



8 October 2015

## "Better food: what are the challenges and what are their solutions?"

### Context

France has been chosen to organise the United Nations Conference on Climate Change, or COP21, which will be held in Paris in December 2015 and welcome nearly 50,000 international participants and delegates.

As well as the important challenges linked to the success of negotiations between the 194 countries taking part, the 201 Paris Climate Conference will offer an exceptional opportunity to evaluate all the solutions and initiatives implemented with respect to energy, mobility, construction and many other sectors, both in France and other countries, by industry, institutions, regional government bodies, citizen organisations and centres for research and innovation.

### **Thematic dossiers compiled at the initiative of two founder partners in Solutions COP21: Carrefour and the Avril Group**

In order to contribute to its content, and give a collegiate sense to their actions, the founder partners in Solutions COP21 decided in October 2014 to compile dossiers on the transversal themes defined as follows: "Mieux se nourrir" (better food); "Mieux consommer, moins gaspiller" (better consumption, less waste); "Mieux se loger" (better housing); "Mieux transporter" (better transport); "Mieux financer et assurer" (better finance and insurance), and "Mieux s'informer, s'impliquer" (better information, more involvement).

Highly mobilised on these themes, the partners then displayed their commitment by organising several meetings in 2014 and 2015 to present the challenges and raise awareness to present and future solutions to climate issues. Through these dossiers, they have created links and placed in perspective the solutions already online at the [Hub des Solutions climat](#).

***This dossier was formulated in the context of the "Mieux se nourrir" Working Group of Solutions COP21.***

Its compilation was initiated by **Carrefour** and the **Avril Group** and then finalised with support from the Solutions COP21 teams.

### **Meetings of the "Mieux se nourrir" working group:**

- Monday 23 February 2015
- Wednesday 13 May 2015
- Thursday 28 May 2015
- Monday 20 July 2015
- Thursday 10 September 2015

***N.B.: This dossier was compiled as a result of discussions by the "Mieux se nourrir" Working Group of Solutions COP21. It does not necessarily reflect the opinions of the organisers and other partners in Solutions COP21.***

## **Introduction**

In 2030, our planet will be home to 8.4 billion people, which corresponds to 15% more than in 2015. Rising living standards and the dietary changes which accompany them will imply a significant increase in food demand, such that food security, access to nourishment and the impact of food production on the environment are today decisive elements that must be taken into account if we are to control global warming.

Two numbers testify to the importance of mobilising actors in the farming and food industries and their stakeholders: food contributes 21% to all greenhouse gas emissions, and 30% to global energy consumption.

Upstream in production sectors, these emissions are mainly linked to either the manufacture of fertilisers and the fertilisation of crops to produce plants, or enteric fermentation in ruminants and management of the waste arising from livestock production.

Downstream, the energy consumed to process foods and transport merchandise is a significant source of greenhouse gas emissions. Goods that are not exploited or not consumed because of production losses or food waste, account for a not inconsiderable share of these emissions, while a third of the food produced for human consumption throughout the world is lost or wasted, or 1.3 billion tonnes each year<sup>1</sup> representing 3.3 billion equivalent CO<sub>2</sub><sup>2</sup>.

**To better understand the impact of food on climate change, a study carried out by the BIPE, on behalf of the French vegetable oils and proteins sector and the Avril Group, focused on the evolution of diets and their impacts in different regions of the world at a horizon of 2030. This study highlighted the growing importance of the link between food and climate during the next 15 years, while food-related emissions are expected to have increased by 7% between 2014 and 2030.**

## **The "Food and Climate" study: the challenges it poses**

### **"Food: a crucial element in the control of climate change"**

Principal lessons of the "Food and Climate" study  
(BIPE, April 2015)

The global population will grow by 15% during the next fifteen years, to reach 8.4 billion people. It will therefore be necessary to feed one billion people more than at present. This demographic growth, and the socio-economic changes that accompany it - economic development, urbanisation, rising living standards, etc. – will result in changes to our diets and an increase in food demand.

- **Demographic growth + Economic development → changes to diets**

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1

*Global food losses and food waste*, FAO report, 2011.

2

*Food wastage footprint: impacts on natural resources*, FAO, 2013.


