

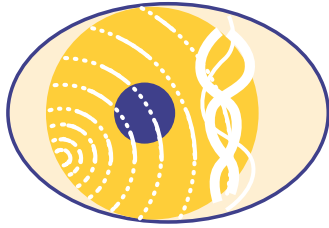
European Group
on Ethics in Science
and New Technologies
to the European Commission

Ethics of modern developments in agricultural technologies

BRUSSELS, 17 DECEMBER 2008

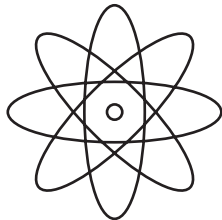


EUROPEAN COMMISSION



**European Group
on Ethics in Science
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Ethics of modern developments in agricultural technologies



Brussels, 17 December 2008

24
Opinion No



European Commission

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OPINION OF THE EUROPEAN GROUP ON ETHICS IN SCIENCE AND NEW TECHNOLOGIES TO THE EUROPEAN COMMISSION

Ethics of modern developments in agricultural technologies

No 24

17/12/08

Reference: Request from President Barroso

Rapporteurs: E. Agius, D. Banati and J. Kinderlerer

THE EUROPEAN GROUP ON ETHICS IN SCIENCE AND NEW TECHNOLOGIES (EGE),

Having regard to the Treaty on European Union, and in particular Article 188d ⁽¹⁾ thereof,

Having regard to the EU common agricultural policy (CAP) and to Council Regulation (EC) No 1290/2005 of 21 June 2005 on the financing of the common agricultural policy ⁽²⁾,

Having regard to the Food and Agriculture Organisation of the United Nations (FAO) and the World Health Organisation (WHO) *Codex Alimentarius* of 1963 for consumers, food producers, manufacturers and national food control agencies,

Having regard to the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) reports, agreed at an Intergovernmental Plenary Session in Johannesburg, South Africa, in April 2008,

Having regard to Council Directive 76/895/EEC of 23 November 1976 (as amended by Directive 2002/79/EC) and to Directives 86/362/EEC and 86/363/EEC (as amended by Directive 2002/97/EC) relating to the fixing of maximum levels for pesticide residues in and on food ⁽³⁾,

Having regard to Council Directive 80/68/EEC of 17 December 1979 on the protection of groundwater against pollution caused by certain dangerous substances ⁽⁴⁾,

Having regard to Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment ⁽⁵⁾,

Having regard to the Treaty of Amsterdam of 17 June 1997, and in particular to the sustainable development strategy (SDS) and Article 152 thereof concerning public health,

Having regard to the Gothenburg European Environment Council held in June 2001,

Having regard to Council Directive 90/219/EEC of 23 April 1990 on the contained use of genetically modified micro-organisms ⁽⁶⁾, as amended by Directive 98/81/EC,

Having regard to Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources ⁽⁷⁾ in order to reduce overall use of nitrates,

Having regard to Council Directive 91/414/EEC of 15 July 1991 concerning the placing of plant protection products on the market ⁽⁸⁾,

⁽¹⁾ 'Union development cooperation policy shall have as its primary objective the reduction and, in the long term, the eradication of poverty. The Union shall take account of the objectives of development cooperation in the policies that it implements which are likely to affect developing countries.'

⁽²⁾ OJ L 329, 16.12.2005.

⁽³⁾ OJ L 340, 9.12.1976; OJ L 291, 28.10.2002; OJ L 221, 7.8.1986; OJ L 343, 18.12.2002; OJ L 350, 14.12.1990; OJ L 2, 7.1.2003.

⁽⁴⁾ OJ L 20, 26.1.1980.

⁽⁵⁾ OJ L 175, 5.7.1985.

⁽⁶⁾ OJ L 117, 8.5.1990.

⁽⁷⁾ OJ L 375, 31.12.1991.

⁽⁸⁾ OJ L 230, 19.8.1991.

Having regard to Council Regulation (EEC) No 2078/92 of 30 June 1992 on agricultural production methods compatible with the requirements of the protection of the environment and the maintenance of the countryside ⁽⁹⁾,

Having regard to Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora ⁽¹⁰⁾,

Having regard to EGE Opinion No 1 of 12 March 1993 on the ethical implications of the use of performance-enhancers in agriculture and fisheries,

Having regard to EGE Opinion No 5 of 5 May 1995 on ethical aspects of the labelling of the food derived from modern biotechnology,

Having regard to the United Nations Convention on Biological Diversity of 6 June 1992, ratified by the European Union on 25 October 1993, and to the Cartagena Protocol on Biosafety, approved by the European Community on 11 September 2003,

Having regard to Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control ⁽¹¹⁾,

Having regard to the Kyoto Protocol, adopted on 11 December 1997 with the aim of reducing greenhouse gas emissions in order to fight global climate change (for the period 2005–12),

Having regard to Directive 98/8/EC of the European Parliament and of the Council of 16 February 1998 concerning the placing of biocidal products on the market ⁽¹²⁾,

Having regard to the Commission communication 'Directions towards sustainable agriculture' ⁽¹³⁾,

Having regard to Council Regulation (EC) No 1257/1999 of 17 May 1999 on support for rural development ⁽¹⁴⁾,

Having regard to the World Trade Organisation (WTO) Sanitary and Phytosanitary (SPS) Agreements of 1995, and in particular Article 5.1, 5.2 and 5.3 thereof on health risk assessments,

Having regard to Regulation (EC) No 258/97 of the European Parliament and of the Council of 27 January 1997 concerning novel foods and novel food ingredients ⁽¹⁵⁾,

Having regard to Council Directive 98/44/EC of the European Parliament and of the Council of 6 July 1998 on the legal protection of biotechnological inventions, and in particular Article 6 thereof ⁽¹⁶⁾,

Having regard to the Commission communication 'EU policies and measures to reduce greenhouse gas emissions: Towards a European climate change programme (ECCP)' ⁽¹⁷⁾,

Having regard to Directive 2000/13/EC of the European Parliament and of the Council of 20 March 2000 on the approximation of the laws of the Member States relating to the labelling, presentation and advertising of foodstuffs ⁽¹⁸⁾,

Having regard to Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy ⁽¹⁹⁾,

⁽⁹⁾ OJ L 215, 30.7.1992.

⁽¹⁰⁾ OJ L 206, 22.7.1992.

⁽¹¹⁾ OJ L 257, 10.10.1996.

⁽¹²⁾ OJ L 123, 24.4.1998.

⁽¹³⁾ COM(1999) 22, 27.1.1999.

⁽¹⁴⁾ OJ L 160, 26.6.1999.

⁽¹⁵⁾ OJ L 42, 14.2.1997.

⁽¹⁶⁾ OJ L 213, 30.7.1998.

⁽¹⁷⁾ COM(2000) 88, 8.3.2000.

⁽¹⁸⁾ OJ L 109, 6.5.2000.

⁽¹⁹⁾ OJ L 327, 22.12.2000.

Having regard to Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment ⁽²⁰⁾,

Having regard to Directive 2001/18/EC of the European Parliament and of the Council of 12 March 2001 on the deliberate release into the environment of genetically modified organisms and repealing Council Directive 90/220/EEC ⁽²¹⁾,

Having regard to the sixth Community environment action programme, as laid down by Decision No 1600/2002/EC of the European Parliament and of the Council of 22 July 2002 ⁽²²⁾,

Having regard to the Commission communication 'Pricing policies for enhancing the sustainability of water resources' ⁽²³⁾,

Having regard to Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety ⁽²⁴⁾, with a view to protection of human life and health, taking account of, where appropriate, protection of animal health and welfare, plant health and the environment,

Having regard to the Commission communication 'Towards a thematic strategy for soil protection' ⁽²⁵⁾,

Having regard to the Commission communication 'Towards a thematic strategy on the sustainable use of pesticides' ⁽²⁶⁾,

Having regard to Regulation (EC) No 1829/2003 of the European Parliament and of the Council of 22 September 2003 on genetically modified food and feed ⁽²⁷⁾,

Having regard to Regulation (EC) No 1830/2003 of the European Parliament and of the Council of 22 September 2003 concerning the traceability and labelling of genetically modified organisms and the traceability of food and feed products produced from genetically modified organisms and amending Directive 2001/18/EC ⁽²⁸⁾,

Having regard to Regulation (EC) No 1946/2003 of the European Parliament and of the Council of 15 July 2003 on transboundary movements of genetically modified organisms ⁽²⁹⁾,

Having regard to Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC ⁽³⁰⁾,

Having regard to the Commission communication 'Halting the loss of biodiversity by 2010 — and beyond: Sustaining ecosystem services for human well-being' ⁽³¹⁾,

Having regard to the Commission communication 'A thematic strategy on the sustainable use of pesticides' ⁽³²⁾,

⁽²⁰⁾ OJ L 197, 21.7.2001.

⁽²¹⁾ OJ L 106, 17.4.2001.

⁽²²⁾ OJ L 242, 10.9.2002.

⁽²³⁾ COM(2000) 477, 26.7.2000.

⁽²⁴⁾ OJ L 31, 1.2.2002.

⁽²⁵⁾ COM(2002) 179, 16.4.2002.

⁽²⁶⁾ COM(2002) 349, 1.7.2002.

⁽²⁷⁾ OJ L 268, 18.10.2003.

⁽²⁸⁾ OJ L 268, 18.10.2003.

⁽²⁹⁾ OJ L 287, 5.11.2003.

⁽³⁰⁾ OJ L 275, 25.10.2003.

⁽³¹⁾ COM(2006) 216, 22.5.2006.

⁽³²⁾ COM(2006) 372, 17.12.2006.

Having regard to Council Regulation (EC) No 172/2007 of 16 February 2007 on persistent organic pollutants ⁽³³⁾, which introduced maximum concentration limits,

Having regard to Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an infrastructure for spatial information in the European Community ⁽³⁴⁾, in order to support environmental protection by requiring Member States to make geographical information available in a coordinated manner,

Having regard to Regulation (EC) No 614/2007 of the European Parliament and of the Council of 23 May 2007 concerning the financial instrument for the environment (LIFE) ⁽³⁵⁾, which aimed at merging existing environmental programmes into a single mechanism,

Having regard to the Commission communication 'Limiting global climate change to 2 degrees Celsius — The way ahead for 2020 and beyond' ⁽³⁶⁾,

Having regard to the Commission communication on implementation of Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources ⁽³⁷⁾,

Having regard to the Commission communication 'Towards sustainable water management in the European Union — First stage in the implementation of the water framework Directive 2000/60/EC' ⁽³⁸⁾,

Having regard to the Commission communication on a 'Proposal for a Council regulation on information provision and promotion measures for agricultural products on the internal market and in third countries' ⁽³⁹⁾,

Having regard to Council Regulation (EC) No 1107/2007 of 26 September 2007 derogating from Regulation (EC) No 1782/2003 establishing common rules for direct support schemes under the common agricultural policy and establishing certain support schemes for farmers, as regards set-aside for the year ⁽⁴⁰⁾, with the aim of reducing the set-aside rate from 10 % to 0 % of agricultural land for sowing in autumn 2007 and spring 2008,

Having regard to Regulations (EC) No 1180/2007 and (EC) No 1182/2007 amending existing legislation in the fruit and vegetable sector to make it more competitive and market-oriented ⁽⁴¹⁾,

Having regard to Council Regulation (EC) No 1234/2007 of 22 October 2007 establishing a common organisation of agricultural markets and on specific provisions for certain agricultural products (single CMO regulation) ⁽⁴²⁾, creating a horizontal legal framework for the agricultural markets,

Having regard to the Commission communication '2006 environment policy review' describing the action taken by the EU on the environment ⁽⁴³⁾,

Having regard to the Commission communication 'Mid-term review of the sixth Community environment action programme' with reference to protection of the environment, biodiversity and natural resources ⁽⁴⁴⁾,

⁽³³⁾ OJ L 55, 23.2.2007.

⁽³⁴⁾ OJ L 108, 24.4.2007.

⁽³⁵⁾ OJ L 149, 9.6.2007.

⁽³⁶⁾ COM(2007) 2, 10.1.2007; OJ C 138, 22.6.2007.

⁽³⁷⁾ COM(2007) 120, 19.3.2007; OJ C 181, 3.8.2007.

⁽³⁸⁾ COM(2007) 128, 22.3.2007.

⁽³⁹⁾ COM(2007) 268, 23.5.2007; OJ C 191, 17.8.2007.

⁽⁴⁰⁾ OJ L 253, 28.9.2007.

⁽⁴¹⁾ OJ L 273, 17.10.2007; OJ L 350, 31.12.2007.

⁽⁴²⁾ OJ L 299, 16.11.2007.

⁽⁴³⁾ COM(2007) 195, 30.4.2007; OJ C 181, 3.10.2007.

⁽⁴⁴⁾ COM(2007) 225, 30.4.2007; OJ C 181, 3.10.2007.

Having regard to the Commission communication on the implementation of the Community strategy for dioxins, furans and polychlorinated biphenyls ⁽⁴⁵⁾,

Having regard to the Commission communication 'Addressing the challenge of water scarcity and droughts in the European Union' ⁽⁴⁶⁾,

Having regard to Council Regulations (EC) No 1290/2005 and (EC) No 3730/87 laying down general rules for the supply of food from intervention stocks to designated organisations for distribution to the most deprived persons in the European Union ⁽⁴⁷⁾,

Having regard to the Commission communication 'Preparing for the "health check" of the CAP reform' on the overview of the adjustments needed in the CAP ⁽⁴⁸⁾,

Having regard to the 'Bali roadmap' agreed between 3 and 14 December 2007 by 180 countries and opening the formal negotiations for a system to combat climate change after 2012,

Having regard to the Treaty of Lisbon, signed on 13 December 2007 and currently open for ratification,

Having regard to Article 6 of the seventh framework programme of the European Community for research, technological development and demonstration activities (2007–13), which states that 'All the research activities carried out under the seventh framework programme shall be carried out in compliance with fundamental ethical principles',

Having regard to the Commission communication 'Supporting early demonstration of sustainable power generation from fossil fuels' ⁽⁴⁹⁾,

Having regard to the Commission communication on a proposal for a directive on the promotion of the use of energy from renewable sources ⁽⁵⁰⁾,

Having regard to the report by the WHO Commission on Social Determinants of Health 'Closing the gap in a generation — Health equity through action on the social determinants of health', published on 28 August 2008,

*Having heard the rapporteurs **E. Agius, D. Banati and J. Kinderlerer**,
Hereby adopts the following opinion.*

⁽⁴⁵⁾ COM(2007) 396, 10.7.2007; OJ C 191, 17.8.2007.

⁽⁴⁶⁾ COM(2007) 414, 18.7.2007; OJ C 246, 20.10.2007.

⁽⁴⁷⁾ OJ L 209, 11.8.2005; OJ L 352, 15.12.1987.

⁽⁴⁸⁾ COM(2007) 722, 20.11.2007.

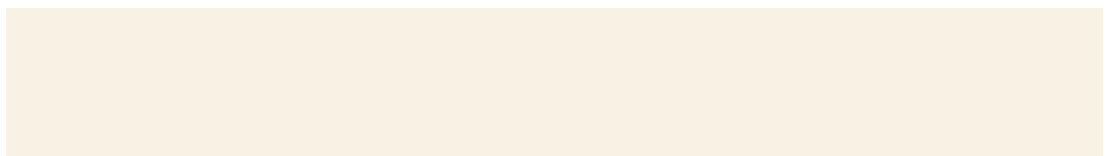
⁽⁴⁹⁾ COM(2008) 13, 23.1.2008.

⁽⁵⁰⁾ COM(2008) 19, 23.1.2008.

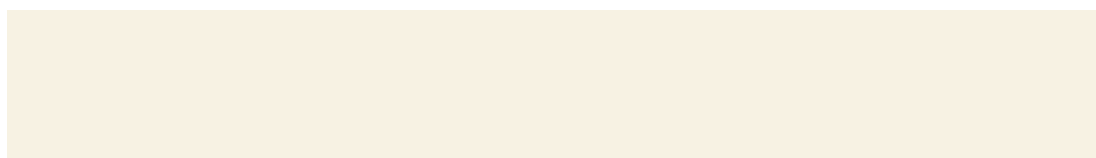
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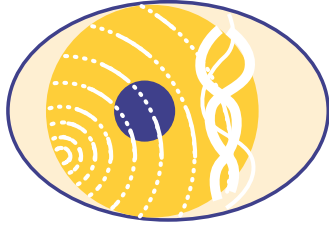
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AND NEW TECHNOLOGIES TO THE EUROPEAN COMMISSION

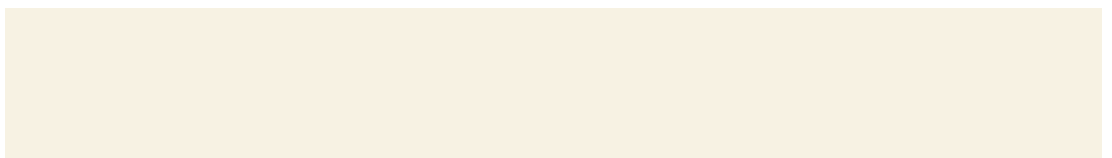
Ethics of modern developments in agricultural technologies

Reference: Request from **President Barroso**

Rapporteurs: **E. Agius, D. Banati and J. Kinderlerer**

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Opinion No



1. Scope of the opinion

Food security, energy security, sustainability and globalisation have become core issues in the current political debate worldwide. This debate is enriched by other issues, including climate change, global trade, fluctuations in food and energy prices and the future need for additional energy sources, the revision of the EU common agricultural policy (CAP) and the link between the CAP and the EU economic strategy (the 'Lisbon agenda').

In order to address the new challenges and opportunities which lie ahead for EU agriculture, President Barroso asked the EGE to prepare an opinion on the ethical implications of modern developments in agricultural technologies. These should include primary agricultural production, bearing in mind the relationship between agriculture and the natural environment, the UN millennium development goals, such as the fight against world hunger, and the impact of changing agricultural methods on rural and urban communities ⁽¹⁾.

The EGE accepted this complex task, aware that any such opinion, while addressing agricultural technologies, cannot avoid referring to a plethora of interrelated issues, such as the competition for arable land between food, feed, fibres, feedstock or fuel. Because of these considerations, and out of pragmatism, the EGE therefore decided to address the technologies that could be conducive to the priorities supported by the group, namely:

- (1) food security;
- (2) sustainable use of resources and fair trade at world level in agricultural products; and
- (3) ethically sound design of sustainable EU agricultural policies.

Food security and sustainability are therefore the main subjects of this opinion, which will refer mainly to primary production of food of plant origin, and not to other areas of the EU agricultural policy such as fisheries, livestock farming, food processing and green biotechnology for pharmaceutical uses. These, together with other issues that play a role in the global discussion on the CAP (such as fisheries, forestry, climate change and energy), will not be covered 'specifically' in this opinion, although they are all recognised by the group as being

⁽¹⁾ Adapted from 'Frontiers in agricultural research: food, health, environment and communities' (2002), published by the National Academy of Sciences (New York).

of fundamental importance in a global discussion on ethics in EU agriculture. However, the group also intends to formulate, in this opinion, an ethical frame for agriculture within which further EGE opinions addressing some of the abovementioned issues may be conceived in the future, respecting the group's remit ⁽²⁾.

This EGE opinion is also conceived as a contribution to a global ethical debate on sustainable agriculture, in which international organisations ⁽³⁾ and European institutions ⁽⁴⁾ will work closely together to implement the UN millennium development goals and design sustainable and responsible agricultural policies.

2. State of the art in agriculture

2.1. Introduction

'None of us can avoid being interested in food. Our very existence depends on the supply of safe, nutritious foods. It is then hardly surprising that food has become the focus of a wide range of ethical concerns' ⁽⁵⁾.

The majority of people in developed countries not only have enough to eat, but also have a vast choice and probably eat too much. Others, particularly in the developing world, remain unable to choose, at the very least, or do not have enough to eat.

The ecosystems surrounding us are the lifeblood of the planet, providing us with everything from the water we drink to the food we eat and the fibre we use for clothing, paper or lumber ⁽⁶⁾. Historically, agricultural

⁽²⁾ The EGE advises the European Commission on ethical aspects of science and new technologies in connection with preparation and implementation of Community legislation or policies.

⁽³⁾ Inter alia, the Food and Agriculture Organisation of the United Nations (FAO), United Nations Educational, Scientific and Cultural Organisation (Unesco), World Health Organisation (WHO), World Intellectual Property Organisation (WIPO), International Centre for Genetic Engineering and Biotechnology (ICGEB) and World Trade Organisation (WTO).

⁽⁴⁾ Inter alia, the European Environment Agency, European Food Safety Agency and departments of the European Commission.

⁽⁵⁾ Frans W. A. Brom and Bart Gremmen, 'Food ethics and consumer concerns', *Journal of Agricultural and Environmental Ethics* 12: 111–112 (2000).

⁽⁶⁾ Stanley Wood, Kate Sebastian and Sara J. Scherr, 'Pilot analysis of global ecosystems: agroecosystems', a joint study by the In-

production was stepped up by increasing land use and employing the best technologies available. Densely populated parts of the world, such as in China, India, Egypt and some regions of Europe, reached the limits of arable land expansion many years ago ⁽⁷⁾. Intensification of production has therefore become a key strategy — obtaining more from the same amount of land. Until recently, food output kept up with global population growth: in 1997 agriculture provided (on average) 24 % more food per person than in 1961, despite the population growing by 89 %.

The FAO estimated that at the end of the last century there were between 300 000 and 500 000 species of higher plants (i.e. flowering and cone-bearing plants), of which about half have been identified or described. About 30 000 are edible and about 7 000 have been cultivated or collected by humans for food at one time or another. Of these, approximately 120 species are important on a national scale, and 30 species provide 90 % of the world's calorie intake ⁽⁸⁾. At the time of the FAO survey, wheat covered 23 % of the world's calorie needs, rice 26 % and maize 7 % ⁽⁹⁾. During 2004 and 2006 wheat and maize production in the EU and the United States fell by between 12 % and 16 % and in 2006 global cereal stocks (especially wheat) were at their lowest level since the early 1980s ⁽¹⁰⁾.

Cropland and managed pasture cover some 28 % of the world's land surface; 31 % of this area is occupied by crops and the remaining 69 % is under pasture. Annual cropland is relatively stable at about 1.38 billion hectares. As much as 91 % of cropland is under annual crops such as wheat, while perennial crops, such as fruit trees and tea, occupy the remainder. Irrigated areas make up about 5.4 % of the world's agricultural land and 17.5 % of cropland ⁽¹¹⁾.

International Food Policy Research Institute and World Resources Institute, Washington D.C. (2000), ISBN 1-56973-457-7.

⁽⁷⁾ Stanley Wood, Kate Sebastian and Sara J. Scherr, 'Pilot analysis of global ecosystems: agroecosystems', a joint study by the International Food Policy Research Institute and World Resources Institute, Washington D.C. (2000), ISBN 1-56973-457-7.

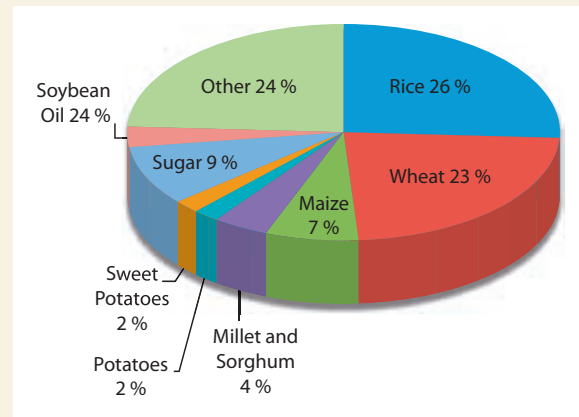
⁽⁸⁾ FAO, 'The state of the world's plant genetic resources' (1998).

⁽⁹⁾ FAO, 'Food balance sheets 1984–86', Rome (1991).

⁽¹⁰⁾ Joachim von Braun, 'The world food situation — New driving forces and required actions', International Food Policy Research Institute, Washington D.C. (2007).

⁽¹¹⁾ Stanley Wood, Kate Sebastian and Sara J. Scherr, 'Pilot analysis of global ecosystems: agroecosystems', a joint study by the International Food Policy Research Institute and World

Percentage of calorific intake by food group



2.2. Historical developments in agriculture

Between 1900 and 1940 farmers began using powered machinery (tractors, drainage pumps, electric poultry equipment, etc.), new chemical applications (synthetic nitrogen fertilisers) and new applications of biological science for both crop and livestock production (hybrid corn, artificial insemination, etc.).

By the 1930s, farmers had started to make proper use of technological innovations seeking to optimise production and increase the economic return from farming. Since the 1950s extensive use of tractors in West European countries has been helping to optimise agricultural production but has also been instrumental in:

- (1) reducing job availability in rural areas — accompanied by migration of workers to urban areas;
- (2) increasing the dependence of agriculture on energy sources (mainly fossil fuels). Provision of 'fuel' for the transport system (horses, for example) became redundant in the developed world, as farmers grew produce for food or for feed for food animals.

Agriculture changed very significantly in the second half of the 20th century. The first revolution, called the 'green revolution' ⁽¹²⁾, involved using an understanding of the biology of plants and of organic chemistry to provide tools to produce a massive increase in the

Resources Institute, Washington D.C., (2000), Executive summary, p. 3, ISBN 1-56973-457-7.

⁽¹²⁾ Term coined by William Gaud, Director of the US Agency for International Development, in March 1968.

Historical milestones in agriculture	
10000 to 2000 BC	Start of cultivation by mankind
1800s	Selective cross-breeding of plants
Early 1900s	Wide cross-hybridisation
Mid-1900s	Plant mutagenesis and selection
1930s to 1950s	Cell culture and somaclonal variation
	Embryo rescue
	Poly-embryogenesis
	Anther culture
1960 to 1970	Green revolution
1970s to 1980s	Recombinant DNA technologies (GMOs etc.)
	Marker-assisted selection (MAS)
1990s	Genomics
	Bioinformatics
	Nanotechnology

yields of many major crop plants. Farmers were able to provide products for a much greater market than had hitherto been possible. The development of hybrids of some of the major crops also changed the manner in which seed is used. For most of history, farmers had kept seed from one harvest for use in following years. Hybrids and the ready availability of good quality seed from seed merchants changed this practice in many developed countries for some of the major commodity crops. Modern arable agriculture, involving searching for and finding new varieties best suited to particular conditions, has been practised for centuries.

The green revolution started in the 1960s when varieties of wheat were improved by selection and produced dramatically increased yields. These varieties were particularly responsive to irrigation and fertilisers.

A significant advance in agriculture in the 20th century came with the understanding and use of genetic tools to produce appropriate seeds effectively. An understanding of the morphology, physiology, genetics and methods for handling seed transformed agriculture during the second half of the century. Chemical and radiation mutagenesis, tissue culture, embryo rescue and many other techniques have been used in plant breeding to alter the genetic characteristics of the seeds that are only one of the many factors that determine the viability of and yield from the resulting plants. The percentage that germinate and the vigour of the seedlings are important in enabling the yield to fulfil its potential. In developing countries, provision of virus-free seed to farmers has possibly had more of an impact on yield than almost any other technology. Indeed, seed 'is a

key tool for technology transfer and technology-driven development strategies and is widely considered a focal point in agricultural progress' (13). This genetic value identified in seeds has raised concern about the availability of genetic diversity for the future. There are initiatives to conserve genetic resources on farms, in gene banks and *in situ* (14).

2.3. A paradigm shift: from food security to food safety

At the end of the Second World War, there was an enormous need to increase food production both in Europe and in the United States for export to Europe. The goal was, therefore, to supply abundant food at the lowest possible cost to consumers. EU farmers accordingly adopted new technologies to enhance production and, at the same time, fiscal policies to externalise the environmental costs of food production were promoted (15).

Subsequently, steps were taken to optimise production. Farmers moved towards full electrification and mechanisation, wider use of chemicals to control weeds and pests, applications of information and computer sciences to improve management and marketing

(13) McMullen, 'Seeds and world agricultural progress', Washington D.C., National Planning Association Report No 227. ISBN 978-0890680889 (1987).

(14) Maxted et al., 'Plant genetic conservation: the *in situ* approach', London, Chapman Hall (1997).

(15) Maarten and Mandoli, 'Agricultural ethics', *Plant Physiology*, Vol. 132, pp. 4–9 (2003).

efficiency, use of knowledge of genetics to select appropriate varieties and modify desired characteristics and, finally, new sensor systems such as lasers for precise levelling of fields and global positioning system (GPS) technologies with satellite tracking and onboard computer monitoring to assist with more precise application of chemicals.

