads to rear depends on the area available to the farm. The farming method should meet the ethological and physiological needs of the animals, thus allowing the expression of natural behaviour and ensuring adequate living conditions. The facilities for breeding must also ensure sufficient free space available to the animals and allow outdoor access, even in winter. Animals must be fed with vegetable products obtained by the organic production method, possibly grown on the farm. As for veterinary treatments, remedies should aim to stimulate the immune system of the animal. A maximum of two drug treatments per year.

Finally, there are many companies that, despite not joining standard or special certifications have voluntarily developed additional protocols containing measures to protect animal welfare.

The most common interventions include maintaining the animal outdoors for part or all of its life cycle, the offer of environmental enrichment and maintaining a farming density less the legal limits. Another case is constituted by the supply policy of manufacturers or the GDO, according to which suppliers are only accepted whose products fulfil certain criteria of well-being: for example, the choice of some distributors and processing companies only use eggs from free-range hens.

MANUAL FOR THE WELFARE EVALUATION OF THE IZS CATTLE FARM OF BRESCIA

The "Manual for the welfare assessment and bio safety in breeding cattle for meat", prepared by the National Reference Centre for Animal Welfare (CRENBA) and published by the Institute of Experimental Animal Disease Prevention of Lombardy and Emilia Romagna, addresses the need of creating a balanced and objective assessment system, easy to apply, that also allows comparisons between different farms on the basis of the measurements themselves ensuring greater objectivity of the assessment provided.

According to the developed methodology, the evaluation the welfare level of a farm includes both aspects relating to the structures and management (evaluated through the so-called "non-animal based measures" - N-ABMS), and those linked to the animals' reactions to their living conditions (measured through the "animal-based measures" - ABMS).

In detail, the aspects of farming considered a priority by the system refer to the stable staff, to the condition of the facilities and equipment that are in daily contact with the cattle, the micro-climatic conditions and certain social and health aspects. The choice of the aspects to be evaluated fell on those easily measurable by objective surveys in almost all the Italian beef cattle farms. The ultimate goal is to compare the different farms on the basis of these assessments, ensuring a greater objectivity to the assessment provided.



The assessment on farm animal welfare and bio-security is done through a checklist consisting of 56 items, divided into 5 areas: corporate and personal management; facilities and equipment; animal based measures (ABMS); bio-security; great risks and alarm systems. Each item has a triple (negative, acceptable, positive) or double (negative and positive) response option.

The result of the evaluations is a numerical value expressed on a scale from 0 to 100, capable of identifying the general conditions of well-being of animals.

FREQUENTLY ASKED QUESTIONS

FOOD SAFETY
AND ANIMAL WELFARE

IS IT TRUE THAT BREEDING FARMS USES AN INDISCRIMINATE AMOUNT OF ANTIBIOTICS?

No. The use of antibiotics on farms is subject to the compliance with strict rules. Not only is preventive treatment prohibited, but drugs can only be used in the presence of diseases and after prescription. Drugs permitted are those authorised by the health authorities and their use must be limited in time. To minimise the risk for people, it is compulsory to comply with the "suspension period", i.e. waiting a certain number of days after the discontinuation of treatment before slaughter.

In any case, the problem of antibiotic resistance (i.e. the appearance of bacteria which have developed resistance to certain antibiotics) is very serious and important, to the point that the WHO has drawn to an overall approach that regards livestock, but also the use of non suitable antibiotics in human medicine.

ARE HORMONES PRESENT IN BEEF?

In Europe the use of substances with hormonal effects is prohibi-

ted in the livestock sector (bovine, poultry and pork chains) since 1981. Their use, furthermore, besides being prohibited by the regulations would be useless, if not counterproductive.

WHAT ARE THE CONTROL MEASURES ON TRACEABILITY AND SAFETY OF MEAT IN ITALY?

The quality and food safety, in Italy as well as throughout the European Union, are such a priority as to consider the Regulations on food safety among the EU regulatory milestones. Among all control systems activated in the last few decades, most important are those related to the traceability and labelling of meat products. The European strategy is to prevent any contamination of foodstuffs from substances present in the environment or due to human activities (preventive actions), and create a network of controls that constantly monitor the presence of residues of substances in food that could be harmful to public health (control actions).

Among the preventive actions, is a self-control plan by all operators in the food sector, im-

plemented with the application of HACCP (Hazard Analysis and Critical Control Points). This, in particular, aims to prevent the presence in food of substances potentially harmful to the human body, from a downstream control of the foods that end up on our tables to controlling each stage of their production. With regards to control measures, since 2006 acceptability limits of the contaminants have been defined in foods such as nitrates, mycotoxins, heavy metals and dioxins. At the same time, they are in charge of the research organisations to carry out a consistent scientific analysis of the impact that the known contaminants can have on human health, and the potential toxicity of new substances used in agriculture. For six years, moreover, three Regulations (149, 260 and 839 of 2008) were adopted relating to



FREQUENTLY ASKED QUESTIONS

FOOD SAFETY AND ANIMAL WELFARE

the maximum limits for pesticide residues (MRLs) in foodstuffs, for the use of pesticides on crops intended for animal feed.

The reliability of these limits is verified by the EFSA (European Food Safety Authority), an independent body that provides scientific advice on all matters that affect food security. In Italy, however, the Ministry of Health annually issues the National Plan for the Search of residues (PNR), which shows the results of the analysis regarding the presence of residues of toxic substances in food. According to the NRP Final Report of 2014, the results of the monitoring plan have shown that as many as 99.89% of the samples was in accordance with the regulations set by the European regulations.

MAD COW HAS BEEN FORGOTTEN FOR SOME TIME: WHAT CAN BE SAID TODAY ABOUT BEEF CONTROLS? CAN ITALIAN CONSUMERS REST ASSURED?

The controls in Italy are many and accurate, so Italians can rest assured. The Italian system of controls is avant-garde especially with regards to the meat production chain; since the mad cow

crisis it has structured a package of regulations and capillary control programs that protect the consumer all along the phases of the supply chain.

ARE GMO DANGEROUS?

In the debate on food safety, one of the most contentious issues definitely concerns Genetically Modified Organisms (GMO), often accused of representing a danger to human health and the environment. The question is delicate, because it brings into play different points of view.

What is a GMO? Literally, the term "genetically modified" refers to any "organism whose genetic material has been altered in a way that does not occur naturally by mating and/or natural genetic recombination". Indeed, the improvement or modification of the genetic characteristics of an animal or a plant species has been common knowledge for ever.

So it is good to clarify that the GMO techniques "on trial" are those that have developed over the last 40 years, that permits the change of some features of living species "in the laboratory":

for example, you can increase the resistance of a plant to pesticides or certain parasites, improve the nutritional profile and the ability to adapt to adverse weather conditions (e.g. increasing the resistance in case of drought). The main GMO crops worldwide are soybeans, corn and cotton.

In the document "20 Questions on Genetically Modified Organisms", the WHO said that there is no evidence that GMO foods currently on the market represent a risk to health. Similarly, no negative effects on health has been noted from the consumption of GMO foods in the countries where they have already been approved.

However, their use in the agri-food sector is opposed by a considerable part of public opinion, for reasons mainly related to environmental and ethical issues that have little to do with food safety itself.

IS IT TRUE THAT THE MEAT FOUND IN THE SUPERMARKET ALL COMES FROM ABROAD?

The Italian beef production is insufficient to meet domestic demand: currently about 40% of live calves and meat is imported



from other European countries. Live calves of beef breeds, which are characterised by a genetic profile of high level, are bred in Italy integrating perfectly with the wide availability of quality corn in the Po Valley and the increasing possibilities of pastures and fodder for the reduced production of durum wheat, especially in the centre-south. Through breeding techniques perfected over the years and in particular the best practices in nutrition and in respect of animal welfare, the Italian chain ensures the quality and safety of meat "bred in Italy". Thanks to the traceability system, on the label of the final product it is always possible to check the animal's country of origin.

ON FARMS ARE ANIMALS REALLY ABUSED AS SHOWN ON SOME TV SHOWS?

The respect of animal welfare in farming, transport and slaughter has taken on great significance in recent years, in the European Union as well as in countries that export meat to Europe, obliged to comply with standards equivalent to those applied to EU members.

The reasons are many, but beyond the undoubted ethical value and therefore the attention of public opinion and of the control bodies, there is also a purely economic reason: potential stressors and poor living conditions not only create conditions of unnec-

essary suffering to the animal, but also low quality meat.

The European Union is particularly advanced in the field of welfare of farm animals: the Commission is in fact working hard to increase the level of animal welfare in the Member States, with continuous investment in the improvement of regulatory standards.

An effort that leads Europe to invest an average of 70 million Euro per year in actions aimed solely to the protection of animal welfare.

In the European Union all those rearing methods that cause suffering or injury to livestock are prohibited, and it requires that animals are observed daily and, if necessary, treated.

Not only that, according to European legislation freedom of movement to all animals must be guaranteed, while the equipment for the administration of feed and water must be designed, constructed and installed so as to minimise the chances of food or water contamination, and the negative effects of competition between animals.

FREQUENTLY ASKED QUESTIONS

FOOD SAFETY
AND ANIMAL WELFARE

IS IT TRUE THAT CHICKENS GROW IN CLOSED CAGES?

No, it is not true. And to confirm this, simply visit one of more than 4000 Italian farms, where all the chickens, turkeys and other poultry for meat are not kept in cages, but on the ground, free to roam in spacious and bright areas, moving on layers of straw or wood chips that are absorbent and hygienic. In some cases there are also open-air farms.

It is 50 years, from the early '60s, that the "battery" breeding of chickens for meat does not exist. This prejudice (common today to as many as 8 out of 10 Italians) is mainly due to the legacies of the past and to an erroneous confusion between the rearing of broiler chickens and that, still widely diffused today, of egg laying hens, where the animals are no longer bred in batteries, but in cages according to the most recent Community legislation on animal welfare, so as to ensure the animals ease and health, together with hygiene of eggs produced.

Next to the horizontal rules, which guarantee the welfare of any animal species in farming, transport and slaughter, also nu-

merous vertical regulations are in force, which establish the welfare requirements in the breeding of each species, including egg laying hens or broilers.

The commitment of the poultry sector in ensuring a smooth and optimal application of these laws throughout the country has resulted in important initiatives, such as the drafting of the "Operating Procedures for the protection of poultry during transport" manual, in collaboration with the Italian Company of Preventive Veterinary Medicine and with the approval of the Ministry of Health.

Still awaiting approval by the same Ministry is, on the other hand, the "Proper operating practices for poultry hatcheries" manual. Finally, the poultry industry (Unaitalia) has promoted a number of training courses on animal welfare for livestock farmers throughout the country, training more than 1,500 farmers.

Now all broilers are raised on the ground and sexes are separated in special sheds, where the density is usually maintained at around 30-33 kg of live weight per square meter (corresponding to a maximum of about 12 chickens, with an estimated average

weight to 2.5 kg) at slaughter. Breeding on the ground is, among other things, the preferred choice considering the positive effects on the organoleptic characteristics of the meat, which are in this way much more pleasing to consumers.

The current laws in Italy (Legislative Decree. 27/09/2010 n. 181) provide that both the owner, and the holder are responsible for animal welfare and the application of the measures foreseen. The norm sets a maximum stocking density equal to 33 and 39 kg/m² depending on the environmental conditions of the farms. In an interview in March 2014 for the magazine Food, the president of Unaitalia Aldo Muraro notes still many prejudices and myths resist regarding poultry meat: "For example, only three out of 10 Italians know that 99% of the chicken we eat in Italy it is bred in our country and to verify this all you have to do is simply read the label.

Similarly, over 80% of Italians ignore that the breeding of broiler chickens happens on the ground and not in a cage". To inform consumers properly, Unaitalia launched the blog vivailpollo.it, a site with answers also to doubts and curiosities.

IS IT TRUE THAT CALVES ARE BRED IN CAGES?

Contrary to popular belief, the rearing of calves is not allowed to cage. Animals should in fact remain exclusively in the box and in groups to respect the highly social features that characterise the behaviour of these animals. In this regard, the rules are established by Legislative Decree July 7, 2011, n. 126.

They require that no calf older than eight weeks may be confined in an individual pen; each individual pen must not have solid walls, but perforated walls which allow direct contact, sight and touch amongst the calves.

As for the calves kept in groups, instead, the free space available to each calf varies according to the weight: and must be at least 1.5 m² for each calf of a live weight less than 150 kg, at least 1.7 m² for each calf with a live weight of 150 kilograms or more but less than 220 kilograms, and at least 1.8 m² for each calf with a live weight equal to or greater than 220 kg. In addition, they must ensure thermal insulation, heating, ventilation and proper lighting in order to maintain the healthy environment and en-

courage growth and well-being of calves. In addition to these conditions, the building must be able to allow each calf to lie down, rest and stand up without difficulty.

DO PIGS LIVE IN THE DIRT?

Often mistakenly pigs are thought of as dirty animals. Actually pigs, having little ability of sweating, in nature tend to roll in mud to cool off and control pests. When confined in an enclosure of sufficient size, they tend to defecate in defined areas (unlike other farm animals), keeping their rest and activities areas clean.

There is also the Legislative Decree of 7 July 2011, n.122 (which in fact is the law that applies in Italy as a transposition of Directive 2008/120/EC), relating to the management of breeding pigs. This standard contains many requirements for the protection of health, in particular in relation to the space available for each animal, the type of flooring and the provision of specific material because pigs can root around.



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- Stefano Cinotti, *General Director of the Animal Disease Prevention Institute of Lombardy and Emilia-Romagna*
- Kees De Roest, *Economics Sector and Technical Resources Director at the Research Center for Animal Production (CRPA), Reggio Emilia*



THE MEAT CHAIN CONTRIBUTES TO ABOUT 15% OF THE ECONOMIC PROFIT OF THE ITALIAN FOOD INDUSTRIES

THE ORGANISATION OF AGRICULTURAL WORKERS IS CRITICAL TO THEIR ECONOMIC SUSTAINABILITY IN THE MEDIUM AND LONG-TERM

WHEN MEAT IS PLACED IN A BALANCED DIET IT DOES NOT INVOLVE EXCESSIVE COSTS FOR THE CONSUMER

SOCIAL AND ECONOMIC ASPECTS OF MEAT CONSUMPTION

THE MEAT SECTOR IN ITALY GENERATES AN ECONOMIC VALUE IN THE ORDER OF 30 BILLION EURO PER YEAR, COMPARED TO ABOUT 180 OF THE ENTIRE FOOD SECTOR AND TO THE 1,500 OF THE NATIONAL GDP.

While the three main sectors of poultry, beef and pork roughly share the total economic value, the differences lie in the analysis of the trade balance: the beef industry imports about 40% of its total requirement, the poultry industry is almost neutral, the pork industry imports 45% of its raw materials but is characterised by strong exports of cured meats.

The reality of the production of Italian farms is highly composite, characterised by the coexistence of multiple types of produce on the land, behind which lies a complex and varied system closely linked to the rural dimension.

This fragmentation makes economic sustainability difficult for the farms, with the risk that farmers and their families abandon the land. For this reason the tendency to organise themselves in cooperatives or in small and large industries, must be seen as a positive thing, because the objective is to ensure economic sustainability whilst maintaining their original identity.

This trend, highly developed in countries that make agriculture a richness, allows the organisation of supply chains to be able to control the products better. A key aspect of an "organised" system is the ability to better integrate the various

related production systems (meat, milk, cereals), hence maximising production efficiencies. Similarly, to what was done for environmental aspects, the economic aspect has been considered from a consumer point of view.

Essentially to follow a balanced diet that includes all foods in the right quantities, is not only advantageous in terms of nutrition and environmental perspectives, but also for the consumer's wallet.

- 🌿 THE SIZE OF THE SECTOR IN ITALY
- 🌿 COMPANIES ORGANISATION
- 🌿 THE COST FOR CONSUMERS

THE SIZE OF THE SECTOR IN ITALY

> Pork meat and cured meats

Adding the agricultural part to that of the industrial transformation, pork and cured meat, between all kind of meat, have the greatest economic dimension. In 2014 about 1.8 million tonnes of pig meat¹ (between fresh meat and cured meats), of which approximately **61% was produced in Italy** and the rest was imported (such as fresh meat or raw materials for cured meats) from other countries Europeans. The trade balance of live animal imports is less than 1 million whereas exports are almost negligible (about 4,000 animals)².

As for the sector of **cured meats**, in 2014 a decrease was again recorded both for production and consumption, confirming the negative trend over the last three years. Production fell to **1.17 million tonnes**, a decrease of 1.2% compared to 2013; of these almost **149,000 tonnes³** were **exported**, of which about 42% was crude ham (+ 5.7% compared to the previous twelve months). The cured meat sector has a **positive trade balance**, with exports exceeding imports (about 48,700 t, 32% coming from Germany), both in terms of quantity and economic value.

> Beef meat

Following ISTAT data, of the 2,5 million heads slaughtered in 2014, 54,5% came from young bulls, 27% from veal calves, 17% from old cows and the remaining 1,5% from bulls/oxen.