2

At present, most of the world's population is at the start of the first nutrition transition, which involves a rise in demand for proteins and leads gradually to increasingly meat-based diets. In 2030, 85% of the world's inhabitants will still be in the first nutrition transition. The first and second nutrition transitions – the latter implying a reduction in total protein consumption and a rise in the share of protein from plant sources – will thus be under way concomitantly, affecting all products.

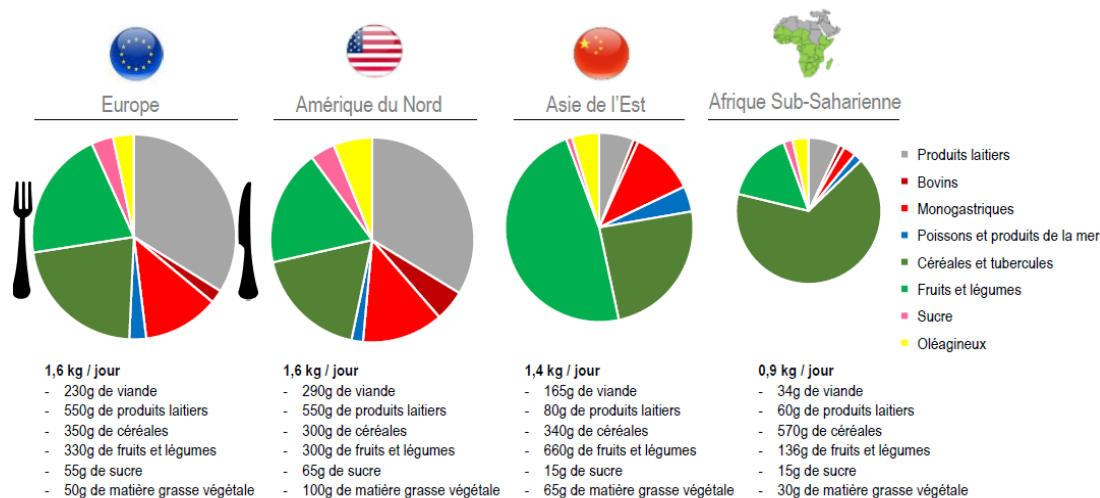
At the scale of an individual, the first nutrition transition is characterised by an overall increase in demand for kcal consumed, and particularly a demand for proteins, driven initially from plant sources and then from animal sources, and particularly meat; the diet thus becomes increasingly meat-based. This transition is completed by a stabilisation in the total level of protein demand and a replacement of plant sources by animal sources. This initial transition is concomitant with the economic development and urbanisation of a country. Developed countries experienced this transition during the 20<sup>th</sup> century, while Sub-Saharan Africa, North Africa and the Middle East and India are only at the start.

The second nutrition transition is characterised by a reduction in total protein consumption and a rise in the share of protein from plant sources, achieved either by reducing the level of demand for animal proteins - as has been seen in France during the past ten years or so - or by increasing the consumption of plant proteins - as is currently the case in North America. This second transition is induced by societal and environmental factors, such as increased awareness to the importance of a balanced diet.