In the 1990s, crops with enhanced traits were introduced, partially with the aid of genetic engineering. The productivity gains made possible by these science-based enhancements were dramatic. For example, the index of total output in American farming relative to total input increased by roughly 300 % between 1910 and 1990. The green revolution also led to the creation of new varieties of wheat (*Triticum aestivum*) and rice (*Oryza sativa*), which increased food production in Asia and Latin America and provided food for hundreds of millions. Over the last 50 years, therefore, improvements in knowledge of plant genetics, physiology and agronomy have underpinned large increases in crop productivity.

Some farmers, however, felt that the introduction of new technologies did not necessarily lead to economic returns, as grain prices had been falling continuously. Farmers started to question industrialised intensive agriculture policies⁽¹⁶⁾ (cf. the debate about organic farming and conventional and traditional agriculture for food production). On the other hand, emerging pathogens (e.g. prions causing bovine spongiform encephalopathy (BSE, more commonly known as 'mad cow disease') or the highly pathogenic H5N1 virus) grabbed the attention of consumers throughout Europe. Worldwide outbreaks of food-borne illnesses have occurred in the past. Nevertheless, recent cases have made consumers increasingly aware of the naturally occurring threats and production-induced risks to food safety all over Europe. It must be borne in mind that food is not only an agricultural or trade commodity but also an essential emotional, political and public health issue. The demand for healthy and safe food increased throughout the EU. Health-related concerns about food products generated a need for reassurance about the presence of pesticide residues, heavy metals, hormones, antibiotics and additives used in the food system or large-scale livestock farming. Food safety issues and consumers' rights became key components of EU policies on agriculture. Farmers and consumers have

⁽¹⁶⁾ Brouwer, 'Main trends in agriculture', Policy Brief 1. EU FP6 SSA, 'Agriculture for sustainable development: a dialogue on societal demand, pressures and options for policy', p. 3 (2006).

begun questioning some technologies, especially pest control practices and genetic engineering of crops, and want to know if they are consistent with human health, stewardship of the land and the sustainability of the Earth's ecosystems.

2.4. *Modern agriculture: security and sustainability*

The growth rate for global demand for agricultural commodities has increased from 1.5 % per year in the mid-1970s to 1980s to 1.9 % per annum from the mid-1990s to the present (USDA, Goldman Sachs Commodities Research, 2008⁽¹⁷⁾). Although production is an excellent goal, the challenge that lies ahead in the 21st century is to make the transition from production agriculture to agricultural sustainability. This transition will require substantial institutional innovation⁽¹⁸⁾.

3. **Agricultural methods and technologies**

The rapid growth in world population (13 %), global income (36 %) and meat consumption (beef 14 %, pork 11 % and chicken 45 %) in the last decade⁽¹⁹⁾ are major drivers behind increased demand for raw materials. There are essentially four options available to meet this challenge:

- (1) increase the area cultivated, thus putting further pressure on the remaining land, including marginal ground and forests;
- (2) increase the productivity of the land currently cultivated, which is a more sustainable option;
- (3) improve distribution of agricultural products to ensure they are in the right place at the right time;
- (4) modify the consumption habits of those enjoying excess and redistribute.

These challenges can be met by modern technologies, which therefore play a considerable role in sustainable agriculture.

⁽¹⁷⁾ Quoted by Colin Ruscoe, British Crop Protection Council (April 2008).

⁽¹⁸⁾ Ruttan (1999).

⁽¹⁹⁾ Data from EuropaBio (www.europabio.org). Source: USDA/Pioneer Market Economics.

Agricultural technologies by category

Technologies and methods to ensure sustainability	Technologies and methods to ensure food security	Other technologies not directly linked to agri-food
Sustainable land use, production and distribution	Improved production efficiency	Biofuel production
Non-tillage practices	Food stocks' storage	R & D
ICT-based agriculture	Grain improvement	
Indicators for monitoring	Marker-assisted selection	
Technologies to counteract climate change	Genetically modified plants	

3.1. Sustainable agricultural technologies

Sustainable agricultural technologies aim to reduce input and increase output without depleting resources, such as soil-derived nutrients and water. Among them, biotechnologies have assumed an increasingly important role in boosting productivity while reducing manpower and production costs. As a result, over the last 50 years the cost of food has been decreasing steadily by between 10 % and 50 % compared with the average family's income (but see Section 3.2 for a description of the latest trend). In order to achieve this, food production and distribution processes have been evolving, from optimisation of use of arable land to new methods to turn areas not accessible at present, due to adverse environmental conditions, into arable land.

3.1.1. Soil conservation: non-tillage practices to limit soil erosion

Erosion is a natural process heightened by human land use, particularly if the land is used for growing agricultural crops. Tillage used to be (and still is) a common practice that reduces surface vegetation and disrupts both the soil architecture and the root systems present in the soil that would offer a natural defence against soil erosion. As a consequence, valuable nutrients and biomass are continuously lost from arable fields and need to be replaced for each harvest, at farmers' expense, by spreading added fertiliser. Non-tillage options have been developed over the last few decades in order to implement better preservation practices in agriculture.

Non-tillage techniques against erosion can take the form of contour farming (on gentle slopes), terrace-building and strip-crop farming, but each of these requires significant changes in crop management, including use of herbicides and, probably, herbicide-tolerant crops. Non-tillage practice is becoming important as industrial demand for what used to be waste mater-

ial increases. Leaves and stalks (e.g. corn stover or straw ⁽²⁰⁾) have traditionally been left on fields after harvest, but bio-refineries are set to use such waste material as cellulosic biomass for ethanol production. Conventional tillage practice involves intensive tilling of soils to control weeds and aid irrigation. This disturbs more than 70 % of the soil. Residues should be left on the land in order to prevent soil erosion. Use of herbicides and herbicide-tolerant plants reduces the need to till and makes residue removal less critical — allowing the residue to be taken for refining ⁽²¹⁾.

Contour farming consists of ploughing the land following its natural contours and planting across its slope, so that water can be retained when it rains and the soil is not washed off the fields. Terraces also reduce erosion by counteracting surface run-off and are built with supporting down-slope borders across the slope. A series of terraces can effectively break up long slopes, which are more susceptible to soil erosion, into short sections, each of which collects some of the excess water from a smaller partitioned area.

Strip-crop farming consists of planting alternating rows (or strips) of a closely sown crop (e.g. wheat) plus a cereal crop (known as 'row crops', e.g. corn). This helps to prevent soil erosion because it preserves moisture better, as the different layers of plant roots will adsorb water differentially, helping to keep up the soil's strength. It resembles simultaneous in-field rotation,

⁽²⁰⁾ Corn stover consists of the leaves and stalks of maize plants left in the field after harvest. It makes up about half of the yield of a crop and is similar to straw, the residue left in the field after harvesting of any cereal grain. Stover can be grazed as forage or collected for use as fodder but is commonly left unused. It is used for cattle feed in Europe.

⁽²¹⁾ BIO (Biotechnology Industry Organisation), 'Achieving sustainable production of agricultural biomass of biorefinery feedstock' (2006).

providing a means of keeping the land fertile for longer than in standard farming. Good **drainage** is also necessary in all farming practices and is an important conservation practice. It can reduce surface water dispersion in the rainy season by letting water soak deeper into the soil and can lead to increased crop production by guaranteeing optimum soil humidity.

3.1.2. Pesticides, herbicides and fertilisers

Pesticides are chemicals used (usually sprayed) on crops to kill pests harmful to plants, usually insects. Theoretically, they are targeted in order not to affect other insects or animals. They are designed to eliminate pests; however, they could also harm other species, either by direct contact or by accumulation in the food chain. Repeated use of pesticides creates the selection pressure required for disease-resistant species to evolve. **Herbicides** (and fungicides) are chemicals used to eliminate unwanted weeds from plantations. Some of them are less of a problem to animals because their mode of action is based on metabolic pathways present only in plants, but others have been shown to cause various negative health effects (such as skin irritation or even carcinogenic effects) attributable to improper use/dosage and unwanted contact with animal species and humans. **Fertilisers** are chemicals that are applied to soil to provide crops with nutrients. Nitrogen available in the form of nitrates is one example of a nutrient essential for plants that can be provided by fertilisers. Their composition and mode of action are therefore totally different from pesticides, but, like pesticides, they pose an environmental hazard when over-accumulated in the soil. As a source of nutrients, they normally have no direct negative effects on plants and animals; however, some plants can utilise the extra nutrients more effectively than others and therefore out-compete others. In this way, fertilisers can be responsible for a reduction in species diversity.

Use of chemicals has had a deep influence on agriculture in general, by avoiding crop losses due to pests and increasing production, but has also had a number of disadvantages, such as chemical intake — bioaccumulation — carcinogenic and other effects and related consumer concerns. An increasing number of farmers have started to use organic fertilisers and pesticides to avoid chemicals which could have polluting and ill effects on crops or those eating them. Another approach that has been used is **integrated pest management** where different crops are cultivated that promote the presence of animal species that compete with, or are

predators on, harmful insects. The population of predators or competitors against harmful species may also be increased by cultivating them and spreading in fields.

3.1.3. Information and communication technologies (ICT) in agriculture: precision farming as a method to reduce chemicals input and maximise land use

In the era of computer technology, an increasing number of agricultural practices may be remotely controlled and monitored by computer-assisted methods. Precision farming, also called 'site-specific farming', is the newest method in the most developed countries, in which advanced information technology tools are employed to ensure better land management and use of resources. With the aid of a global positioning system (GPS) and a geographical information system (GIS), nowadays it is possible to map precisely the area of farmed land and to monitor physical soil characteristics such as topography, salinity, etc. All the data can be stored and analysed at any time. Major advantages of such technology include improved crop yields, more efficient (lower) application of chemicals and, therefore, a reduction in the pollution caused by releases of chemicals into the environment.

The decrease in chemical input applies both to use of fertilisers, due to 'variable-rate' fertilisation (applying discrete quantities exactly when they are needed), and to variable spraying of pesticides and herbicides, based on precise topographical maps which make restricted use possible. Precision farming is still at an experimental phase in some countries (e.g. USA), but could spread quickly once its advantages over conventional farming are established and commonly accepted.

3.1.4. Double-crop systems

The ability to thrive through stress is a genetically complex trait, but involves a relatively small number of genes that have a significant effect on stress tolerance. Thanks to this genetic information, new crop varieties have been selected that can withstand and grow through environmental stresses such as frost, heat and drought. Some crops, for example rice and cotton, do not tolerate environmental stresses well and require large amounts of water. Sorghum, on the other hand, is a crop that tolerates drought well. By harnessing these different properties and the increasing knowledge about how crops and other plants withstand environmental stresses, new agricultural systems

such as 'double cropping' have been developed ⁽²²⁾. As a result, now it is possible to plant two crops per season every year, for example by planting crops in the spring to be harvested in the summer (e.g. early maturing soybean) and autumn, taking advantage of the different maturation times ⁽²³⁾ in double crops such as soybean/winter barley and wheat/maize. This system could significantly reduce the amount of cropland needed for current food production and is becoming an option for increasing food production to feed the ever-increasing world population.

3.1.5. Intercropping systems

Many farmers have adopted intercropping techniques, where two crops are grown at the same time. This has been found to be beneficial in suppressing weeds, increasing crop competition and providing allelopathic effects. Two crops could use light, water and nutrients more effectively than one, leaving fewer resources available for weeds ⁽²⁴⁾.

'Intercropping is most successful when the two crops have complementary growth patterns and resource needs. For example, an intercrop of peas and oats controls weeds in several ways: the oats provide early competition with weeds while the peas are becoming established; the peas then climb on the oats, blocking out light to the soil; the rooting patterns of the two crops also differ; the oats compete more with grassy weeds for nutrients and the peas compete with the broadleaf weeds; the oats also take up excess nitrogen that would otherwise stimulate weed growth.

Other successful intercrops include: oats and pulses (such as lentils or beans), flax and wheat, flax and medic, wheat and lentils, flax and lentils, barley and peas.

Seeding rates need to be adjusted so that the two crops compete with the weeds, but not with each other. Seeding each crop at two thirds of its normal rate has produced good results.' ⁽²⁵⁾

⁽²²⁾ See, for example, <http://extension.missouri.edu/xplor/agguides/crops/g04090.htm>

⁽²³⁾ See, for example, <http://www.plantmanagementnetwork.org/>

⁽²⁴⁾ <http://www.gov.mb.ca/agriculture/crops/weeds/fba09s00.html#Intercropping>

⁽²⁵⁾ Ibid.

3.1.6. Climate-change-related sustainable technologies

As global warming is changing the climate worldwide and is aggravating, for instance, the process of desertification, there is a pressing need to adapt agricultural technologies in order to make greater use of land in increasingly difficult regions — land with a higher salt content, arid land, etc. Varieties that exhibit stress tolerance are being actively sought and then crossed with local varieties ⁽²⁶⁾. In order to achieve results with greater precision and faster, genetically modified plants are being developed (see also Section 3.2.3).

It is becoming increasingly important to apply agricultural production methods that use less water and to develop technologies to maximise nitrate use (for increased retention of nitrogen) and CO₂ sequestration ⁽²⁷⁾.

Lastly, sugars are essential raw materials for a range of products, including ethanol and bioplastics. Leaves, straw and wood are made up of about 70 % sugar (often in the form of cellulose or starch). This waste material could therefore be fermented into ethanol for use as a fuel or feedstock for chemical synthesis. Natural cellulases, enzymes that break down cellulose into usable glucose, are not very efficient and break down plant material slowly. Biotechnology-based methods (e.g. using micro-organisms as 'bio-factories') to break down cellulose enzymatically to free sugars will therefore assume increasing relevance in future. Such bio-refineries would require significant amounts of material. Current yields of ethanol from agricultural residues are about 250 litres per tonne ⁽²⁸⁾. Assuming that a bio-refinery would produce 250 megalitres per year, it would need approximately 1 million tonnes of feedstock or 200 000 hectares of cropland ⁽²⁹⁾.

⁽²⁶⁾ CGIAR, 'Adapting agricultural systems to climate change' (http://www.cgiar.org/pdf/cc_adapting_agr_systems.pdf) (2007).

⁽²⁷⁾ D. R. Sauerbeck, 'CO₂ emissions and C sequestration by agriculture — perspectives and limitations', Springerlink (2004).

⁽²⁸⁾ US Department of Energy, 'Breaking the biological barriers to cellulosic ethanol — A Joint Research Agenda', DOE/SC-0095: <http://doegenomestolive.org/biofuels/b2bworkshop.shtml> (2006).

⁽²⁹⁾ BIO (Biotechnology Industry Organisation), 'Achieving sustainable production of agricultural biomass for biorefinery feedstock' (www.bio.org/ind/biofuel/SustainableBiomass-Report.pdf) (2006).

3.2. Agricultural technologies and methods

Agricultural technologies offer farmers new and better crops which will allow them to increase harvest yield and minimise losses. These goals are achieved first by certain desirable output traits, such as improved crop quality which increases yield and leads to better nutritional composition (e.g. starch, proteins and oils), and selection for better appearance and better taste. Secondly, crops can display certain input traits, such as disease resistance (to virus, bacteria, fungi, etc.), pest (insect) resistance, herbicide tolerance and resilience to abiotic stresses (tolerance to cold, heat and drought). Although, on the one hand, the advantages of such technologies for farmers are evident, on the other there is a need to make them and improved crops accessible to all farmers, including those in the poorest countries, and for a system to counter-balance the corporate agricultural industry, which often wields monopolistic control over commodity prices.

3.2.1. Grain improvement

One of the most important tasks carried out by agronomists is selective **plant breeding** in order to develop increasingly better quality crops. Over the last few decades, significant improvements have been attained for most commonly used grains, such as wheat, corn and soybean. Creation of hybrids (not only for grains, but also for fruit and vegetables) with improved nutritional value has been another significant development. Selection in multiple generations allows segregation of traits and, therefore, selection of desirable and deletion of unwanted traits⁽³⁰⁾. Selection of desirable traits can be improved by means of markers (see Section 3.2.2) or genetic manipulation (see Section 3.2.3), but traditional backcrossing is always required.

Development of applications of molecular genetics for plant breeding has created new opportunities for breeding cultivated species. These technologies include those listed below.

- **Marker-assisted selection (MAS)** (see Section 3.2.2 for further details), which can speed up studies, leading to better crops by directing selection more efficiently. Coupling of selection with massive analysis of existing germplasm or with muta-

genesis could allow breeding for new characteristics of interest to farmers.

- **Genomic approaches** to analyse complex characteristics. These technologies make it possible to study characteristics inaccessible with previous technologies and allow breeding of species with difficult genetic features. In this way, new crops could become accessible for plant breeding.
- **Genetic modification** (see Section 3.2.3 for further details) of plants where genes of any origin can be introduced into plants in the laboratory. GMO plants normally include a small number of new genes leading to new properties such as insect resistance or herbicide tolerance.

Other plant technologies that have had an impact on improving agronomic properties and sustainability are as follows.

- **Plant tissue culture:** This technique allows whole plants to be produced from minute amounts of parts like the roots, leaves or stems or even just a single plant cell under laboratory conditions. One advantage of tissue culture is rapid production of clean planting materials. Examples of tissue culture products in Kenya include banana, cassava, Irish potato, pyrethrum and citrus.
- **Hybridisation:** Increasingly, plant scientists are harnessing the characteristic feature of better yielding hybrids in plants. Hybrid vigour, or heterosis⁽³¹⁾ as it is scientifically known, exploits the fact that some offspring from the progeny of a cross between two known parents would be better than the parents themselves. Many hybrid varieties of several crop species are being grown all over the world today. One example of this is the hybrid tomatoes commonly eaten.

Additional technologies which lead to optimisation of food production from arable land without using genetic engineering are indicated in the display box.

⁽³⁰⁾ R. Bernardo, 'Breeding for quantitative traits in plants', Stemma Press, Woodbury, United States (2002).

⁽³¹⁾ Heterosis: increase in growth, size, fecundity, function, yield or other characters in hybrids over those of the parents. Retrieved on 5 October 2008 from Dictionary.com (unabridged (v. 1.1)) (<http://dictionary.reference.com/browse/HETeROSIS>).

Some tools of biotechnology (apart from genetic engineering) (*)

- *Marker-assisted breeding uses conventional breeding techniques informed by specific genetic sequences, or 'markers', that segregate on the basis of particular traits. Markers speed up breeding programmes by allowing researchers to determine, early in the life of a progeny, whether the traits they hoped to combine from two organisms are present simply by checking for the presence of the markers.*
- *Tissue culture is used in clonal propagation of plants for which sexual breeding has proved inefficient. It has been important for reproducing crops used across the African continent, including oil palm, plantain, banana, date, aubergine, pineapple, rubber tree, cassava, maize, sweet potato, yam and tomato.*
- *Cloning and in vitro fertilisation allow the manipulation of germ cells for animal-breeding programmes, genetic-resource conservation and germplasm enhancement.*
- *Gene profiling or association mapping tracks the patterns of heritability of variations (alleles) of many genes. The quantitative trait loci (QTLs) collectively contribute to complex plant traits, such as drought tolerance and robust seed production, and understanding of the groupings of QTLs provides insights into how genes work in concert to produce a particular characteristic.*
- *Metabolomics provides a snapshot of all the metabolites being produced in a plant cell at any given time under different environmental conditions.*

(*) 'Global challenges and directions for agricultural biotechnology— Workshop report', Steering Committee on Global Challenges and Directions for Agricultural Biotechnology: Mapping the Course, National Research Council, ISBN 0-309-12078-0 (<http://www.nap.edu/catalog/12216.html>).

3.2.2. Marker-assisted selection (MAS)

Among recent biotechnologies applied to plant breeding, MAS has seen considerable developments over the last few decades ⁽³²⁾. MAS seeks to replace the traditional phenotype-dependent selection of breeds with a type of selection based on a marker associated with the trait of interest. A molecular marker is a short sequence of DNA that is so tightly linked to the desirable trait (such as disease resistance) that selection for its presence ends up selecting for the desirable trait, e.g. maize that is tolerant to drought and maize streak virus. The marker can be morphological, biological, bio-

chemical, cytological or molecular (e.g. DNA-based). The theory behind MAS is that once the desirable trait to be selected has been mapped and is linked with an easily recognisable and easily measurable marker, the marker can be used to select desired breeds instead of the plant phenotype as a whole. The ideal marker needs to be not too far away from the desirable genetic trait in order to avoid too many false positives due to spontaneous recombination or segregation. Marker-assisted backcrossing is now routinely applied in breeding programmes for gene introgression.

⁽³²⁾ B. C. Collard and D. J. Mackill, 'Marker-assisted selection: an approach for precision plant breeding in the 21st century', *Philos Trans R Soc Lond B Biol Sci*, 12 February; 363(1491): 557–572 (2008), and M. Frisch and A. E. Melechingier, 'Selection theory for marker-assisted backcrossing', *Genetics*, 170, 909–917 (June 2005).

Examples of selection markers used in MAS

Marker category	Example
Morphological	Height, leaf coloration or grain colour
Biological	Pathogen or insect resistance
Biochemical	A specific protein produced, e.g. an isozyme
Cytological	A marker that is revealed after histochemical staining only, e.g. for chromosomes
Molecular	For example, DNA-based, which can be detected by sequencing or microsatellite analysis

3.2.3. Genetically modified (GM) plants

Plant genetic engineering means selective and deliberate transfer of beneficial gene(s) from one organism to another to create new improved crops, animals or materials. Examples of genetically engineered crops currently marketed around the world include cotton, maize, sweet potato and soybean. Living modified organisms (effectively the same as genetically modified organisms) are defined in the Cartagena Protocol as organisms that have been produced by:

- (a) application of *in vitro* nucleic acid techniques, including recombinant deoxyribonucleic acid (DNA) and direct injection of nucleic acid into cells or organelles, or
- (b) fusion of cells beyond the taxonomic family that overcome natural, physiological, reproductive or recombination barriers and that are not techniques used in traditional breeding and selection.

During the 1980s the new scientific tools offered by molecular biology began to be used for introducing new characteristics into plants (and animals) for use in commercial agriculture. Many scientists saw little difference between the new technology, where genes were isolated from unrelated organisms (often micro-organisms) and introduced into crop varieties, and traditional methods of plant breeding (natural selection, cross-breeding, conjugation, chemical or radiation-induced mutation and transformation). The first genetically modified plants were then introduced in the mid-1990s, with the goal of creating new plant species with desirable traits such as resistance to pests, herbicides or harsh environmental conditions (e.g. drought). Subsequently, other desirable traits were introduced, such as higher yield and lower perishability. The technology consists of inserting novel genetic sequences into the plant in order to confer the qualities sought. Because of this genetic manipulation, this technology has met with mixed feelings on the part of the general public in several countries and raised concerns about cross-pollination with wild species, cross-

contamination of standard crop fields around GMO fields and increased resistance in pests and weeds.

Herbicide tolerance remains the most common transgenic trait⁽³³⁾. Insect resistance is the second most common genetically modified trait. Herbicide tolerance and insect resistance are often introduced simultaneously. The third most commonly grown transgenic crop is one containing both traits — insect-resistant and herbicide-tolerant maize. Most of the modified crops used today are derived from insertion of a single new gene into the parent plant. Many new traits are being introduced, including those for coping with abiotic stress such as drought or salt tolerance that will markedly increase the area on which the crops concerned can be grown.

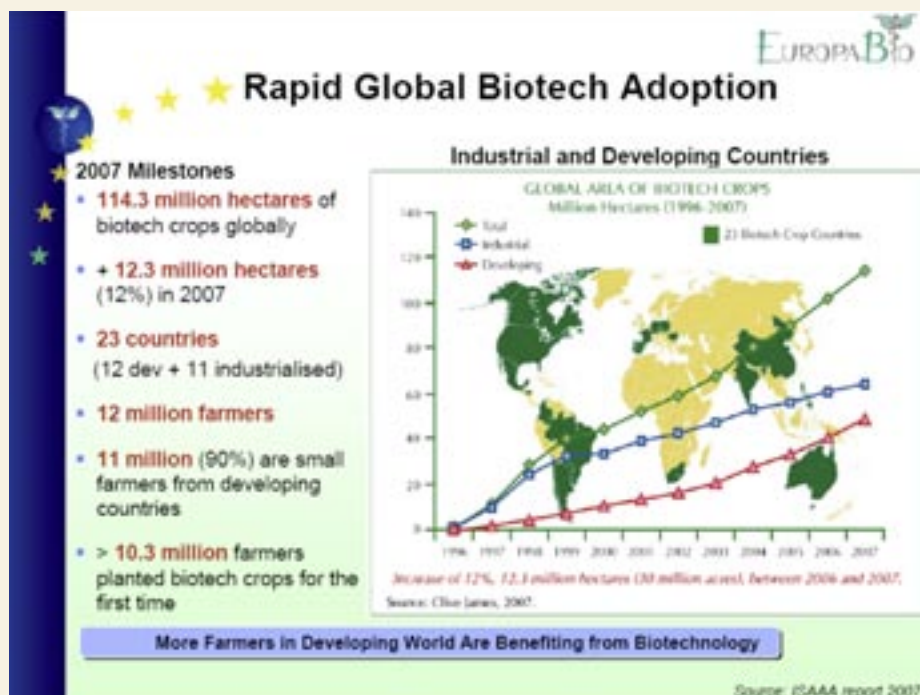
Combined herbicide and insect resistance was the fastest growing GM trait from 2004 to 2005, grown on over 6.5 million hectares in the USA and Canada and covering 7 % of the global biotech area. The recent expansion of biotech crops is mainly down to the increase in Bt maize and Bt cotton production in China, India and Australia. GM varieties of soybean and maize have been widely accepted in the Americas⁽³⁴⁾. Globally, 64 % of soybean, 43 % of cotton, 24 % of maize and 20 % of canola are now GM varieties⁽³⁵⁾.

⁽³³⁾ Herbicide tolerance is available for all the major GM crops, including soybean, maize, rapeseed and cotton. In 2005, the first herbicide-tolerant sugar beets were approved in the USA, Australia, Canada and the Philippines. Herbicide-tolerant rice and wheat have been developed, but are not currently in use. In 2006, herbicide-tolerant alfalfa was widely cultivated for the first time in the USA (80 000 hectares). In 2006, such crops made up 70 % of the 102 million hectares of GM crops worldwide.

⁽³⁴⁾ http://www.gmo-compass.org/eng/agri_biotechnology/gmo_planting/283.usa_cultivations_2007.html, accessed on 7 October 2008.

⁽³⁵⁾ Clive James, International Service for the Acquisition of Agri-biotech Applications (ISAAA) (2008).

Adoption of crop biotechnology between 1996 and 2007



USA: cultivation of GM plants, 2007

	Area in million ha	Percentage share
GM soybean	23.6	91
GM maize	27.4	73
GM cotton	3.9	87
GM plants total	54.9	

3.3. Biofuels production: between the first and second generations

First-generation biofuels — At present, the main raw materials for biofuels and biodiesel production are several kinds of crop, which are cultivated in various countries. Biofuels production and the subsequent transformation chain can differ widely from several points of view, for example in terms of greenhouse gas savings over their life cycle, the cost of the greenhouse gas savings achieved, their requirements as regards arable land and quality, water and fertilisers, the impact on biodiversity, direct competition against food products, and impact on fixed carbon in soils. Some of the issues related to cultivation of first-generation biofuels are discussed below.

Biofuels and land use — The impact of biofuels production on land use can be direct, where land is con-

verted directly from another use to agriculture to grow biofuels feedstocks, or indirect, in cases where biofuels production displaces other land uses (e.g. agriculture or cattle ranching), and can cause conversion of natural vegetation in other areas. Both could have a negative impact on natural resources (biodiversity, for example) and would reverse any positive benefits of biofuels production. Not only must the availability of enough land to accommodate the expansion of biofuels envisaged in many countries' strategies be taken into account, but also steps must be taken to ensure that in practice this expansion of biofuels production will lead to no significant risks of biodiversity loss and carbon dioxide emissions. Both direct land use for future sugar cane expansion and any other indirect impact should be further investigated by ad hoc research. The same applies to countries where not sugar cane but other raw materials are used for biofuels production, for example soybean expansion.

Crop use and impact on food security

Crop	Food security vulnerability ^(*)
Corn	High vulnerability: principal source of protein and eatable fat for the poorest countries (e.g. Central America), which are also net importers. Price increase = reduced availability
Soy	Average vulnerability: important source of eatable fat in most countries which are also net importers. Price increase = reduced availability
Sugar cane	Low vulnerability: principal source of food energy but nearly all countries are net exporters
Palm oil	Very low vulnerability: no significant source of eatable fat or food energy for most countries; affected countries are net exporters

Impact on food security, depending on the type of biofuel

Biofuel	Food security vulnerability
Ethanol	High impact on food security if ethanol expansion is based on corn/wheat (e.g. Argentina) Low impact on food security if ethanol expansion is based on sugar cane
Biodiesel	High impact on food security if biodiesel expansion is based on soy (e.g. Argentina or Bolivia) Low impact on food security if ethanol expansion is based on palm oil

(*) CEPAL (2007).