As for **foreign trade**, the **trade balance was negative**, with a balance that over the years has by passed around **2.6 billion Euro⁴**. Italy is structurally a **strong importer of live cattle for fattening purpose and beef meat** (fresh, chilled or frozen, intended for consumption or further industrial processing); in 2013 the share in value was, respectively of 42% and 58% of the total demand. The self-sufficiency rate of our country is around **58%** (BDN, 2014).

Exchanges with foreign countries are characterized mainly by: **decrease in imports of live animals** both for slaughter and fattening, **increase in imports of cheap cuts for fresh meat**, reduced imports of frozen meat and preserved by all countries and increasing competition from Eastern European countries (Ismea, 2015).

> Poultry meat

The **poultry industry** is based on national **production** that in 2014, **exceeded one million tons** (1.261.200 t). Our country is largely self-sufficient, with a degree of **self-sufficiency** in 2014 in the order of **107%**.

This sector is the only one among Italian meats to show a **positive trade balance both in quantity and value**, because Italy is a net exporter of poultry products. By focusing on the foreign trade of chicken meat, in 2014, **98,000 tonnes of chicken meat were exported** (for an economic value of nearly 197 million Euro), compared with **67,000 tonnes** of imported product (160 million euro)⁵.



¹ Assica, Annual Report 2014, Part 4 "Economic scenario and statistical appendix", p. 82 - available at the following link: <http://www.assica.it/it/pubblicazioni/rapporto-annuale.php>

² In 2014 the imports of live pigs increased by 33.3% compared to 2013; most of the head are imported piglets, sows and breeding animals for Italians farms.

³ Processing by ASSICA on ISTAT data, as reported in the Assica Annual Report of 2014, part 4, p. 85.

⁴ D. Rama 4, 2014. The beef market. Report 2014. Franco Angeli Editore, Milan, Italy. Data on import and export relative to 2013, Chapter 6, "Exchanges with foreign countries."

⁵ The poultry industry, Unaitalia site: www.unaitalia.com (accessed December 2015)



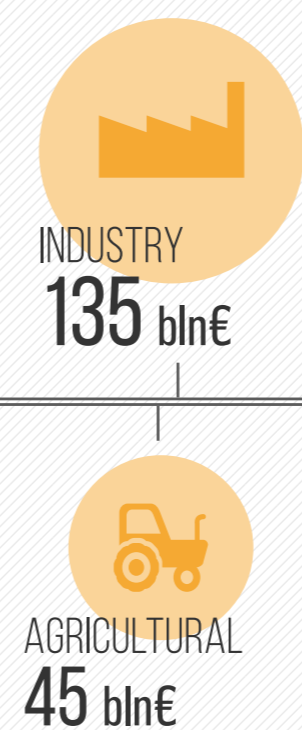
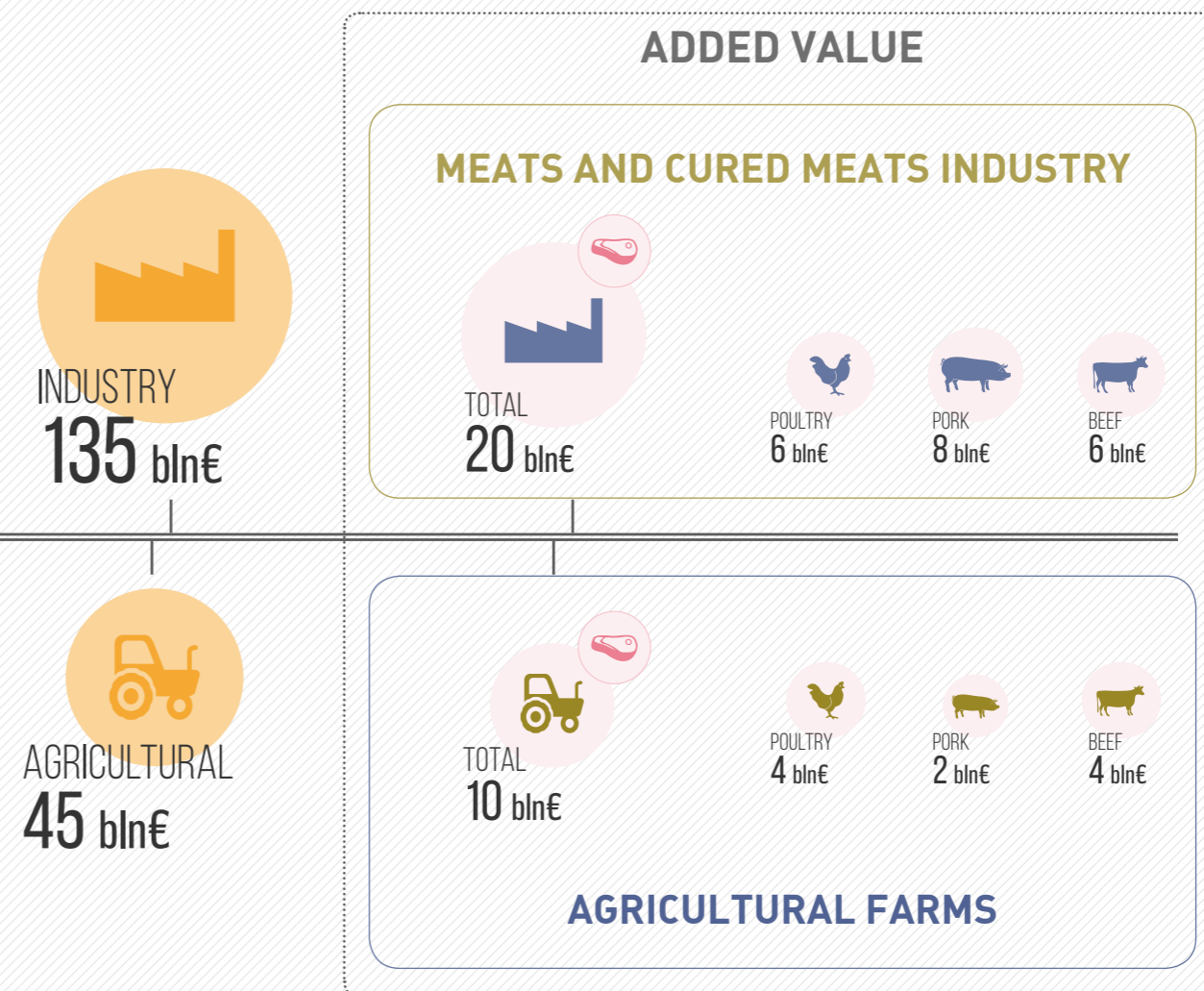
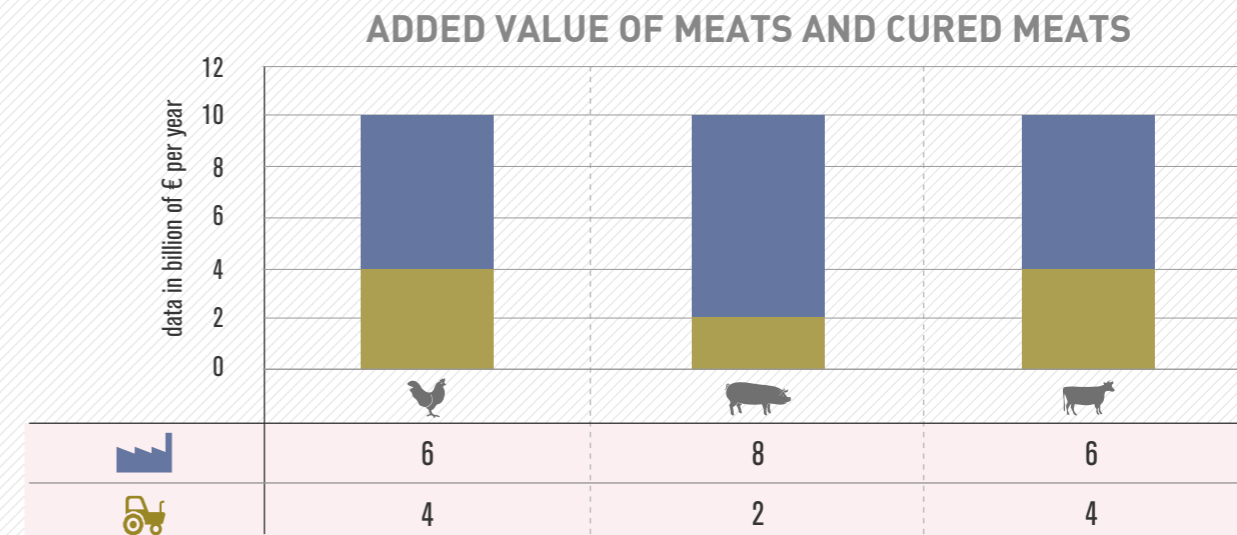
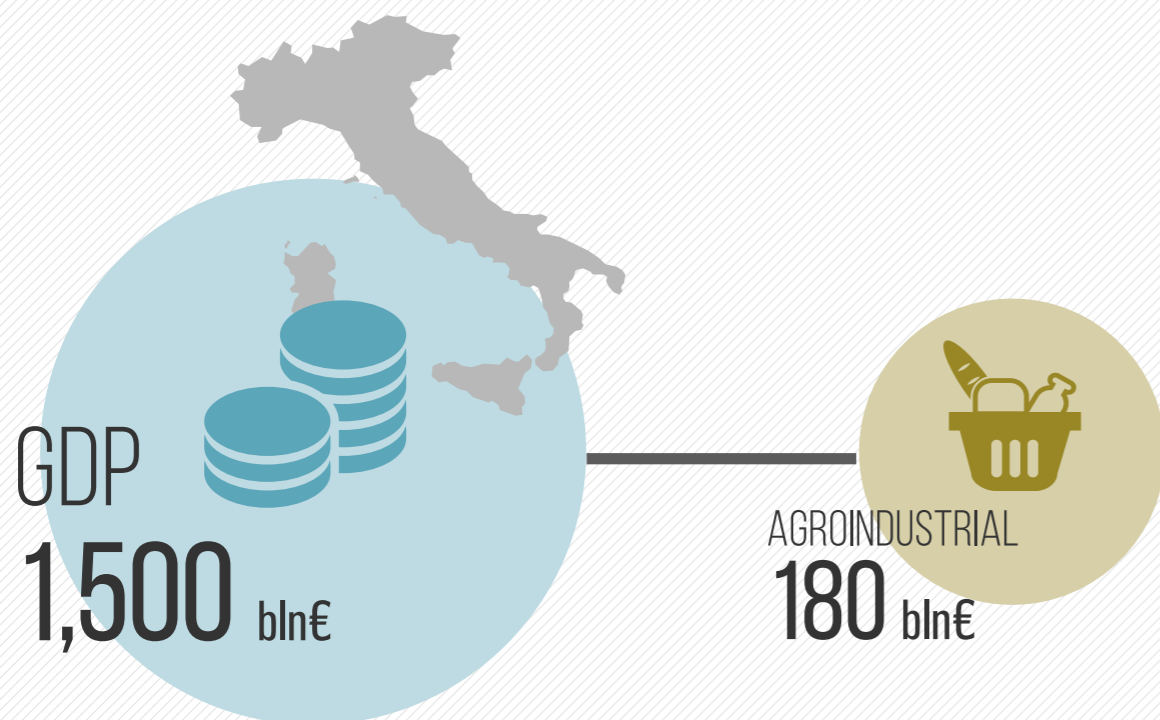
THE MEAT SECTOR

DATA IN BILLIONS OF EURO PER YEAR



The food and agriculture sector in Italy contributes to about 10-15% of the annual gross domestic product, with a total value of about **180 billion Euro**. Of these, about **30 are derived from the meat industry**, including both the agricultural and industrial sides.

The three main sectors (beef, poultry and pork) generate a turnover of **around 20 billion Euro per year, resulting from the processing industry**. The three sectors have substantial differences in terms of size, placement of **both** the area and exchange with other countries.



The macro-economic dimension of the meat sector in Italy. The information presented is intended to provide an overall indication and are the result of revisions of statistical data released by ISMEA* and ISTAT** that should be consulted for more detailed information or in-depth examination.
*www.ismeaservizi.it **www.agri.istat.it

COMPANIES ORGANIZATION



As with many Italian production sectors, the food industry has very complex and organised structures, often small to medium in size and family-run. In fact the trend is slowly changing and the market is moving towards progressively larger and better organised businesses. These are “weak” but unmistakable signals, seen not only in Italy but also in other EU countries. The growth in size has been largely due to the reduction in the number of active businesses which has affected both the agricultural sector and the first and second transformation industries⁶.

Istat data shows that in 2013, the number of livestock farms were approximately 142,000 units: the increased presence of cattle is mostly found in the northern regions, especially Lombardy, Veneto, Emilia-Romagna and Piedmont (compare table next pages).

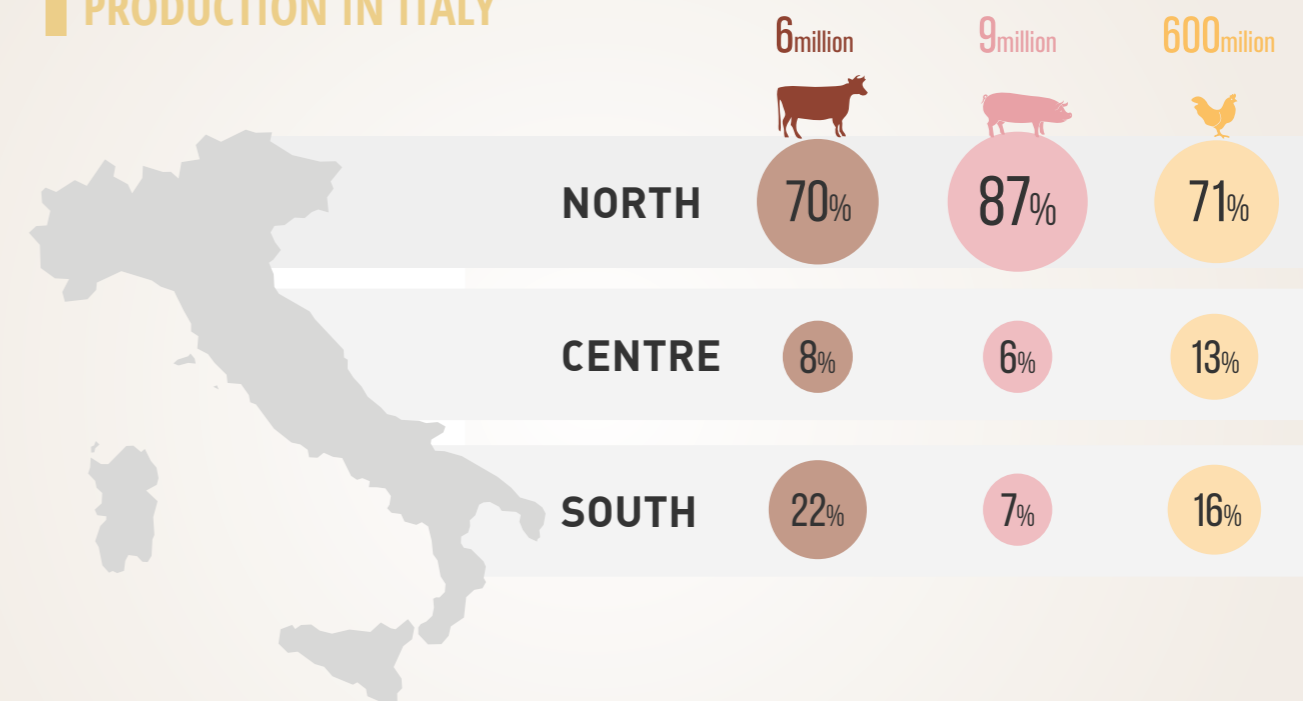
⁶ INEA, 2013 State of Agriculture Report
[\[http://dspace.inea.it/bitstream/inea/637/1/Rapporto_stato_agricoltura_2013.pdf\]](http://dspace.inea.it/bitstream/inea/637/1/Rapporto_stato_agricoltura_2013.pdf)



GEOGRAPHICAL BREAKDOWN	NUMBER FARMS THAT BREED ANIMALS	BEEF		PORK	POULTRY			
		TOTAL	MILK COW	TOTAL	TOTAL	MEAT CHICKEN	HEN	OTHER POULTRY
NORTH	97,794	59,655	21,624	33,402	4,737	2,045	908	1,784
CENTRE	80,519	27,451	2,352	51,425	1,643	675	313	655
SOUTH	93,613	44,507	3,963	48,410	696	274	380	42
ITALY	271,926	131,613	27,939	133,237	7,076	2,994	1,601	2,481

Livestock farms with different species of livestock. Geographical breakdown for the year 2010. Source: National data bank (BDN) of the Zoo-prophylactic Institute of Teramo

LIVESTOCK PRODUCTION IN ITALY



Distribution of Italian livestock.
 Data source: Istat, year 2015 (beef and po sector), Unitalia, 2016 (preliminary data for poultry sector)



Their physical size alone is not enough to grasp the complexity of the universe of Italian farms and their dynamics. To this end, the last General Agricultural Census⁷ offers another dimension, the economic one (DE).