**Les différents régimes alimentaires dans le monde aujourd'hui**

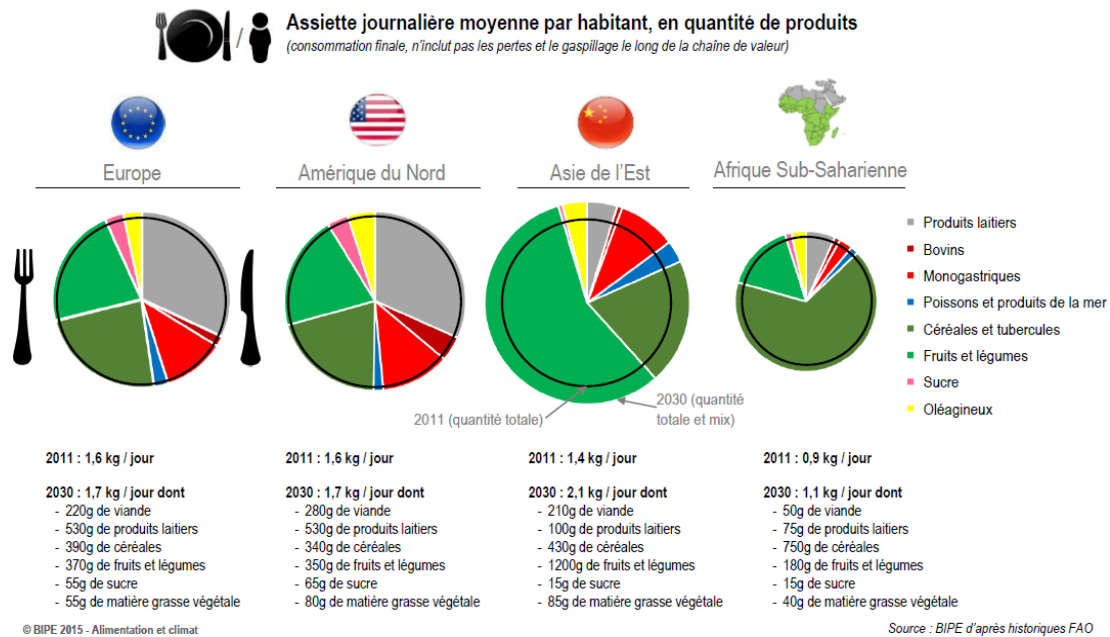


**Assiette journalière moyenne par habitant, en quantité de produits**  
*(consommation finale, n'inclut pas les pertes et le gaspillage le long de la chaîne de valeur)*



## 2030 : les changements de régimes toucheront essentiellement la Chine avec des impacts environnementaux et climatiques directement liés

Le BIPE



### • A larger carbon footprint in 2030

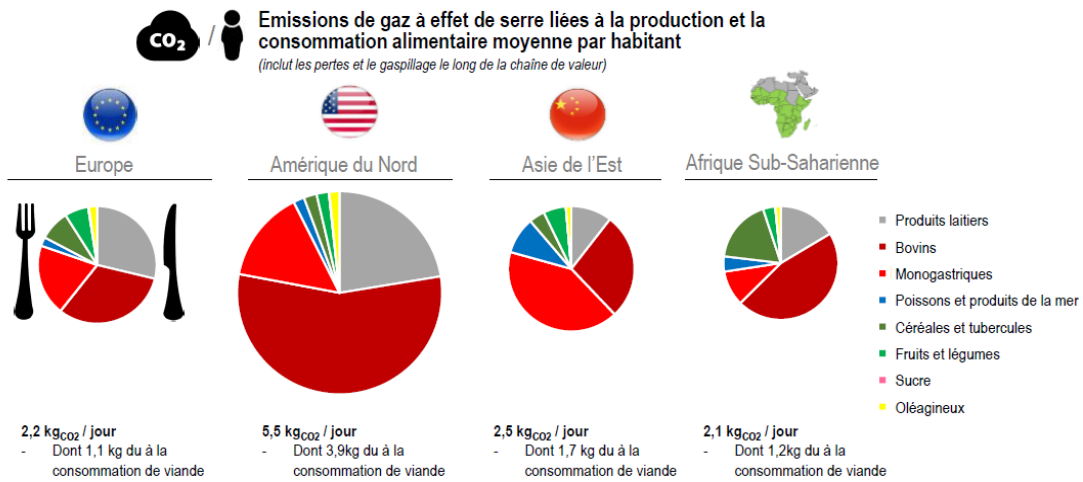
Under a trend scenario, combination of the two nutrition transitions will contribute to further increasing the share of food in greenhouse gas emissions.

In terms of plant products, in 2030, like today, cereals, fruits and vegetables should account for 65% of the foods consumed by the global population. The cultivation of cereals, which alone accounts for nearly half of cultivated land to meet growing demands for human foods (+40% between now and 2030) and livestock farming (+30% between now and 2030), should be at the origin of two-thirds of the greenhouse gas emissions generated by plant production, mainly because of the manufacture and spreading of fertilisers.

In parallel, in terms of animal products, the nutrition transitions under way in all parts of the world should lead to growth in the demand for meat such that **farmers will no longer be able to cover their requirements for livestock feeds**, and notably oilseed meals. Only 85% of needs will thus be met, but this will not be without having positive effects at an environmental level, as the carbon footprint of foods of animal origin is 5 to 50 times larger than that of plant-based food products. But this will not be without impact either on the time-line for nutrition transitions, as the supply and demand balance will be achieved through a rise in meat prices, implying a slowing in the growth of demand, notably in the poorest countries.