Biofuels and food security — The impact on food security of using crops for the production of first-generation biofuels can vary greatly between different countries (see table above ⁽³⁶⁾).

Second-generation biofuels — Some years from now (a reasonable estimate is probably 10 years), second-generation biofuels will be becoming available at competitive prices. These will be based mostly on turning residues and wastes into biofuels (biomass to liquid (BtL) biofuel), by processes that are being studied and developed at the moment. They will benefit from the infrastructure now being developed for the first-generation biofuels and they will signal the end of use of food crops for biofuels production. They might offer a better option for future fuel needs, but no conclusions could be drawn until after additional studies on costs, greenhouse gas emissions and energy balances. Second-generation biofuels can be made from almost any form of biomass. If made from forest or crop residues, they do not compete with food for feedstock. However, if made from dedicated energy crops, they compete for land and water resources ⁽³⁷⁾. Current research is focusing on producing biofuels that can be grown on non-arable land

or by other kinds of cultivation. For example, in 2008 research has been focusing on algae for biofuels (design of new photobioreactors for biomass and bioenergy) that have the advantage of making no impact on food security or use of arable land and inducing positive consequences for the environment.

Second-generation processes are still at the pilot plant stage. They are complex and very expensive, but can use cheaper feedstock. According to a report published by the EU Joint Research Centre (Institute for Energy, 2007), second-generation biofuels are unlikely to be competitive with first-generation biofuels by 2020 and will use largely imported biomass. It should, however, be made clear that the benefits of the second-generation biofuels in terms of food security and environmental protection are controversial, both in the EU ⁽³⁸⁾ and beyond.

3.4. Organic farming

According to the International Federation of Organic Farming, 'Organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines

⁽³⁶⁾ D. Rutz and R. Janssen, 'Biofuels SWOT analysis — WIP renewable energies' (2007).

⁽³⁷⁾ Some energy crops (switchgrass, poplar, etc.) can also be grown (at reduced yield) on present grassland. It is not known how much soil carbon would be released by this change in land use. Much depends on ground cover and how much soil is disturbed in planting.

⁽³⁸⁾ See the EU Institute for Prospective Technological Studies (IPTS) report on biofuels (<http://ipts.jrc.ec.europa.eu/home/report/english/articles/vol74/TRA1E746.htm>) or the JRC report on biofuels in the EU (http://www.fp7.org.tr/tubitak_content_files//306/JRC/dokumanlar/jrc_biofuels_report.pdf).

tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved ...' ⁽³⁹⁾. The *Codex Alimentarius* defines organic agriculture as 'one among the broad spectrum of methodologies which are supportive of the environment. Organic production systems are based on specific and precise standards of production which aim at achieving optimal agro-ecosystems which are socially, ecologically and economically sustainable' ⁽⁴⁰⁾. 'Organic' is a label that denotes products that have been produced in accordance with organic production standards and certified by a duly constituted certification body or authority ⁽⁴¹⁾. Organic agriculture is based on minimising use of external inputs and avoiding use of synthetic fertilisers and pesticides to minimise pollution of air, soil and water.

The recent Natural Products Expo East ⁽⁴²⁾ attracted more than 26 000 visitors, clearly indicating the continued success of natural and organic products on the US market. However, the organic food market is growing rapidly not only in the USA but also in most developed and developing countries. At present, 1 % to 2 % of total food sales worldwide are organic products. World organic food sales increased from USD 23 billion in 2002 to USD 40 billion in 2006 ⁽⁴³⁾. In the EU, in 2006 over 6.8 million hectares of farm land were allotted to organic farming, or 4.5 % of all arable land ⁽⁴⁴⁾.

4. Agriculture in the 21st century

Agriculture not only requires replacing natural ecosystems with crop fields and tree farms (loss of biodiversity

and carbon dioxide release) but also results in ground-water pollution, soil erosion, water depletion, soil degradation, pesticide pollution and other environmental stresses. In the second half of the 20th century a need for a different model of agriculture emerged: a sustainable and multi-functional agriculture where stewardship of the land, preservation of the resource base, the health of farm workers, preservation of the small biota that are rich in biodiversity, the value of rural communities and the value of the agricultural landscape acquired important status. One of the aims of the UN Earth Summit in Johannesburg in 2002 was to 'enhance in a sustainable manner the productivity of land and the efficient use of water resources in agriculture'. But how is it possible to obtain, in agricultural parlance, 'more crop per drop' ⁽⁴⁵⁾? If greater yield is obtained, is it sustainable? ⁽⁴⁶⁾

4.1. World population growth

The world population is expected to top 9 billion by the middle of the century. This growth will put pressure on a range of resources, including land, water and oil, and also on food supply. The extent to which this growth in demand for food on emerging markets will create additional demand for food on world markets also depends on whether the productivity growth in agriculture in the countries concerned can keep pace with the demand growth.

Modern agriculture currently feeds over 6 billion people. Before the dawn of agriculture the hunter-gatherer lifestyle could have supported about 4 million people worldwide ⁽⁴⁷⁾. Over the next 50 years food production will have to double in order to feed the world's population. Global cereal production has doubled in the last 40 years, but this has led to increased use of fertilisers, water and pesticides, of new crop strains and other technologies associated with the 'green revolution' and also of fossil fuels.

⁽³⁹⁾ International Federation of Organic Agriculture Movements (IFOAM) (http://www.ifoam.org/about_ifoam/principles/index.html).

⁽⁴⁰⁾ ftp://ftp.fao.org/codex/Publications/Booklets/Organics/organic_2007e.pdf

⁽⁴¹⁾ To be certified as organic, food must be produced, processed, labelled and marketed in accordance with strict standards set by organic organisations in the countries where it is sold, e.g. by the US Department of Agriculture (USDA), by the Bristol-based Soil Association in the UK and under the EU policy on organic farming.

⁽⁴²⁾ The Natural Products Expo East (www.expoeast.com) held in Boston, MA, USA (15–18 October 2008).

⁽⁴³⁾ Organic Monitor: *The global market for organic food and drink*: <http://www.organicmonitor.com/>

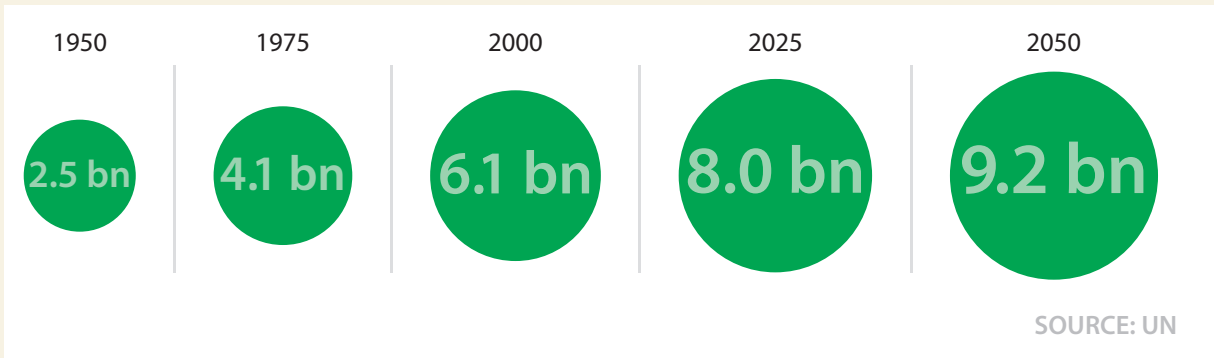
⁽⁴⁴⁾ Data from <http://www.zmp.de/oekomarkt/Marktdatenbank/en/downloads.asp>

⁽⁴⁵⁾ Christian Verschuere, 'Scientists aim for more crop per drop', Business Day, Johannesburg, South Africa, 30 March 2005 (<http://allafrica.com/stories/200503300191.html>) (2005).

⁽⁴⁶⁾ On this specific issue, Dr Christian Verschuere argues that 'Stewardship, research and development, good agricultural practices and proper land management techniques are fundamental to water protection and preservation. The plant science industry is well placed to address the challenges of feeding a growing population while conserving water.'

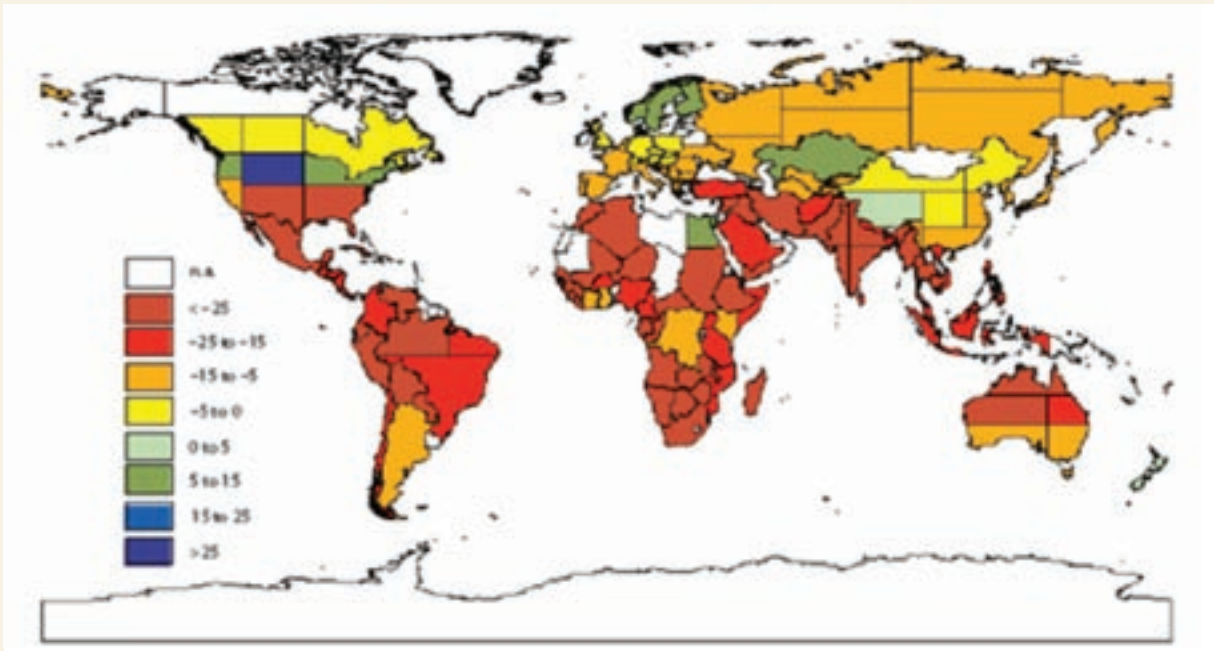
⁽⁴⁷⁾ D. Tilman et al., 'Agricultural sustainability and intensive production practices', *Nature*, 418, 671–677 (2002).

World population growth



Climate change will reduce production growth in many of the poorest countries and regions. This will have further price-increasing effects.

Percentage change in agricultural production due to climate change, 2080



4.2. Climate change

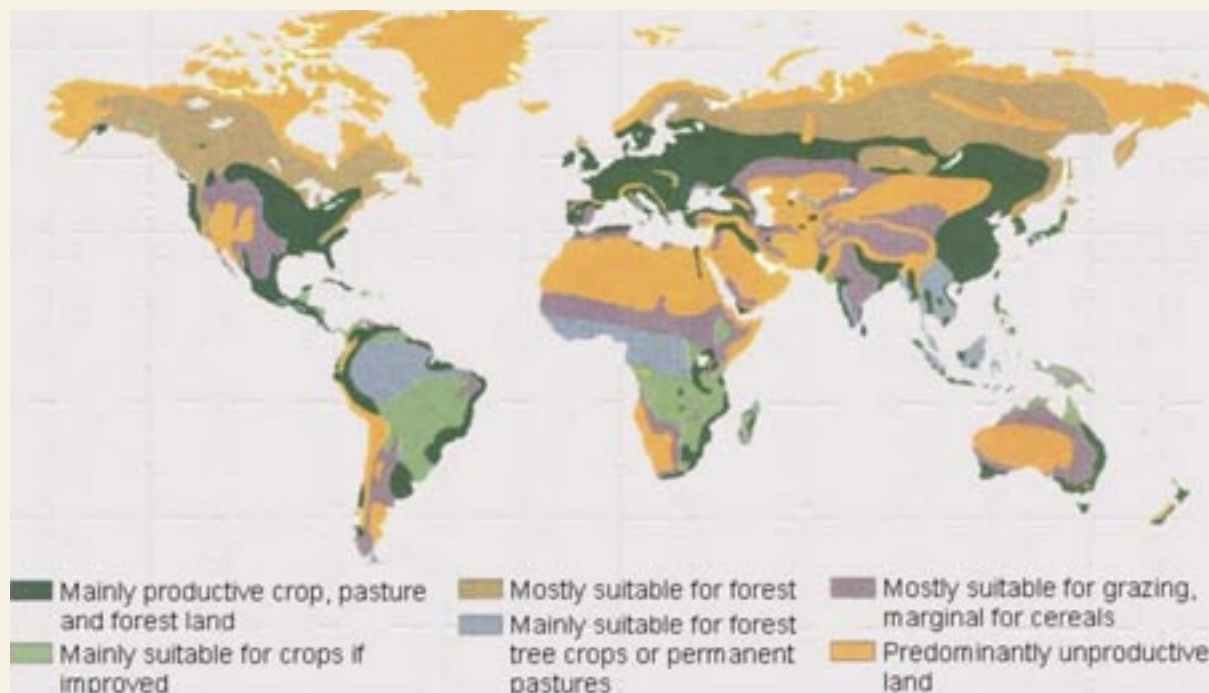
Desertification is accelerating in various regions, such as China and sub-Saharan Africa, while more frequent floods and changing patterns of rainfall are already beginning to have a significant impact on agricultural production worldwide. Poor countries are more vulnerable to adverse consequences of global warming ⁽⁴⁸⁾.

Climate change analyses suggest that unusual weather patterns are likely to become more pronounced, with possible consequences in the form of volatility of agricultural production because of weather-related supply shortfalls. The FAO has forecast that world cereal stocks will fall to a 25-year low of 405 million tonnes

⁽⁴⁸⁾ Some of the reasons for this may be: (1) geography; (2) greater dependence on agriculture and natural resources; (3) limited infrastructure; and (4) low income, poverty and

malnutrition. All these factors have contributed to lower adaptability to food crises and of complementary services, like health and education.

World potential land use capabilities



in 2007/08, down by 21 million tonnes, or 5 %, from the previous year's already reduced level. However, the effects of climate change are difficult to predict and, among others, include the emergence of new pests, harmful viruses and/or bacteria plus animal and plant diseases which have an influence not only on the quantity but also on the quality and, especially, safety of crop (and livestock) production. Furthermore, the higher frequency of extreme climatic events, which often disrupt agricultural production too, could potentially have an impact on food security and food prices.

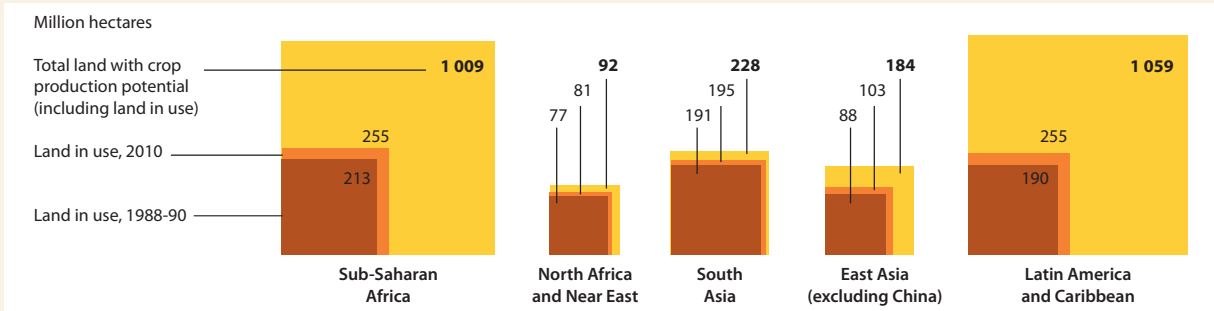
Agriculture contributes to climate change in several major ways and climate change in general has adverse effects on agriculture. Climate change, at a time of increasing demand for food, feed, fibre and fuel, has the potential to damage irreversibly the natural resource base on which agriculture depends. Technological improvements, increased yields and expansion of production area may help meet the demand growth and reduce price inflation. However, even assuming constant favourable climatic conditions, a number of factors will limit the pace at which production can catch up with demand. Factors like availability of land and water, agricultural input prices, technological innovation and investment will limit the scope for increases in productivity.

4.3. Arable land capability

In the 1970s the FAO began a decade-long study of 117 developing countries to see which of them could grow enough food for their populations on their available land. The study found that, in 1975, 54 countries could not feed their populations with traditional methods of food production and that 38 % of their entire land area — home to 1 165 million people — was more populated than it could theoretically support. From population projections to 2000, it estimated that 64 countries — more than half the total — would be facing a critical situation; at low input levels 38 would then be unable to support even half their projected population. Much of the agricultural area of any country or region has limitations that could make it less suitable for arable farming. For example, there are some countries with, essentially, no arable land reserves, such as Tunisia and Burundi, and others with large amounts, for example Angola, Guyana and Brazil. Desertification and other climate change phenomena are increasing the shortage of arable land around the globe.

Dryland areas are home to one third of the people in the world and 90 % of them are in developing countries. They are more vulnerable to environmental degradation than other areas. They are defined as land

Land under cultivation and land with crop production potential in developing countries



where plant production is limited by water availability and make up 40 % of the total land area with 7 % of all freshwater resources ⁽⁴⁹⁾.

In 1995 a FAO study, *World agriculture: towards 2010*, estimated that net cereal import requirements would increase from about 8 million to 19 million tonnes for sub-Saharan Africa, 38 million to 71 million tonnes for the Near East and North Africa, 27 million to 35 million tonnes for east Asia (excluding China) and 5 million to 10 million tonnes for south Asia, primarily as a result of shortages of arable land.

4.4. Water protection

Population growth, lifestyle changes and economic development have been putting increasing strain on water resources that were already limited. Extreme weather conditions and other environmental problems, especially climate change which is leading to increasing floods and droughts in some regions of the world, cause loss of lives, material and economic damage and pollution and decrease food security. Since water is essential for life, its supply and improved management are key components of any development policy, as poor water management can be a source of conflict.

In 2000, 17 % of the world’s population did not have access to a secure water supply and 40 % lacked adequate sanitation. Most of these people lived in Africa and Asia. Modern technologies with the aim of securing water supply to communities focus on three approaches:

- (1) improvement of irrigation water management by optimising efficiency and farm output;

- (2) efficient management, treatment and reuse of wastewater by improved treatment technologies; and
- (3) autonomous desalination systems for sea water and other salty water in areas with scarce water resources.

4.5. Biodiversity loss

Agriculture and the natural environment are essentially in conflict, for by its very nature agriculture has an impact on the environment and is likely to reduce the diversity of plants, insects and animals that would have been found in the natural environment. Biodiversity loss is considerable and is twofold within high-input agro-ecosystems: on the one hand, the loss of wild animal and plant species and, on the other, the loss of varieties among crop plants. Concerning wildlife, modern large-scale farming can harm biodiversity because large fields and the removal of margins (such as hedges) lead to loss of connectivity and habitat diversity ⁽⁵⁰⁾. Similarly, the number of varieties of major food crops fell dramatically during the 20th century. Humans now rely on just 14 species of mammals and birds to supply 90 % of all animal-derived foods (FAO). Twelve plant crops account for more than three quarters of the food consumed in the world, and just three — rice, wheat and maize — are relied on for more than half of the world’s food ⁽⁵¹⁾ ⁽⁵²⁾. Because of modern trends towards mass production,

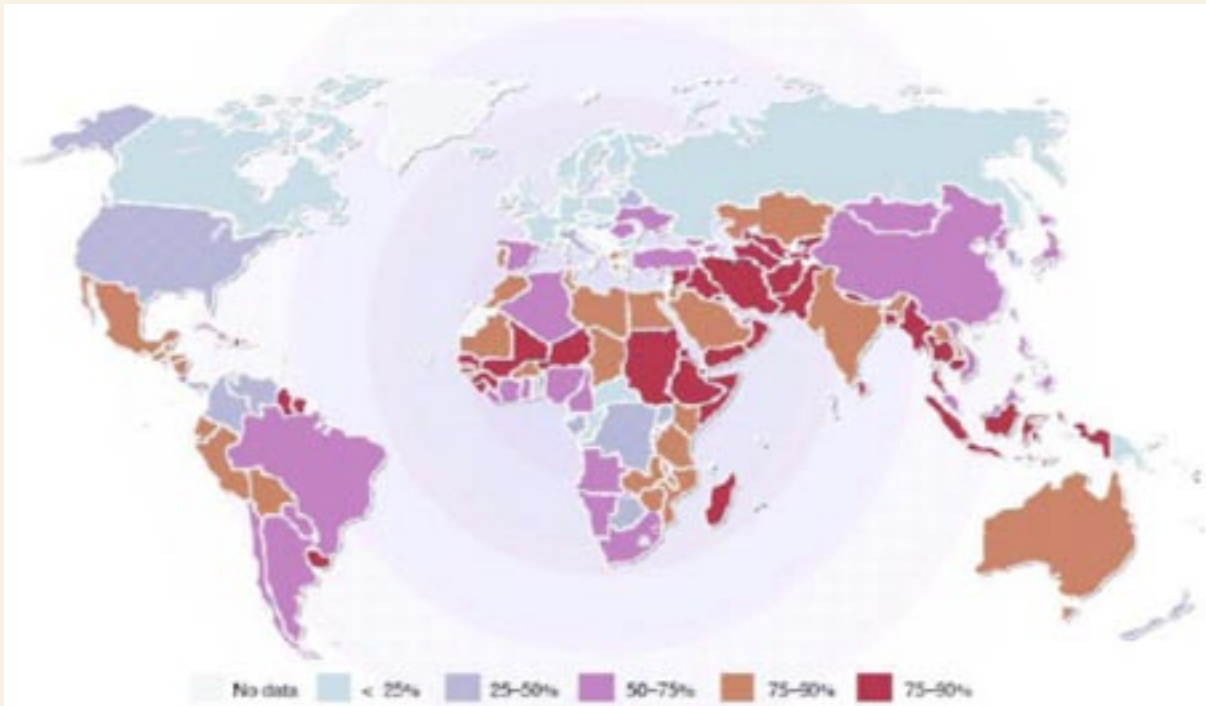
⁽⁵⁰⁾ The disappearance of farmland margins has a negative impact on wildlife biodiversity. The same applies to increased use of pesticides, herbicides and fertilisers. In the same direction, the reduction of traditional rotation agriculture has led to de facto monocultures. In addition, reduced crop and weed diversity has a negative effect on the food chain, as it results in a reduction of food available for indigenous insects, birds and other animals.

⁽⁵¹⁾ FAO, ‘The state of the world’s plant genetic resources for food and agriculture’, Rome, pp. 14–15 (1997).

⁽⁵²⁾ The International Development Research Centre (IDRC) (2006).

⁽⁴⁹⁾ C. Ringler, ‘The millennium ecosystem assessment: tradeoffs between food security and the environment’, *Turk J Agric For*, 32, 147–157 (2008).

A critical challenge — Proportion of water withdrawal for agriculture 2001



Source: IAASTD ppt.

only 15 plant and 8 animal species are now relied upon for about 90 % of all human food ⁽⁵³⁾.

Farmers and plant breeders tend to choose high-yield, insect-resistant varieties and this has led to the disappearance of over 90 % of the varieties that were grown in the early 20th century. Crop management has changed radically with the availability of modern pesticides and herbicides, with management (including rotation, fertilisers, herbicides, ploughing, hoeing, etc.) depending on the crops actually used in the new-style rotations (the technology used will aim to protect the most susceptible crops in the rotation). A variety of herbicides are used to control weeds, ensuring that the seedbank present in the soil has as little diversity as possible. Removal of these plants has a direct effect on herbivores, seed-eaters, pollen- and nectar-feeders and an indirect effect on the whole food chain.

4.6. Depopulation of rural areas

By the end of the 20th century European farming had been transformed into a high-tech, highly specialised and highly productive modern industry. This greater use of technology has prompted a significant shift in

the urban/rural population ratio. The same phenomenon can also be observed at global level.

Between the late 19th and late 20th century, the percentage of citizens employed in farming fell from 50 % to just 3 % in the United States, from 47 % to just 3 % in Germany and from 48 % to just 6 % in Denmark. This migration of labour out of farming triggered rapid growth in industry, where parallel applications of new science were boosting productivity and income to new levels. But it also unleashed a phenomenon of depopulation of rural areas, with far-reaching cultural consequences on the perception of food and its naturalness. Today, in the enlarged EU, different urban/rural ratios coexist, with some EU regions having a strong tradition of organic or conventional farming (Poland, Bulgaria or Mediterranean countries) and others importing food products, after having chosen to switch production to other sectors of the economy (e.g. Scandinavian countries). In general, the urban population has grown more than the population in rural areas and more than 60 % of the population are expected to live in cities in the near future ⁽⁵⁴⁾.

⁽⁵³⁾ UN Convention on Biological Diversity: <http://www.cbd.int/>

⁽⁵⁴⁾ Joachim von Braun, 'The world food situation — New driving forces and required actions', International Food Policy Research Institute, Washington D.C. (December 2007).

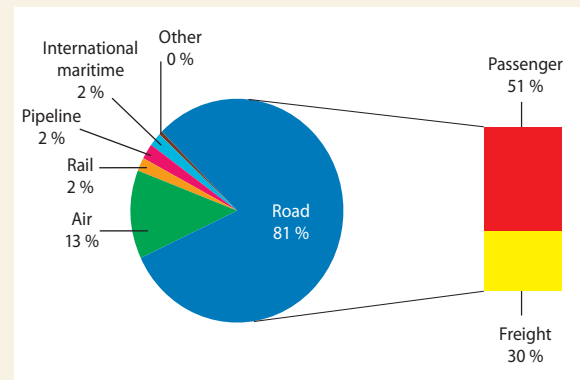
4.7. Food transport and distribution: the ecological impact

In the more developed countries, over the last few decades food production and trade have been rising steadily, with a parallel increase in transport between production and retail sites. Due to globalisation, the general trend has been towards fewer and larger suppliers rather than small, local producers. In the same way, delivery methods have shifted towards greater use of aircraft and heavy goods vehicles for carriage and local transport. Consumers have also changed their habits. In the past they used to frequent local shops, but now they tend to concentrate on bulk purchases on specific days of the week or month, usually by car and at large shopping centres not necessarily located in their neighbourhood. Factors leading to increased transport include, among others, increased global trade, the spread of big supermarket chains with centralised distribution systems, greater use of cars for shopping and increased packaging and processing.

'Food miles' — the distance travelled to market food products, also used as an indicator of sustainability (pollution) — have risen by over 15 % over the last 15 years and are still rising, with an impact on traffic congestion, pollution and, ultimately, climate change⁽⁵⁵⁾. The average distance driven to shop for food each year is almost 1 600 km, compared with 1 200 km 15 years ago. Food accounts for 25 % of all transport by heavy goods vehicles on roads and this figure has doubled since the 1970s⁽⁵⁶⁾. This increase resulted in a rise in the amount of CO₂ emitted⁽⁵⁷⁾: 19 million tonnes of carbon dioxide were emitted in 2002 (12 % more than in 1992). Air freight, the most polluting form of food transport, is growing fastest. Food mile indicators take into account several factors — not just how many kilometres were

travelled to deliver the product, but also the method of production and the degree to which it is sustainable, the mode and efficiency of transport and the CO₂ emitted in the process — to calculate the impact on the climate, social costs and benefits⁽⁵⁸⁾.

Energy consumption per transport sector



Source: IEA and IFP estimates: <http://www.ifp.com/content/download/57516/1274819/file/IFP-Panorama05%2009-ConsommationVA.pdf>

4.8. Food waste

Food waste is a major issue in modern times from several points of view. First of all, from an ethical point of view, as better management and distribution of food resources could be beneficial to society's least privileged. Secondly, from an economic point of view, as food waste implies a considerable loss of money. And thirdly, from an environmental perspective, as decomposition of organic material is a major contributor to greenhouse gas (GHG) emissions which cause global warming⁽⁵⁹⁾.