⁷Istat, 6th General Agricultural Census – The Italian agriculture Atlas, 2010. Published in March 2014, <http://www.istat.it/it/files/2014/03/Atlante-dellagricoltura-italiana.-6%C2%B0-Censimento-generale-dellagricoltura.pdf>

	FARM INCOMES CLASSES			
	< 8,000 €	8,000 - 15,000 €	> 15,000 €	TOTAL
NORTH-WEST	42.0	13.0	45.0	100.0
NORTH-EST	47.2	12.6	40.2	100.0
CENTRE	66.5	10.4	23.1	100.0
SOUTH	72.4	10.1	17.5	100.0
ISLANDS	60.7	10.9	28.5	100.0
ITALY	62.8	10.9	26.2	100.0

Italian farms per economic dimension (DE) – Values expressed in %
Source: Table 1.1 p. 78 of 2013 General Agricultural Census

The analysis shows that 63% of companies, while playing an important role on the land (in terms of presence, environmental supervision and care of the land and landscape) from a strictly economic point of view produce a very low income (< 8,000 EUR / year), which must therefore be integrated with other complementary activities. Diversification of activities is, in fact, an important tool used by farms to achieve economic stability.

> The importance of the “agricultural” dimension in Italian food and agriculture

The statistical data does not reveal the unmistakable characteristic of the Italian agricultural heritage: its “agricultural dimension”, the cultural values, identity, traditions and social membership that it represents.

>> Farmers by tradition

The Italian territory is historically characterised by a plurality of agricultural systems with a great diversity of landscapes, agro-ecosystems and socio-economic conditions, that over time have produced a multiplicity of economic realities, production facilities and relative markets.

About 80% of the half a million Italian farms are small businesses, to which must be added the countless practices of auto consumption. This diversity and ubiquity represents the Italian specificities, on which rests the heritage of great wealth and agricultural biodiversity production that also represents the safest method to maintain the mountain and hill areas.

Some peculiar characteristics of peasant agriculture are fundamental: the different ways of family run businesses, the community and co-operative work-related land, local roots and the various agricultural practices of sustainable conservation, the control of the reproductive cycle through the reproduction of local seeds, traditional varieties and native breeds.

Practices and methods that are now found in many forms of agricultural reality, of family tradition or new settlement, in every Italian region.

>> Land protection

The presence of these realities is very important and serves to guarantee the preservation and protection of the territory, to reduce the continuing depopulation of agricultural areas by bringing back work and employment, thereby reducing the environmental costs (hydro-geological, the maintenance of the soil and the protection of biodiversity), reconstructing the social and rural landscapes, ensuring the presence of people in places that might otherwise be abandoned.

Land conservation is achieved mainly by using a wide variety of farm protection policies: It has been seen that severe hydro-geological instability increased when those agricultural activities that were carried out in full harmony with the territory stopped.

The cultivated land, in fact, along with forests, play an essential role in stabilising and consolidating the slopes and holding back the river banks, thanks to



their high absorption capacity, helping to prevent landslides and land erosion.

The protection of the territory by the farmer, whose maintenance work is essential especially in the marginal areas of the hills and mountain, must therefore be guaranteed by a proper environmental protection policy, supporting and promoting the activities of the farmer. In the mountains cattle and sheep breeding is an excellent way for monitoring activities through the careful management of pastures.

Since there is a plurality of patterns of agriculture, for the purpose of proper land management, depending on the different production realities, appropriate and diversified measures are necessary, recognising agriculture as a socio-economic model and consequently identifying standards that are appropriate for it.

European agricultural policy (PAC) - the set of rules that the European Union, since its inception, has sought to create, by recognising the central role of agriculture for an equal and stable development of its member countries⁸, is specifically intended to help farmers not only to produce food but also to protect the environment, improve animal welfare and to maintain rural communities economically.

>> Organised agriculture

The fragmentation of farms makes economic sustainability difficult for them and the entire food farming sector, with the risk that farmers and their families abandon the land.

For this reason, the tendency to organise themselves into cooperatives or small and big industries must be judged positively, since the objective is to ensure the economic sustainability of the companies themselves, while maintaining their original identity. This trend is highly developed in countries that make agriculture a source of wealth, and allows for the organisation of supply chains which, as can be seen, are those that provide the most control over the products. Finally, a fundamental aspect of an "organised" system is the ability to better integrate the various related production systems (e.g. Meat, milk, cereals), thereby maximising production efficiency.

This kind of agriculture, sometimes mistakenly called "professional", is the most representative of the main meat production chains in Italy.

⁸ European agricultural policy (PAC): http://europa.eu/pol/agr/index_it.htm



HISTORICAL AND SOCIAL ASPECTS OF MEAT CONSUMPTION IN HUMAN HISTORY

Edited by Massimo Montanari and Giovanni Sorlini

The history of man has been, first of all, to continually search for answers to his food needs, at a time when food was the essential reason for survival, the first daily and unavoidable necessity. How can we not think of the vivid images of cattle kept in the French caves of Lascaux, whose meat was already at that time probably the main source of livelihood for the European primitive man?



At some point in history, however, the pure need for food transforms into the pleasure of farming, an element constituting a particular social affiliation; a radical transformation of its original function to the exact opposite, represented by the research of hedonism and cultural belonging. This dual polarity, or rather the change in the function of meat, unfolds a complex history, closely linked to power relations and social inequalities that went with it. The history of this food is closely interconnected to mankind's history, which constitutes one of the basic elements, in each case either the cause or the effect of human affairs.

When trying to identify some of the stages that we consider particularly significant, the first that

seems appropriate to recall is the fall of the Roman Empire: the centuries III-VI AD, the dissolution of this millennial cultural horizon has indeed given way to the establishment of new political and administrative realities, the turbulent mixing of peoples and cultures, the depopulation of the countryside and the breaking up of the patterns of production and food distribution, present at the time.

In this moment in history we are witnessing the depletion of the food model based on the cultivation of the fields, determining the general conditions of food scarcity and, with them, an unquestionable period of hunger. In this period of history in fact the tes-

timony of war, famine and pestilence are widely documented by historians of the period and with them especially the general demographic decline of the European population.

The European man of the III-VI century, from consumer of products obtained from the cultivation of the fields, the typical model of the Roman period, differentiated himself, by significantly using products from the forests, which in those centuries grew heavily at the expense of agricultural land, often not able to be used due to the demographic imbalances of that difficult period.

The need to develop a new model of consumption that combined the traditional model of the cul-

tivated ager with the exploitation of uncultivated areas typical of the barbaric matrix (the so-called saltus, a term used by the Romans, not without a pejorative connotation to the peoples beyond the Alps), determined the process of more food supply systems which together formed the foundations of a food model in which we Europeans still recognise ourselves today.

For meat, we can say that the controlled production model typical of the Romans and based primarily on the rearing of small ruminants in confined spaces, is combined with the spontaneous model of Germanic and Celtic matrix, based on the exploitation of virgin nature and uncultivated spaces, ideal for example for hunting, or the natural breeding of wild pigs.

In this historical phase, in which various food supply systems in different and distant historical and cultural origin are integrated and the cultivation of the fields becomes more difficult because of demographic imbalances, meat becomes once again a mainstream food, the food value "par excellence".

If the Latin doctor Cornelius Celsus considered bread to be the absolute best food, the icon based on the cultivation model of the fields, his colleague Antimo of the sixth century did not



hesitate to consider meat as the "king of food", showing a particular sensitivity to pork; so dear to the powerful of the time, the court of Theodoric in Ravenna. In other words, Antimo was already influenced by food supply models based on the exploitation of uncultivated areas, particularly important in that historical period. Again ager versus saltus.

In later centuries, characterised in Europe by the consolidation of Christian thought and, with it, the symbolism of oil, wine and bread as a food symbols of purity and rectitude, meat however does not lose its core value. In the Europe of the post barbarian invasions, in fact, there seems to finally have been determined an unprecedented and definitive integration between the culture of bread and that of meat, so that both end up enjoying the statute

(no less ideological than material) of primary and indispensable food.

In the Christian era, the polarity between the Roman and barbaric model overlaps with that of the "monastic" and "aristocratic" model: between them they play for the leading role of cultural hegemony. A comparison with many different sides and meanings, where social ethical values clash with those of religious morality, the reasons for fasting with those of power and strength.

How can we not consider Charlemagne to be the archetype of this cultural tension? The first emperor who contributed to the modern picture of Europe left us a historical trace, constantly torn between images of war and an abundance of food, that hinged on the consumption of

meat and the Christian ethic of moderation. The first monarch who made meat consumption an element of his powerful iconography, without denying the values of frugality and moderation in food consumption of the Christian religion that he had embraced, and that animated his political actions.

From the start of the eighth-ninth century, thanks to this successful integration between the agricultural food model and that based on the exploitation of forests, the demographic curve starts to rise again, and with it, deforestation, land reclamation and the colonisation of uncultivated areas to build new agricultural set-

tlements. Again, a new intensive agriculture at the expense of forestry was the inevitable reaction to the growing demand for food, especially proteins, and, with it, a question of civilization and progress: from then on, the concepts of natural and wild-related with regards to the food industry are relegated to the margins of production and its dominant ideological values.

It is the beginning of a big boom, which probably continues to this day. But agrarian expansion brings with it new tensions and social inequalities, conflicts born from the search for fertile lands, duties, claims and property rights, as well as natural

disasters, as frequent then as today. Here the countryside-cities model is born, with all the implications related to the distribution and the storage of food on a large scale.

It is a model that ensures stability and the balance of noble protein sources and culminates in the thirteenth century, especially after its progress in agricultural production techniques and more favourable weather climates. This nutritional well-being, the abundance represented by the new wide availability of meat, reaches such a level that even the Pope Innocent III feels the need for an indictment against the sin of gluttony and the new delica-



Vincenzo Campi, La Fruttivendola, 1580, Oil painting on canvas, Pinacoteca di Brera, Milano

cies that the insane passion of men has managed to invent.

“Wine, beer, or the good things that come to us from the trees, the earth, the sea, the sky are no longer enough: you want spices and perfumes”.

It is in this century, in fact, that gastronomy is born and its written codification of food recipes, due precisely to the abundance of flavours and gastronomic delights that the cultivation techniques and the expansion of the spice and food markets allowed.

Over the centuries of food abundance meat consumption represents a status symbol, particularly in the fourteenth century, during which there was a reduction in cereal crops in favour of pasture and forage crops. It is in this period that farms specialised in livestock breeding are born, with its focus on the short and long-range meat trade. It is the so-called carnivorous period of Europe, like the lucky definition that Braudel has accustomed us to call it. A period of happy and individual life, which will last until the sixteenth century.

The repeated pleas of the ecclesiastical community to eat less, at least in certain periods of the year, more than being a deterrent, indirectly confirms the centrality in the role of meat in the food system of the time.

In modern times, with the emergence of the middle classes and the industrial revolution, meat reaches larger sections of the population. In the wider horizon of a new food democracy, the concept of quality and industry standards were born; with the progress of scientific knowledge, the nutritional properties of meat and its relationship with our health were better associated.

In the past century, efficiency and technology, in a context of even greater food availability, the new model of thinness as the ideal beauty of a powerful body, with perfect productivity, speed and efficiency is finally imposed; even in this new context, the unstoppable rise in consumption of meat continues, without losing the symbolic value of a conquered dignity to social classes who once were hungry.

And today? Meat is always at the centre of this story of hunger and abundance. Forgotten the famine of the past, we live with abundance and its problems. In this polarisation between two extremes that have always chased each other in history, today the real challenge is that of moderation and balance. The rediscovery of the original value of the meat as a good and necessary nourishment and, with it, the word “diet”: a term invented by the ancient Greeks to design

the daily food regimen (but more generally the rule of life): knowledge necessary for a conscious, varied and balanced food consumption, that each individual has to build on their personal needs, attitudes and knowledge of himself.

Unlike today, where this word expresses, more superficially, the simple restriction or deprivation of particular foods, often following fashions or models imposed by consumer society. This is the role of meat in the modern diet, a precious and irreplaceable food that finds its rightful place in the Mediterranean Diet, as intended by the wise fathers of our civilisation and not that of some propagators of today, who are more interested in market dynamics rather than our true cultural identity.

THE COST FOR CONSUMERS



At a time when the economic crisis is the protagonist of everyday life for businesses and households, we have tried to present a brief insight into the importance of the cost of food in household consumption. It is indeed interesting to note that the proportion spent on food has declined significantly over the past four decades, at the expense of items such as housing or recreation.



COMPOSITION OF COST	EUROPE 27	EUROZONE	FRANCE	GERMANY	ITALY	UNITED KINGDOM	SPAIN
Food products and non-alcoholic drinks	-1.4	-1.4	-2.3	-1.0	-0.9	-1.1	-3.3
Alcoholic drinks and tobacco	-0.9	-0.8	-1.4	-1.1	-0.3	-1.2	-0.6
Clothing and footwear	0	-0.6	-0.5	-0.7	-1.0	2.6	-0.5
Housing, water, electricity and fuels	-1.7	-0.9	-0.6	-0.5	-1.7	-3.7	0.6
Furniture, and household services	-0.3	-0.5	0.1	-1	-0.6	0.7	-0.2
Health services	0.2	0.3	0.5	0.7	0.1	-0.4	0.5
Transport	-0.3	-0.5	-1.4	-1.4	0.8	-0.1	0.4
Communication	2	2.2	2.4	2.1	2.8	1	2
Recreation, show and culture	2.4	1.8	3.7	2.1	0.7	5.9	1.8
Education	-0.1	-0.1	0	0	-0.1	-0.5	-0.4
Accommodation and food services	-0.3	-0.1	-0.3	-0.4	0.6	-1.4	-2.3
Other good and services	0.3	0.4	-0.1	1	-0.3	-1.1	2.3

Differences in the composition of household basket expressed in percentage [%] for the year 2007 compared to 1995*

Figures for Europe 27, the Eurozone and the United Kingdom are referred to year 2006

Source: Elaboration made on data from National Accounts Eurostat.

* Martini E., 2009. La struttura dei consumi delle famiglie europee nel periodo 1995-2007

MEDIAN MONTHLY EXPENDITURE (€)	2013		2014	
	€ 2,168		€ 2,110	
AVERAGE MONTHLY EXPENDITURE (€) (=100%)	€ 2,471	%	€ 2,489	%
Food products and nonalcoholic drinks	€ 439	18%	€ 436	18%
Non-food products	€ 2,032	82%	€ 2,052	82%
Alcoholic drinks and tobacco	€ 43	2%	€ 43	2%
Clothing and footwear	€ 110	4%	€ 114	5%
Housing, water, electricity and fuels, of which:	€ 920	37%	€ 913	37%
<i>Furniture, and household services</i>	€ 93	4%	€ 102	4%
<i>Health services</i>	€ 96	4%	€ 109	4%
<i>Transport</i>	€ 260	11%	€ 257	10%
<i>Communication</i>	€ 70	3%	€ 66	3%
<i>Recreation, show and culture</i>	€ 121	5%	€ 121	5%
<i>Education</i>	€ 12	0%	€ 14	1%
<i>Accommodation and food services</i>	€ 119	5%	€ 110	4%
<i>Other good and services**</i>	€ 190	8%	€ 202	8%

Median and average monthly expenditure*** of the sample households. Years 2013-2014, valued in Euro. Source: Istat, 2015 ****

** They include goods and services for personal care, personal effects, social care services

*** The median monthly expenditure is the spending value for consumption that divides the distribution frequency into two equal parts (50% of families have a spending value for consumption that is lower or equal to the median, 50% have a higher value). Since consumer spending has an asymmetrical distribution, the median is always below the average value. The average monthly expenditure, however, is calculated by dividing the total expenditure by the number of families living in Italy.

**** Istat, 2015. year 2014 – The expenditure for household consumption.

As part of food consumption, meat contributes to about 20-23% of the “monthly bill” of an average family.

	NORTH		CENTRE		SOUTH		ITALY	
	2013	2014	2013	2014	2013	2014	2013	2014
MEDIAN MONTHLY EXPENDITURE (€)	2,441.1	2,368.3	2,296.5	2,218.0	1,690.5	1,696.9	2,168.2	2,110.5
AVERAGE MONTHLY EXPENDITURE (€) (=100%)	2,763.9	%	2,787.6	%	2,593.7	%	2,608.5	%
Food products and non-alcoholic drinks	435		434		444		449	
Bread and cereals	74	17%	76	18%	73	16%	72	16%
Meat	96	22%	93	21%	102	23%	104	23%
Fish and fish products	30	7%	31	7%	38	9%	37	8%
Milk, cheese and eggs	61	14%	61	14%	58	13%	58	13%
Oil and fats	14	3%	14	3%	16	4%	14	3%
Fruit	40	9%	39	9%	40	9%	41	9%
Vegetables	57	13%	58	13%	61	14%	62	14%
Sugar, jams, honey, chocolate and sweets	20	5%	19	4%	18	4%	19	4%
Ready-to-eat and other food preparations	11	2%	11	3%	9	2%	10	2%
Coffee, tea and cocoa	12	3%	12	3%	12	3%	12	3%
Mineral water, non-alcoholic drinks, fruit and vegetables juices	21	5%	19	4%	19	4%	20	4%

Contribution of various items to the monthly food expenditure expressed in absolute terms [€] and percentages [%]. Source: Istat, 2015.