## Emission de gaz à effet de serre : les produits animaux sont à l'origine de 85% des émissions, même dans les zones où l'on en consomme très peu par habitant

Le BIPE



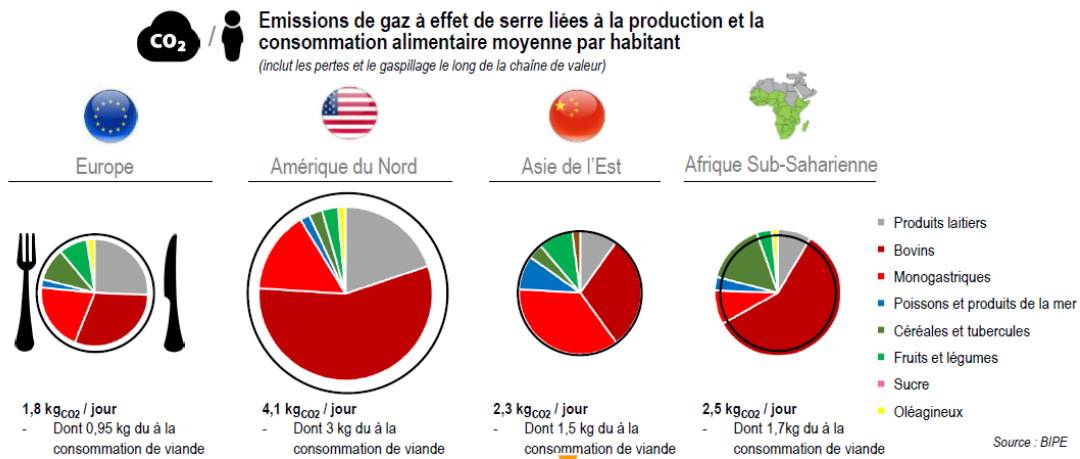
- Même dans les zones à très faibles consommation de viande, celle-ci est à l'origine de la majorité des émissions dans tous les cas
  - L'impact d'une augmentation de productivité dans ces zones serait donc extrêmement fort. **Le coût marginal d'émission de GES d'un gain de productivité dans ces zones est négatif**, tandis qu'il est positif dans les zones développées.
  - De même une augmentation, même faible, de la consommation de viande bovine entraînerait une très forte hausse des émissions dans ces zones
- Les zones les plus émettrices sont l'Amérique du Nord et l'Amérique Latine (8,2 kg<sub>CO2</sub>/jour), car elles consomment le plus de viande bovine

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Source : BIPE

## Emissions GES à 2030 – Dans toutes les zones, même celles avec une faible consommation de protéines, la viande sera à l'origine de la majorité des émissions

Le BIPE



- En Europe et aux USA, l'impact carbone de l'alimentation diminue entre 2014 et 2030
  - Diminution de la quantité de protéine animale consommée
  - Evolution du mixe de protéine animale, plus important en volaille, moins émettrice de GES
- En Asie de l'Est et en Afrique Sub-Saharienne, l'impact carbone de l'alimentation augmente entre 2014 et 2030
  - Augmentation de la quantité de nourriture consommé par habitant
  - Augmentation de la part des protéines animales, non compensée par l'effet changement du mixe de consommation, la part du bœuf étant faible en 2014

Hypothèse sur les évolutions des pertes et du gaspillage : maintien des valeurs 2011 et le FAO.

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In 2030, the demand for foods of plant origin should account for 15% of food-related emissions. In parallel, **the demand for foods of animal origin should, like today, be the source of more than 80% of food-related greenhouse emissions** (85% in 2014, 82% in 2030). This figure results from demographic growth and an increase in protein demand from countries in their first nutrition transition, notably Sub-Saharan Africa (which alone will account for nearly 40% of the increase in the world's population in 2030), and Latin America (nearly

10% of growth in the world's population in 2030). It is therefore in these two regions that most of the increase in food-related emissions will be concentrated.

In this context, beef will be particularly susceptible: although current demand for beef only accounts for 7% of the overall volume of demand for animal products, it is still responsible for 43% of the greenhouse emissions resulting from such products. This constitutes a major "environmental shock", mainly due to the low consumption index (CI) of beef cattle farming, or in other words the production potential attached to an animal relative to its feed intake, and to enteric fermentation in cattle, which alone accounts for 40% of the greenhouse gas emissions related to animal products.

By contrast with that balance, the consumption of poultry meat has increased throughout the world and displays a more moderate environmental footprint. It may therefore constitute a lever to attenuate the rise in emissions resulting from meat production. In this respect, improvements in livestock production techniques will be crucial and could enable a 10-14% reduction in greenhouse gas emissions, depending on the sector.