Every process entails a certain margin of error, from production to distribution and consumption. There are several sources of waste all along the process, starting from harvest, where efficiency is never 100 % and some of the harvest is lost because it is damaged or not ripe enough. Post-harvest losses then add up

⁽⁵⁵⁾ Local sourcing helps as long as local food is transported efficiently. Organic food reduces environmental damage, but does not deliver a net environmental benefit if it has to be flown in from abroad. In energy terms, out-of-season local produce needing artificial light and heat generates more emissions than products imported by truck from abroad.

⁽⁵⁶⁾ Data from the UK Department for Environment, Food and Rural Affairs (<http://www.defra.gov.uk/corporate/deprep/2006/2006deptreport.pdf>).

⁽⁵⁷⁾ The most fuel-efficient mode of transport is by waterway: one litre of fuel can transport one tonne of freight 222 km by river barge, 164 km by rail and only about 20 km by articulated lorry. The continuous increase in fuel costs will have a more pronounced effect on the overall food-delivery system and prices.

⁽⁵⁸⁾ A. Smith et al., 'The validity of food miles as an indicator of sustainable development', AEA Technology Environment (1994).

⁽⁵⁹⁾ WRAP (2008), 'The food we waste', ISBN: 1-84405-383-0 (version 2) (http://www.wrap.org.uk/downloads/The_Food_We_Waste_v2__2_.99cb5cae.5635.pdf).

to 30 % to 70 % ⁽⁶⁰⁾ during storage (where part of the harvest will be lost because of inappropriate storage conditions, e.g. due to mould, rodents, etc.) and during transport from the production, storage or processing site to retail shops, where a certain amount of production is lost because of damage. Eventually food reaches supermarket shelves where, under current marketing practice, a proportion of it is unavoidably thrown away because either it has passed its sell-by date (a problem connected to overstocking of products) ⁽⁶¹⁾ or it is over-ripe or spoiled. Last but not least, at the consumers' end, household food stocks are not optimally managed, resulting in remarkable quantities of food waste (though very difficult to quantify).

Country	Food waste as a percentage of food production	Food waste (million tonnes per year)
USA	30–50 % ⁽¹⁾	25.9–52.9 ⁽²⁾
JP	40 %	20.0 ⁽³⁾
UK	30 %	6.7 ⁽⁴⁾
NL	15 %	3.0 ⁽⁵⁾

⁽¹⁾ Data vary, depending on the source. See <http://edition.cnn.com/2007/WORLD/asiapcf/09/24/food.leftovers/index.html#cnSTCTextt> and <http://uanews.org/node/10448>

⁽²⁾ Ibid.

⁽³⁾ 70 % of which are now recycled (data from <http://www.japanfs.org/>; see also <http://www.enn.com/agriculture/article/37737>).

⁽⁴⁾ Data from http://www.wrap.org.uk/retail/food_waste/, accessed in October 2008.

⁽⁵⁾ 2006 data from www.minInv.nl/consumentenvoedselplatform

Apart from ethical and economic issues, environmental concerns about food waste are attracting increasing attention, as biodegradation of food releases methane, a greenhouse gas (GHG) 20 times more damaging to the environment than carbon dioxide (CO₂) as it adsorbs 23 times as much heat as CO₂ ⁽⁶²⁾. Biodegradation in low-oxygen conditions ('anaerobic digestion') produces

⁽⁶⁰⁾ According to Tessema Astatkie, Director of Canada's Post-Harvest Management to Improve Livelihoods Project, 'Post-harvest crop losses can range from 30 to 70 % depending on the crop' (http://www.enn.com/top_stories/article/35940).

⁽⁶¹⁾ In a recent movement started in the 1990s (known as 'dumpster diving') people sift through commercial trash bins looking for and retrieving products in good and edible condition discarded by supermarkets. This movement aims to prove that it is possible to make a good living out of superfluous commercial waste.

⁽⁶²⁾ According to the US Environmental Protection Agency (EPA).

biogas, a natural gas which is made up of 60 % methane and 40 % CO₂. If this process takes place in an open landfill ⁽⁶³⁾, the biogas released makes an extremely negative contribution as a GHG emission, but if it occurs in a controlled manner (such as in a biogas power plant), this form of biogas conversion offers a renewable source of fuel. In this way, organic matter such as food waste could be used to generate energy in an environmentally friendly manner and as an alternative to using fossil fuels for the same purpose.

5. Modern agriculture: moving towards food security and sustainability

Global income has increased sevenfold over the last 50 years while income per person has more than tripled, but this wealth is unevenly distributed. By the early 1990s, about 20 % of the world's population, most of it in the developed world, received over 80 % of the world's income, while the poorest 20 % received only 1.4 % ⁽⁶⁴⁾. The developed countries consume 70 % of the world's energy, 75 % of its metals, 85 % of its wood and 60 % of its food. Food security and sustainability are therefore specific needs to be met by agriculture in the 21st century.

5.1. Food security

According to the Nuffield Council report ⁽⁶⁵⁾ on the use of genetically modified crops in developing countries, 70 % of the world's poor live in rural areas and depend mainly upon agriculture for their livelihood and this situation seems unlikely to change in the next few decades. Agriculture's role of providing adequate food to all and the need to guarantee fair access to food resources are therefore central.

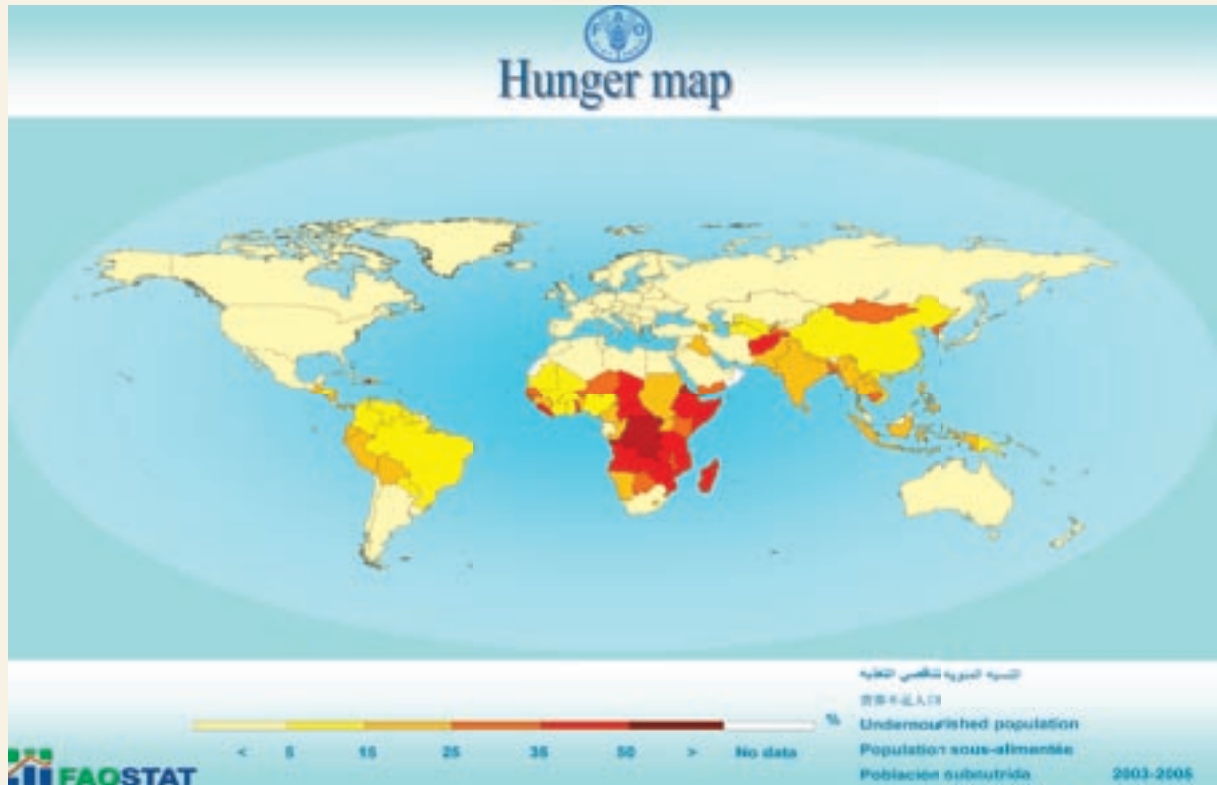
The term 'food security' originated in the mid-1970s, when the World Food Conference (1974) defined food security in terms of supply. In 1983, FAO analyses focused on access to food, leading to a definition based

⁽⁶³⁾ Council Directive 99/31/EC of 26 April 1999: to reduce GHG emissions stemming from biodegradable waste in landfills, the European landfill directive set the target that the amount of biodegradable waste sent to landfills in Member States must be reduced to 35 % of the 1995 levels by 2020.

⁽⁶⁴⁾ CIA, *The World Factbook*, ISSN 1553-8133 (July 2008).

⁽⁶⁵⁾ http://www.nuffieldbioethics.org/go/ourwork/gmccrops/publication_301.html

FAO 'Hunger map'



Source: FAOSTAT data: <http://www.fao.org/es/ess/faostat/foodsecurity/FSTMap/map14.htm>

on the balance between the demand and supply sides of the food security equation. In 1986, the World Bank report on poverty and hunger introduced the distinction between chronic food insecurity, associated with continuing or structural poverty and low incomes, and transitory food insecurity, which was the result of periods of intensified pressure caused by natural disasters, economic collapse or conflict (FAO, 2006) ⁽⁶⁶⁾.

Recently, the ethical and human rights dimensions of food security have come into the spotlight. According to a FAO policy brief on food security (2006), the main concepts that currently characterise food security are the following.

Food availability: The availability of sufficient quantities of food of appropriate quality, supplied by domestic production or imports (including food aid).

Food access: Access by individuals to adequate resources (entitlements) for acquiring appropriate foods for a nutritious diet.

Utilisation: Utilisation of food with the aid of adequate diet, clean water, sanitation and healthcare to achieve a state of nutritional well-being where all physiological needs are met.

Stability: To be food-secure, a population, household or individual must have access to adequate food at all times. They should not be at risk of losing access to food as a consequence of sudden shocks (e.g. an economic or climatic crisis) or cyclical events (e.g. seasonal food insecurity).

Food security therefore exists when all people, at all times, have (physical, social and economic) access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life ⁽⁶⁷⁾. Food security incorporates the concepts of availability, accessibility, acceptability and adequacy ⁽⁶⁸⁾ and is inextricably linked with issues related to ethics, trade, humanitarian aid, etc.

⁽⁶⁷⁾ FAO, 'The state of food insecurity in the world' (2001).

⁽⁶⁸⁾ 'Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious

⁽⁶⁶⁾ ftp://ftp.fao.org/es/ESA/policybriefs/pb_02.pdf

'Halve, between 1990 and 2015, the proportion of people who suffer from hunger' (*)

Population below minimum level of dietary energy consumption

(No new global or regional data are available. Data presented are from the 2006 report)

Percentage of undernourished in total population		
	1990–92	2001–03
Developing regions	20	17
Northern Africa	4	4
Sub-Saharan Africa	33	31
Latin America and the Caribbean	13	10
Eastern Asia	16	12
Southern Asia	25	21
South-eastern Asia	18	12
Western Asia	6	9
Oceania	15	12
Commonwealth of Independent States	7 (**)	7
Commonwealth of Independent States, Asia	16 (**)	20
Commonwealth of Independent States, Europe	4 (**)	3
Developed regions	< 2.5 (**)	< 2.5
Least developed countries (LDCs)	22	19
Landlocked developing countries (LLDCs)	38	36
Small island developing states (SIDS)	23	19

(*) <http://mdgs.un.org/unsd/mdg/Resources/Static/Data/Stat%20Annex.pdf>

(**) Data refer to the period 1993–95.

5.1.1. Subsistence agriculture

The majority of the world's poor, food-insecure and malnourished live in rural areas that have agricultural potential but limited and unreliable rainfall and fragile soils⁽⁶⁹⁾. Many in developed and developing countries alike have an image of agriculture very different from the truth: the myth depicts farmers 'romantically but demeaningly'⁽⁷⁰⁾. This idealisation of farming has a strong impact on views on globalisation and on the impact of multinationals that appear to industrialise agriculture and to destroy taste and texture in the quest for yield, particularly in countries where choice is possible.

In many countries food grown for local people may be very different from that grown for export. If the best land and facilities are given over to exports, local mar-

kets may not have the food which has been traditional for rural populations in developing countries. Many of the rural poor have been forced off the land and have migrated into the cities⁽⁷¹⁾.

In many cases arable agriculture systems are grouped to distinguish between large industrialised farming, small commercial farming and subsistence farms. 'Resource-poor farmers constitute over half of the world's farmers and produce 15–20 % of the world's food'⁽⁷²⁾. 'It is estimated that some 1 400 million people, approximately 100 million in Latin America, 300 million in Africa and 1 000 million in Asia, are now dependent on resource-poor farming systems in marginal environments'⁽⁷³⁾.

food that meets their dietary needs and food preferences for an active and healthy life' (UN, World Food Summit, 1996).

⁽⁶⁹⁾ Per Pinstrup-Andersen, presentation at the Annual John Pesek Colloquium on Sustainable Agriculture, Iowa State University (March 2002).

⁽⁷⁰⁾ Gail Omvedt, 'Terminating choice', *The Hindu*, p. 12 (1998), quoted in Thomas R. DeGregori, 'Green myth vs. the green revolution' (<http://www.butterfliesandwheels.com/article-print.php?num=50>).

⁽⁷¹⁾ Sidney Mintz, 'Food and eating: some persisting questions' in Warren Belasco and Philip Scranton (eds), *Food nations: selling taste in consumer societies*, Routledge, New York, pp. 25–26 (2002).

⁽⁷²⁾ C. A. Francis, *Multiple cropping systems*, Macmillan, New York, 383 pp. (1986).

⁽⁷³⁾ Food and Agriculture Organisation of the United Nations, 'The state of the world's plant genetic resources for food and agriculture', Rome, p. 25 (1997).

Comparison between family farms and commercial agriculture

Characteristics	Family farms	Commercial agriculture
Role of household labour	Major	Little or none
Community linkages	Strong — based on solidarity and mutual help between household and broader group	Weak — often based on social connection between entrepreneur and local community
Priority objectives	Consume	Sell
	Stock	Buy
	Sell	Consume
Diversification	High, to reduce exposure to risk	Low, specialisation in very few crops and activities
Flexibility	High	Low
Size of holding	Small, average 5–10 ha	Large, may exceed 100 ha
Links to market	Weak, but becoming stronger	Strong
Access to land	Inheritance and social arrangements	Purchase

Source: C. Toulmin and B. Gueye, 'Is there a future for family farming in West Africa?', *IDS Bulletin*, 36(2), 23–29 (2005), quoted in Xinchun Diao et al., *The role of agriculture in development: implications for sub-Saharan Africa*, International Food Policy Research Institute, ISBN 978-0-89629-161-4 (2007).

5.1.2. Quality and healthy food and public health

In the EU, food quality has played an important role in agricultural production since the 1960s. Quantity is the main issue in other regions of the world, where malnutrition is still a major global public health problem, causing over 15 % of the global disease burden. Protein, energy and micronutrient malnutrition remain challenges, with high variability between and within countries. Lower dietary quality and diversity and inexpensive foods with low nutrient density have been associated with rising worldwide obesity and chronic disease rates. Poor diet throughout life is, however, a major risk factor for chronic diseases, which are the leading cause of death worldwide. Public health considerations are the reason why it is important to make dietary quality a key driver of production, rather than follow production strategies based mainly on quantity or low price.

5.2. Sustainability

A good definition of sustainable development is given in the Brundtland report ⁽⁷⁴⁾, namely 'development that meets the needs of the present generation with-

out compromising the ability of future generations to meet their own needs' ⁽⁷⁵⁾.

In the context of agriculture, the way in which land is used determines the level of food production and, effectively, the state of the environment. Currently about half of global usable land is in use for arable (intensive) or pastoral agriculture ⁽⁷⁶⁾. The impact of agriculture on the natural environment is therefore extensive. Agriculture adds significant and environmentally detrimental amounts of nitrogen and phosphorus to ecosystems ⁽⁷⁷⁾. In addition, most of the best land is already in use for agriculture; any increase in land use will have to be on marginal land that is unlikely to sustain high yields and is vulnerable to degradation ⁽⁷⁸⁾. Immense efforts are being made to use ge-

⁽⁷⁴⁾ Available at <http://www.worldinbalance.net/pdf/1987-brundtland.pdf>

⁽⁷⁵⁾ World Commission for Environment and Development (1987), *Our common future*, Oxford University Press, Oxford, UK, ISBN 0-19-282080-X.

⁽⁷⁶⁾ 'Usable' land is all land that is not desert, tundra, rock or boreal. Hence it includes urban areas.

⁽⁷⁷⁾ D. Tilman et al., 'Agricultural sustainability and intensive production practices'. The authors define sustainable agriculture as practices that meet current and future societal needs for food and fibre, for ecosystem services and for healthy lives by maximising the net benefit to society when all costs and benefits of the practices are considered, *Nature*, 418, 671–677 (2002).

⁽⁷⁸⁾ V. W. Ruttan, 'The transition to agricultural sustainability', *Proc Natl Acad Sci*, 96, 5690–5697 (<http://dx.doi.org/10.1073/pnas.96.11.5960>) (1999).

netic techniques to improve varieties grown on marginal land, including their drought and salt tolerance.

Proponents of biotechnology and many agro-food policymakers around the world predict an optimistic future in which technology will overcome food shortages, improve the environment, heal or eradicate disease and lead to a prosperous and healthy society. For example, in 2007 Colin Ruscoe (British Crop Production Council) stated that 'European farmers need to produce food, feed, biofuel and fibre, whilst protecting the environment and human health, in an increasingly global, competitive market. This has to be achieved within the framework of EU common agricultural policy, WTO agreements and extensive regulation. Supermarkets exert huge influence on farmers, in terms of production standards, traceability and prices, in this USD 3 trillion business.'

6. Trends in international and European policies

Globalisation in the literal sense means the process of transforming local or regional issues or phenomena into global ones ⁽⁷⁹⁾. It can also be used to describe a process which unifies the world population into a single society continuously interacting together. This process is the result of a combination of economic, technological, socio-cultural and political forces ⁽⁸⁰⁾. Globalisation is often used to refer to economic globalisation, that is integration of national economies into the international economy by means of trade, foreign direct investment, capital flows, migration and the spread of technology ⁽⁸¹⁾.

The economic impact of globalisation, particularly on poverty and developments on agro-food and energy markets, has received much attention in recent years ⁽⁸²⁾. Due to the global dimension of agricultural products, in terms not only of trade but also of use of land, water and other natural resources, and of the

possible implications for the environment and climate (food production or energy policies), the debate on agriculture cannot deny the interconnection between the abovementioned forces at global level.

6.1. Globalisation and agriculture

Globalisation is a complex process which involves liberalisation of trade between countries and which leads to more intense exchanges of products, culture and knowledge than in the past. In its narrowest sense, the term means the 'worldwide spread of sales, production facilities and manufacturing processes, all of which reconstitute the international division of labour' ⁽⁸³⁾. This is particularly true of agricultural markets, since many agricultural products are sold worldwide, as is the case with cotton, soybean (particularly for feed production), palm oil for biofuels production, etc. Globalisation is having an impact on the availability of food and on changes to the lifestyles of many in countries which critically depend on their agricultural base.

6.2. The global strategy: the UN millennium development goals

According to UN data (UNIDO, 2008), today 475 million people are living on less than EUR 0.75 per day, 325 million on less than EUR 0.50 and 162 million on less than EUR 0.25. The sharp increase in prices for some of the most basic foodstuffs traded on international commodity markets will be affecting everyone who has to buy food, but the poor will be the hardest hit. The price of wheat has doubled in less than a year, while other staples, such as corn, maize and soy, are trading at well above their 1990s averages. Rice and coffee prices are running at 10-year highs, and in some countries prices for milk and meat have more than doubled. This trend seems unlikely to be reversed and prices of different food crops will grow by from 30 % to 130 %, according to a 2007 FAO report.

⁽⁷⁹⁾ <http://en.wikipedia.org/wiki/Globalization>

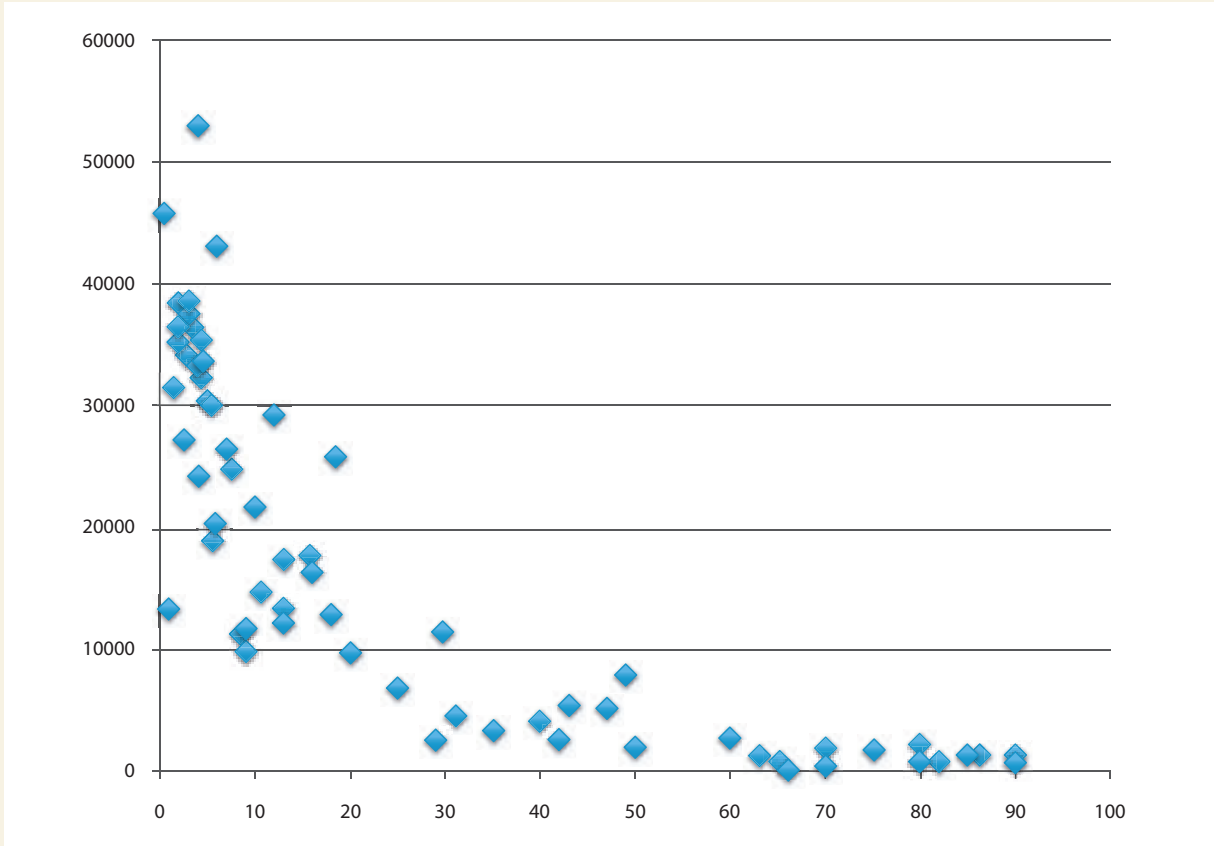
⁽⁸⁰⁾ Sheila L. Croucher, 'Globalization and belonging — the politics of identity in a changing world', Rowman & Littlefield, p. 10 (2004).

⁽⁸¹⁾ Bhagwati, Jagdish, 'In defense of globalization', Oxford University Press, Oxford, New York (2004).

⁽⁸²⁾ See Joachim von Braun and Eugenio Diaz-Bonilla, 'Globalization of food and agriculture and the poor', Oxford University Press, ISBN 9780195695281 (2007) (www.ifpri.org/PUBS/otherpubs/globalpoor.asp).

⁽⁸³⁾ Anthony McGrew, 'A global society' in Stuart Hall, David Held and Anthony McGrew, *Modernity and its futures*, Cambridge, Polity Press (1990), quoted by Simon Reich (1998) in 'What is globalization? Four possible answers', Working Paper 261, December 1998, Kellogg Foundation (<http://www.nd.edu/~kellogg/WPS/261.pdf>).

Plot of GDP per capita against proportion of the population involved in agriculture



The graph demonstrates that the proportion of people involved in agriculture is much greater in poorer countries than in richer countries. Source: Data derived from CIA, *The World Factbook* (July 2008), ISSN 1553-8133.

The consequences for society are therefore severe, both for the least developed countries (LDCs) and for EU citizens from countries with less favourable economies.

In 2002, UN countries and the world’s leading development institutions agreed on a global strategy to eradicate major calamities. The agreement is based on a joint effort to achieve eight main goals (millennium development goals — MDGs) by 2015:

- (1) eradicate extreme poverty and hunger;
- (2) achieve universal primary education;
- (3) ensure gender equality;
- (4) reduce child mortality;
- (5) improve maternal health;
- (6) combat HIV/AIDS;
- (7) ensure environmental sustainability; and
- (8) develop a global partnership for development.

Agriculture has a major role to play in achieving the UN millennium development goals. The data published on implementation of the MDGs in April 2008 show that hunger is still a major issue at world level and that the target is still far from met ⁽⁸⁴⁾.

On 5 June 2008 delegates at the Rome Food Security Summit announced their increased commitment to the fight against hunger and to agricultural development. The financial support will benefit countries hard hit by the current world food crisis, allowing them to grow enough food for themselves in future planting seasons and helping them to achieve continuing food security as a result of investment in agriculture and research. Financing totalling USD 8 billion was announced during the summit, which was attended by 181 nations and more than 40 Heads of State or Government.

⁽⁸⁴⁾ <http://www.un.org/ga/president/62/letters/bckgpoverty.pdf>

Goal 1: Eradicate extreme poverty and hunger

Goals	Africa		Asia			
	Northern	Sub-Saharan	Eastern	South-eastern	Southern	Western
Reduce extreme poverty by half	Low poverty	Very high poverty	Moderate poverty	Moderate poverty	Very high poverty	Low poverty
Reduce hunger by half	Very low hunger	Very high hunger	Moderate hunger	Moderate hunger	High hunger	Moderate hunger
	Oceania	Latin America and Caribbean	Commonwealth of Independent States			
			Europe	Asia		
Reduce extreme poverty by half	—	Moderate poverty	Low poverty	Low poverty		
Reduce hunger by half	Moderate hunger	Moderate hunger	Very low hunger	High hunger		

Source: <http://www.un.org/millenniumgoals/docs/MDGProgressChart2006.pdf>

6.3. The millennium development goals and the EU

To achieve the millennium development goals, on 24 May 2005 the EU foreign and development ministers agreed to spend at least 0.51 % of gross national income (GNI) on aid by 2010 and at least 0.7 % by 2015 ⁽⁸⁵⁾. The EU-10 promised to work towards allocating at least 0.17 % of GNI to aid by 2010. The aim is to reach a target of 0.33 % in 2015. These new targets will bring the EU-25 average as a whole up to 0.56 % by 2010 (as proposed by the European Commission). If successful, the new plans would increase EU development aid by EUR 20 billion a year by 2010 and thus double the total amount of aid by 2015 (from the current EUR 60 billion to EUR 120 billion a year). Half of the aid will go to Africa.

In addition, the EU has responded to the price surge on agricultural markets by adjusting market management under the common agricultural policy (CAP): intervention stocks have been sold and export subsidies reduced — for example, to zero for dairy products. In addition, the EU Council of Ministers of Agriculture and Fisheries agreed to suspend, for the current marketing year, the obligation for farmers to set aside 10 % of their arable land, along with the import duties on cereals. Furthermore, the general move towards more market-oriented agriculture, with less market support but also less restrictive supply control mechanisms, will allow farmers to respond quicker to price signals.

In 2007, the EU adopted specific short-term measures to reduce prices of agricultural products, including increasing the volume of arable land by abolishing mandatory set-aside, increasing milk production quotas for 2008, reducing buffer stocks and export refunds and suspending import duties on most cereals.

On 29 July 2008, the European Commission proposed establishing a special 'facility for rapid response to soaring food prices in developing countries'. The fund would operate for two years, 2008 and 2009 ⁽⁸⁶⁾, in addition to existing development funds and would total EUR 1 billion, drawn from unused money from the European Union's agricultural budget.

6.4. Global trade

Trade in agricultural commodities and products is important for industrialised and non-industrialised countries alike. The volume of goods traded is increasing every year and affecting the global economy. A number of recent phenomena, from oil prices to climate change and from energy policies to population growth, are shaping the ongoing food security crisis at global level.