In this context it is interesting to look for a relationship between spending and the adoption of sustainable diets “such as, for example, the Mediterranean nutritional model. Income levels are indeed often used to determine the quality of life and the type of food eaten.

Many authors⁹ have developed scientific studies to this regard and in this document too, we also decided to present a reinterpretation of the public data in order to provide an additional perspective. Using the same approach as with the environmental information, the amount of daily food recommended by INRAN has been multiplied by the average prices of individual product categories, as reported for the month of February 2016 by the Observatory for Prices and Tariffs¹⁰.

The conclusion to which it arrives, which is clearly shown in the “economic hourglass” graphic is one that, by following a diet with the “correct” portions, the meat category does not have higher costs than fruit and vegetables, for which the unit cost is lower, but suggested consumption is greater.

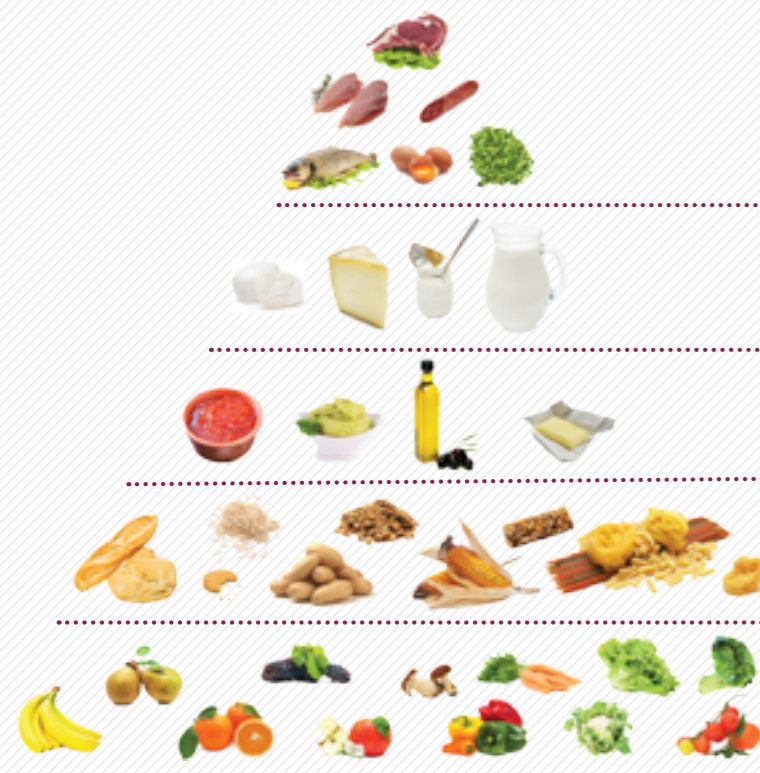
⁹ Among the most active authors is Drewnowski who in his works, some of which are cited in the bibliography, show the relationship between the cost of food, nutritional aspects, people’s income and lifestyle

¹⁰ GOODS AND SERVICES OF MASS CONSUMPTION - Prices recorded for food, fish and fruit and vegetables - February 2016. Last accessed: May 2016. (http://osservaprezzi.sviluppoeconomico.gov.it/index.php?option=com_content&view=article&id=22:beni-e-servizi-di-largo-consumo&catid=14:livelliprezzi&Itemid=138)



THE ECONOMIC HOURGLASS

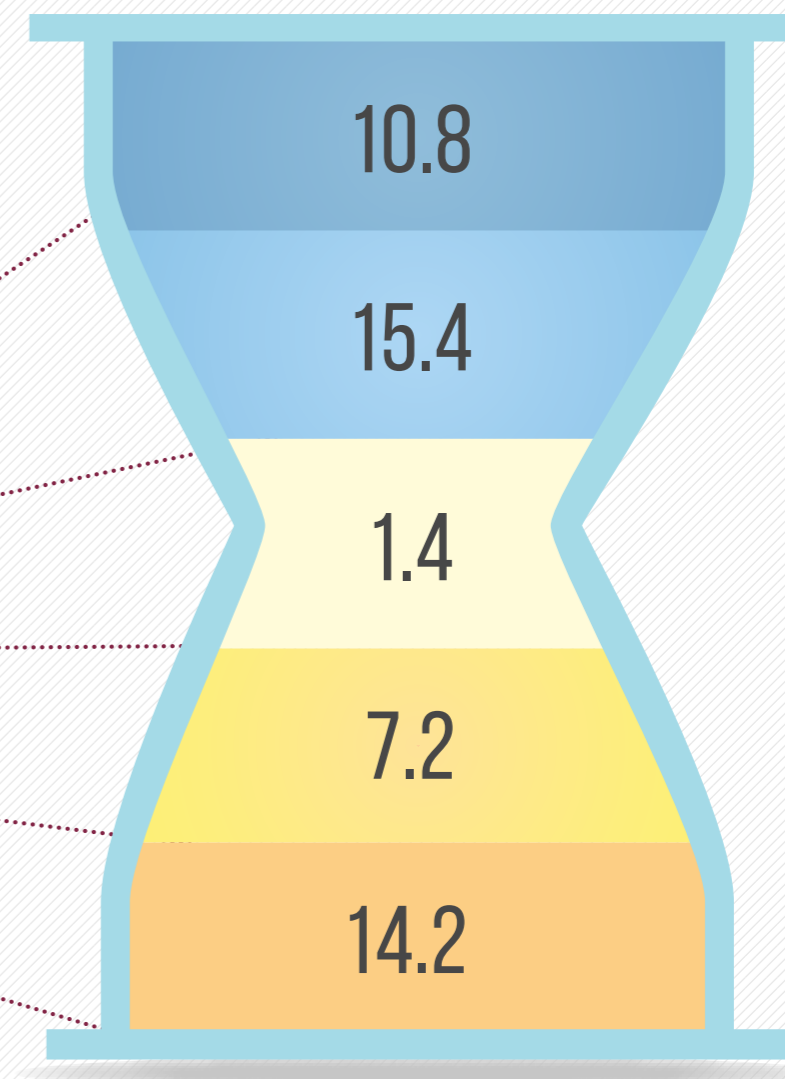
THE FOOD PYRAMID



WEEKLY PORTIONS

- 14 MEAT, FISH, EGG
LEGUMES, CURED MEATS
- 24 MILK, YOGURT, CHEESE
- 21 CONDIMENT, OIL, FAT
- 51 BREAD, PASTA, RICE
BISCUIT, POTATO
- 35 FRUIT, VEGETABLE

WEEKLY COST (€)



Economic Hourglass expresses the weekly cost of the diet suggested by **INRAN guidelines (now CREA - Alimentazione e Nutrizione)**, in analogy to what was described for the construction of the environmental hourglass's scenario B (intermediate). The weekly economic expense has been elaborated on the basis of the data provided by the Observatory for Prices and Tariffs, relating to the cities of Turin, Milan, Naples and Palermo, of February 2016.

THE IMPORTANCE OF COST IN THE CHOICE OF CONSUMERS

As reported in the study "Consumers Purchase Behaviours" conducted by Nielsen - on behalf of Elanco Animal Health¹¹, price is one of the variables that most influence the choice of food, and more in general consumer behaviour.

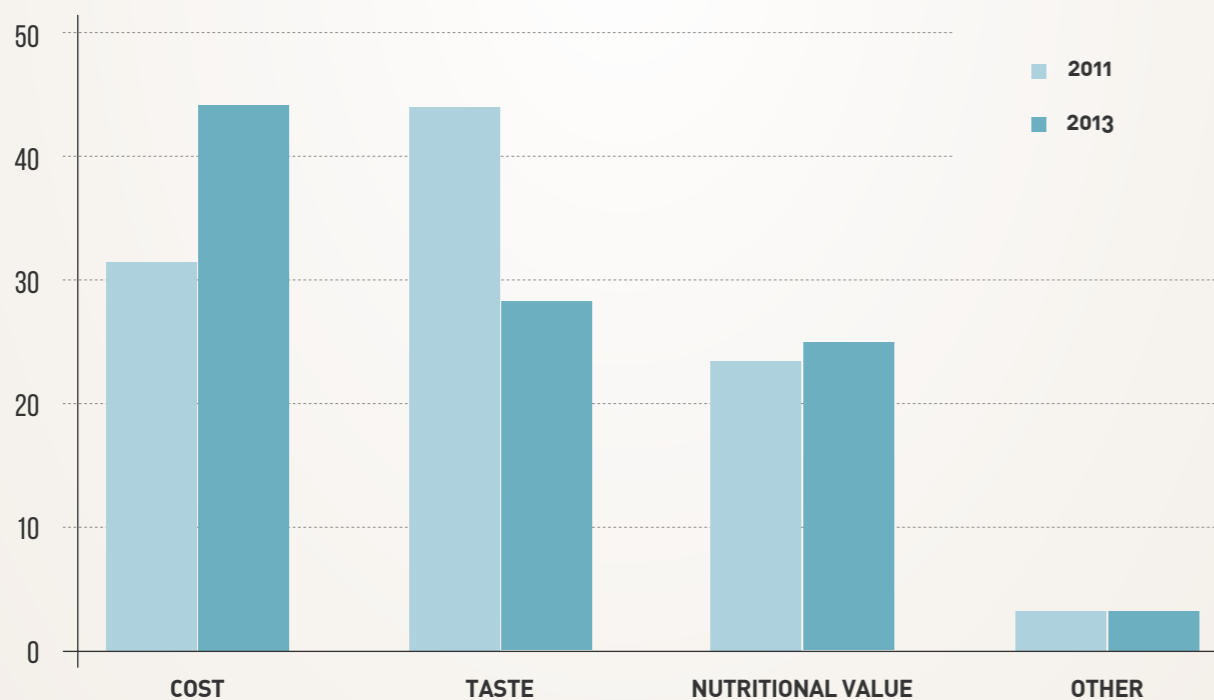
The analysis of the data for consumer spending, provides a realistic picture: consumers are increasingly careful about how they spend their money and the

cost of products constitute the main factor in the choice of food. In the spring of 2013, when the survey was done, Nielsen interviewed 13,000 Americans and British consumers asking them what was the main factor that influenced their choice when buying: cost was found to be the most significant answer.

To follow were "taste", therefore the importance of the most enjoyable aspect of food and the "nutritional levels", i.e. the at-

tention to caloric intake. In the category "other" are the desire to buy organic products, the concerns related to OGM and other variables, but these only account for 2% of consumers' purchasing decisions.

¹¹Taken from: "Elanco, 2014. "Movimento Enough - La nostra battaglia per la sicurezza ambientale di domani", pag. 16-17 "Solution#2: Ensuring consumers' ability to choose" (http://www.sensibletable.com/pdf/enoughreport_italian.pdf)



The cost of products is the factor that counts most today for consumer choice. Source: Nielsen

FREQUENTLY ASKED QUESTIONS

SOCIAL AND ECONOMIC ASPECTS OF MEAT CONSUMPTION



WHAT IS THE ECONOMIC VALUE OF FARMS IN ITALY?

Meat economic sector in Italy generates an economic value of the order of 30 billion Euro per year, compared with about 180 of the entire food sector and to 1,500 of the national GDP. The three main sectors (poultry, cattle and pig) generate an approximately equivalent value.

The differences lie in the analysis of the trade balance: the beef industry imports about 40% of its total requirement, the poultry industry is practically neutral, the cured meat industry is characterised mainly by exports of finished products.

In a country that, like Italy, is strongly affected by the effects of the global crisis, the economic role of the production of meat and dairy products on the one hand is

al production, on the other plays an important role in various local economies, which largely contribute to the national total. Livestock farming is also a major source of income in the rest of the world.

WHY IS MEAT SO EXPENSIVE, COMPARED TO MANY OTHER FOODS?

As part of food consumption, meat contributes to about 20-23% of the total monthly "cost" of an average family.

The meat production chain is complex, and it is necessary to take into account the different aspects, from feed production, farm management, to the slaughter and subsequent meat processing, as well as the distribution and preservation. The presence of these phases, each of which is key, causes the cost of meat to be higher, compared with oth-

er foods of the same weight, especially if some foods are more "simple" and characterised by a short production chain.

Meat is more expensive when compared to other foods but this is not true in an absolute sense: take for example poultry, who surely have the best price to quality rapport.

Meat generally does not lead to higher costs if consumed according to the amounts suggested by the nutritional guidelines of the Mediterranean Diet, a concept well described by the "economic hourglass" (calculated starting from the same assumptions of the environmental one), which expresses the weekly cost of the diet recommended by INRAN guidelines (now CREA - Alimentazione e Nutrizione).

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REVIEW

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FOOD WASTE

- 🌱 WHAT FOOD WASTE IS
- 🌱 WHY AND HOW WASTE IS GENERATED
- 🌱 HOW MUCH FOOD IS WASTED?
- 🌱 WASTE IN THE MEAT CHAIN
- 🌱 HOW TO REDUCE WASTE

IT IS APPROPRIATE TO INTRODUCE THE CONCEPT OF SOCIAL VALUE TO IDENTIFY CORRECTLY FOOD WASTE

THE MEAT SECTOR IS AMONG THE MOST VIRTUOUS AND ONE OF THOSE WHICH PRODUCE THE LEAST WASTE

CONSUMER AWARENESS IS CRITICAL FOR LIMITING WASTE IN THE DOMESTIC CONSUMPTION PHASE

IN THE EU EACH YEAR ABOUT 90 MILLION TONNES OF FOOD ARE THROWN AWAY, FOR AN AVERAGE OF 180 KILOS PER PERSON

Source: European Commission (DG ENV), Technical Report-054, 2010

The total amount of food produced worldwide each year amounted to **about 4 billion tonnes**, of which an estimated 30%, is lost before consumption. When the weight of the food waste is converted into calories, global food loss reaches **24% of the total production**.

The causes of waste can be found in a combination of effects, which belong both to the world of production, and to that of consumption: from the analysis of the causes, several initiatives aimed at reducing waste were born, with **particular attention to people's education**.

Without losing sight on the ultimate goal of reducing waste, an in-depth analysis of the available information makes it clear that we should avoid trivial errors, such as that of including in the waste both the actually wasted food and the inevitable non edible waste.

A correct interpretation of the concept of waste and its data should take into account the social value of food, separating what is recovered for purposes of human consumption from what instead is recovered as a resource. In order to try to shed light on these aspects, the data available in the publication "**Feed the hungry**" of the Polytechnic of Milan and the Foundation for Subsidiarity in Italy was analysed, being considered among the most up to date from a scientific point of view.

The agri-food chain is divided into several stages which include agricultural and/or industrial operations characterised by different degrees of efficiency and types of losses and waste. Starting with the losses of the primary sector and the food processing industry, it continues with waste that occurs during distribution, both in collective and commercial catering, up to those of

domestic consumption.

The elaboration of the available data shows how the meat sector is amongst those **less subject to the phenomenon of waste, both from the production side and from that of consumption**. Despite the inherently degradable nature of the marketed product, in fact, meat is the sector with the least social waste.

The reasons for this virtuosity are due to the structure and organisation of the supply chain, which allows the processing of by-products in secondary processes, but also the **economic, cultural and social value** attributed by consumers to these foods.

WHAT FOOD WASTE IS

The Commission for Agriculture and Rural Development of the European Commission has defined waste as:

“the quantity of rejected products from the agri-food chain that, for economic or aesthetic reasons, or because of the proximity of the sell-by-date, although still edible and therefore potentially useable for human consumption, in the absence of a possible alternative use, are removed and disposed of, producing negative effects in environmental terms, economic costs and lost earnings for companies”¹

Despite the “official” definition there are many publications which offer different interpretations, leading, as a result, to different estimates of the amount wasted.