- **Developing agriculture for the future while taking account of climatic conditions that are already deteriorating**

In order to respond sustainably and equitably to changes in worldwide food demand, both plant and animal production sectors must take account of climatic conditions that are already deteriorating because of global warming. As well as higher temperatures, we are already seeing an increase in rainfall episodes, droughts and, more generally, extreme climatic phenomena which, in the long term, will impact agricultural yields in almost all parts of the world and indirectly affect the evolution of our diets.

These climatic changes should favour northernmost countries, which by 2030 should become more favourable for agricultural production because of more abundant rainfall and fewer periods of frost due to global warming. Inversely, agricultural production will become more difficult in southernmost countries, subject as they will be to an intensification and prolongation of very dry and very hot periods. And it is precisely in these northernmost regions, where a true agroecological transition can be initiated, that we expect to see a reduction in the area of cultivated land.

Although the global total of arable land should increase by 3.4% from the level seen in 2010 (to reach 1610 million hectares in 2030) it will diminish in North America and Europe. However, these regions are the most productive and exert less impact on the environment, notably in terms of livestock farming. Inversely, the surface areas of arable land should increase in Latin America, Sub-Saharan Africa and Asia.

This evolution affecting arable land confirms the fact that agriculture will indeed be capable of feeding the planet. The BIPE also estimates that in 2030, **1 cultivated hectare should be able to feed an average of 5.3 people, or almost one person more than in 2010** (4.5 people). The marked increases seen during the past fifty years thus appear to be continuing, and thanks to improvements in crop yields and potential land reserves - or in other words, reserves that do not include crops, forests and protected or populated areas – should be able to meet the need for additional land.

The study also indicated that maintaining certain types of production – notably livestock – in North America and Europe could have numerous advantages. As well as reinforcing the food independence of these regions, it will allow them to meet demands from Sub-Saharan Africa, where diets are increasingly calling upon European or American production, and also to limit the greenhouse gas emissions and environmental impacts that these activities may have generated in more southerly regions; for example, the development of livestock farming in Latin America and its impacts on forests and biodiversity.

In terms of these evolutions, **the principal challenge of the "food and climate" equation concerns the ability of different agricultural sectors to feed more people per hectare**

**while implementing sustainable agricultural and livestock practices that are consistent with their environments, under the logic of constructive agroecology.**

### **Methodology of the study**

As a first stage, the BIPE compiled an inventory of knowledge concerning the impact of food on: climate change, fish stocks, biodiversity and water resources. To achieve this, two types of resource were mobilised:

- Studies performed by international organisations (FAO, OECD, OilWorld, World Bank, IPCC, EPA, USDA) and national reports on different agricultural sectors.
- The BIPE's knowledge acquired through its different studies on the proteins sector, and notably its "Horizon 2030" study on the global supply and demand balance.

Following this inventory, the foresight study focused on the impacts of four types of transition (climatic, agrarian, nutrition and demographic/economic) under the previous frame of reference. A "business as usual" approach was adopted, or in other words, without there being any breakdown in the transitions already under way. Relevant figures were obtained from the same sources.

### **Multiple contexts but common solutions**

Agricultural strategies have a major impact on food-related greenhouse gas emissions. The abandonment of agriculture in the northern hemisphere, international and regional cooperation or the global trade in food products must more than ever take account of the major imbalances of the future, so that food itself will also be able to take control of its environmental footprint and thus better reduce its impact.

Demographic growth, economic development, urbanisation, rising living standards and evolutions to diet – production and consumption parameters vary from one region of the world to another. The principal challenges to respond effectively and equitably to the challenges concern the carbon footprint of diets, improvements to performance in less advanced regions and a reduction in losses and waste.

#### **1. Removing carbons from diets by varying protein intakes**

One of the levers to limit the impact of food on the climate resides in reducing the carbon content of diets and thus calling on different sources of protein.

Some sources of animal protein emit more gases than other; depending on the livestock involved, the efficiency in transforming plant nutrients into animal products can vary by a factor of 1 to 10 (from the least efficient to the most efficient: beef, pork, poultry, dairy products, eggs).