⁽⁸⁵⁾ <http://www.eu2005.lu/en/actualites/conseil/2005/05/23cagre/milldego.pdf>

⁽⁸⁶⁾ It would be provided to developing countries which are most in need, based on a set of objective criteria. The facility would give priority to supply-side measures, improving access to farm inputs such as fertilisers and seed, possibly via credit, and to safety-net measures with the aim of improving productive capacity in agriculture. The support would be paid via international organisations, including regional organisations.

Main world agricultural products		
Wheat	Rice	Jute
Wheat is the most important cereal traded on international markets. Total world trade in wheat and wheat flour (in grain equivalent) is close to 95 million tonnes, with the developing countries accounting for some 80 % of imports. The United States ranks as the world's leading wheat exporter, normally contributing around one third of world export volume.	Developing countries account for about 95 % of production and about 80 % of trade in rice. Most rice, a staple food for almost half the people in the world, is consumed in the countries where it is produced. Only about 3 % to 5 % of all rice produced is traded on the world market. Rice is one of the most difficult food commodities for trade because of consumer preferences, the small quantities involved and the dependence of production on local climatic conditions.	Jute is a fibre crop which is used mainly for sacking, although efforts are being made to diversify into other end-uses. In recent years, world production of jute has been about 3 million tonnes per year, of which 300 000 tonnes are traded internationally in the form of raw fibre and 900 000 tonnes in the form of products. World trade in jute products is dominated by (in order of importance) sacking, yarn, hessian and carpet backing.

The incidence of these phenomena in different regions of the world varies, depending on socioeconomic and geopolitical factors.

Although agriculture makes up only 8 % of world trade, it is the main source of income for about 2.5 billion people, mainly in developing countries. However, farmers from poor countries are unable to compete against heavily subsidised exports from the EU, USA and Japan.

Global trade in agriculture is a major area of activity of the World Trade Organisation (WTO). In 1986 negotiations seeking to liberalise agricultural trade began. They eventually led to new treaties under the General Agreement on Tariffs and Trade ⁽⁸⁷⁾ and to the founding of the WTO in 1995 (WTO GATT Uruguay Round). Several meetings with the aim of negotiating global trade provisions for agricultural commodities have taken place since 2000. The negotiations were launched by ministers of WTO member countries in November 2001 in the Qatari capital, Doha (Declaration of the Fourth WTO Ministerial Conference — Trade Negotiations Committee ⁽⁸⁸⁾). Further meetings followed (see Annex II). The main goal of the Doha Round negotiations was 'to establish a fair and market-oriented trading system through a programme of fundamental reform encompassing strengthened rules and specific com-

mitments on support and protection in order to correct and prevent restrictions and distortions in world agricultural markets'. In practice, this involves efforts on substantially improving market access, reducing, with the aim of phasing out, all forms of export subsidies and substantially reducing domestic support distorting trade. In order to achieve these goals, WTO member countries' ministers ⁽⁸⁹⁾ agreed to launch tariff-cutting negotiations on all non-agricultural products. The aim was 'to reduce or, as appropriate, eliminate tariffs, including the reduction or elimination of tariff peaks, high tariffs and tariff escalation, as well as non-tariff barriers, in particular on products of export interest to developing countries'. The major difficulties concerned:

- (1) access to agricultural markets,
- (2) agricultural subsidies,
- (3) access to industrial markets,
- (4) services.

On 21 July 2008, ministers of trade met in Geneva in an attempt to agree a basic framework for a final deal in the Doha Round of WTO world trade talks. They hoped to agree on parameters to generate new trade in agriculture, industrial goods and services. The agricultural negotiations were the most advanced chapter of the Doha Round, but they failed on 29 July 2008 and the future looked uncertain. However, the latest G20

⁽⁸⁷⁾ GATT began in 1948. The original agreement covered trade in goods. Later, the Uruguay Round and the WTO extended the remit to trade in services and traded inventions.

⁽⁸⁸⁾ http://www.wto.org/english/news_e/news02_e/tnc_01feb02_e.htm#principles

⁽⁸⁹⁾ The key players in the negotiations, known as the G6, were Brazil and India (representing the G20 group of developing countries), the EU, the USA, Australia (representing the Cairns group of agricultural exporters) and Japan (representing the G10 group of net agricultural importers).

meeting, which took place in Washington in November 2008, signalled a strong attempt to start a new session of the Doha Round of trade negotiations in the WTO. In addition, the EC indicated that it was committed to bringing the Doha Round to a successful, rapid and pro-development conclusion and to improving both the quality and the volume of the EU aid for trade for developing countries, an important supplement to trade agreements to ensure that the benefits of trade are more widely shared.

6.5. *European Union common agricultural policy*

The common agricultural policy (CAP) has been a key policy pillar of the European Union since its origins. It was originally conceived to expand production and provide secure food supplies to Europeans, following the food crisis after the Second World War. The CAP was therefore a key objective of the Treaty of Rome in 1957.

The most important step allowed by the CAP in Europe was establishment of free trade in agricultural products between European Member States, in response to the need to allow a controlled market with a system of annual guaranteed prices and a compensation system to maintain fixed prices regardless of market fluctuations. The CAP also established:

- (1) a mechanism of high tariffs to prevent imports of products from non-EU countries at prices cheaper than those agreed in the EU; and
- (2) subsidies for EU agricultural exports at a reduced price to help them to penetrate non-European markets. This system, typical of the 1960s and 1970s, led to overproduction of food supplies. In the 1990s it was criticised for lack of food security, for the environmental impact of intensive farming and for its effects on rural employment and global justice. The reform of the CAP then began.

Whereas the previous philosophy behind the CAP was mainly to preserve and boost productivity, the current version is geared to liberalisation of trade. The main trends in the abovementioned revisions of the CAP were, therefore, cuts in the guaranteed prices and 'partial' compensation of farmers with direct payments made to farmers on a yearly basis ⁽⁹⁰⁾ (supporting the

producer rather than the product). The other aspect affected by the new version of the CAP was the overproduction of agricultural products. Measures to avoid this phenomenon were introduced, such as quotas (maximum allowed quantities) and the set-aside scheme. The first were designed to control prices and avoid overproduction and the second was introduced in 1992 and required keeping a portion (10 %) of arable land out of production. Incentives for environmental protection and modernisation of farming were also introduced in 1999, although they were different from CAP expenditure.

From 1992 to 2002 the CAP reform was geared to gradually reducing price support for products in the form of direct payments to producers. This trend was confirmed in 2003 when the CAP reform introduced further price cuts (for milk, rice and rye), but added a substantial change in the link ('uncoupling') between production and payments. In the new CAP, direct payments are linked only to environmental, food safety and animal welfare obligations ⁽⁹¹⁾. Environmental, food safety and animal welfare standards, based on existing EU directives and 'good agricultural and environmental conditions' (GAEC) were then set and made a condition for CAP subsidies ⁽⁹²⁾. Other measures supporting food quality and safety included new rural development measures to support farmers who improved food quality or animal welfare. Other reforms of given sectors of the CAP followed in 2004 (e.g. for 'Mediterranean products' — olives, hops, cotton, tobacco and sugar). The European Commission is currently finalising a 'health check' of the new CAP. The current CAP aims at promoting environmental sustainability, animal welfare, biodiversity protection and food safety.

Cuts in tariffs and reductions in export subsidies were then instrumental in promoting competitive agriculture in the EU and beyond.

⁽⁹¹⁾ Farmers will receive a single farm payment (neither crop- nor product-specific) unconnected to the quantity of the product produced, in order to avoid overproduction.

⁽⁹²⁾ The 18 directives on cross-compliance include five environmental directives, three on animal welfare, four on food safety and animal health and six on registration of livestock and notification of animal diseases.

⁽⁹⁰⁾ This shift has helped to bring the EU into line with the logics of GATT/WTO rules and global agricultural trade in general.

EU CAP

Moving away from payments based on historical receipts to a 'flatter rate' system.

Increasing the rate of decoupling in countries which opted to maintain the link between subsidy and production in a number of agricultural sectors, although coupled support may still play a role in regions where production is small-scale but of particular economic or environmental importance.

Gradually reducing the support level as total payments to big farmers increase, starting from a level of, for example, EUR 100 000 per year.

Increasing the amount of land a farmer has to own before qualifying for EU support from the current level of 0.3 hectares.

Reviewing the cross-compliance standards which farmers are required to meet in order to receive support from Brussels.

The options considered in the current 'health check' of the EU common agricultural policy⁽⁹³⁾ include abolishing the set-aside requirement, gradually abolishing milk quotas by 2015, adjusting market price aid in the cereals sector and making the transition from support for energy plants to more effective solutions to bolster the bio-energy sector — without, however, having an adverse impact on production of food and feedstuffs — including production of second-generation biofuels. In addition, the European Commission recently adopted communications on food prices, energy and oil prices.

6.6. European Union agricultural market

The agro-food sector accounts for around 7 % of the total EU economy, distributed mainly between the retail and primary sectors and manufacturing or processing of food products. Particularly in the primary sector, biotechnologies play a key role and account for 13 % to 23 % of turnover. The main applications include breeding and propagation of crops, production of food additives, diagnostics for screening and enzymes for food production.

Agriculture involves around 5 % of the EU population and accounts for 20 % of average EU household consumer expenditure and a large proportion of the EU's internal and export trade. It generates less than 1 % of GDP in Germany and the United Kingdom and about 8 % in Portugal and Romania (the figure for the European Union as a whole is about 2 % of GDP). The proportion of the European population directly involved in agriculture is about 4.4 %, ranging from only about 1.4 % in the United Kingdom to nearly 30 % in Romania.

⁽⁹³⁾ http://ec.europa.eu/agriculture/healthcheck/index_en.htm

The economic value of agriculture in local economies in the EU increases in rural areas to 5 % of their gross value added (GVA)⁽⁹⁴⁾. In the 10 Member States that joined the EU in 2004 the contribution in rural areas is as high as 7 % of GVA. Within the primary sector, agriculture is the most important contributor to the EU economy with 1.8 % of the EU's GVA (87 % of the primary sector's GVA), while the remaining 0.2 % of the primary sector's contribution to the EU's GVA comes from forestry and fisheries. The input sectors account for a much smaller share of the EU economy, generating only 0.1 % of the EU's GVA. In all, the sectors covered by this analysis contribute 4.22 % of the EU's GVA. By comparison, with 3.36 % of the EU's total GVA, the food and beverage wholesale and retail sectors are almost as important to the EU economy as the primary sector.

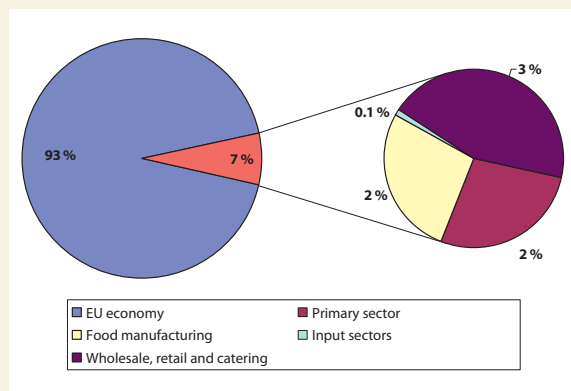
Agriculture is therefore not only a key economic sector in the EU of high social and political importance, but also the sector where the process of European integration is furthest advanced. The revised CAP is an integral component of the EU's economic strategy (the renewed Lisbon agenda) and of the role played by the EU in global trade.

The impact of food and energy price shocks on this sector is severe and affects EU trade, employment and social welfare. In that sense, concerns about food security and the sustainability of agriculture are of primary importance for any discussion on a policy design for the CAP which is responsive to climate change, world

⁽⁹⁴⁾ European Commission, Directorate-General for Agriculture and Rural Development (2006), 'Rural development in the European Union — Statistical and economic information report 2006' (http://ec.europa.eu/agriculture/agrista/rurdev2006/RD_Report_2006_Foreword_Content.pdf).

population growth, energy and food crises and global trade rules.

Economic significance of the agro-food and food services sectors to the EU economy (overall GVA)

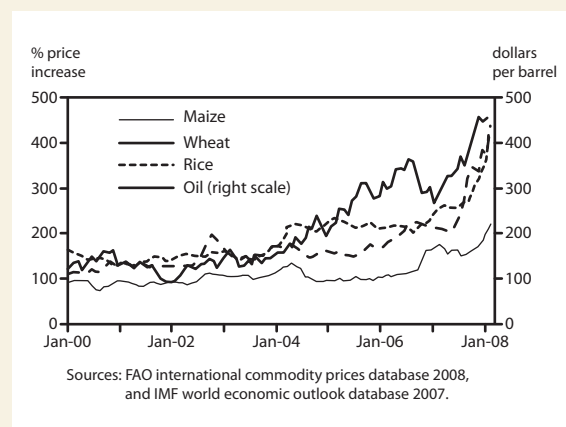


6.7. Price trends

For 30 years, food prices, both in Europe and globally, have been falling in real terms. This trend has been reversed over the last few months by sudden, steep increases in world agricultural commodity prices. Between September 2006 and February 2008, world agricultural commodity prices rose by 70 % in dollar terms. Particularly sharp increases were recorded in wheat, maize and rice prices and for dairy products. Reference prices for world markets in early February 2008 compared with the same month in 2007 were of the following orders of magnitude: +113 % for US wheat versus +93 % for EU wheat, +83 % for US soybean, +52 % for Thai rice and +24 % for US maize. Since February 2008, the reference price for rice (Thailand's export price) has doubled, as it soared beyond USD 1 000 a tonne at the end of April. Meat, such as poultry, and vegetable oils also showed hefty price increases. In Europe, prices for wheat and dairy products increased by 96 % and 30 % respectively between September 2006 and February 2008. Some exporting countries have responded to rising prices with restrictive export policies ⁽⁹⁵⁾.

⁽⁹⁵⁾ India has introduced export bans, Vietnam and Thailand export limits on rice, Indonesia export taxes on palm oil and Kazakhstan a ban on wheat exports. Such taxes and export bans are designed to protect domestic markets from short-term supply shortfalls and price shocks. However, they further tighten international agricultural markets for food-importing developing countries. In the medium term, such restrictions reduce the incentives for farmers to invest and increase production and contribute to imbalances on regional markets.

World commodity prices (January 2000 to February 2008)



The price surge affected several commodities at the same time: cereals, meat and dairy products all posted two-digit or even three-digit increases in less than a year. The scale and abruptness of the price surge have generated macroeconomic imbalances across the world. Developing countries and the most vulnerable populations have been hit disproportionately. Millions living on the edge of poverty face hunger and malnutrition.

There are many reasons for the increases, including a large increase in energy prices. This has an indirect impact on food prices, as costs of chemicals, mechanical cultivation, transport and distribution increase dramatically, but has also triggered a shift away from production of food crops towards crops for energy. About 30 % of US maize production will be used for bioethanol production during 2008 ⁽⁹⁶⁾.

In addition, an increase in prosperity in emerging countries has generated demand for more and different kinds of food to those traditionally eaten ⁽⁹⁷⁾. The growth of emerging economies, such as China, Brazil and India, is radically changing food requirements and having an impact on sustainable agriculture, as consumers demand more meat and processed food.

⁽⁹⁶⁾ Ibid.

⁽⁹⁷⁾ Growth brought annual increases of 9 % in Asia, 6 % in Africa and 2 % in industrialised countries in the time frame 2004–06. If these trends were to continue, this would produce an increase in food consumption proportional to the growth of the emerging economies. For example, it has been calculated that in India (2000–25) this would lead to per capita growth in annual consumption of 176 % for meat, 70 % for milk and vegetables and 27 % for grain.

1990/2005 ratios of per capita consumption (FAO)	India	China	Brazil	Nigeria
Cereals	1.0	0.8	1.2	1.0
Meat	1.2	2.4	1.7	1.0
Milk	1.2	3.0	1.2	1.3
Fish	1.2	2.3	0.9	0.8
Fruit	1.3	3.5	0.8	1.1
Vegetables	1.3	2.9	1.3	1.3

The most populous country in the world, China, exemplifies this. Chinese consumers now eat 50 kg of meat per year, compared with just 20 kg in 1985. Developing countries that are net importers of food, such as in Africa but also the Philippines, Indonesia, China and Moldova, are the hardest hit by the crisis. Countries dependent on food aid and which are also energy importers are the most vulnerable. According to the FAO ⁽⁹⁸⁾, the cereal import bill of the world's poorest countries is forecast to rise by 56 % in 2007/08. This follows a hefty increase of 37 % in 2006/07. For low-income food-deficit countries in Africa, the cereal bill is projected to increase by 74 %. As food takes the largest share in these countries' consumer price basket, fully passing on higher food prices means higher inflation, with possible adverse macroeconomic effects on stability and/or growth due to tighter monetary policies.

According to Eurostat data, prices of all categories of food grew substantially in the EU from February 2007 to February 2008. While food price increases in the EU-15 were around 5 % to 7 %, they were much higher in the new Member States (21.8 % in Bulgaria and 17 % in Estonia). This coincides with a higher proportion of expenditure on food in household budgets. The percentage of household expenditure ranges from 9.06 % in the UK to 41.87 % in Romania. In addition, the poorest 20 % of households spend a much higher proportion of their income on food — e.g. 30.7 % in Slovakia and 27.2 % in Hungary. Also, in some countries with higher income levels the proportion spent on food by the poorest households is substantially higher than for an average household (27 % in Italy, 23.8 % in Spain, 19.9 % in Slovenia, 20.2 % in Greece, 22.6 % in Cyprus, 16.2 % in Ireland and 14 % in Germany) ⁽⁹⁹⁾. In the European Union, food price inflation rose to 7 % in March 2008. Households' purchasing power has fallen and the 16 %

of Europeans living below the poverty threshold are the most exposed ⁽¹⁰⁰⁾.

Additional information on food price increases can be found in Annex IV to this opinion. It should, however, be added that commodity prices are continuously changing and that this report could only be updated to November/December 2008. Recent developments seem to point to a reversal of the trend seen in 2007 and up to March/April 2008, in that producers' and wholesale prices started falling during the final months of 2008. Consumer prices continued to rise, but at a slower pace than during previous months and in line with the standard inflation rate. At the moment, it is difficult to predict future developments.

6.8. Speculation and its economic impact on the food market

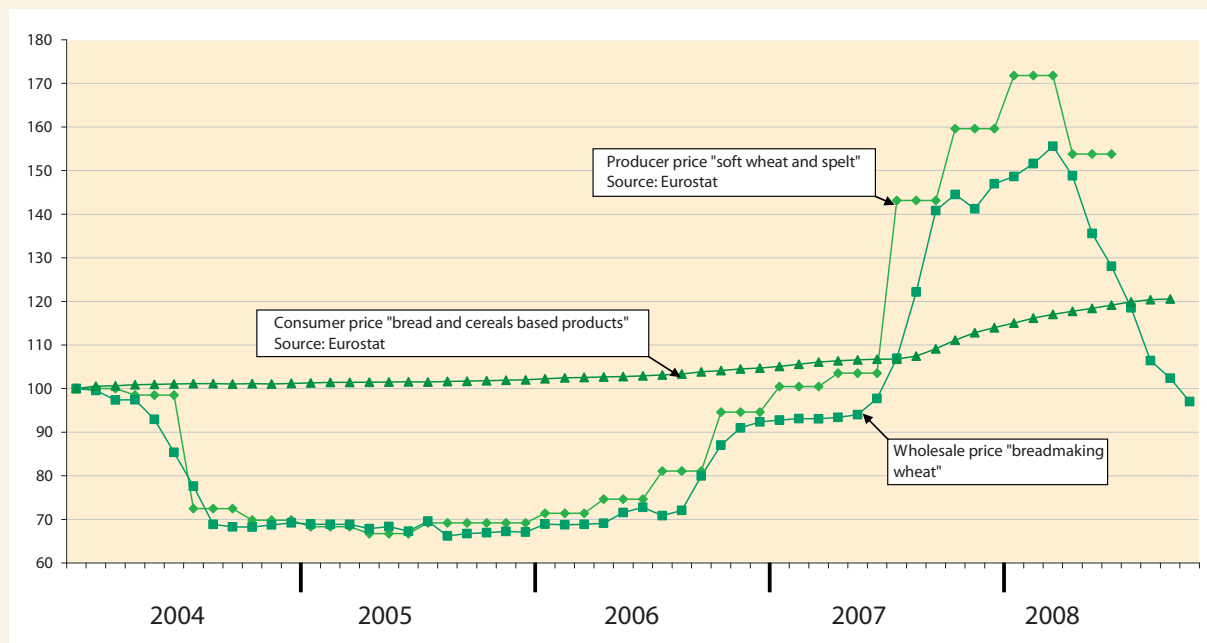
The general price increase is a phenomenon accompanying the current financial crisis. The loss of confidence in the financial markets has encouraged many investors to abandon equity investments (i.e. shares) and turn to raw materials, such as gold, oil, wheat or dairy products. Increases in the raw materials price have had only a small impact on the final price of food, as the raw materials cost accounts for only 10 % of the total cost of the product. The rise in energy and fuel prices has had the biggest impact, as it affects the cost of many components, from fertilisers to transport, food processing and then, of course, final distribu-

⁽⁹⁸⁾ FAO, *Crop prospects and food situation*, No 2, April 2008.

⁽⁹⁹⁾ According to Eurostat data for the year from February 2007 to February 2008.

⁽¹⁰⁰⁾ In 1987 the EU established the 'Most deprived' scheme for distribution of free food to people in need in the European Union. Before the reform of the CAP, such food stocks were stored in warehouses around Europe, but nowadays large surplus stocks are non-existent. Since 1995 the food aid scheme has therefore allowed the surplus stocks to be topped up by a financial contribution, when necessary. In 2008, 19 of the 27 EU Member States are participating in the scheme. As intervention stocks are likely to remain low in the future, the Commission is launching an impact assessment of the 'Most deprived' programme in 2008, with the aim of examining options for the future.

Monthly producers', wholesale and consumer prices in the EU cereals sector



NB: 2004–08, January 2004 = 100.

tion. Crude oil prices have been rising since 2004 and reached well over USD 130 per barrel, before slipping back to USD 70 in November 2008⁽¹⁰¹⁾. Some argue⁽¹⁰²⁾ that there has been increased activity by speculative investors in commodity-related financial markets to hedge price risks or use excess liquidity in the wake of the financial market crisis, and that such activities lead to increased price movements and volatility on futures and spot commodity markets and have amplified the underlying price movements. However, in 2008 the US Commodity Futures Trading Commission studied the role of speculators on commodity and oil markets and found no evidence of any causative role played by

financial speculation in food price rises. The same was reported by other sources independently⁽¹⁰³⁾⁽¹⁰⁴⁾.

The depreciation of the US dollar has also contributed to driving prices upwards. Exchange rate effects have added to the unequal impact of price increases. For countries whose currencies are tied to the euro (e.g. FCFA countries in west and central Africa) the negative effects have been somewhat softened. Countries whose currencies are depreciating are hit particularly hard.

⁽¹⁰¹⁾ The average price in 2007 was USD 73 compared with USD 25 in 2002. The price rise has mainly been due to increased demand by emerging economies, as supply has struggled to keep up with demand, resulting in a very tight market. High oil prices can also be attributed to the weakening dollar, as oil has been used by the market as a safer investment and as a hedge against inflation.

⁽¹⁰²⁾ See the testimony of Michael W. Masters, Managing Member/Portfolio Manager of Masters Capital Management LLC, before the Committee on Homeland Security and Governmental Affairs of the United States Senate, 20 May 2008: hsgac.senate.gov/public/_files/052008Masters.pdf

⁽¹⁰³⁾ *The Wall Street Journal*, editorial, 'See you later speculator' (15.9.2008) (<http://online.wsj.com/article/SB122143397998234079.html>).

⁽¹⁰⁴⁾ *The Economist*, 'Of froth and fundamentals' (9.10.2008) (http://www.economist.com/research/articlesbysubject/PrinterFriendly.cfm?story_id=12373732).

7. Intellectual property rights (IPR) in agriculture

Intellectual property occupies a central position in the biotechnology innovation system, which is expected to provide a source of new medicines, foods and bio-energy. Intellectual property rights are a relatively new phenomenon in agriculture. The manner in which they are recognised, traded and managed — both nationally and globally — has already made an impact on the way in which agriculture provides material to growers and consumers ⁽¹⁰⁵⁾. Patents were originally a mechanism whereby a state provided an inventor with exclusive rights to deny others use of the invention in return for disclosing details so that anyone skilled in the art could reproduce the invention. Today, they are almost a currency.

The TRIPS agreement (agreement on trade-related aspects of intellectual property rights ⁽¹⁰⁶⁾) is one of the agreements that form the Uruguay Round of negotiations under the GATT Treaty which led to the founding of the World Trade Organisation. It addresses most forms of intellectual property rights (IPR). Although there are many different forms of IPR, only three are significant to agriculture — appellations of origin, plant variety rights, and patents. Appellations of origin are mainly used for food products ⁽¹⁰⁷⁾ (including cheese and wine). There had been hopes that use thereof would be extended by the Doha Round of World Trade Organisation negotiations ⁽¹⁰⁸⁾.

⁽¹⁰⁵⁾ Matthew Herder and E. Richard Gold, 'Intellectual property issues in biotechnology: health and industry' (2008), OECD international futures project on 'The bioeconomy to 2030: designing a policy agenda', third meeting of the Steering Group, Paris, 7 and 8 February 2008.

⁽¹⁰⁶⁾ Article 7 of the agreement states: 'The protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations.'

⁽¹⁰⁷⁾ Appellations of origin are a special form of geographical indication and generally consist of a geographical name or a traditional designation used on products that have a specific quality or characteristics that are essentially due to the geographical environment in which they are produced. They are protected in accordance with international treaties, regional or bilateral agreements and national laws.

⁽¹⁰⁸⁾ Both the Paris Convention for the Protection of Industrial Property and the Madrid Agreement for the Repression of False or Deceptive Indications of Source on Goods use the

National governments grant plant variety rights to enable plant breeders to exclude others (for a limited time) from producing or marketing material of a specific plant variety. There are international agreements relating to the granting of such rights, in particular the International Convention for the Protection of New Varieties of Plants (UPOV Convention), and there is a European regulation on Community plant variety rights (Council Regulation (EC) No 2100/94 of 27 July 1994). The UPOV Convention originally came into force in 1961, followed by revisions in 1972, 1978 and 1991. Unusually for an international agreement, it is possible to remain a member of the convention without complying with the latest version but by adhering to an earlier one instead ⁽¹⁰⁹⁾.

The differences are significant. In order to obtain the rights, a variety must be distinct, uniform and stable. Under the 1991 Act ⁽¹¹⁰⁾, it must also be novel. The 1991 revision defines a new concept — 'essentially derived variety' — that attempts to protect varieties with only 'cosmetic' changes from pre-existing varieties. A variety is deemed to be 'essentially derived' from another (initial) variety if it is predominantly derived from the initial variety and retains the essential characteristics resulting from the genotype, or combination of genotypes, of the initial variety. Whether a new variety is essentially derived or not is a private, commercial matter which, in the event of dispute, could be for the courts to resolve. In most EU countries agricultural crops must also meet VCU criteria, i.e. they must have satisfactory value for cultivation and use compared with products already on the market.

Patents are arguably the strongest form of IP protection. A patent is a right granted by a government to inventors to exclude others from imitating, manufacturing, using or selling a specific invention for commercial

term 'indications of source'. An indication of source refers simply to a country, or place in that country, as the place of origin of a product, the quality or characteristics of which are due exclusively or essentially to the geographical environment, including natural and human factors.

⁽¹⁰⁹⁾ Most of the members of the EU have acceded to the 1991 revision, including the European Union itself under Regulation (EC) No 2100/94, but Belgium still adheres to the 1961/1972 version and France, Ireland, Italy, Portugal and Slovakia (as well as Norway and Switzerland) to the 1978 version.

⁽¹¹⁰⁾ The 1991 revision curtailed the right of farmers to retain seed from one season to the next. The system is primarily directed towards providing plant breeders with the right to use material already on the market as a starting point for developing a new variety.

	UPOV 1978	UPOV 1991
Protection	Plant varieties of nationally defined species	Plant varieties of all genera and species
Requirements	Distinctness; uniformity; stability	Novelty; distinctness; uniformity; stability
Protection term	Minimum: 15 years	Minimum: 20 years
Protection scope	Commercial use of reproductive material of the variety	Commercial use of all material of the variety
Breeders' exemption	Yes	Not for essentially derived varieties
Farmers' privilege	In practice: yes	Up to national law
Double protection (PVR and patent)	Any species eligible for PVR cannot be patented	—

use for a certain period. In industrialised countries this lies between 17 and 20 years. The invention must be novel, must not be obvious to someone skilled in the art and must have utility. It is a compact between the inventor and society, in which the patent protection is 'exchanged' for disclosure so that new inventions may use the information published about the original invention. They are 'territorial' in that they apply within the borders of the country granting them.