In the preparation of this document, it was decided to consider the publication “Feed the hungry” according to which the availability of food, that is, the amount of food produced, has three destinations:

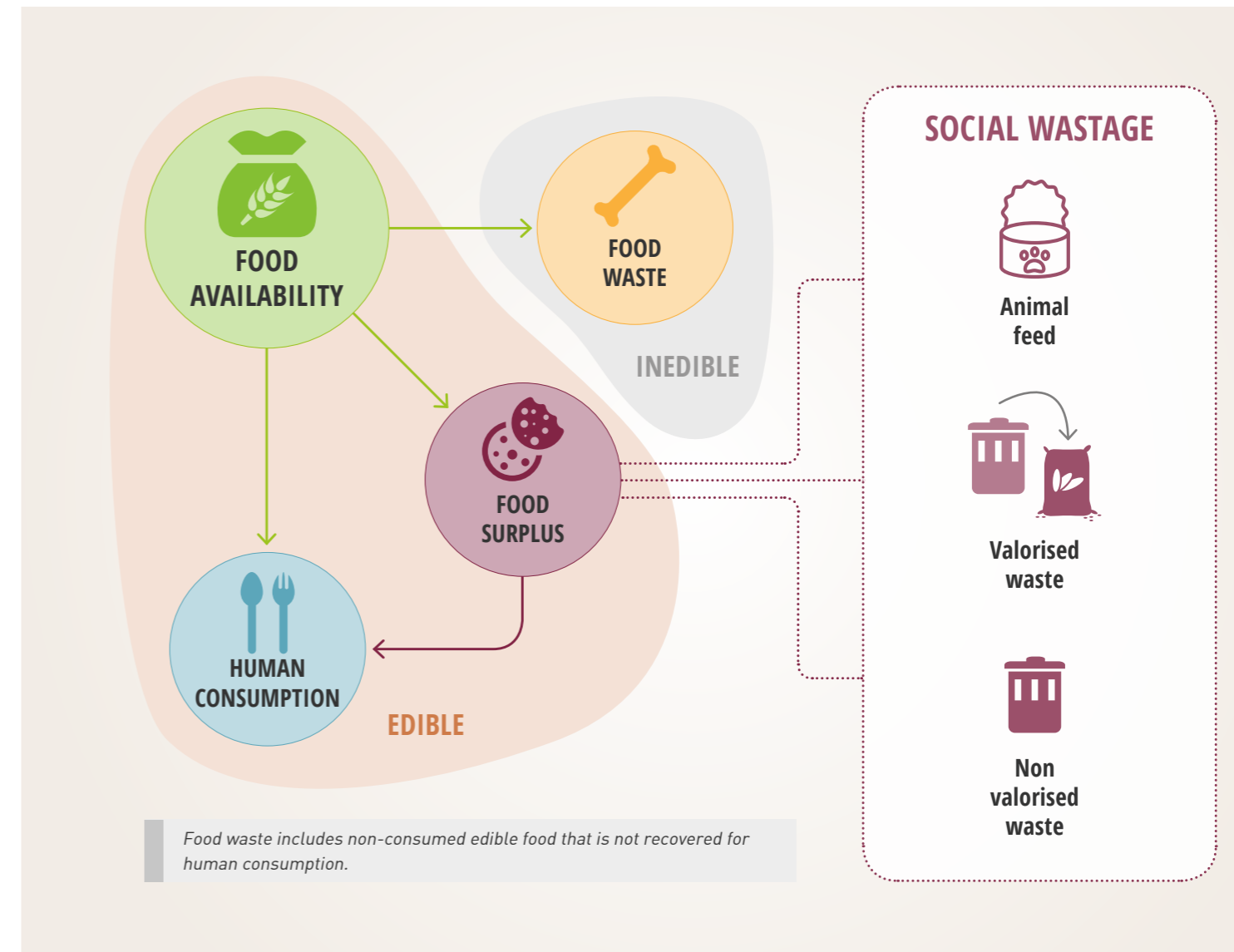
- **HUMAN CONSUMPTION:** component of edible food that reaches people to satisfy their alimentary needs;
- **FOOD SURPLUS:** edible part of the food that is produced, processed, transformed and distributed but not sold or consumed. Includes food purchased by the consumer but not consumed;
- **SCRAPED FOOD:** inedible components of food that includes the remains of the transformation process, damaged products, broken or sub-quality standards, the inedible parts (bones, fruit stones, etc ...).

The excess food can in turn be divided according to how it is managed and its uses:

- **HUMAN NUTRITION:** used to satisfy human needs, through sale in secondary markets, charities, food banks, etc.;
- ⊗ **ANIMAL FEED:** used to satisfy animal needs, through sale to kennels or zoos, or transferring them to companies dedicated to the production of feed;
- ⊗ **VALORISED WASTE:** used for the production of fertilisers;
- ⊗ **NON VALORISED WASTE:** not used and disposed of in landfills .

¹Commission for Agriculture and Rural Development - European Parliament, “Avoiding food wastage: strategies for improving the efficiency of the food chain in the EU”, 22nd June 2011

²Garrone P., Melancini M., Perego A., Feed the hungry, Guerini and Associates, Milan 2012



> Social wastage

According to this classification, it is therefore essential to introduce the **social value of uneaten food** to the definition of waste, so as to include only the food produced (and therefore edible) that is not used for human nutrition. The **inedible** parts should not be included in the definition.

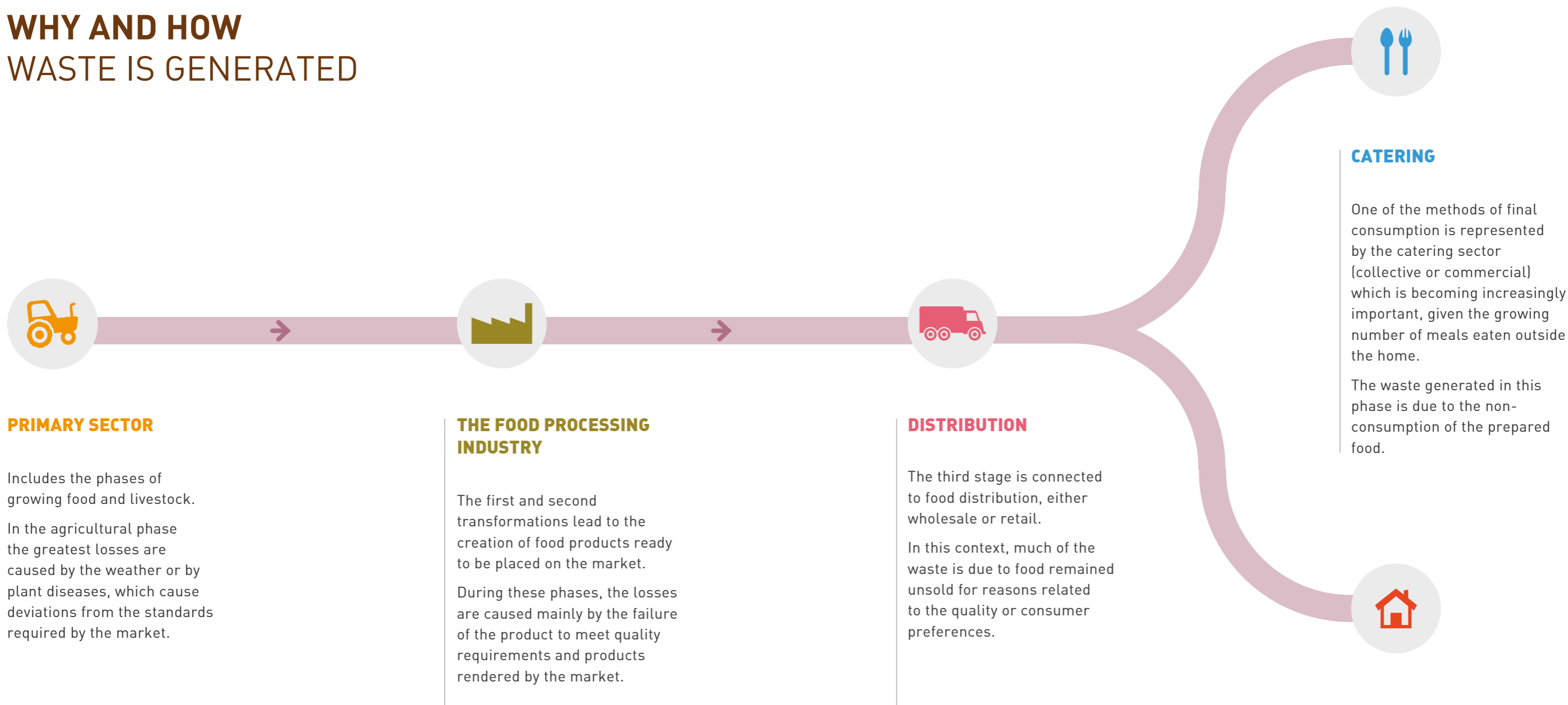
For completeness, it is noted that other scholars⁵ include in the definition of food waste the overfeeding of individuals, which is the difference between the amount of food a person consumes and the quantity really needed according to recommended calories,

involving even the overweight and obesity (and resulting pathologies) in the debate.

It was decided not to follow this approach because it is closely tied to nutritional aspects whose in-depth analysis is beyond the scope of this document.

⁵Cited as an example: Smil, 2004

WHY AND HOW WASTE IS GENERATED



PRIMARY SECTOR

Includes the phases of growing food and livestock.

In the agricultural phase the greatest losses are caused by the weather or by plant diseases, which cause deviations from the standards required by the market.

THE FOOD PROCESSING INDUSTRY

The first and second transformations lead to the creation of food products ready to be placed on the market.

During these phases, the losses are caused mainly by the failure of the product to meet quality requirements and products rendered by the market.

DISTRIBUTION

The third stage is connected to food distribution, either wholesale or retail.

In this context, much of the waste is due to food remained unsold for reasons related to the quality or consumer preferences.

CATERING

One of the methods of final consumption is represented by the catering sector (collective or commercial) which is becoming increasingly important, given the growing number of meals eaten outside the home.

The waste generated in this phase is due to the non-consumption of the prepared food.

FINAL CONSUMER

In the phase of domestic consumption wastes are mainly due to the overabundance of food bought, inability to consume within the expiry-date or proper food conservation.



The waste can take place during **production** (including distribution), or during **consumption** of the food.

However, it is to be noted that flows considered as waste may have very different destinations; while it is very likely that waste produced during the production and the distribution is intended for animal feed or in any case recycled (e.g. energy as biogas or transformation into compost), it is equally likely that the food wasted during the consumption stages is destined for disposal with significant impacts on the environment.

“ THE FOOD CHAIN IS DIVIDED INTO SEVERAL STAGES WHICH INCLUDE AGRICULTURAL AND INDUSTRIAL OPERATIONS CHARACTERISED BY DIFFERENT TYPES OF LOSSES AND WASTE. ”

HOW MUCH FOOD IS WASTED?



Literature and databases offer a lot of information which is not always comparable due to the different hypothesis that are at the base of the methods of investigation used. In Italy, the first survey on the subject was done in 2011 with the project Last Minute Market⁴ which led to an estimated annual waste of average 27% with an economic value of about € 1,700 per family⁵.

In 2012, the aforementioned study of the Milan Polytechnic has led to an estimated waste equal to 16% of consumption. This second publication is characterised by a greater degree of detail and you can analyse the characteristics of different food categories for the different stages of the supply chain.

The main considerations are:

- the stages where you have the greatest wastage are primary production and consumption;
- breeding is among phases characterised by minor social waste in percentage terms.

⁴Segrè AND Falasconi, 2011

⁵The results of the research were published in the report "The black book of waste in Italy: food" which estimated that, at household level 17% of fruit and vegetables purchased, 15% of fish, 28% of pasta and bread, 29% of eggs, 30% of meat and 32% of dairy products are wasted on average

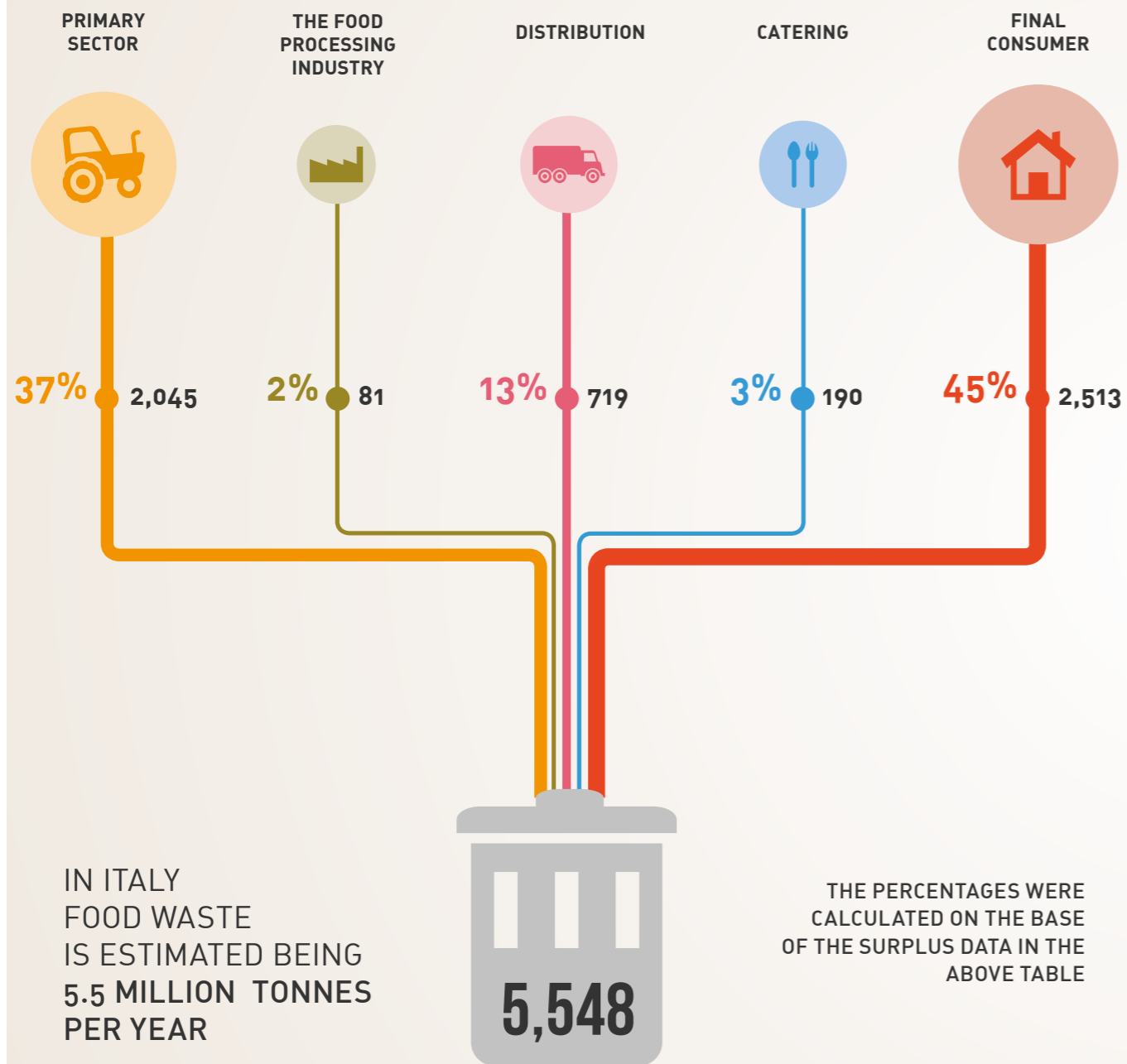


SEGMENT OF THE FOOD CHAIN		PRODUCTION [1,000T/YEAR]	SURPLUS		
			TOTAL [1,000T/YEAR]	OF WHICH SOCIAL WASTE [1,000T/YEAR]	
PRIMARY SECTOR	Fruit and Vegetables	41,728	2,187.1	1,948.2	89%
	Cereals	22,031	68.1	67.4	99%
	Breeding	14,989	52.5	20.3	39%
	Fishing	475	10.5	9.4	90%
	Total	74,223	2,318.2	2,045.2	88%
PROCESSING	Environment	34,641	118.2	36.1	30%
	Fresh	8,553	51.5	33.5	65%
	Frozen	1,592	11.7	11.4	97%
	Total	44,786	181.4	81	45%
DISTRIBUTION	Distributive centers	24,524	73.6	47.8	65%
	Points of sale	30,665	704.0	671.3	95%
	Total	55,189	777.6	719.1	92%
CATERING	Collective	869	86.9	73.8	85%
	Commercial	2,443	122.2	116.1	95%
	Total	3,312	209.1	189.9	91%
FINAL CONSUMPTION	-	31,268	2,513.5	2,513.5	100%
TOTAL	-	213,778	6,000.0	5,548	92%

Summary of the quantitative results of the survey "Feed the hungry" of the Milan Polytechnic. For the main phases of the chain the surplus (i.e. the edible part of the food that is not consumed) and social waste (i.e. the excess not recovered for human consumption) are reported. The data relating to Italy, are reported both in quantity (t/year) and percentage (for surplus is calculated relative to production and waste is calculated relative to surplus). (Source: Garrone, 2012)

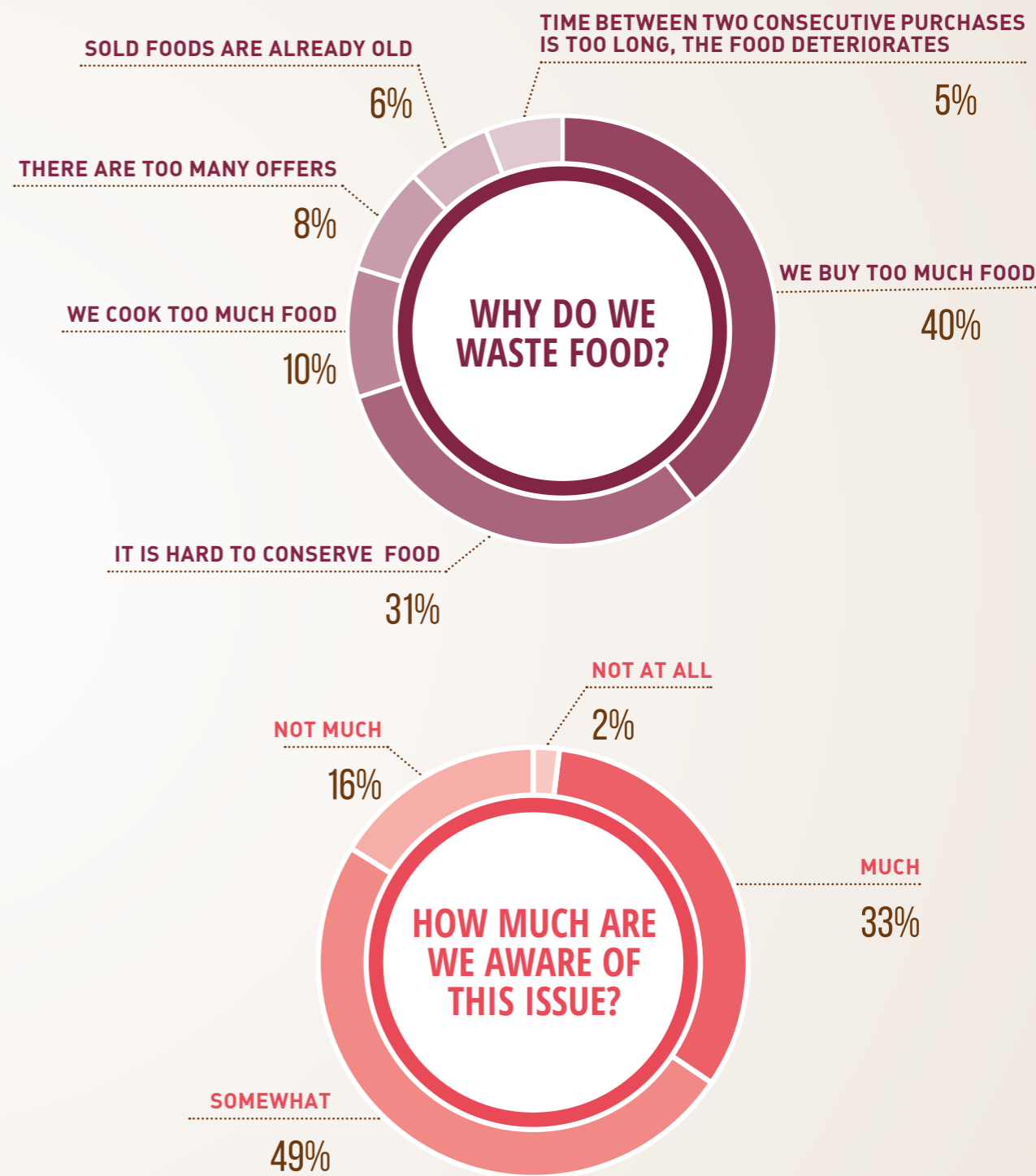


WHO WASTE MORE?