It is also necessary to change consumption habits by using vegetable proteins instead of animal proteins because the latter generate more greenhouse gas emissions: proactive measures on dietary education and supply effects, particularly in regions consuming large quantities of meat products that generate more emissions, have already proven their efficacy. Replacement by other protein sources emitting fewer greenhouse gases (artificial meat, insects, algae, etc.) may also have a beneficial effect.

### **Some practical solutions:**

To change behaviours it is necessary to raise awareness and educate.

For this purpose, information and calculation tools, such as the [Paris City Council menu carbon simulator](#), or food education materials such as the methodological guide issued by the ADEME: "[Create a low-carbon menu](#)", are simple and effective solutions to ensuring that everyone contributes to reducing food-related emissions.

- Designed by managers of the city catering services, the **Paris City Council menu carbon simulator** aims to take account of the goals of the Paris Climate plan (a 30% reduction in emissions by the authorities between now and 2020). It can be used by anyone and evaluates the emissions linked to meals eaten in restaurants operated by the council, depending on the choice of menu.
- **ADEME's** methodological guide, "[Create a low-carbon menu](#)", provides step by step support for catering professionals in developing low-carbon menus. Based on the experience of several chefs, it is able to calculate the carbon footprint of a menu and then work out the economic advantages of this approach.

These tools are particularly effective because alternatives are available, and notably **non-animal sources of protein**, such as the [Grönsaksbullar](#) vegetarian meatballs sold by IKEA.

## 2. Maintaining and improving agricultural and livestock practices

- *Pursuing improvements to farming practices in northern countries*

Maintaining and improving agricultural and livestock practices can not only limit the impacts of production activities on the environment, both upstream and downstream in the value chain, but also enhance the food independence of producing countries.

### **A few practical solutions:**

Thanks to research, different techniques can be tested, including *in situ* on **experimental farms**, such as the [Grignon positive energy farm](#) near Paris (Essonne), operated by AgroParisTech. Based on the principle that farmers can become important actors in dealing with global warming and the programmed end of fossil energy sources, the [Grignon Énergie Positive](#) programme set up by the farm aims to experiment and evaluate technical options to reduce farming-related energy consumption and greenhouse gas emissions.

A variety of initiatives can limit the **loss of farm land**, notably due to urbanisation, by ensuring markets for the land farmed around towns. The [Metropolitan Food Cluster](#) (MFC), a member of [Climate-KIC](#)<sup>3</sup>, is thus working on transforming rural landscapes near urban areas to offer land for sustainable agricultural production, directly linked to their upstream and downstream partners under the logic of territorial economic and social development.

Nitrate fertilisers are one of the leading sources of farming-related emissions. Nitrates thus account for between 54% and 85% of the emissions generated by growing plants. It is possible to limit their use by modulating the doses as a function of need, thanks to the development of new technologies applied to agriculture, such as the "agridrones" developed by the company [Airinov](#), a member of [Climate-KIC](#), which can reduce impacts by enabling the optimum adjustment of doses to plant requirements.

Stringent specifications, such as those designed by GreenFlex with respect to B2B2C cereals, also encourage low-impact production. This has also been the effect of the **Filières Qualité Carrefour** (FQC) (Carrefour Quality Sectors) which encourage the practise of

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<sup>3</sup> Climate-KIC (Knowledge and Innovation Community) is a community of actors in innovation working in the fields of agriculture, industry and waste management. It was set up at the initiative of the European Institute of Innovation and Technology to attenuate climate change.



**agroecology** by promoting **precision farming** (and notably the moderate use of nitrate fertilisers) and the use of environmentally-friendly **natural fertilisers**. Examples of FQC good practices include the Carrefour Beef sector in Taiwan, where all beef are 100% grazed at pasture and do not receive antibiotics.

**Enteric emissions** by cattle during digestion are another significant source of emissions. Enteric methane, nearly 80% of which arises from the digestive tract of ruminants, is the most important source of emissions by livestock farming.

A specific emission-reducing feed has been developed by the [RuMeClean](#) project, part of Climate-KIC.

Initiatives such as the "**Grand défi des fournisseurs pour le climat**" (the great supplier challenge for the climate) launched by Carrefour are designed to stimulate the creativity of companies supplying major retailers, encouraging them to develop projects that will reduce their CO2 emissions or introduce more climate-friendly farming and livestock practices. A good example is a French candidate which has been selling its nut products to Carrefour for the past ten years. The nuts are grown according to the principles of permaculture; no use is made of plant health products, weed-killers or chemical fertilisers. The producer reduces weeds in the nut groves by grazing sheep on the land beneath the trees; the animals in turn supply a natural fertiliser (droppings) which meets the needs of the trees.