Patents could not be obtained for plant varieties within the European Union until recently. Article 53(b) of the European Patent Convention ⁽¹¹¹⁾, to which all EU countries adhere, specifies that European patents should not be granted for 'plant or animal varieties or essentially biological processes for the production of plants or animals'. Article 27(3) of the TRIPS agreement permits members to exclude from patentability 'plants and animals other than micro-organisms and essentially biological processes for the production of plants or animals other than non-biological and micro-biological processes. However, members shall provide for the protection of plant varieties either by patents or by an effective *sui generis* system or by any combination thereof.' Directive 98/44/EC allows patents on plants, on condition that they are not directed to a single variety. Article 4(1) prohibits patents on plant and animal varieties, but Articles 4(2) ⁽¹¹²⁾, 8(2) ⁽¹¹³⁾

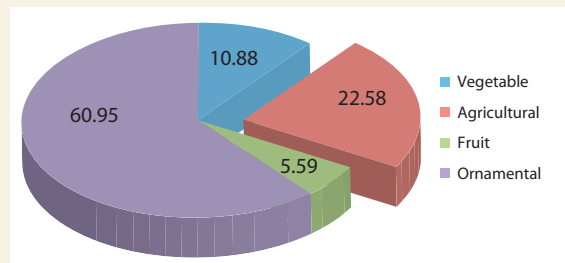
⁽¹¹¹⁾ The EPC is an international treaty on the basis of which the European Patent Office grants patents valid for the Member States which are then interpreted in the national courts.

⁽¹¹²⁾ 'Inventions which concern plants or animals shall be patentable if the technical feasibility of the invention is not confined to a particular plant or animal variety.'

⁽¹¹³⁾ 'The protection conferred by a patent on a process that enables a biological material to be produced possessing specific characteristics as a result of the invention shall extend to biological material directly obtained through that process and to any other biological material derived from

and 9 ⁽¹¹⁴⁾ broaden the patentability to all subsequent generations. Food was once a local commodity produced and consumed in a relatively small area. This has changed markedly in the last few years, and intellectual property protection of food products could have an impact on food availability and prices. Recent cases in the United Kingdom and in the Netherlands provide insight into the implications of globalisation and intellectual property in relation to food ⁽¹¹⁵⁾.

Average annual number of applications for Community plant variety rights by crop sector ^(*)



^(*) Statistics from the Community Plant Variety Office. The total is about 3 000 per annum (July 2008).

the directly obtained biological material through propagation or multiplication in an identical or divergent form and possessing those same characteristics.'

⁽¹¹⁴⁾ 'The protection conferred by a patent on a product containing or consisting of genetic information shall extend to all material, save as provided in Article 5(1), in which the product is incorporated and in which the genetic information is contained and performs its function.'

⁽¹¹⁵⁾ See the *Monsanto Technology LLC v Cargill* case, heard in the High Court in London (Chancery Division, Patents Court) by Mr Justice Pumfrey (*Monsanto v Cargill* [2007] EWHC 2257 (Pat), 10 October 2007).

8. Ethics in agriculture

Production, processing, storage and distribution of food and agricultural products are generally accepted as routine parts of everyday life all around the world. Therefore, these activities have rarely been addressed within the realm of ethics. But food and agriculture, and the economic benefits derived from taking part in the associated system, are means to an inherently ethical end: feeding the world's population and preserving the Earth's food-producing capacity and natural ecosystems for future generations. The ethical dimension of agriculture is therefore inherent to discussions on modern agricultural technologies.

8.1. Ethical principles and values for responsible action

In 2007, to mark the 50th anniversary of the founding of the EU, the EU-27 Heads of State or Government unanimously adopted the Berlin Declaration indicating the milestones of the EU political project. The declaration states that peace, freedom, democracy, justice and solidarity⁽¹¹⁶⁾ are key values of the EU and that EU policies, including on agriculture, have to be conceived and implemented in accordance with them.

On 12 December 2007, the Presidents of the European Commission, the Council and the European Parliament proclaimed the European Charter of Fundamental Rights. The charter indicates, inter alia, a set of values, such as human dignity (a key value of the European Union⁽¹¹⁷⁾), freedom, democracy, pluralism, non-discrimination, tolerance, justice, solidarity and gender equality, as the milestones of the European Union and its policy design.

The European Charter of Fundamental Rights shows that, while Europe is multicultural, a set of shared values exists in the EU. Ethical goals for responsible action in agriculture (food security and sustainability) can be extrapolated from the Charter. Their under-

lying values are rooted in two fundamental ethical principles:

- (1) **respect for human dignity;**
- (2) **justice.**

Beyond that, EU policy is also rooted in the principle of solidarity, which puts the emphasis on sharing responsibilities, benefits and burdens within the Community and, indeed, globally. Moreover, in the case of new technologies, the precautionary principle has been applied⁽¹¹⁸⁾.

Respect for **human dignity** is a universal and fundamental ethical principle. According to the explanations given in the declaration relating to the Charter of Fundamental Rights, 'The dignity of the human person is not only a fundamental right in itself but constitutes the real basis of fundamental rights.' The 1948 Universal Declaration of Human Rights enshrined this principle in its preamble: 'Whereas recognition of the inherent dignity and of the equal and inalienable rights of all members of the human family is the foundation of freedom, justice and peace in the world'⁽¹¹⁹⁾. This fundamental principle entails fundamental human rights: in the context of this opinion, the right to food, the need to respect individual freedom, self-determination and well-being. All these rights are to be met by specific obligations and responsibilities which are discussed below.

Justice is the principle that covers the institutional dimension of ethics. Justice is the guiding reference to guarantee equality, fairness and equity between citizens within a society and between all societies. The European Union aspires to create a democratic society based on justice in order to safeguard the rights and freedoms of all its citizens. This fundamental principle

⁽¹¹⁶⁾ 'We are striving for peace and freedom, for democracy and the rule of law, for mutual respect and shared responsibility, for prosperity and security, for tolerance and participation, for justice and solidarity.' Berlin Declaration, 2007.

⁽¹¹⁷⁾ Article 1 of the European Charter of Fundamental Rights states that 'Human dignity is inviolable. It must be respected and protected.' The concept of human dignity was addressed in EGE Opinion No 20 (see http://ec.europa.eu/european_group_ethics/docs/avis20_en.pdf).

⁽¹¹⁸⁾ The **precautionary principle** (or approach) has been interpreted in various ways. For many it means that if relevant scientific data are not available and if there is a risk of environmental damage, we should not proceed. Others interpret this as an injunction to proceed with caution, considering each release into the environment case by case and probably also proceeding step by step. Recourse to this approach 'presupposes that potentially dangerous effects deriving from a phenomenon, product or process have been identified, and that scientific evaluation does not allow the risk to be determined with sufficient certainty' (European Commission, COM(2000) 1 of 2 February 2000).

⁽¹¹⁹⁾ http://www.europarl.europa.eu/charter/pdf/04473_en.pdf

embraces the following moral values which are relevant to this opinion:

- **distributive justice** (which guarantees the right to food on an equitable and fair basis);
- **social justice** (which protects the most disadvantaged in society) and **equal opportunities** (which guarantee fair trade at national and international levels);
- **intergenerational justice** (which safeguards the interests of future generations).

8.2. Anthropocentric and ecocentric ethics

Many traditional western ethical approaches have advocated **anthropocentric** or human-centred positions and assigned an intrinsic value to human beings or a significantly greater intrinsic value to human beings than to any non-human things. This therefore justifies protecting or promoting human interests or well-being at the expense of non-human things. Anthropocentrism is a key characteristic of much western philosophy and of monotheistic religions.

Anthropocentric theories justify making instrumental use of nature for human purposes, although some of them have underlined that there are limits to human activities affecting the environment because they could damage the well-being of human beings now and in the future, since our well-being is essentially dependent on a sustainable environment⁽¹²⁰⁾. Anthropocentric ethics argue strongly that humans are at the centre of reality and that it is right for them to be so.

By contrast, since the 1960s ecocentric theories have been advocating the intrinsic value of the biosphere or the ethical dimension of nature⁽¹²¹⁾. Environmental ethics therefore emerged as a new discipline of philosophy in the early 1970s. It questioned the moral superiority of human beings over other species on Earth and advocated the need to make basic changes to values and goals at individual, national and world levels with a view to protecting the environment. The main tenets of ecocentric ethics can be summed up as follows.

⁽¹²⁰⁾ See Passmore (1974), Bookchin (1990) and Norton, Hutchins, Stevens and Maple (1995).

⁽¹²¹⁾ Rachel Carson, *Silent spring* (1963), which brought together a number of essays published earlier in *The New Yorker* magazine giving details of how pesticides, such as DDT, aldrin and dieldrin, concentrated along the food chain.

- Ecological humanism (eco-humanism or 'deep ecology'⁽¹²²⁾) argues that all ontological entities, both animate and inanimate, can be given ethical worth purely on the ground that they exist.
- Ecological theories argue in favour of the intrinsic value inherent in collective ecological entities like ecosystems or the global environment as a whole⁽¹²³⁾.
- Conservation ethics theories argue in favour of preservation of the environment on the ground that it has extrinsic value — instrumental to the welfare of human beings. Conservation is therefore a means to an end and purely concerned with mankind and intergenerational considerations⁽¹²⁴⁾.

The philosophical debate on environmental ethics remains unresolved. It has focused, inter alia, on animals, the biosphere, environmental protection, wildness, the role of human beings in nature (erosion of natural resources), urbanisation, the built-up environment, etc. However, relatively little attention has been paid to the ethical implications of modern agriculture.

Connections between environmental destruction, unequal resource consumption, poverty and the global economic order have been discussed from an interdisciplinary point of view⁽¹²⁵⁾. Many of the more recent assessments of issues concerned with biodiversity, ecosystem health, poverty, environmental justice and sustainability look at both the human and environmental sides, eschewing in the process commitment to either a purely

⁽¹²²⁾ 'Deep ecology' is the argument in favour of the intrinsic value or inherent worth of the environment — the view that it is valuable in itself.

⁽¹²³⁾ This category includes James Lovelock's Gaia hypothesis, i.e. the theory that the planet Earth alters its geo-physiological structure over time in order to ensure the continuation of an equilibrium of evolving organic and inorganic matter. The planet is seen as a unified, holistic entity with ethical worth, to which the human race is of no particular significance in the long run.

⁽¹²⁴⁾ Some have also advocated preservation of 'world heritage sites', unspoilt parts of the world that acquire 'scarcity value' as they diminish over time. Their preservation is a bequest for future generations, as they have been inherited from our ancestors and should be passed down to future generations, so that they can have the opportunity to decide whether to enjoy unspoilt countryside or an entirely urban landscape.

⁽¹²⁵⁾ Shrader-Frechette (1984), Gruen and Jamieson (eds) (1994), Karliner (1997), Diesendorf and Hamilton (1997) and Schmitz and Willott (2002).

anthropocentric or a purely ecocentric perspective ⁽¹²⁶⁾. The EGE recognises the relevance of both anthropocentric and ecocentric ethics theories. However, the topic covered by this opinion (agriculture) implies *per se* instrumental use of natural resources by human beings. Whatever philosophical position is used to assess the ethics of modern agriculture, it is important to address the complex balance of protagonists involved: human beings, the environment and future generations.

8.3. Rights and responsibilities

Agricultural ethics is about choices for people engaged in agriculture, either directly as farmers or indirectly as government regulators, extension agents, researchers, industrial workers, lawmakers, technology developers, consumers or protestors ⁽¹²⁷⁾. This calls on decision-makers and relevant stakeholders to promote and implement responsible use of agriculture, based on respect of a number of (ethically justified) fundamental rights. In this context, decisions on ethically sound design of new technologies in modern agriculture place responsibilities on those called to take them and monitor their implementation.

8.3.1. The right to food

Sufficient food is a basic prerequisite for survival. Therefore the right to adequate food ⁽¹²⁸⁾ is recognised as one of our most important values. The right to food is one of the principles enshrined in the 1948 Universal Declaration of Human Rights. Likewise, the Universal Declaration on the Eradication of Hunger and Malnutrition, adopted in 1974, declared that every person has the inalienable right to be free of hunger and malnutrition for their full development and to preserve their physical and mental capabilities. In 1992 the World Declaration on Nutrition recognised that access to suitable, wholesome and safe food is a universal right.

In 2002 the UN Special Rapporteur on the right to food defined the right to adequate food as a human right, inherent in all people, 'to have regular, permanent and unrestricted access, either directly or by means of financial purchases, to quantitatively and qualitatively adequate and sufficient food corresponding to the cul-

tural traditions of the people to which the consumer belongs, and which ensures a physical and mental, individual and collective fulfilling and dignified life free of fear'. This definition embraces all the normative components ⁽¹²⁹⁾ explained in detail in General Comment 12 of the International Covenant on Economic, Social and Cultural Rights (ICESCR) ⁽¹³⁰⁾. The United Nations Commission on Human Rights has asserted that the right to food is a human right, protected under international human rights and humanitarian law ⁽¹³¹⁾.

From a sustainability perspective, the human right to food and to a healthy natural environment are inextricably related, because environmental degradation jeopardises the world's capacity to meet rising food needs ⁽¹³²⁾. In addition, as the opportunities for agricultural production decline because of depletion of natural resources, communities in the developing world that depend on agriculture as their primary source of income face a loss of broader economic development opportunities. In the long term, equitable food production and ethical principles — the rights of humankind to a healthy environment, the rights of future generations to inherit natural resources and the human right to food — are therefore overlapping and complementary.

8.3.2. Responsibilities

Of necessity, agriculture is intended for the benefit of human beings, society and, if sustainable, the environment. These are not necessarily the same, since the benefits to living human beings could, in the short

⁽¹²⁶⁾ Hayward and O'Neill (1997) and Dobson (1999).

⁽¹²⁷⁾ M. J. Chrispeels, 'Agricultural ethics' (<http://www.plantphysiol.org/cgi/content/full/132/1/4>).

⁽¹²⁸⁾ Article 1 of the International Covenant on Economic, Social and Cultural Rights.

⁽¹²⁹⁾ In 2004, after two years of discussion and negotiation in a working group, the FAO Council adopted by consensus the 'Voluntary guidelines to support the progressive realization of the right to adequate food in the context of national food security'. The voluntary guidelines are not legally binding but draw on international law and provide guidance on implementation of existing obligations. They are addressed to states party to the International Covenant on Economic, Social and Cultural Rights and to states that still have to ratify it. But they are also intended for stakeholders working towards better implementation of the right to food at national level.

⁽¹³⁰⁾ 'The right to adequate food is realised when every man, woman and child, alone or in community with others, has physical and economic access at all times to adequate food or means for its procurement.'

⁽¹³¹⁾ UN Economic and Social Council, Commission on Human Rights (2004), 'Economic, social and cultural rights — The right to food', E/Cn.4/2004/10, p. 4, paragraph 3.

⁽¹³²⁾ Von Braun and Ashy Brown (2006), 'Ethical questions of equitable worldwide food production systems'.

or long term, entail a cost to the environment. Human use of the environment over the 10 000 years we have been harnessing nature has been relatively benign. In the last 100 years, however, we have made rapid, and possibly irreversible, changes to the environment, including excessive use of fossil fuels in relation to their replacement, excessive use of water, production of greenhouse gases and a huge increase in the human population. In this context, the concepts of beneficence and non-maleficence acquire a relevance to support the production of safe, healthy and high-quality food in agriculture.

Individual and collective responsibilities for food security and sustainability should not be confused or overlapped when food security and sustainability are discussed. Clear separation between individual and collective responsibilities is difficult with regard to the issues addressed here (for example, food waste). As far as food security is concerned, responsibility also lies with individuals and their choices in food consumption. For example, following diets rich in meat products and purchasing non-seasonal food certainly have an impact on global warming, food scarcity and erosion of arable land. Similar considerations apply to management of food waste and global hunger. Consumers' responsibility with regard to food security and the hunger divide is lower than their responsibility for food sustainability, since food security depends mainly on the design of national or supranational agricultural policies and trade rules.

Responsibilities also lie with different players involved in the agro-food sector: food producers, food retailers, food distributors and policymakers in the agricultural sector at regional, national or supranational levels (the EU Member States and the EU as a whole).

Food producers have direct responsibilities for food safety and quality (technologies used for production and methods) and food sustainability (methods of production and raw materials imports).

Food retailers have direct responsibilities for food security (monopolies, food price increases, non-seasonal food, etc.), food safety (food quality and public health) and food sustainability (imports of food, large-scale farm production, etc.).

Food distributors have direct responsibility for sustainability (food miles and methods of transport).

Policymakers have responsibility for implementation of equitable and fair food systems (food security, safety

and sustainability) at both national and supranational levels. They also have responsibility for monitoring that all involved in the food production, processing and distribution system act in ways consistent with the above-mentioned rights.

8.4. Justice

Theories of justice vary greatly and have formed the basis of philosophical debate in Europe for millennia. The contemporary discussions on the concept of justice emerged from the philosophical debate on the relationship between the state and citizens with the work of J. Rawls⁽¹³³⁾ and its critics⁽¹³⁴⁾, but also concerns the role of the state in protecting and advancing human rights as such. Today, two dimensions are of central importance in the context of modern agricultural technologies: the global justice discourse, with the priority of food security and safety, and the question of intergenerational justice, i.e. the obligation to preserve the environment and (natural) resources for future generations.

8.4.1. Distributive and social justice

Although the philosophical debate on the theory of justice continues, fairness and **distributive justice** are key principles for the modern debate on agricultural ethics. The principle of distributive justice addresses the question of which goods a society or a collective group must distribute among its individual members, and in what way, in proportion to (1) the individual's needs and (2) the resources available (which would include market and other financial considerations).

Production efficiency must be balanced by distribution efficiency reflecting ethical concerns such as fairness and justice.

⁽¹³³⁾ Rawls develops what he claims are principles of justice by using an entirely and deliberately artificial device which he calls the 'original position', in which everyone decides principles of justice from behind a 'veil of ignorance'. Rawls claims that all those in the original position would adopt a 'maximin' strategy which would maximise the position of the least well-off. Rawls claims that parties in the original position would adopt two such principles, which would then govern the assignment of rights and duties and regulate the distribution of social and economic advantages across society (Rawls, 1971).

⁽¹³⁴⁾ R. Nozick (1974), M. Walzer (1995), G. A. Cohen (2000) and R. P. Wolff (1977).

Justice in the agro-food domain mainly concerns food safety considerations (nutritional features of food products), ecological considerations (intergenerational justice and use of natural resources) and economic considerations (global trade and the impact of given import/export measures on the economies of other regions of the world).

8.4.2. Intergenerational justice

The concept of sustainable development enshrines the principle of **justice between generations**. Consequently, another important factor to consider in the ethics of agriculture is intergenerational justice. Based on a broad understanding of justice⁽¹³⁵⁾, future or past generations can be viewed as holding legitimate claims or rights against present generations, who in turn bear correlative duties to future or past generations. One of the legitimate claims of future generations vis-à-vis present generations appears to be a claim to distributive justice. Depending on the understanding of the relevant principles of distributive justice to be applied, if there is an intergenerational conflict of interests, considerations of justice could place an obligation on present generations not to pursue policies that create benefits for themselves but at the expense of those who will live in the future⁽¹³⁶⁾. The philosophical debate on intergenerational justice is complex⁽¹³⁷⁾, but plays a key role in discussions on ethics, food security and sustainability.

⁽¹³⁵⁾ See Mill, Chapter 5 (1969).

⁽¹³⁶⁾ See Rawls (1971 and 1991), D. Parfit (1987), Partridge (1981) and Miller and Kumar (2007).

⁽¹³⁷⁾ See Andrew Dobson (ed.), *Fairness and futurity — Essays on environmental sustainability*, Oxford University Press, Oxford (1999); E. Agius, 'Towards a relational theory of intergenerational ethics', in *Bijdragen*, 50 (1989), 293–313; Nick Fotion and Jan C. Heller (eds), *Contingent future persons — On the ethics of deciding who will live, or not, in the future* (1997), Kluwer Academic Publishers, Dordrecht, Boston and London; Jon Miller and Rahul Kumar (eds), *Reparations — Interdisciplinary inquiries* (2007), Oxford University Press, Oxford; Ernest Partridge (ed.), *Responsibilities to future generations — Environmental ethics*, Prometheus Books, New York (1981); Jesper Ryberg and Torbjörn Tännsjö (eds), *The repugnant conclusion — Essays on population ethics*, Kluwer Academic Publishers, Dordrecht, Boston and London; R. I. Sikora (2004) and Brian Barry (ed.), *Obligations to future generations*, Temple University Press, Philadelphia (1978).

For further information see <http://plato.stanford.edu/entries/justice-intergenerational/#Bib>

9. Ethical concerns

Agronomy policies adopted over the last few decades have been aiming to increase production by developing new technologies and have achieved considerable improvements in yields. Taking the abovementioned principles of the EU and the UN seriously, the ecological balance could be significantly tilted as agriculture becomes more efficient. However, modern technologies can be used in agriculture to favour sustainability and food security and to bridge gaps between some parts of the world and others and between present and future generations. But the uneven development paths, unsustainable use of natural resources, worsening impact of climate change, loss of biodiversity, poverty, malnutrition and poor quality of food, in spite of modern technology, are clear indicators that economic and technological progress needs to be inextricably related to ethics and to be based on sustainability of natural resources and food security. However, the ethical dimension of agriculture is not only confined to policy design. It also deeply concerns the technological dimension of modern agriculture, at EU and global levels, and any unexpected consequences that arise from use of new technologies in agriculture⁽¹³⁸⁾. When deciding whether certain developments or technologies should be accepted or promoted, we look at the outcomes, at the benefits. But how should these benefits be calculated? Benefits for whom and for how long?

The ethical concerns outlined below address issues described in the previous chapters of this opinion, namely the present trends (methods used, costs, etc.), existing legal regulation and policies on agriculture and trade, and the values and principles outlined in the previous chapter.

⁽¹³⁸⁾ As an example, some argue that use of the pesticide DDT has beneficial effects on populations of areas where malaria is endemic but, due to its accumulation in the food chain and consequent adverse neurological effects on both animals and humans, DDT has been banned in many countries, despite the fact that its potential use against malaria might save millions of lives in various regions of Africa. As another example, the new varieties of wheat (*Triticum aestivum*) and rice (*Oryza sativa*) produced by the green revolution increased food production in Asia and Latin America and provided food for hundreds of millions of people, but also marginalised untold millions who lost their access to land or their employment (Conway, *The doubly green revolution*, Comstock Publishing Associates, Ithaca, NY, pp. 78 et seq., 1997). See also M. J. Chrispeels, 'Agricultural ethics' (<http://www.plantphysiol.org/cgi/content/full/132/1/4>).

Global and regional per capita food consumption (kcal)

Region	1964–66	1997–99	Projected for 2015
World	2 358	2 803	2 940
Developing countries	2 054	2 681	2 850
Sub-Saharan Africa (excluding South Africa)	2 058	2 195	2 360
Industrialised countries	2 947	3 380	3 440

Source: WHO, 'Global and regional food consumption patterns and trends' (http://www.who.int/nutrition/topics/3_foodconsumption/en/print.html).

9.1. Food security at global, national and individual levels

Agriculture is the main provider of food and has a great impact on nutrition and health and on economic growth. There have been many arguments about the distribution of both food and farmland between the rich and poor, in developed and developing countries alike. Most of the world's poor are small tenant farmers. In order to increase their standard of living, the governments of many developing countries adopted (in the 1970s) policies for 'industrialising' agriculture. The fact that today there are more than 800 million people worldwide whose food supply is uncertain, even though sufficient food is being produced⁽¹³⁹⁾, points to a worrying distribution problem and is a sign of inadequate structures in agriculture and in world trade in agricultural goods. Global food production has apparently 'more than kept pace with population growth in recent decades and a diminishing proportion of the world's population are undernourished'⁽¹⁴⁰⁾. There is, however, a worrying distribution problem in many countries. As the population has been increasing steadily during the last century in every continent, agriculture has been facing increasing challenges to meet goals such as provision of resources and, most importantly, of food. Since one of the major causes of hunger is poverty, the fight against poverty can provide part of the solution to both world hunger and the consequent threats to political stability and peace, especially in developing countries. The questions are how to find a proper balance between access to food for all and open trade in agricultural products? Should specific measures be

conceived to limit the food divide between industrialised and non-industrialised countries? To what extent should individual freedoms in connection with food affect global production and distribution of food products? Should specific measures be conceived to guarantee food security while affecting individual dietary choices (in view of the increased consumption of meat and its impact on agriculture)? To what extent can economic considerations to protect the welfare of given geopolitical realities, such as Europe, prevail over food security and hunger in global strategies?

9.2. Food insecurity

To ensure food security, first of all the sources of food insecurity must be identified and dealt with case by case. A working definition of food insecurity given by the WHO is consumption of less than 80 % of what is considered the average per capita calories intake (2 850 kcal). Threats to food security can take different forms, have different dynamics⁽¹⁴¹⁾ and be caused by several factors⁽¹⁴²⁾. The practices that have evolved to support production agriculture (low commodity prices made possible by efficient, large-scale farms) are seen by many as unsustainable and contrary to stewardship of the land (Gliessman, 2000). However, abandoning production agriculture could push up food prices and then affect food security in the EU and worldwide.

⁽¹³⁹⁾ Jacques Diouf, Director-General of the FAO, 'Enough food is produced in the world today for everyone to be adequately fed. But 800 million people in the developing world do not have enough to eat.' (*World Chronicle*, 31 October 2003).

⁽¹⁴⁰⁾ Øystein Kravdal (2001), 'Has population growth restricted improvements in food availability per head 1970–1995?', *Population Studies*, 55, pp. 10–117.

⁽¹⁴¹⁾ Transitional food insecurity means a momentary food shortage, as could be the case with seasonal food insecurity, for instance during the cropping season. Chronic food insecurity means permanent reduced food availability to the population, lasting two or more seasons, rendering a region vulnerable to famine.

⁽¹⁴²⁾ For example, the sharp price increases for staple foods over the last few months, harvest losses due to prolonged droughts or floods (partly due to climate change in many regions of the world) or in cases where agricultural raw products are used for energy production instead of food (see the biofuels debate mentioned earlier in this opinion).

9.3. Sustainability of both resources and technologies

Sustainability requires limiting the ecological footprints of agriculture and safeguarding the environment for future generations⁽¹⁴³⁾. Sustainable development is defined in the Brundtland report⁽¹⁴⁴⁾ as ‘development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs’⁽¹⁴⁵⁾. It embodies the principle of **justice between generations**: future generations are vulnerable because they are ‘downstream’ in time from us and thus exposed to the long-term consequences of our present activities. They therefore need to be protected from natural resources’ misuse by the present generation who have decision-making powers over current agricultural policies.

If new technologies or new practices are involved, are they likely to widen the gap between the rich and the poor, both within countries (particularly in developing countries) and between developed and developing countries⁽¹⁴⁶⁾? Will they generate wealth for society as a whole which can assist those who need it? If they are more efficient and will provide more food but at the expense of some traditional farmers, is this acceptable? How can a balance be struck between increased productivity and environmental sustainability?⁽¹⁴⁷⁾

⁽¹⁴³⁾ The UN Earth Summit in Johannesburg in 2002 focused, inter alia, on how to ‘enhance in a sustainable manner the productivity of land and the efficient use of water resources in agriculture’. Stewardship, research and development in good agricultural practices and proper land management techniques are fundamental, as are water protection and preservation.

⁽¹⁴⁴⁾ Available at <http://www.worldinbalance.net/pdf/1987-brundtland.pdf>

⁽¹⁴⁵⁾ World Commission for Environment and Development (1987), *Our common future*, Oxford University Press, Oxford, UK, ISBN 0-19-282080-X.

⁽¹⁴⁶⁾ A small but significant array of policymakers, citizens and consumers have argued that new technology will exacerbate food insecurity, threaten the environment, endanger human health and, ultimately, impoverish some parts of society. There seems to be a conflict between those who see technology as all good and those who see it as an example of globalisation and of the takeover of people’s lives by anonymous, big multinational conglomerates.

⁽¹⁴⁷⁾ Low commodity prices are beneficial for consumers and safeguard export markets, but ecosystems and rural communities may suffer from some of the policies that encourage specific agricultural practices. For example, the current agricultural system relies heavily on irrigation, continuous

It has been argued that, as the world population along with its need for food grows, new technologies are necessary for creating and encouraging new methods of agricultural production and trade with a view to developing equitable food distribution capacity and a food-secure world. The current amount of land under cultivation cannot expand much further without detrimental environmental effects. Therefore, food production technology must create methods to improve the productivity of the land currently under cultivation and prevent harvest losses. An integrated scheme for effective use of land is crucial.