DATAS IN MILLION TONNES

SOME INVESTIGATIONS ON FOOD WASTE



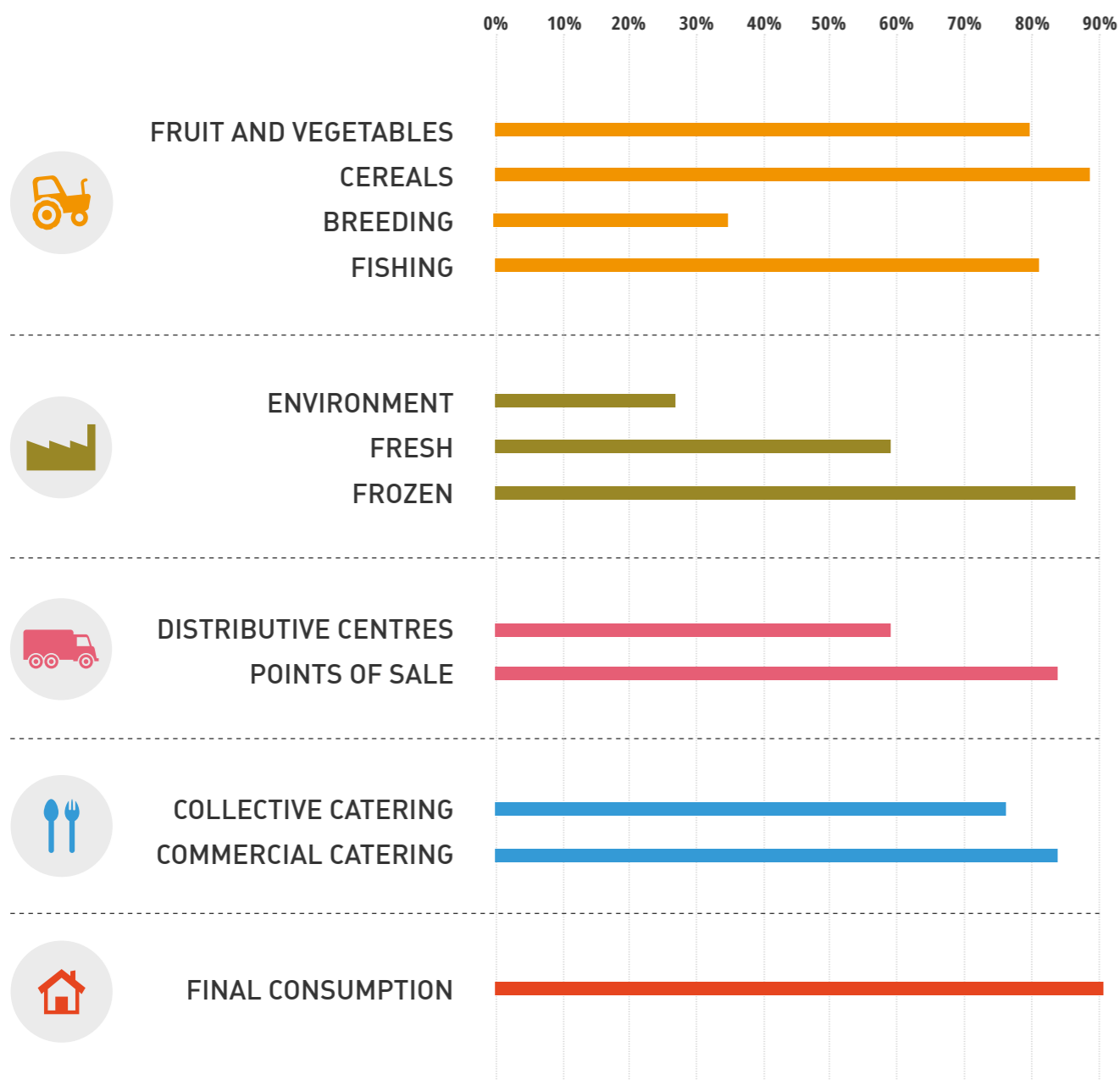
The Waste Watcher in 2013, made a study on consumers to investigate the main causes of domestic waste: The main reasons include those relating to the conservation and management of food supplies.
Source: Report Waste Watcher 2015



Source: processing of data relating to Italy and available in Garrone, 2012



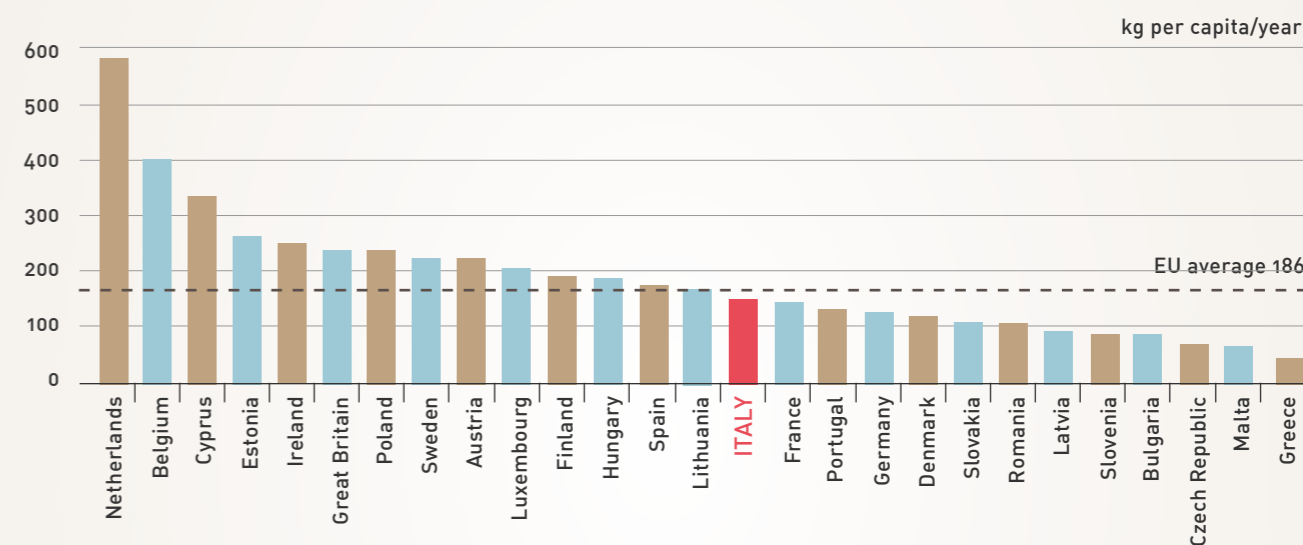
SOCIAL WASTE REPRESENTS HOW MUCH SURPLUS FOOD IS WASTED



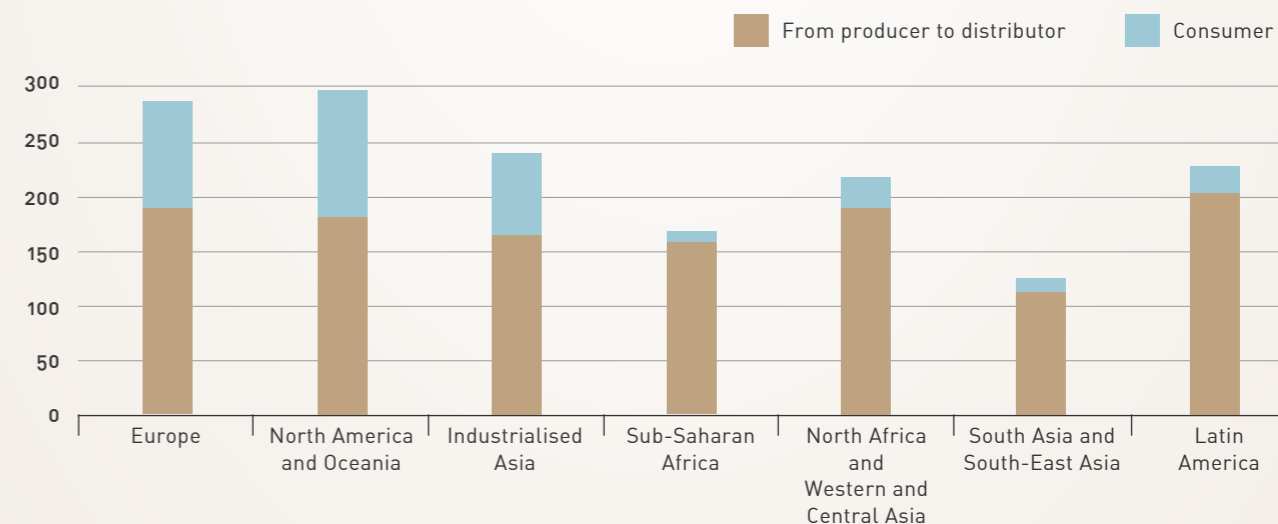
Among the categories "less wasteful" there are foods derived from breeding as well as those included in the "environment" category (i.e. less perishable) in the processing chains [Source: Based on data available in Garrone, 2012]

WASTE IN EUROPE AND THE WORLD

The available data is difficult to interpret because of the lack of homogeneity in the analysis methodology. Among the various sources available, the European Commission study should be highlighted, that cites a Community waste average of 180 kg of food per capita per year. The data available worldwide, however, shows the differences between developed and developing countries.



Waste in Europe: The data is not strictly comparable since the survey methodologies may vary depending on the country [Source: Eurostat 2006 from Report: European Commission, 2010. Preparatory study on food waste across EU 27. Technical Report - 2010 - 054].



Waste in the world: In addition to the quantity, the main differences concern the breakdown between the various stages of the chain. Source: FAO, 2011



WASTE

IN THE FOOD CHAIN

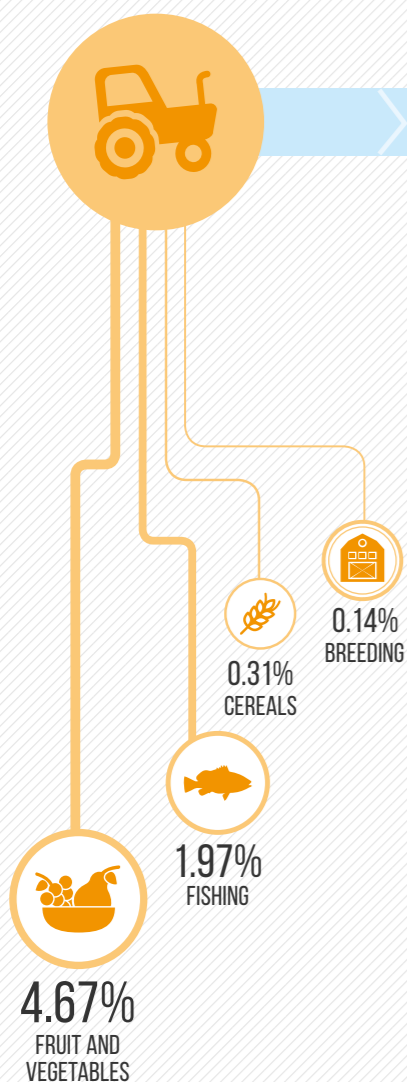
THE PERCENTAGE INDICATES, FOR EACH PHASE OF THE CHAIN, THE SOCIAL WASTE OF THE TOTAL PRODUCTION

SURPLUS: edible part of the food that is not sold or consumed.

SOCIAL WASTE: part of the surplus that is not used for human nutrition.

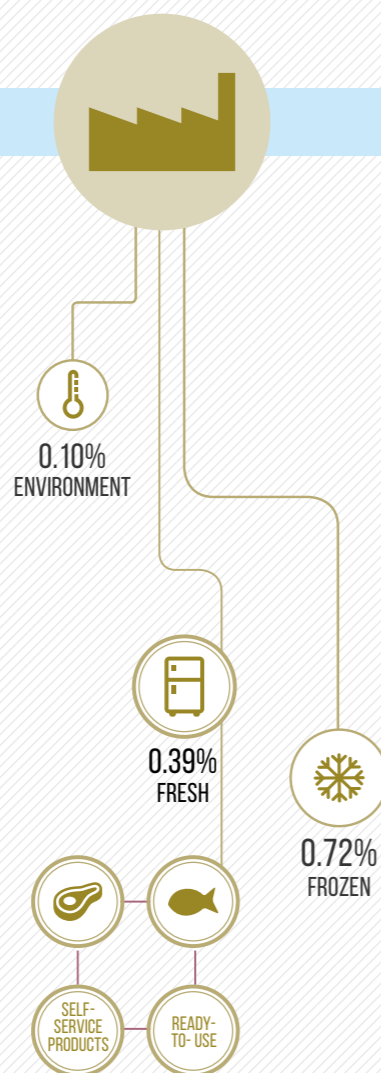
PRIMARY SECTOR

Production: 79,000
Surplus: 2,300
Waste: 2,000



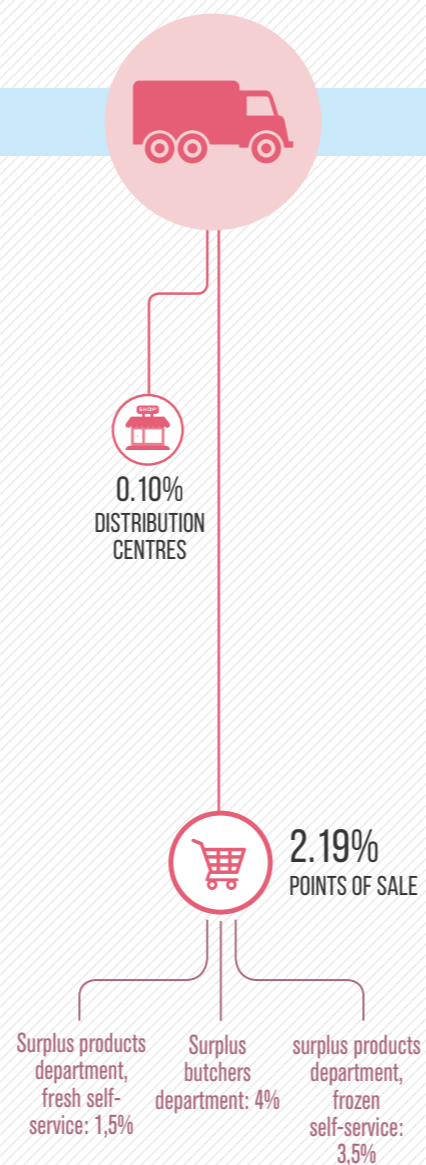
PROCESSING

Production: 45,000
Surplus: 181
Waste: 81



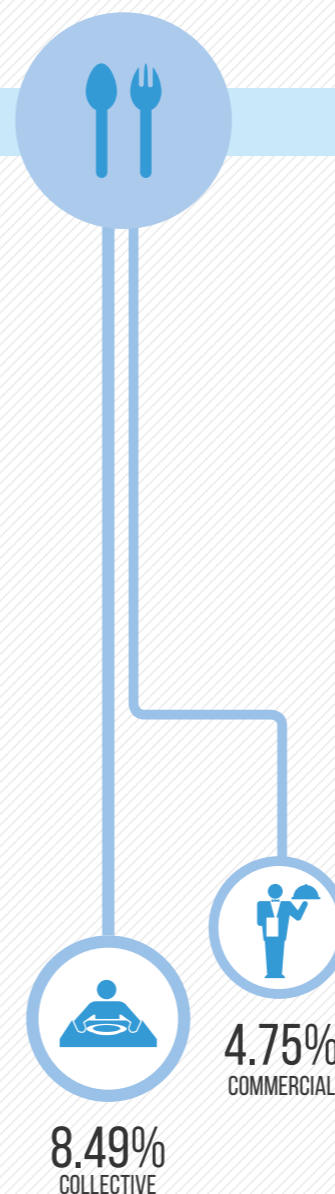
DISTRIBUTION

Production: 55,000
Surplus: 777
Waste: 719



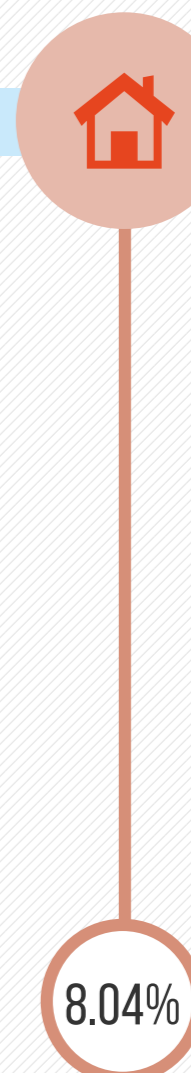
CATERING

Production: 3,000
Surplus: 209
Waste: 190



FINAL CONSUMER

Production: 31,000
Surplus: 2,500
Waste: 2,500



*DATA EXPRESSED IN THOUSANDS OF TONNES

WASTE IN THE MEAT CHAIN



Among the available and examined data there is no information that allows a precise and definitive figure on wastage in the meat chain. However, a survey conducted by Nielsen in 2011 on a panel of 9,000 Italian families (available in the text cited by Garrone) estimated the incidence of waste by the consumer for each product sector.