In terms of **livestock farming**, development by the Avril Group of a **French animal feed sector** is also contributing to reducing emissions. Its growth has numerous advantages because it has favoured a **reconquest of the protein sufficiency of France** and reduced its dependence on imported soybean, increasing its self-sufficiency in vegetable proteins for animal feeds from 25% in the 1980s to more than 65% today. The rapeseed used by this sector is also notably favourable to the **rotation of crops** and to **biodiversity**. Rapeseed stimulates the yield of subsequent cereal crops, significantly reducing the amounts of plant health products used, efficiently exploiting the mineral nitrogen arising from organic effluents and breaking the cycle of certain diseases.

As for **deforestation**, which causes 20% of greenhouse gases throughout the world, the efforts put into traceability by Carrefour have meant that their supplies have no impact on forest resources. This is the focus of the commitment by Carrefour to 100% RSPO certified palm oil, the traceability of soybean used for livestock feeds and the support it gives to the moratorium on soybean from the Amazon region.

Options consisting in **exploiting by-products**, and notably the biomethanisation of slurry developed by Climate-KIC, can also contribute to improving performance.

- *In southern countries with the greatest margin for progress:*

For products of both plant and animal origin, the unit carbon footprint is greater in the least productive regions. This is due to farming practices that are often less optimised in developing countries. As an example, the greenhouse gas emissions per kilogram of meat produced can vary by a factor of 1 to 5 between Europe and South-East Asia. By improving livestock practices, the greenhouse gas emissions related to animal production could fall by between 10% and 45% per unit produced between now and 2030.

Improving production conditions and systems in southern countries should enable an increase in agricultural yields and limit the impacts of cultivation practices that are not adapted to the agricultural environment. This is an agrarian transition that will favour the maintenance of soil fertility and reduce the pressures on natural resources that compromise their regeneration.

**A few practical solutions:**

To the emissions intrinsic to different food types should be added those linked to the trade in certain goods, and notably cereals, fruits and vegetables and oilseeds. In a context of growing demand and price volatility, the challenges of food security must not be ignored, and it is necessary to determine strategies that will improve the food independence of each region while at the same time reducing global emission levels.

This will notably be achieved by grouping plots of arable land, mechanisation and more generally improving practices. By encouraging the development of agroecology based on the [Filières Qualité Carrefour](#) (FQC) in countries such as China or Brazil, by developing the supply of alternative products with the target of zero deforestation in 2020, Carrefour is making its contribution, whether this be with respect to cattle farming or the cultivation of palm oil. The FQC are based in particular on developing a rigorous traceability system that will guarantee healthy, high quality and authentic products for consumers. This initiative will contribute to preserving local assets and know-how, encourage environmentally-friendly farming practices and favour the development of long-term relationships with livestock breeders and farmers who commit themselves to this quality approach.

### 3. Limiting losses and waste

Finally, downstream in the chain, it is also by limiting losses (on both the supply and demand sides) that we shall limit food-related emissions, which on average reach 33% of global production.

#### **A few practical solutions:**

In developed countries, reducing losses can notably be achieved by controlling **food waste**.

The development by Carrefour of a **Plan Antigaspi** (Anti-waste Plan) is an action emblematic of the collective fight against waste throughout the food chain. This plan is based in particular on the following actions:

- Controlling all types of waste in retail outlets (anti-waste coaches),
- Redefining the shelf-life of certain products with their suppliers: 50 references with a BBD (Best Before Date) removed; 300 references with a UBD (Use By Date)/BBD extended.
- Donations to associations, which in 2014 reached €88 million equivalent meals.
- Raising the awareness of consumers (sorting of waste).

For several years, Carrefour has also been developing a **system for the recycling of organic waste** from its supermarkets (the pilot project was initiated in northern France) so that it can be transformed into biomethane and used as fuel by the company's vehicles. The target for 2017 is the deployment of 200 delivery lorries fuelled by biomethane.

Information and education for consumers, and also the existence of dedicated equipment such as the storage boxes and waste sorting bins sold by IKEA, will contribute to improving consumer behaviour towards generating less waste.

In emerging countries, it is above all improvements to logistics (transport and storage) that will help to reduce losses.