9.4. Food safety

Food safety covers the conditions and practices that preserve the quality of food to prevent contamination and food-borne illnesses. It entails protecting the food supply from microbial, chemical and physical hazards or contamination that can occur at all stages of food production and handling: growing, harvesting, processing, transporting, preparing, distributing and storing. Food safety is therefore a heterogeneous and multidisciplinary issue that concerns not only the food products as such but also the production methods. In this context, considerations relating to agricultural safety (use of chemicals) for the environment, wildlife and farm workers take on key importance.

This opinion has described the relevance of this factor in EU agriculture. Some, however, have argued that food safety standards that developed countries impose on exports from developing countries have sometimes created barriers to market access⁽¹⁴⁸⁾. The major problem for farmers who supply supermarkets is that they cannot raise their prices to pay for the investments needed to meet the quality and safety requirements set by the supermarkets. This appears to be true through-

monocultures and purchased inputs (fertilisers, pesticides, herbicides, farm machinery, etc.) and many such practices have a negative impact on the environment.

⁽¹⁴⁸⁾ ‘Higher quality and safety standards mean that consumers will ingest fewer pesticides and harmful microbes, and generally eat higher-quality fresh produce, but they also mean that agricultural development programmes must take on the responsibility and challenge of assisting small farmers in making the transition to producing safer and higher-quality produce.’ Julio A. Berdegué, Fernando Balsevich, Luis Flores, Denise Mainville and Thomas Reardon (2003), ‘Case study: supermarkets and quality and safety standards for produce in Latin America’ in J. Laurian (ed.), *Food safety in food security and food trade*, Unnevehr, IFPRI.

out the world, whether in developed or developing countries. An emerging concern is, therefore, whether the EU CAP should focus on food safety and consumer protection and promote the quality and healthiness of food products. European food safety measures applied to importing countries should be proportionate.

9.5. *Loss of biodiversity*

For decades the development of agriculture has been leading to continuous biodiversity loss of species used in industrial farming. During the Fourth International Conference on Sustainable Agriculture for Food, Energy and Industry ⁽¹⁴⁹⁾, the Executive Secretary of the Convention on Biological Diversity (CBD) addressed, *inter alia*, the risk of extinction and biodiversity loss in agriculture and how agricultural production is becoming more vulnerable to climate change and diseases that could spread more easily in monoculture systems ⁽¹⁵⁰⁾. In addition to loss of agricultural biodiversity, other serious problems can arise from the loss of natural biodiversity and of habitat, for example due to deforestation of new areas to make room for intensive agriculture. A decrease in genetic diversity means fewer opportunities for the growth and innovation needed to boost agriculture at a time of soaring food prices. Furthermore, as biodiversity in food and agriculture declines, the food supply becomes more vulnerable and unsustainable. Agriculture becomes less able to adapt to environmental challenges, such as climate change or water scarcity.

9.6. *Soil and water protection*

Water availability is a crucial question when considering any requirement to increase agricultural production and product availability. Agriculture accounts for approximately 80 % of the world's water consumption ⁽¹⁵¹⁾

⁽¹⁴⁹⁾ The Fourth International Conference on Sustainable Agriculture for Food, Energy and Industry was held from 2 to 5 July 2008 in Sapporo, Japan.

⁽¹⁵⁰⁾ The Executive Secretary of the Convention on Biological Diversity (CBD), Ahmed Djoghlaif, stressed that 'while not caused solely by the decreases in the number of cultivated species, the current food crisis is an example of what lies ahead if we continue to allow the loss of agricultural biodiversity, despite predicted global changes in growing conditions' (<http://www.cbd.int/doc/speech/2008/sp-2008-07-02-sapporo-en.pdf>).

⁽¹⁵¹⁾ Dobrowolski et al., USDA-CSREES 2006 National Water Quality Conference, 'What price water? Status of water availability for agriculture in changing economic times'. See www.usawaterquality.org/conferences/2006/Abstracts/Huffaker.pdf

and is the cause of much pollution of water supplies. Water availability and access are key constraints to poverty reduction and food security. 'Maintaining enough water for agriculture of reasonable quality will be increasingly difficult due to climate change; competition for water with industries, urban uses and the environment; and the need to produce biofuels ... [an] improved understanding of water availability is critical to integrated water resources management' ⁽¹⁵²⁾. There is an obvious necessity to 'maintain equity in water access, agricultural productivity, human health and environmental quality in the face of increasing water scarcity at local, basin and transboundary scales via development of adaptive management strategies, policy responses and trade-offs' ⁽¹⁵³⁾.

Maintaining land and soil quality is also a major determinant of agricultural productivity, and steps must be taken to ensure that land is used in an efficient and sustainable manner.

9.7. *GM crops in the EU*

Genetic modification of food crops and foods has been controversial in the EU and worldwide. In the United States and Argentina, in particular, the new products have been welcomed by the farming community and have not met with significant rejection by consumers. In both these countries the introduction of new variants has proceeded apace and farmers have benefited from the agronomic traits that have been added. In Argentina, in particular, the adoption of no-till approaches when using the new variants has had a dramatic effect on conservation.

The picture in Europe has been very different. Governments reacted to this new technology in different ways. Communities in much of Europe made their feelings clear to governments, and a strong movement to reject these products began in the late 1990s and is still active. Many regions have declared themselves GM-free. In much of Europe consumers have chosen to shun products containing GMOs and retailers have chosen to use this as a marketing ploy to attract customers. In 1998 the European Union introduced a *de facto* moratorium on the introduction of GM products both into the environment and as new foods — although

⁽¹⁵²⁾ Research theme of the CGIAR International Water Management Institute (http://www.iwmi.cgiar.org/Research_Impacts/Research_Themes/Theme_1/index.aspx).

⁽¹⁵³⁾ *Ibid.*

not restricting GM feed for animals to quite the same extent. This triggered a dispute between the EU and Argentina, Canada and the United States. Developing countries have been wary of introducing the new varieties, as the impact on their income if they fail to sell in Europe would be substantial, even though agricultural production could have improved considerably if the transgenic varieties had proved effective in their agricultural conditions.

The impact of rejection of the products and of the requirement for regulation that draws a distinction between transgenic products and those produced by conventional methods has been profound. There appears to be a degree of polarisation — with many countries fearful of EU rejection of their products and of accepting products that some consider harmful, but others expecting significant gains from adopting the new technology. Commercial applications have resulted in insertion of genes into a small number of crops, primarily oilseed rape (canola), soybean, cotton and maize, to provide herbicide tolerance or pest resistance. These have captured a large market share but have also come in for heavy criticism⁽¹⁵⁴⁾.

Positions on GMOs are sharply divided across the EU. Industrial stakeholders point to the advantages of this technology in terms of ecological sustainability⁽¹⁵⁵⁾, economic sustainability⁽¹⁵⁶⁾ and social sustainability⁽¹⁵⁷⁾ and underline both the increasing public acceptance of this technology⁽¹⁵⁸⁾ and its potential to produce enough

healthy food for the population, while preserving precious resources, such as soil and water, and mitigating climate change. Consumers' organisations, environmental protection organisations and several NGOs underline the risks associated with coexistence of GM crops alongside natural species, the lack of public acceptance and the risks stemming from the monopoly which this sector of industry could induce (see also the UN International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD, 2008)⁽¹⁵⁹⁾). Others argue that 'the scientific risks and socioeconomic issues associated with biotechnology need to be examined in the context of technology's role in addressing long-term goals, such as preserving biodiversity, conserving natural resources, achieving food security, improving the health of populations, cleaning up polluted lands and bodies of water, and obtaining adequate sources of energy'⁽¹⁶⁰⁾. Yet others underline that genetic technologies not only involve genetic modification. Identification of genes which confer desirable or undesirable traits (salt tolerance, disease resistance or susceptibility) make plant breeding a much more effective tool than it was in the past, without any need to insert new genes from unrelated species. Many are now arguing for mechanisms for performing an environmental impact assessment of new technologies, taking into account the risks and benefits of new technologies and the risks of not implementing them — persisting with inefficient, unsustainable agriculture, for example⁽¹⁶¹⁾.

⁽¹⁵⁴⁾ Peter W. B. Phillips (2002), 'Biotechnology in the global agri-food system', *Trends in Biotechnology*, Vol. 20, No 9, September 2002.

⁽¹⁵⁵⁾ Over the 10-year period from 1996 to 2006, agricultural biotech reduced greenhouse gas emissions from agriculture by 14.8 billion kg of CO₂, which is equivalent to taking 6.6 million cars off the roads in one year (= 25 % of the cars registered in the UK), and also reduced crop spraying by 286 million kg.

⁽¹⁵⁶⁾ The global net economic benefits of biotech crop cultivation at farm level totalled EUR 4.5 billion in 2006 and EUR 21.6 billion over the 10-year period.

⁽¹⁵⁷⁾ In 2006, 54 % of farm income gain went to farmers in developing countries. In Europe, as in the rest of the world, two thirds of the benefits of growing biotech crops are shared between European farmers and consumers, while one third goes to the developers and seed suppliers.

⁽¹⁵⁸⁾ Consumers' perception of GMOs is changing, as shown by the latest Eurobarometer survey (2008), where the number of Europeans worried about biotech crops was down to 20 %, from 24 % in 2004.

⁽¹⁵⁹⁾ The UN International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD, 2008) notes that contained use of modern biotechnologies (enzymes, DNA diagnostics, etc.) is widely accepted, whereas uncontained application of modern biotechnology — for instance, GM crops — is contentious. The IAASTD emphasises the need for more and better targeted investment in biotechnology, for example marker-assisted selection (MAS) in plant breeding, and platform technologies (DNA diagnostics or chips for screening planting material, nanotechnology for targeted input delivery or pathogen elimination, etc.) and argues that transgenics do not contribute to addressing the IAASTD goals. See www.agassessment.org

⁽¹⁶⁰⁾ National Academy of Sciences (2008), 'Global challenges and directions for agricultural biotechnology — Workshop report' (<http://www.nap.edu/catalog/12216.html> ISBN 978-0-309012077-7), p. vii.

⁽¹⁶¹⁾ For example, see UK Department for Environment, Food and Rural Affairs (2007), 'Managing the footprint of agriculture: towards a comparative assessment of risks and benefits for novel agricultural systems', report of the ACRE sub-group on wider issues raised by the farm-scale evaluations of herbicide-tolerant GM crops (revised after public consultation), 3 May 2007 (<http://www.defra.gov.uk/environment/acre/pdf/acre-annrpt14.pdf>).

9.8. Biofuels

Some technologies are not directly implicated in food production (and therefore in food security). However, their introduction does have implications for use of the available arable land and then has an impact on the sustainability of natural resources. In particular, one technology which has acquired specific importance and attracted special attention is production of biofuels and its impact on global hunger and agricultural policies at EU and global levels. An international debate is under way on the sustainability of biofuels production from food-related materials, as an increase in biofuels production based on these methods would possibly have a negative impact on food markets and lead to certain food price increases. One solution would be to develop new methods for production of biofuels which would use alternative raw source materials, such as biomass derived from recycling biological waste.

Bioethanol produced in Brazil from sugar cane is one example of effective use of agriculture to produce fuel. The cane grows with little water and no fertilisers and all the residues are used or recycled. This produces 45 % of the fuel used in Brazil on less than 1 % of its arable land. A less favourable example is the biofuel produced in the USA from corn and maize, which requires large quantities of water and fertilisers and is already taking 25 % (140 million tonnes) of the current US maize production, with public support totalling USD 6 billion. In particular, in terms of greenhouse gas savings, this route is estimated to have a negative impact or at best produce a 20 % saving over its complete cycle compared with oil ⁽¹⁶²⁾.

9.9. Food waste

Food waste is a phenomenon which concerns not only mechanisms from food production to distribution and consumption and the legal obligations set out in the EU food law but also, particularly, consumers' attitudes. A general trend, at least in the most developed countries, is to buy too much for a variety of reasons: because of miscalculation of needs (groceries shopping is often reduced to bulk purchases a long time apart from each other, which therefore makes it difficult to estimate exactly how much will be needed), because portions are often bigger than consumers' appetite and because the higher standard of living means that consumers tend to pay less attention to saving. At the same

time, stricter food safety standards lead, for example, to restaurants not being allowed to give away leftovers to charities and having to throw away any excess food prepared. In these ways, a considerable amount of food waste is generated, and only a small proportion of it is recycled appropriately, e.g. via organic waste disposers. A huge amount of food is thrown away every day. As an example, the bread produced during the last hour of business in Vienna's bakeries and then discarded if unsold could feed the entire population of Graz, Austria's second largest city. There are many examples like this and, apart from the underlying ethical questions, the economic side of the story is significant. Better management of food resources and distribution would lead to substantial savings that could be diverted to other purposes. For example, 5 % of the USA's yearly food waste equals one day's food for 4 million people ⁽¹⁶³⁾. The total food surplus of the USA alone could feed Africa's undernourished, France's could feed the Democratic Republic of the Congo's and Italy's could feed Ethiopia's ⁽¹⁶⁴⁾. Other potential uses of food waste concern environmental protection and energy production. The following list gives a few figures.

- A 50 % reduction in food waste could reduce the environmental impact (in the form of greenhouse gas emissions) by 25 % ⁽¹⁶⁵⁾.
- Biogas cars can reduce CO₂ emissions by between 75 % and 200 % compared with fossil fuel cars ⁽¹⁶⁶⁾.
- In Europe, biogas is available as a fuel in Austria, France, Germany, Sweden and Switzerland. Sweden is the leading user in Europe ⁽¹⁶⁷⁾ and already has 7 000 biogas cars and 779 biogas buses.

9.10. Research funding and the brain drain in agro-food sciences

The seventh EU research framework programme (FP7) has a dedicated theme entitled 'Food, agriculture and

⁽¹⁶³⁾ According to the US Department of Agriculture (USDA).

⁽¹⁶⁴⁾ According to the UN World Food Programme.

⁽¹⁶⁵⁾ The UK's waste and resources action programme (WRAP) calculates that the entire food supply chain in the UK contributes 20 % of the UK's greenhouse gas emissions.

⁽¹⁶⁶⁾ According to a study by the National Society for Clean Air (www.nasca.org.uk).

⁽¹⁶⁷⁾ Source: New Energy Finance, London.

⁽¹⁶²⁾ *Time* (14 April 2008), pp. 28 et seq.

fisheries, and biotechnology' covering three major activities:

- (1) sustainable production and management of biological resources from land, forest and aquatic environments;
- (2) 'from farm to fork': food (including seafood), health and well-being; and
- (3) life sciences, biotechnology and biochemistry for sustainable non-food products and processes. It is important that Europe continues to have the highest standards of knowledge in these fields (including food safety and food technology) and, most importantly, that researchers in agro-food sciences are supported and motivated to stay and work in Europe. The brain drain towards non-EU countries seems to be a serious problem, as there is a risk of not fostering the next generation of researchers who will maintain high skills and knowledge in the EU.

9.11. *Dietary habits and lifestyles*

Systems for rapid distribution of speciality foods and efficient distribution of commodities have changed the eating habits of millions in the developed world. The availability of cold storage and effective packaging has accentuated this change. It has become possible to grow food and non-food crops throughout the world and to deliver them to consumers able to pay for them. Low costs in African, Asian and South American countries have made it possible to produce food costing less than home-grown products in many markets in Europe and North America. Even meat products are no longer necessarily produced locally and can be shipped to markets all over the world. The impact on agriculture of being able to grow more food, either for local consumption or for export in return for hard currency, is profound and leads to situations where some countries (including in the EU) are becoming increasingly dependent on massive imports of certain food (or feed), with all the potential risks this entails.

There are many ethical issues related to environmental protection and sustainability that need to be considered, as this change has consequences both for those who gain from greater variety and availability, e.g. farmers and exporters who are able to innovate in new locations throughout the world and to market products new to consumers in other parts of the world, and for those who are made even poorer, as productivity is geared to exports rather than to local markets.

9.12. *Equal opportunities and global trade*

Production efficiency in agriculture must be balanced by distribution efficiency reflecting ethical concerns such as fairness and justice. The most important prerequisite for independent, stable development in the agricultural sector is greater **justice of opportunities** in economic competition at national and international levels and better starting conditions in education, infrastructure or a fair legal framework enabling participation in market activities. Above all, greater justice demands empowerment of groups that were previously excluded, including farmers in many parts of the world. Greater justice of opportunities has both an instrumental value and a high inherent value for those concerned. The principle of justice of opportunities as 'positive discrimination' demands preferential treatment, until at least approximately equal opportunities have been created. Special arrangements are needed to improve the opportunities of poor countries in competition for worldwide agricultural trade.

9.13. *Stakeholder participation and the importance of local culture and knowledge*

It is important to recognise that agriculture is practised at a number of levels. Industrial agriculture, whether practised in developed or developing countries, cannot be confined to the requirements set out in this opinion, but provides currency and security to countries that can be used for the benefit of the people. It might be necessary to ensure that agriculture addresses the needs of local and/or regional markets first. This consideration makes it clear that development of the agricultural sector calls for an integrative action plan that covers, among other things, local and regional transport systems, health and education infrastructure and systems of accountability of political institutions and companies as much as rules for regional, international and global trade. How can a balance be struck to 'ensure food security, decent and dignified employment, health and respect for the environment'? ⁽¹⁶⁸⁾

⁽¹⁶⁸⁾ 'Agriculture is the main source of employment for the majority of the world's people, especially in developing countries. It cannot be held captive to the profitmaking interests of a minority.' Food Sovereignty over Trade (<http://www.peoplesfoodsovereignty.org/statements/new/18-b.htm>). UN Economic and Social Council, Commission on Human Rights, 2004 'Economic, social and cultural rights — The right to food', E/Cn.4/2004/10, paragraph 26.

The ways in which food is prepared, served and consumed differ from one culture to another. Traditional and local knowledge constitutes an extensive realm of accumulated practical knowledge and knowledge-generating capacity that is needed if sustainability and development goals are to be achieved. Many effective innovations are generated locally, based on the knowledge and expertise of indigenous and local communities rather than on formal scientific research. Traditional knowledge of indigenous and local communities is recognised by the UN Convention on Biological Diversity. Traditional farmers embody ways of life beneficial to conservation of biodiversity and to sustainable rural development. Local and traditional knowledge has been successfully built into several areas of agriculture, for example in the domestication of wild trees, in plant breeding and in soil and water management.

9.14. IPR system

The current IPR system (for plant varieties and GM crops) could pave the way for market predominance where a few companies control much of agricultural production, with an impact on innovation and the growth of local economies in developing countries. This raises concerns about how to promote IPR policies that could avoid such risks. In this context, a proper balance between WTO rules and the socioeconomic aspects of different regions of the world calls for consideration guided by concern for fair trade, justice and solidarity in global trade in agricultural products, including seed.

9.15. Fair competition

According to Food and Water Watch ⁽¹⁶⁹⁾, in 2006 just two firms controlled nearly three fifths (58 %) of the corn seed market. For the nearly three quarters (73 %) of corn farmers that plant genetically modified varieties, the concentration is much higher. The agrochemical market is similarly concentrated, with four firms controlling 60 % of global agrochemical sales in 2004. Four wet corn milling firms control more than two thirds (68.7 %) of the market and the top four breakfast cereal companies control more than three quarters (78.4 %) of cereal sales. Today the top 30 supermarket chains now control one third of global sales; the top 10 seed companies

control one third of the global market; and two companies control 75 % of the world cereal market ⁽¹⁷⁰⁾.

The risk of monopolies on the food market is a cause for concern. In the same way, seeds and chemicals used in agriculture are controlled by just a few companies and intellectual property rights, cross-licensing and user licences limit use of seed for cultivation.

The current system, consisting of various state aid schemes and the resultant subsidy competition between industrialised nations, is geared almost exclusively to the fight for global market share, for instance by means of a substantial increase in export promotion. This system affects worldwide agricultural trade in favour of the industrialised nations and in many cases leaves poor countries at the mercy of highly subsidised exports from the north. Complete liberalisation of agriculture can therefore be questionable, because it could increase the concentration into just a few agro-industrial complexes and undermine small-scale farms. Poorer countries need a greater degree of flexibility to protect their still under-developed agriculture against foreign competition, for example by means of one-sided external protection or by providing scope for internal subsidies, such as for small-scale farms.

One kind of impact of globalisation has been that global commodity markets are increasingly dominated by a few companies that can set prices. Even at national level, liberalisation has led to only a small number of private companies — meaning that farmers are forced to accept low prices whilst consumers have often not benefited from the lower prices promised by ‘free trade’ ⁽¹⁷¹⁾. Indeed, it is argued that ‘monopolistic practices by transnational agribusiness corporations increasingly in control of agricultural trade, processing and marketing’ result in consumers failing to benefit from ‘free trade’ ⁽¹⁷²⁾.

⁽¹⁷⁰⁾ Dr Eric Drésin, ‘Strengthening consumer health through sustainability’ in *The ethical aspects of modern developments in agriculture technologies*, Proceedings of the round table debate, Brussels, 18 June 2008. See http://ec.europa.eu/european_group_ethics/publications/docs/agriculture_technologies_ethics.pdf

⁽¹⁷¹⁾ UN Economic and Social Council, Commission on Human Rights, ‘Economic, social and cultural rights — The right to food’, E/Cn.4/2004/10, paragraph 21 (2004).

⁽¹⁷²⁾ Ibid.

⁽¹⁶⁹⁾ <http://www.foodandwaterwatch.org/food/agricultural-policy/us-farmland/retail-realities/winners-and-losers-in-us-farm-policy/?searchterm=seed>. See also data provided in the *Food Policy Report*, ‘The world food situation’, December 2007.

9.16. Food prices

According to recent FAO data, the world food price index rose by nearly 40 % during 2007. Most agricultural commodities have been affected, with the price of wheat tripling since 2000 ⁽¹⁷³⁾. These developments are having an impact on the food and nutrition of poor people ⁽¹⁷⁴⁾. Moreover, the food price shocks are affecting the social stability of several less developed countries across the world. Violent protests and food riots in Latin America, Africa and Asia bear witness to the dramatic impact on the world's poorest, putting years of progress at risk. The heavy burden of food price inflation is borne by the urban poor, but also by the rural poor. According to preliminary estimates from the World Bank, the surge in food prices could push around 100 million people into deeper poverty. Europe is also affected by this phenomenon and the affordability of food is becoming a problem for some European citizens. The social implications of food price rises are therefore significant and action is both needed, to alleviate the negative consequences of food price volatility on a large portion of European society, and justified from an ethical perspective, in the name of social justice and solidarity.

10. Recommendations

10.1. Introduction

Production, processing and distribution of agricultural products and food are generally accepted as routine parts of everyday life. Food and agriculture are means to an end that is not only technical, economic or political in nature but also inherently ethical, namely to feed the world's population while respecting future generations' needs and expectations in terms of food security, safety and sustainability.

The current revision of the EU common agricultural policy, food security and safety, climate change, agricultural sustainability and global trade in agricultural

⁽¹⁷³⁾ Ibid.

⁽¹⁷⁴⁾ Joachim von Braun, 'Rising food prices — What should be done?', *IFPRI Policy Brief* (<http://www.ifpri.org/pubs/bp/bp001.pdf>) (2008).

commodities are all issues that have grabbed the attention of media, policymakers and civil society in the last few years. According to the latest FAO report published in early December 2008, some 963 million people were suffering from hunger in the world in 2008, 40 million more than in 2007, as a consequence of higher food prices. The continuing financial and economic crisis could push even more people into hunger and poverty. There is therefore a passionate debate on how to face these challenges, with high expectations that new technologies in agriculture could contribute to solving this problem. In order to address the new challenges and opportunities which lie ahead for EU agriculture, President Barroso therefore asked the EGE to give its advice on the ethical implications of modern developments in agricultural technologies. The group accepted this difficult task and decided to focus primarily on agricultural technologies and methods for primary production of food of plant origin.

The group is aware of the need to promote innovation in agriculture but it is equally aware that technologies alone cannot provide final solutions to the challenges modern agriculture is facing in the EU and worldwide. However, the group supports all technologies in agriculture, insofar as they are conducive to the goals and priorities indicated in this opinion. The group also emphasises the need for an integrated view and an integrated approach on agricultural technologies, so that the production, storage and distribution processes are considered together when the ethical implications of any new technology are assessed.

10.2. The EGE's ethical approach to agriculture

The group considers the goals of:

- (1) food security,*
- (2) food safety, and*
- (3) sustainability*

as first priorities and guiding principles to which any technology in agriculture must adhere.

Therefore the group recommends an integrated approach to agriculture, based on a system where its constituent units are balanced, not just at technical level (where there is continuous assessment of the balance between the input required, e.g. resources, energy, etc.,

and the outcomes expected to achieve its goals) but also at ethical level (where members of society act and interact on the basis of commonly held values).

The EGE calls for explicit embedding of ethical principles in agricultural policy (whether traditional or innovative) and argues that respect for human dignity and justice, two fundamental ethical principles, have to apply to production and distribution of food products too (see Section 8.1). In addition, the EGE calls for impact assessment of agricultural technologies, as described in Section 10.2.4 of this opinion.

10.2.1. The right to food

The starting point of any ethical agricultural policy must be the obligation of states and of the international community to secure all human beings' right to food. Agricultural policies at national, EU and international levels must therefore aim, first and foremost, to secure access to food at regional, national and international levels, so that everyone has sufficient access to safe and healthy food corresponding to their particular cultural background and available scientific data.

10.2.2. Sustainability of agricultural technologies

The need to maintain productive agriculture worldwide is emphasised by the fact that a large proportion of the world population lacks proper access to food and by the recurrent food crisis in 2007 and early 2008. However, the strong ecological impact of agriculture highlights the need to implement a different model of agriculture in the future: a sustainable and multi-functional agriculture where, apart from securing safe food for everybody, stewardship of the land, preservation of the resource base, the health of farm workers, preservation of the small biota that are rich in biodiversity, the value of rural communities and the value of the agricultural landscape acquire important status.

From an ethical perspective, sustainable agricultural technologies should help to maximise use of natural resources while protecting them from exhaustion and thereby allowing natural regeneration. In order to achieve this, the group advocates that:

- (1) there is a need to optimise processes involved in primary production, distribution and storage of food;
- (2) use of arable land needs to be optimised and methods are needed to turn areas not accessible at present, due to adverse environmental conditions, into arable land;
- (3) all other processes involved, 'from farm to fork', need to be optimised and simplified (to reduce harvest losses and waste and, where possible, to implement waste recycling systems).

10.2.3. Food safety

The group considers food safety a prerequisite for production and marketing of food products from arable agriculture, including imports of agricultural commodities and products from third countries, and calls on the competent authorities to monitor enforcement of food safety provisions.

The group supports the work done by the EU, Member States and relevant bodies (EFSA in particular) on enforcement of food safety standards and considers it necessary that:

- *EU food safety standards have to be based on scientific data only;*
- *if EU food safety standards for food products from arable agriculture differ from international standards, they must be scientifically justified.*

In addition, the group urges the EU to enforce current legislation and traceability provisions in order to avoid fraud, and calls for further research on new technologies for food safety.

10.2.4. Technology impact assessment

In the field of new agricultural technologies, in addition to risk assessment, there is a need for impact assessment at national and European levels⁽¹⁷⁵⁾. Impact assessments examine the risks and benefits to human health and the

⁽¹⁷⁵⁾ Details on the prospective technology assessment proposed here can be found in EGE Opinion No 22.

environment of using a new technology and those of not using it, including the risks and benefits of retaining current technologies. They take account of the need to ensure sustainability, food and feed security and safety.

The group proposes that such impact assessments should consider safety (agro-food and environmental) issues and also address the social implications, e.g. how agricultural technologies will affect social, economic and institutional structures, with particular concern for justice (equal access and participation in decision-making) and fair distribution of goods. Furthermore, the group suggests that the Commission should, inter alia, continue to fund studies on the social effects of agricultural technologies. Such research should also focus on macroeconomic trends, trade implications and possible international problems and, in particular, examine the risk of creating a technological divide which could widen the gap between the developed and developing countries.

10.3. Recommendations on introduction and promotion of agricultural technologies

The EGE is aware of the great variety in primary production methods for agricultural products of plant origin and of the fact that several regions in the EU still use traditional methods of agricultural production. The group recognises the need to respect the diversity of EU primary production, but is equally aware of the need to make EU primary production of food, feed and fibre of plant origin competitive on the global market and, therefore, of the need for innovation in this sector.