Starting from the value of food purchases, the volume of food availability was calculated and to this volume were then applied the waste percentages reported by the families. The overall domestic waste of Italian families is estimated to be 2.6 million tonnes (about 8% of the total purchased).

Of these, the meat and fish sectors have less waste with a value equal to 6% of the total waste.

The better result is attributable to different factors during the various stages of the supply chain.

First of all in **farming and primary processing** waste is reduced due to the fact that any overproduction of meat from the slaughtering plants are easily preserved using freezing systems.

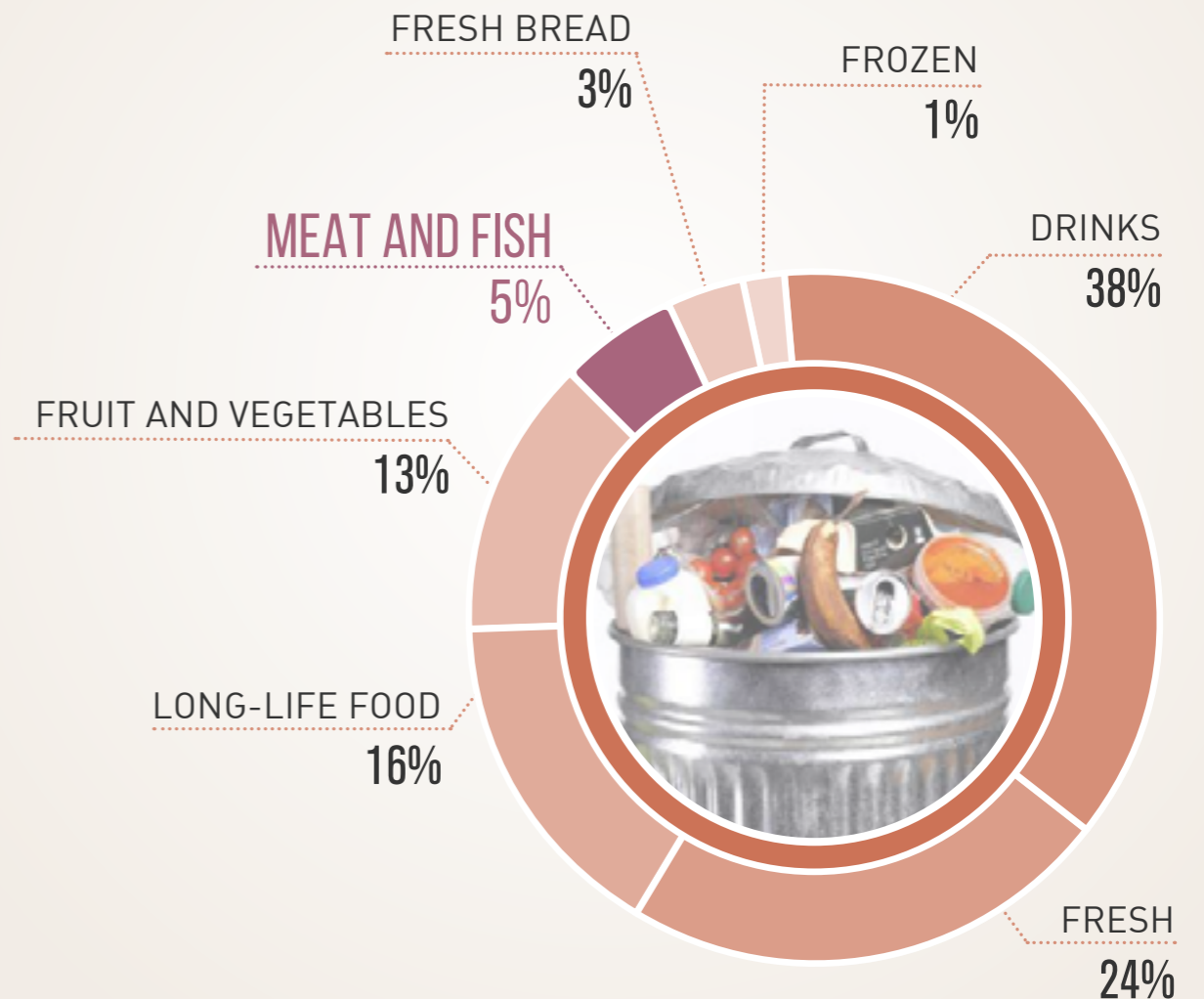
In **distribution**, the major cause of waste is reaching the expiry date which can be controlled with careful management of the orders to the producers; at this stage one must consider that the highly perishable nature of the product causes waste, because reaching the expiry date or having interruptions in the cooling processes, means that the product no longer meets the health and safety standards.

With regards to **domestic consumption**, wastage is reduced because the consumer states that he freezes the food to avoid waste (51%) and stocks less food by shopping frequently (49%).



BREAKDOWN BY TYPE OF THE TOTAL WASTE OF ITALIAN FAMILIES

Source: Garrone P., et al, 2012



> Meat wastage worldwide

As in Italy, also in the rest of the world the waste of meat is reduced and the differences between the countries are not particularly evident.

However, it is interesting to observe that in industrialized countries the consumer contributes to about 50% of the total waste.

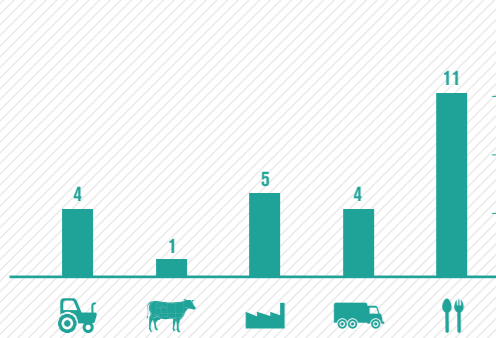
In developing countries losses occur in almost homogeneous amounts throughout the supply chain. Indeed, in the data on sub-Saharan Africa in the primary sector, losses stand out due to the high animal mortality rate caused by frequent diseases to cattle that are not always properly cured.



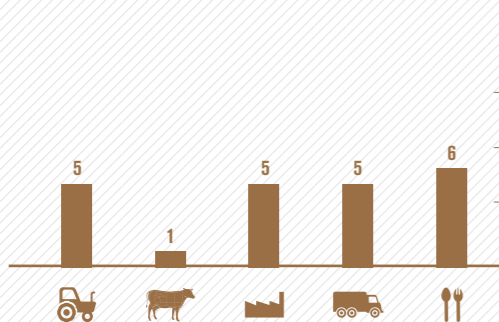
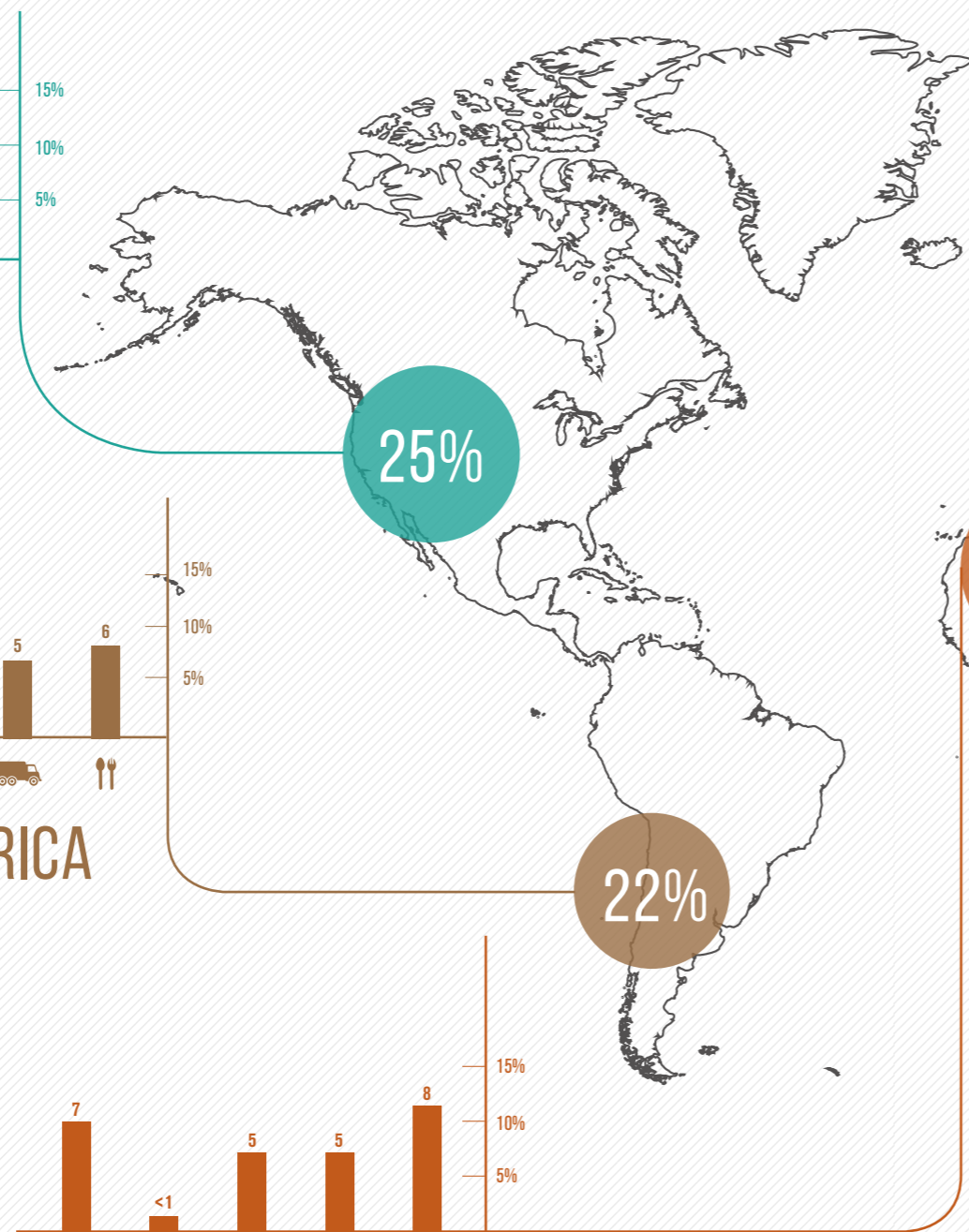
MEAT WASTAGE WORLDWIDE

Source: FAO, 2011

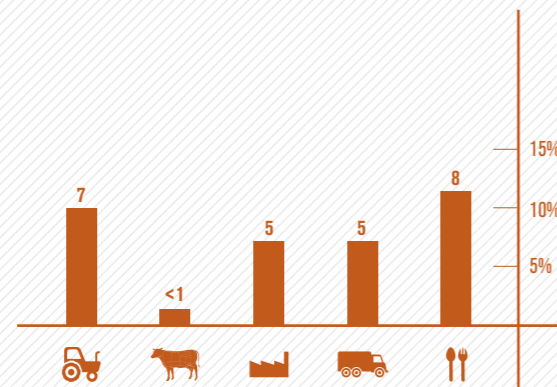
IN INDUSTRIALIZED COUNTRIES THE CONSUMER CONTRIBUTES TO ABOUT 50% OF THE TOTAL WASTE



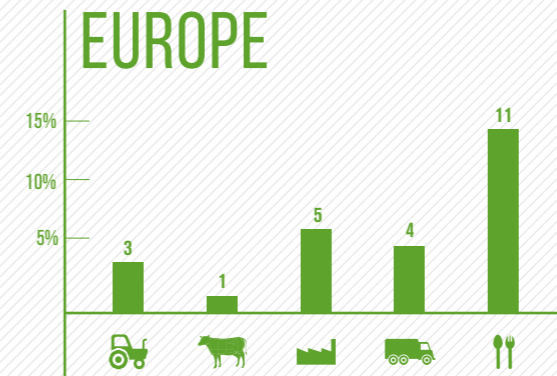
NORTH AMERICA and OCEANIA



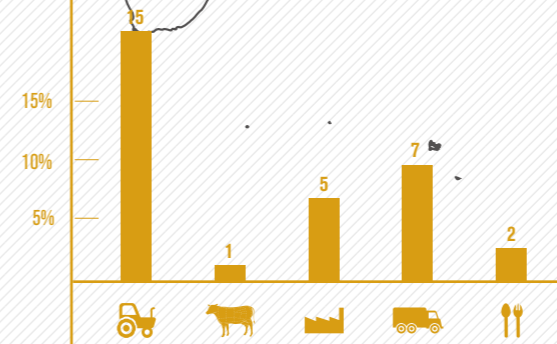
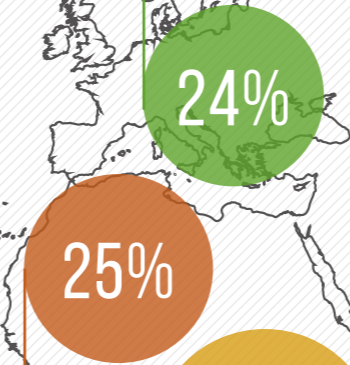
LATIN AMERICA



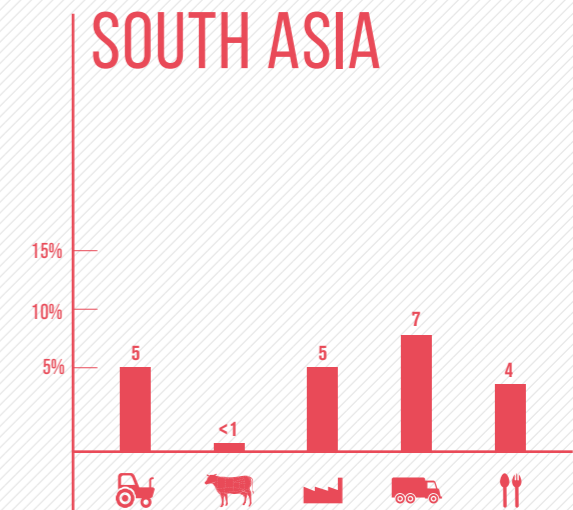
NORTH AFRICA



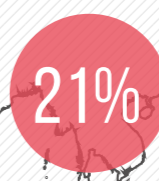
EUROPE



SUB-SAHARAN AFRICA



SOUTH ASIA



INDUSTRIALISED ASIA

- ANIMAL PRODUCTION
- SLAUGHTER
- PROCESSING
- DISTRIBUTION
- CONSUMPTION

HOW TO REDUCE WASTE



To find solutions for food waste is an institutional political priority but also a real commitment required from farmers and industries, without forgetting however that the consumer is responsible for the majority of food waste.

Distribution companies (shops and supermarkets) play an important role in reducing the waste of food still purchasable but not "perfect" in the consumer's eye (products about to expire, minimal defects of packaging ...).

Restaurants, bars and canteens can reduce much of their waste by empowering customers (for example with the doggy-bag or supplying kitchens for the poor) and cutting down on waste. Mentioned below are some of the major initiatives in a list that could certainly be longer and more complex.



BANCO ALIMENTARE



The Banco Alimentare Onlus (FBAO) was formed in 1989 with the aim of providing for the collection of surpluses in agricultural production, industry, organised retail and catering and then redistribute it to people in need.

The FBAO operates nationwide with 21 Banco Alimentare Organ-

isations and in 2011 recovered about 68,000 tonnes of food re-deploying them to over 8,000 facilities operating within the network, which in turn have helped more than 1.7 million people. As for the recovery of surpluses, through the development of the network built in over 20 years of work, the FBAO manages to intercept surplus food from all along the food chain.

In detail, the network includes more than 800 companies that donate more than 10 thousand

tonnes of products. The Distribution Centres (CE.DI), where FBAO intercepts the products offered and more than 400 points of sale, where direct withdrawal is organised, 53 company canteens and 130 school canteens, 5 catering companies and 23 commercial services directly supporting 146 charitable residential structures.

WWW.BANCOALIMENTARE.IT

LAST MINUTE MARKET



Last Minute Market (LMM) is a spin-off company of the University of Bologna, founded in 1998 and became a business reality present throughout Italy with projects aimed at recovering unsold goods (or not marketable) in favour of charitable organisations.

From an operational standpoint

LMM does not directly manage the products but promotes the direct encounter between demand and supply, taking care of the safety of all phases of the system.

Today, LMM activities related to food waste are aiming at commercial and productive activities (LMM-FOOD), to fruit and vegetables (LMM-HARVEST) and meals recovered from collecting catering, such as schools and companies (LMM-CATERING).

Among the many events organ-

ized by LMM we report the initiative, launch and promotion of the "Joint Declaration against Food Waste", presented on 28th October 2010 to the European Parliament, in which are mentioned in detail the actions intending to reduce food waste by 50% within 2025.

WWW.LASTMINUTEMARKET.IT



GDO INITIATIVES

In Italy several great distribution organisation chains have intervened to contain food waste.

One example is the promotion by Coop Italy with their initiative Happy Ending, finalised at recovering unsold food and donating it to non-profit organisations that take care of poor people.

In 2010, the project involved 471 points of sale (63% of the total) and about 1,000 non-profit organisations by allowing the recovery and redistribution of nearly 3,000 tonnes of food with

a value of about 18 million euro .

Coop also opened a website [CoopNonSpreca.it](http://www.coopnonspreca.it), run in partnership with Liquidia, where news and advice against food wastage are reported.

WWW.COOPNONSPRECA.IT

⁶ Coop, Rapporto Sociale Nazionale 2012, progetto Buon Fine, pag. 23



WASTE IS STUPID: THE INITIATIVE OF UNES SUPERMARKETS

Unes, a supermarket chain located between Lombardy, Piedmont and Emilia Romagna, in 2014 launched the initiative "Waste is stupid", dedicated to the topic of waste, with a slogan that both embodies and orientates the campaign itself.

The campaign invited people to become aware of how many opportunities we have each day to avoid wasting anything: food, time and emotions. But the tone is not assertive and the company, in fact, declares that everyone is aware of the fact that waste is wrong, not only because it is labelled as unethical behaviour by society, but above all because it is counterproductive.

The ways to reduce food waste involve the abolition of promotions and accumulated points, discounted prices up to 50% for products close to the expiration date, the opportunity to buy certain unpacked products, such as bread, choosing the desired amount, and finally, education and consumer awareness.

Online, at www.stupidosprecare.it website users are invited to indicate what they feel is stupid to waste. A coloured diamond acts as the container for the messages and the diamonds and messages then became the first anti waste poster network "U2" on the web (wall.stupidosprecare.it) to then also be spread in the aisles of the supermarkets, to recall

the campaign to customers during the daily act of shopping.

With regards to this issue, Unes determined that the contribution of schools was decisive in making citizens aware of the value of not wasting and respecting mankind and environment.

To this end, in 2015 the project was also spread to schools through didactic material and a competition to raise awareness among children on the theme of waste (www.stupidosprecarescuola.it).

WWW.STUPIDOSPRECARE.IT

RESULTS OF THE PROJECT "BUON FINE" - NOVACOOP	2010	2011	2012
Associations involved (n°)	60	58	57
Value of goods donated (k€)	1,330	2,273	2,508
Shops participating in the collection (n°)	59	56	60
Supermarkets (n°)	44	40	44
Hypermarkets (n°)	15	16	16

Example of NovaCoop results - Source: <http://www.e-coop.it/web/nova-coop/buon-fine#>



ITALIAN NATIONAL PLAN FOR THE PREVENTION OF FOOD WASTE: THE PINPAS PROJECT

Italy will soon have a national plan for the prevention of food waste (PINPAS) part of the activities of the **National Program for Prevention of Waste**.

The PINPAS plan wants to be the result of a shared initiative with the various players of the agri-food industry chain and organizations active in the fight against waste, in line with what is indicated by the **"Guidelines on the preparation of food waste prevention programmes"** commis-

sioned by the European Commission DG Environment.

Starting from the activities of **Last Minute Market** and in particular from the Joint Declaration in 2010 against waste, the programme assumed the long term objective of reducing food waste by 50% within 2025.

The activities will focus primarily on the definition of measures to reduce the amount of food products that end up wasted.

With the help of the first national awareness campaign against food waste in Italy, the Plan will also have an impact on the domestic side, between the refrigerator and the rubbish bin, where food waste touches **0.5% of GDP**.

WWW.MINAMBIENTE.IT



THE ANTI-WASTE INITIATIVES OF HOTELS AND ASSOCIATIONS

The number of hotel establishments that donate the excesses of catering to those who need it most is steadily increasing. For example, thanks to the **"Lake Maggiore Meeting Industry"** project, the conference and events hotel businesses gathered together to say no to waste and have begun testing how to recuperate breakfast food, bread, cakes, pastries and cookies from the Food Bank Foundation Siticibo.

It is not only the hotels that carry out anti-waste initiatives; many companies and associations are also committed every day in preventing that good foods end up directly in the trash. It is estimated that with the food thrown away in 24 hours across Europe, you could feed up to 200 thousand people.

For example, on the web site Do not Waste it you can find iFood Share (www.ifoodshare.org) which promotes the sharing and free exchange of food in excess between private individuals, traders and producers. On this point the association Urban Fruit (www.fruttaurbana.org) is to be remembered which recovers the fruit that grows wild in the city



and avoids it being wasted and the project Waiting Bread (www.paneinattesa.altervista.org) developed by a group from Padua university to make sure that a precious commodity such as the bread does not go to waste.



HOW TO REDUCE WASTE WITH MASSIMO BOTTURA AND LISA CASALI

Producing any food involves the consumption of natural resources, and wasting food means wasting valuable resources. Each food chain, unfortunately, generates waste and scrap. That of meat, thanks also to its thousands of co-products and by-products and the re-use of livestock waste slurry and slaughter waste for the production of energy, in this sense makes it the most virtuous of the entire food sector.

Waste and meat scraps, in fact, are more than 50% when compared to those of fruits and vegetables, and almost half compared to the cereal chain. This waste is due mainly to the phase of final consumption, and remains one of the points on which the entire chain is increasingly committed.



Aware of the importance of this theme, the project Sustainable Meat dedicates increasing space to the subject. Not only with information, but also through events and initiatives that,



Massimo Bottura, Chef Ambassador of Expo 2015

thanks to the presence of prominent personalities such as Massimo Bottura, the patron of the Osteria Francescana in Modena and food-blogger Lisa Casali, can raise public awareness on the need to avoid wasting food.

With Massimo Bottura, Ambassador Chef of Expo 2015, and the patronage of the Universal Exposition, Sustainable Meat presented a "Sustainable menu for the world of meat". The chef, inspired by the rich culinary tradition of Emilia and the Italian hinterland, prepared an economically sustainable menu without waste: 5 recipes that, thanks to his skill,

ennoble all types of meat, including the poorest cuts.

Inspired by traditional Emilian recipes but with a modern twist, Massimo Bottura, during an event held in Milan in July 2015, enhanced many cuts of meat too often forgotten, recovering kitchen habits of the past when nothing went to waste. An idea, recalls the famous chef, from which some of his dishes are based on. The meat, after all, is a food always present on Italian tables as well as being one of the protagonists of the Mediterranean Diet, which includes moderate and varied consumption of

all foods, including those based on animal protein.

"I ask myself questions. The moment a cook asks questions he also gives answers and those answers come through culture", said Massimo Bottura when explaining how to make a conceptually sustainable menu: "Culture generates knowledge, knowledge opens the conscience and consciousness is the sense of responsibility", added the chef before starting the preparation of the five-course sustainable menu without waste. "To create a

sustainable menu, you have to have spirituality, recovering memories and remembering that an Emilian classic, for example, when they killed the pig, was using every single part of the animal, because the pig was like gold. In the very same way, a piece of dry bread is like gold, this is the key". Through culture you can create and give yourself these type of answers".

With the same intent the queen of the reduction of domestic waste in the kitchen, Lisa Casali, has launched a dedicated section on the portal www.carnisostenibili.it/en.

it/en.

A colourful space full of photos that will inspire its users, through original and imaginative recipes, to reuse scraps of meat. Despite the crisis of recent years, food thrown away unnecessarily in Italy still exists.

Environmental scientist, blogger, writer and ambassador for the WWF for sustainable food, Lisa Casali reached the notoriety of the general public with a brilliant idea: the opportunity to cook in the dishwasher. But above all with your imagination.



Beautiful Sonic Disco of Love and Hate at the Gate of Hell Painting with Wicked Poots of Glorius Color and Psychedelic Spin-painted Cotechino, not Flame Grilled. One of the sustainable dishes on the menu without waste by Massimo Bottura at the event of Sustainable Meat at Expo 2015.

In Italy, no one better than she has been able to enhance food scraps, making them even become trendy.

With this background, the union with the meat chain was simple, because people tend to throw away this precious food much less than other foods. Beyond the environment and respect for a product as noble as meat, avoiding waste simply amounts to avoiding unnecessary costs. And "not to waste" can be considered a synonym of "savings". Besides that, though, there is to consider also the high social and

cultural value with which it is associated.

Lisa Casali offers very interesting opportunities to visitors of the Sustainable meat website. With her recipes, her advice, her inspiration, she shows how to eliminate the meat wastage at Festivities, and once a month gives ideas for cooking red meat, white meat and cured meats using the scraps that you have in the fridge for preparing meals inspired by the Mediterranean tradition and the culinary innovation of an increasingly multi-ethnic world.

The Project Sustainable Meat, through the recipes and creativity of Massimo Bottura and Lisa Casali, wants to promote lifestyles marked by sustainability, the reduction of food waste and the valorisation of that which all too often are destined to become waste, going from our tables to the trash can. Yet, it invites us to pay close attention to the ingredients that are used during the preparation of the dishes. And, therefore, to always remember to check the state of preservation of the leftovers, before reusing them.

IN ITALY TOO A LAW AGAINST FOOD WASTE

The struggle against food waste is one of the major challenges of this century. To avoid wasting food means avoiding squandering natural resources, but above all making sure that the inequalities that too often characterise this planet are reduced. To stop wasting food also means fighting hunger, malnutrition and poverty. The meat industry is particularly aware of this, so much so that in the food industry it is the one that produces the least amount of waste. But it is not the only one. After the roadmap of Expo Milano 2015, institutions have also taken ever more seriously this problem, and now Italy is aiming to approve a law on the fight against food waste.

To combat waste at the bottom of the food chain, in distribution and then in household consumption, two laws have been approved, one in France and one in Italy. The French law is very strict, and even has fines of up to 75 thousand Euro and up to two years in prison, for those who do not make business agreements with voluntary organisations for the donation of surpluses; Italian law, however, does little to remove the bureaucratic cloak that

has so far hindered donations and provides incentives for the points of sale who donate.

According to Maurizio Martina, Minister of Agricultural, Food and Forestry policies, this ruling would strengthen the work of contrasting a phenomenon that in Italy alone is worth several billion Euro per year. The objective is clear: "Increase awareness among consumers with respect to food habits and simplify donations for companies". Moreover, as the minister Martina explains, "Italy has already reached a good result at an international level: each year we recover 550,000 tonnes of surplus from the whole chain. In 2016, we want to reach 1 million".

The law, which is an attempt to fix a situation that at a social level is also assuming alarming tones. According to Istat, in fact, they are 6 million people in a state of absolute poverty. In other words, in the Belpaese around one in ten people are not in a position to purchase the goods and services required to achieve a standard of living considered minimally acceptable.

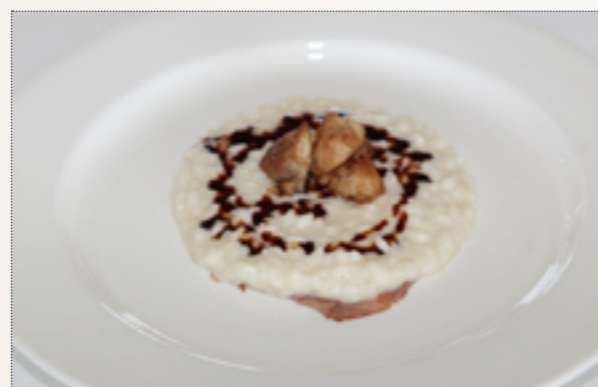
The Ministry thus aims at "Zero-waste", through a plan (with



the same name) that makes it more convenient for businesses to donate food rather than waste it. Furthermore, in addition to the urgency, there is the need to maintain the commitments made with the Milan Charter.

In the world a third of all food production is wasted. It is one of the strongest enemies to be fought against to concretely affirm the right to food as a universal right, to help achieve the goal of Zerohunger 2030 stated in the Milan Charter and the new millennium objectives of the UN.

Food waste is also a major environmental problem. Not only because wasting food means squandering resources used to produce it, but also because this waste produces significant amounts of greenhouse gases. In fact, when food is dumped into landfills, it decomposes and



The sustainable menu without waste by Massimo Bottura.

Photo 1: La parte croccante di una lasagna. Photo 2: Riso omaggio a Cantarelli

releases methane gas, 21 times more potent than carbon dioxide. Its CO2 equivalent emissions demonstrate the size of the phenomenon: if food waste were to be represented as a single nation, it would be the third largest producer of carbon dioxide, after the US and China.

The right to food, the protection of the environment, but also economic efficiency: avoiding unnecessary wastage of food

means saving money. It would be appropriate to do so, given that food waste on the planet each year costs 1,000 billion dollars. A huge figure, which rises to 2,600 billion if we consider the 'hidden' costs related to water and the environmental impact.

In the European Union alone, every year, 90 million tonnes of food are thrown away and every day 720 kcal of food wasted per person. In Italy, however, accord-

ing to the 2015 Waste Watcher Report, domestic food waste is worth 8.4 billion Euro per year, or 6.7 Euro per week per family, for every 650 grams of food wasted.



FREQUENTLY ASKED QUESTIONS

FOOD
WASTE

WHAT DO WE MEAN BY FOOD WASTE?

There are many different definitions of waste. The one used in this document identifies social waste as the amount of edible food that is not used by human consumption.

Not considered in the figures are therefore all the "necessary" waste such as banana peels, egg shells or the bones of a steak. Under this definition, it is estimated that the amount of food in Italy wasted to be about 5.5 million tonnes per year, equal to about 3% of the total quantity produced.

IS THERE A LOT OF WASTE IN THE MEAT CHAIN?

All phases of each food chain, unfortunately, generate waste. Meat, also due to the huge amount of destinations that the by-products have and by reusing livestock waste slurry and slaughter waste for the production of energy, is in this sense among the most virtuous.

The production and consumption of meat, in fact, generate a quantity of less than 50% waste compared to fruits and vegeta-

bles, and almost equal to half of the waste produced by the cereal sector. Waste that, despite efforts to reduce the environmental impact of this sector, are mainly due to the final consumption stage.

A fact that is probably also linked to the social and cultural value perceived for centuries of these foods.

HOW CAN WE REDUCE THE WASTE OF MEAT IN THE KITCHEN?

The least wasted food in the kitchen are those of animal origin, and in particular meat. Moreover, they are those with the highest nutritional value, and those who have always been given the most importance, both socially and culturally. Today like yesterday, therefore, finding ways to avoid throwing away meat is an important skill, for mothers and grandmothers as for the most famous starred chefs.

The methods to reduce to zero the waste of this noble food are innumerable. From valorising the scraps from Festivities or from the day before, simply by heating them, by revising them into new and imaginative recipes



or through ingenious simple culinary inventions like meatballs and meatloaf; to avoid wasting meat, cured meats and other products (such as milk and eggs) that remain in the refrigerator is very simple. It takes a little imagination and memory.

To promote the culture of "recycling" Sustainable Meat has recently collaborated with two well-known chefs Massimo Bottura and Lisa Casali whose recipes are described on the www.carnisostenibili.it/en portal.

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Review in January 2017



Since 2012, a group of livestock sector operators organised themselves to support scientific studies that has brought about, in a pre-competitive logic of transparency, the **"Sustainable Meat" Project**, which with its portal www.carnisostenibili.it/en, as well as many other initiatives, has sought to discuss across the board all matters related to the world of sustainability of meat and cured meats in Italy.

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