The group supports the current efforts by the EU to promote innovation in agriculture but calls for specific efforts to support mainly technologies that are conducive to food security, safety and sustainability in order to ensure ecologically and socially sound agricultural production (techniques and methods), based on fair treatment both of the environment and of farmers.

The EGE also recognises that agriculture brings both benefits and harm, particularly to the environment, and that all technologies could involve risks with irreversible effects. The group therefore believes that, before a technology is considered for use in agriculture, its effects should be carefully studied and evaluated by means of an impact assessment that takes account of a comparative assessment of the current and new technologies. This assessment should be guided by an integrated approach to agriculture where both environmental and social implications are taken into ac-

count. The group urges the EU to promote food safety, health and quality as a prerequisite for (1) production and marketing of EU food products from arable agriculture and (2) imports of such products from non-EU countries and asks the EC to focus efforts on research in the sectors indicated above.

10.3.1. Agricultural biodiversity

The group is aware that any decrease in genetic diversity means fewer opportunities for the growth and innovation needed to boost agriculture at a time of soaring food prices and possible future food shortages. The group is equally aware that any decline of the agricultural biodiversity used in food and agriculture has an impact on the sustainability of agriculture (including its capacity to adapt to climate change or water shortages). The group therefore supports action to protect this biodiversity, such as the International Treaty for Plant Genetics and Resources and the global plan of action for the conservation and sustainable use of plant genetic resources for food and agriculture. This involves setting up systems to store genetic information and seed in order to maintain crop diversity.

10.3.2. Soil and water protection

The group is aware that a number of products currently used in agriculture could pose a risk to human or animal health and to the environment, especially when used in high concentrations. Technologies that reduce the need for dangerous chemicals whilst maintaining yield and quality should be promoted. In particular, protection of human ⁽¹⁷⁶⁾ and animal health by lower exposure to chemicals should be encouraged. As mentioned previously, the group urges that an impact assessment should be conducted for all new technologies used in agriculture in the light of the goals of this opinion, giving priority to food security, safety and sustainability.

The group is aware that soil erosion and water pollution are consequences of agriculture and therefore stresses the importance of the non-tillage techniques and improved water management plans developed over the last few decades in order to implement better preservation practices, in keeping with its recommendation on an integrated approach to agriculture. The group encourages use of all technologies and methods to in-

⁽¹⁷⁶⁾ Including especially farm workers, who may be vulnerable to adverse working conditions.

crease soil productivity, prevent soil erosion (deterioration of soil quality) and water pollution and promote recycling of waste material (e.g. cellulosic biomass for production of ethanol). In this context, the group supports the use of:

- (1) *proven techniques (such as contour farming and non-tillage techniques), where appropriate for sustainable use of soil;*
- (2) *bioengineering for the sustainability purposes indicated above (e.g. reduction of spray pollution, active ingredients in herbicides and CO₂ emissions);*
- (3) *modern genetics, where appropriate and safe in order to improve and select crop varieties appropriate to specific environmental conditions (e.g. in the case of MAS (see Section 3.2.2) for plant tolerance to high salinity);*
- (4) *ICT tools for optimisation of agricultural plant products (global positioning system and geographical information system or ICT tools to optimise irrigation and monitor physical characteristics of soil, such as topography, salinity, etc.);*
- (5) *all technologies and methods that could be beneficial to better water management and prevention of water pollution. The EU should allocate funding for the implementation of optimal use of water resources.*

The group encourages and calls for development and promotion of the abovementioned technologies in the EU and worldwide. In order to narrow the technological divide, the group encourages development of specific measures, both within Europe and on a wider global scale. Development and technology plans should, however, guarantee farmers' and producers' free choice of methods of production⁽¹⁷⁷⁾ and promotion of new technologies for competitive local production. The group also supports precision farming in the EU and

⁽¹⁷⁷⁾ One valuable regulatory tool to protect local production and safeguard local methods of production is the 'protected designation of origin' (PDO, *appellation d'origine contrôlée*) and 'protected geographical indication' (PGI), which protects a specific name and limits use thereof to certain products produced in a restricted area and by a specific method.

in developing countries, where its advantages over conventional farming could be greatest.

The group stresses the importance of the UN Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention), intended to strengthen national measures for protection and ecologically sound management of transboundary surface waters and groundwaters⁽¹⁷⁸⁾. The group also supports international initiatives such as Unesco's International Hydrological Programme (IHP) for water research, water resources management, education and capacity-building, which aim, *inter alia*, to assess the sustainable development of vulnerable water resources and to serve as a platform for increasing awareness of global water issues.

10.3.3. Biofuels and agriculture

The group is aware that positions on the impact of biofuels on use of arable land are sharply divided. The group recognises that introduction of biofuels in Europe could reduce Europe's dependence on fuel imports and could be of interest to some farmers. The group therefore considers that production of biofuels in Europe could be promoted, provided it does not interfere with food production, use of the fuels does not lead to any increase in greenhouse gas emissions and, worldwide, no new land is cleared for biofuel production (e.g. in the form of deforestation). The development of second-generation biofuels is important. Accordingly, the group recommends that the infrastructure necessary for these to be produced sustainably should be set up within the European Union. The group therefore recommends that:

- (1) *planting of crops for biofuel production should not interfere with food production, such as in the case of set-aside or marginal land;*
- (2) *steps should be taken to recycle both crops and food waste in the production chain, using the biofuel derived from crop production in order significantly to improve the energy balance of biofuel production;*⁽¹⁷⁹⁾

⁽¹⁷⁸⁾ See <http://www.unece.org/env/water/>

⁽¹⁷⁹⁾ Adapted from Turley *et al.* (2008) 'Liquid biofuels — Prospects and potential impacts on UK agriculture, the farmed environment, landscape and rural economy', Report prepared for DEFRA, Organics Forestry and Industrial Crops Division.

- (3) *research should be funded, at EU and Member State levels, in order to obtain biofuel from waste materials, from non-edible parts of plants or from plant species that do not compete with food production or for resources such as water and land used for growing food;*
- (4) *reduction of use of fossil fuels, especially in transport, should be promoted;*
- (5) *infrastructure for second-generation biofuels should be promoted, financed and advanced in the European Union.*

10.3.4. GM crops

While agricultural scientists are debating the role of GM crops for food security (to increase production yields and the nutritional capacity of food products), the group acknowledges that use of GM crops is controversial in the EU. In this debate, concerns have been expressed about possible risks of economic monopoly and to biosafety. The group recognises that EU legislation and international treaties place an obligation on the EU to undertake a scientific risk assessment. The group urges that the precautionary principle should be taken into account to make sure that all technologies avoid the risk of ‘serious or irreversible damage’, as provided for in Principle 15 of the Rio Declaration on Environment and Development ⁽¹⁸⁰⁾, and also of unwanted pleiotropic effects. The group recommends that risk management procedures should be revised to take full account of the need for an impact assessment of all new technologies (see Section 10.2.4). Food safety and environmental assessment should therefore be prerequisites for approval. In general, the group takes the view that all agricultural technologies ⁽¹⁸¹⁾ should be sustained in the EU only if they are conducive to the goals of this opinion and if they meet the ethical criteria indicated in it.

⁽¹⁸⁰⁾ ‘In order to protect the environment, the precautionary approach shall be widely applied by states according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.’

⁽¹⁸¹⁾ Other technologies which can improve food security include, for example, technologies aimed at improving harvest yields, such as double-crop systems, etc.

10.3.5. Research in agricultural sciences

The group encourages the EU to increase the budget for research in agricultural sciences, green biotechnologies and all other sustainability-oriented agriculture research sectors within the seventh EU framework programme for research activities (FP7) in order to achieve the goals supported by the group in this opinion. At the same time, the group believes that Europe should ensure the highest standards of knowledge in these fields (including food safety, food technology, nutrition science, etc.), so that it can monitor introduction of these new products for public consumption. Research in these areas should be encouraged both at European and Member State levels for the benefit of European consumers and farmers.

Modern agricultural research should choose an integrated approach; accordingly, the overall aim of agro-system research, including the interaction between different crops and the environment (plant sociology), landscape ecology, etc., should be to achieve an optimum net harvest of solar energy in forms beneficial to mankind and the environment. Specific measures should also be implemented to counter the brain drain of European researchers in this field. The group specifically recommends that research should be funded:

- *on crops that are important for food security and for European farmers in need of public funding, such as for example wheat or Mediterranean horticultural species; the possible impact of climate change should be evaluated and priority should be given to approaches to counteract it;*
- *on crops that are important in parts of the world where food security has not yet been achieved and on characteristics of interest for increasing the yield of these crops in these areas; the role of local knowledge in these cases should be recognised;*
- *to preserve the biodiversity of plant species that are important in agriculture and to preserve the environmental equilibrium disturbed by agriculture; in particular, the European Union should support seed banks existing worldwide and in Europe to preserve existing biodiversity;*

- *to study new energy sources (e.g. biogas and other renewable energy sources) for machinery presently used in agriculture that depends heavily on fossil fuels, which would be more appropriate to the foreseeable scenarios of lower availability of oil.*

10.4. Responsible policymaking in arable agriculture

The group is aware that food security and sustainability are heterogeneous issues which require multiple factors to interact to promote efficient solutions. Unequivocal solutions, including technological ones, are hard to find and need to be scientifically tested, but technological methods could be conducive to sustainable improvements in food security when combined with responsible policymaking and policy implementation. The current food crisis and the delay in progress towards the UN millennium development goals on global hunger highlight the need to promote different agricultural methods more efficiently for food security in the EU and beyond.

The group recommends that the EU promotes access to appropriate infrastructure and technologies in regions where an increase in food production would contribute to solving the problems of hunger and malnutrition. This has to be done respecting local culture and knowledge. Design, implementation and promotion of an ethically sound policy on primary production of agricultural plant products is a complex process which involves many different players (from policymakers to consumers and from international bodies to Member States), each sharing rights and responsibilities.

10.4.1. Global trade in agricultural products: fair and free trade and aid for trade

In agriculture, not only technologies have strong ethical implications but also trade and the framework for trade. The European Union accounts for 60 % of official development assistance worldwide⁽¹⁸²⁾ and yet food security cannot be guaranteed for about 1 billion people. The group supports the key role which the EU is playing in promoting global aid for food security across the EU and worldwide. The group supports the

G20 decision to find a constructive agreement to bring the WTO Doha Round to a successful, rapid and pro-development conclusion. The group is also aware that, to date, the EU has been a world player in agricultural trade, both as an importer and exporter of agricultural products, and urges the EU to take the identified priorities of food security, safety and sustainability as ethical principles in its role in the global economy.

To achieve the goals identified, global agricultural trade needs an ethical framework. Solidarity, justice and free and fair trade in agricultural products and technologies are priorities. The group therefore advocates that the EU promotes a market system that includes aid for trade, fair (protected) trade and free trade⁽¹⁸³⁾ and emphasises the importance of aid for technological development as laid down in the UN millennium development goals. To try to achieve these goals, the group advocates consideration of a new framework for trade in agricultural products and urges policymakers, relevant stakeholders and the international community to take into account the ethical principles and human rights laid down in the EU and UN declarations, and to follow the EGE in setting the priorities of food security, safety and sustainability as ethical goals for the global agricultural market.

In accordance with the principle of justice, as indicated in Section 9.12, the group recommends that the revision of the common agricultural policy, including subsidies, should take into account the effects of European policies on (a) trade with Europe and (b) local agricultural production in countries lacking sufficient production and access to food. In this way the EU could play an important role in promoting fair trade.

The group not only considers that sanitary and phytosanitary standards for imported agricultural products should match those required by the EU regulatory framework but also proposes that the measures provided for in the CAP, such as respect for consumers' choices, animal welfare, biodiversity and socio-environmental protection, should also be taken as the basis for imports of agricultural goods into the EU. This should be progressively implemented at multilateral or bilateral level.

⁽¹⁸²⁾ In June 2008 the European Council reaffirmed that the EU will deliver on the collective target of 0.56 % of gross national income by 2010 and of 0.7 % in 2015.

⁽¹⁸³⁾ Fair and free trade is a market-based approach in which producers from developing countries are empowered and sustainability is promoted, while movement of goods and provision of services are unhindered by government-imposed restrictions.

10.4.2. Intellectual property rights system

The group supports promotion of innovation in agriculture but is concerned about the impact of patents on agricultural crops. The move to control use of seed by means of licence agreements is also troubling. The EGE recommends that the EU carries out an analysis of the shifting of plant variety protection from the UPOV scheme to a patent system and whether it produces a system that effectively stifles innovation.

The group is also aware that patents are associated (primarily) with new technologies and that their take-up may therefore be hindered by the high cost, particularly in developing countries. In accordance with Article 16 of Directive 98/44/EC of the European Parliament and of the Council, the consequences of patents in agriculture (products and technologies) for the developing countries should be taken into account. In order to disseminate useful new developments in this field, patent pools should be considered to ensure availability to farmers in developing countries.

In the short term the group recommends that farmers' rights to keep seeds and use them in following seasons, when this is possible, should be maintained taking into account Article 9 of the International Treaty on Plant Genetics Resources ⁽¹⁸⁴⁾.

10.4.3. Fair competition and 'vertical monopolies'

The group calls for examination of the European and international mechanisms on fair competition by private companies in the agricultural products sector to ensure that the impact of agreements on the sharing of patents and vertical control is properly addressed.

In particular, the group calls for examination of the concentration of industries in the seed, grain transport and food distribution businesses on specific food products and of their prices that reach consumers. Action should be taken against *de facto* 'vertical monopolies' in which a company has control over production, processing and distribution of certain products.

Furthermore, it is not clear whether free and fair competition within Europe or internationally is still guaranteed, as indicated in Section 9.15. The EGE therefore calls for monitoring of the agricultural segment and encourages

⁽¹⁸⁴⁾ <http://www.planttreaty.org/>

evaluation of the effectiveness of the current regulations with respect to the abovementioned monopolies.

10.4.4. Food prices

As a result of the volatility of food prices, access to basic food products has become difficult for millions of citizens in the EU and worldwide. In fact, the volatility and the imbalance of food prices have resulted in social and political instability across the world. The group therefore asks the Commission:

- (1) *to collect data on determinants affecting food price fluctuations (from production to marketing and on the impact of transport and distribution costs);*
- (2) *to use transparent financial mechanisms to stabilise food prices (both increases and decreases) and conceive measures to reduce prices whenever a radical increase occurs;*
- (3) *to study the interrelation between food security and sustainability in financial market governance, particularly whether financial speculation has affected the current food price fluctuations. If so, the Commission should consider what action needs to be taken to promote transparency and the stability and sustainability of the market and currencies in order to achieve the millennium development goals better (e.g. a financial transaction tax).*

10.5. Societal aspects

Agriculture is one of the main policy sectors in the EU and plays a strong role in terms of economics, labour and social goods ⁽¹⁸⁵⁾. The policy design for this sector needs to be consistent with societal needs, goods and expectations. Differences in food products and dietary habits typify European (and global) diversity and reflect consumer demand and different methods of production. Consumers' needs and choice are therefore of central relevance to promoting and designing agricultural

⁽¹⁸⁵⁾ The agro-food sector accounts for around 7 % of the total EU economy, involves around 5 % of the EU population and generates 20 % of average EU household consumer expenditure and a large proportion of the EU's internal trade and exports.

technologies. Since the EU common agricultural policy (CAP) strengthened the consumer-oriented approach, the group calls for active participation by civil society, farmers and other stakeholders in designing EU policy and decisions on trade in agricultural commodities at European and international levels. The group also urges that public health and safety considerations (both for EU citizens, farmers and workers involved in the food production and distribution system) should be duly monitored and assessed by the relevant EU bodies, as stated in Article 152 of the Amsterdam Treaty.

The group also considers that trade in agricultural commodities should be inclusive and transparent (active involvement of consumers), be fair (respect workers' rights and be based on the principle of justice) and respect cultural diversity. Special attention should also be paid to migrant workers' rights, child work (see the International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families ⁽¹⁸⁶⁾ and the UN Convention on the Rights of the Child ⁽¹⁸⁷⁾) and other relevant documents protecting human rights.

10.5.1. Public participation

Given the seriousness of the problems of food security and scarcity of resources, the group argues that it is ethically important that all stakeholders work together. Broad participation in policies and programmes, including promotion of democratic participation by representatives of civil society in negotiations on global trade in agricultural products (WTO) is required.

The group calls on Member States to take specific action to increase public participation in policy design for primary production of food of plant origin. This debate should be linked to information campaigns on the consequences of dietary habits for food sustainability (consumption of meat in particular), including:

- (1) *preventing waste of food products,*
- (2) *promoting healthy lifestyle, and*
- (3) *raising public awareness of agricultural methods and technologies.*

⁽¹⁸⁶⁾ International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families (1990) (<http://www.un.org/documents/ga/res/45/a45r158.htm>).

⁽¹⁸⁷⁾ See the UN Convention on the Rights of the Child (1989) (<http://www2.ohchr.org/english/law/crc.htm>).

The group calls for companies involved in production, transport and distribution of food products to strengthen the values highlighted in this opinion in corporate social responsibility (CSR) policies.

The group sees the involvement of civil society as offering the possibility to increase consumers' sense of responsibility and, therefore, the chance of influencing the food market in the EU towards a more sustainable system. This effort could involve, for example, ethical education concerning agricultural questions, gardening and cooking in schools, internships and trips to farms along with prevention and recycling of waste.

The group suggests that solidarity with respect to the lack of basic goods for the 'bottom billion' should further guide and play an important role in policies and action. This should be promoted and honoured in public and spotlighted by the media in order to achieve the aim of a global society (see also Section 9.1).

10.5.2. Responsibility of EU citizens

Dietary habits affect the sustainability of agriculture. For instance, according to a recent FAO study ⁽¹⁸⁸⁾, the high consumption of meat products affects primary agricultural production, use of land, water and environmental pollution. In this context, education of consumers on public health (healthy dietary habits), food quality, agricultural sustainability (e.g. imports of non-seasonal food, food waste, etc., as described in Section 4.7) would be beneficial and make a major contribution to food security and sustainability. The group therefore underlines the specific responsibilities consumers have for orienting the market.

10.5.3. Food waste

The concept of food waste concerns different levels (production, storage, transport, distribution and consumption) and has strong ethical implications for social and distributive justice. As indicated in Section 4.8 of this opinion, it seems probable that the phenomenon of food waste has taken on very high proportions. The group is aware that waste is a key issue in the context of food security, safety and sustainability. Appropriate technologies should be developed and applied in modern agriculture to reduce and/or recycle food waste.

⁽¹⁸⁸⁾ <http://www.fao.org/newsroom/en/news/2006/1000448/index.html> and <ftp://ftp.fao.org/docrep/fao/010/A0701E/A0701E00.pdf>.

The EGE also proposes quantitative and qualitative analysis of waste dynamics at national and supranational levels, along with research into optimisation of waste recycling.

11. Concluding remarks

In this opinion the EGE has addressed key ethical issues regarding modern developments in agricultural technologies that are evident at present or can be foreseen at this moment in time.

In order to answer the request by President Barroso, the EGE has developed an ethical framework. The group is aware that there are specific issues in this field that could need further and more detailed discussion.

The EGE fully supports the 2008 FAO World Food Security Summit Declaration ⁽¹⁸⁹⁾ and calls on the EU and citizens to ensure a sound design for sustainable and responsible agricultural policies.

⁽¹⁸⁹⁾ See Annex I to this opinion.

17th December 2008

The European Group on Ethics in Science and New Technologies



The Chairperson: Göran Hermerén

The Members:



Emmanuel Agius

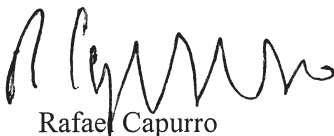


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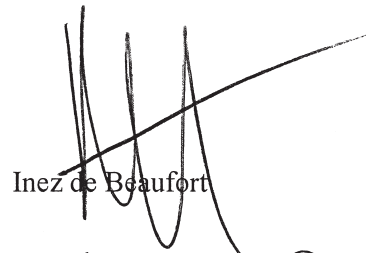
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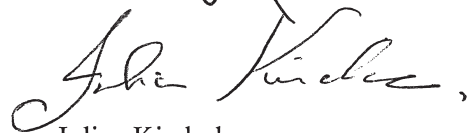
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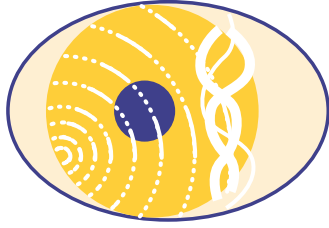
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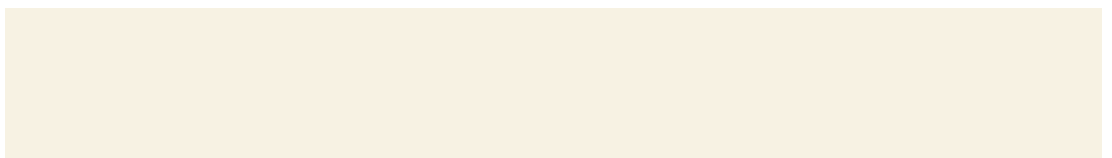
AVIS DU GROUPE EUROPÉEN
D'ÉTHIQUE DES SCIENCES
ET DES NOUVELLES TECHNOLOGIES
AUPRÈS DE LA COMMISSION EUROPÉENNE

Éthique des développements modernes en technologies agricoles

Référence: avis requis par le **président Barroso**

Rapporteurs: **E. Agius, D. Banati et J. Kinderlerer**

Seul le texte original en anglais est authentique.



10. Recommandations

10.1. Introduction

La production, la transformation et la distribution de produits agricoles et de denrées alimentaires sont généralement considérées comme faisant partie intégrante de la vie quotidienne. L'alimentation et l'agriculture sont des moyens d'atteindre une fin qui est non seulement technique, économique ou politique par nature, mais aussi intrinsèquement éthique, en l'occurrence nourrir la population mondiale tout en respectant les besoins et les attentes des générations futures sur le plan de la sécurité alimentaire, de la sûreté alimentaire et de la durabilité.

La révision en cours de la politique agricole commune (PAC) de l'Union européenne (UE), la sécurité et la sûreté alimentaires, le changement climatique, la durabilité agricole et le commerce mondial des denrées agricoles sont des questions qui ont toutes attiré l'attention des médias, des décideurs politiques et de la société civile ces dernières années. Selon le dernier rapport de l'Organisation des Nations unies pour l'alimentation et l'agriculture (FAO), paru au début de décembre 2008, 963 millions de victimes de la faim ont été dénombrées dans le monde en 2008, soit 40 millions de plus qu'en 2007, en raison de la hausse des prix des denrées alimentaires. La crise financière et économique actuelle pourrait plonger un nombre plus important encore de personnes dans la faim et la pauvreté. La manière de résoudre ces difficultés soulève, par conséquent, un débat passionné, et l'espérance est grande que les nouvelles technologies agricoles puissent contribuer à résoudre ces problèmes. Afin de relever les nouveaux défis et de profiter des nouvelles possibilités qui se présentent pour l'agriculture de l'UE, le président Barroso a demandé au groupe européen d'éthique des sciences et des nouvelles technologies (GEE) de rendre un avis sur les implications éthiques des développements modernes en technologies agricoles. Le groupe a accepté cette tâche difficile et a décidé de se concentrer essentiellement sur les technologies et méthodes agricoles destinées à la production primaire d'aliments d'origine végétale.

Le groupe est conscient de la nécessité de promouvoir l'innovation dans l'agriculture, tout en reconnaissant que les technologies seules ne peuvent fournir de

solutions définitives aux difficultés rencontrées par l'agriculture moderne tant au sein de l'UE que dans le monde. Le groupe soutient cependant toutes les technologies agricoles dans la mesure où elles permettent d'atteindre les objectifs et de respecter les priorités qui figurent dans cet avis. Il souligne également la nécessité d'adopter une opinion et une approche intégrées au sujet des technologies agricoles, de manière que les procédés de production, de stockage et de distribution soient examinés ensemble lors de l'évaluation, sur le plan éthique, des implications d'une nouvelle technologie.

10.2. L'approche éthique de l'agriculture du GEE

Pour le groupe, les objectifs:

- 1) *de la sécurité alimentaire,*
- 2) *de la sûreté alimentaire et*
- 3) *de la durabilité*

constituent la première priorité et forment les principes directeurs que toute technologie agricole doit respecter. Le groupe recommande, dès lors, une approche intégrée dans le domaine de l'agriculture, basée sur un système dont les composantes sont équilibrées, sur le plan technique (l'équilibre entre les moyens à mettre en œuvre, comme les ressources, l'énergie, etc., et les résultats escomptés faisant l'objet d'une évaluation constante afin de garantir la réalisation des objectifs), mais aussi sur le plan éthique (les membres de la société interagissant et agissant sur la base de valeurs partagées).

Le GEE recommande que les principes éthiques figurent explicitement dans la politique agricole (que ces principes soient traditionnels ou innovateurs) et fait valoir que le respect de la dignité humaine et de la justice, deux principes éthiques fondamentaux, doivent aussi s'appliquer à la production et à la distribution de produits alimentaires (voir le point 8.1). Le GEE demande en outre que l'impact des technologies agricoles soit évalué, comme indiqué au point 10.2.4 du présent avis.

10.2.1. Le droit à l'alimentation

Toute politique agricole éthique doit avoir pour point de départ l'obligation imposée aux États et à la communauté internationale de garantir le droit à l'alimentation de toute personne. Les politiques agricoles nationales, européennes et internationales doivent dès lors viser avant tout à garantir l'accès à l'alimentation aux niveaux régional, national et international de manière à permettre à toute personne de disposer d'un accès suffisant à une alimentation sûre et saine correspondant à son contexte culturel particulier et aux connaissances scientifiques disponibles.

10.2.2. Durabilité des technologies agricoles

L'absence d'accès correct à l'alimentation pour une grande partie de la population mondiale et la crise alimentaire récurrente qui a sévi en 2007 et au début de 2008 soulignent la nécessité de maintenir une agriculture productive dans le monde. Toutefois, l'impact écologique important de l'agriculture met en lumière la nécessité d'appliquer à l'avenir un modèle d'agriculture différent: une agriculture durable et multifonctionnelle dans laquelle, outre la sécurisation d'une alimentation saine pour tous, la gestion du sol, la préservation des ressources naturelles, la santé des travailleurs agricoles, la conservation des petits biotopes riches en biodiversité ainsi que l'utilité des communautés rurales et du paysage agricole occupent une place importante.

D'un point de vue éthique, les technologies agricoles durables devraient contribuer à maximiser l'utilisation des ressources naturelles, tout en les préservant de l'épuisement et en permettant ainsi une régénération naturelle. À cet effet, le groupe soutient:

- 1) qu'il est nécessaire d'optimiser les processus intervenant dans la production primaire, la distribution et le stockage des aliments;
- 2) qu'il convient d'optimiser l'utilisation des terres arables et de développer des méthodes permettant de transformer en terres arables des zones actuellement non accessibles compte tenu de conditions environnementales défavorables;
- 3) qu'il faut optimiser et simplifier tous les autres processus intervenant «de la fourche à la fourchette» (afin de réduire les pertes et les déchets liés à la récolte et,

dans la mesure du possible, de mettre en œuvre des systèmes de recyclage des déchets).

10.2.3. Sécurité alimentaire

Le groupe considère la sécurité alimentaire comme une condition préalable à la production et la commercialisation de produits alimentaires issus de cultures arables, notamment les importations de produits de base et de produits agricoles en provenance de pays tiers, et invite les autorités compétentes à surveiller la mise en œuvre des dispositions en matière de sécurité alimentaire.

Le groupe soutient les travaux réalisés par l'UE, les États membres et les organismes compétents — l'Autorité européenne de sécurité des aliments (EFSA), en particulier — concernant l'application des normes de sécurité alimentaire et estime qu'il est nécessaire que:

- *les normes de sécurité alimentaire de l'UE reposent uniquement sur des données scientifiques;*
- *les normes de sécurité alimentaire de l'UE pour les produits alimentaires issus de cultures arables, si elles diffèrent des normes internationales, soient étayées par des preuves scientifiques.*

Le groupe demande en outre instamment à l'UE de mettre en œuvre la législation actuelle et les dispositions en matière de traçabilité, afin d'éviter la fraude, et appelle à une intensification des efforts de recherche consacrés au développement de nouvelles technologies visant à garantir la sécurité alimentaire.

10.2.4. Évaluation de l'impact technologique

Dans le domaine des nouvelles technologies agricoles, il est nécessaire de procéder non seulement à une évaluation du risque, mais aussi à une évaluation de l'impact aux niveaux national et européen ⁽¹⁾. Les évaluations d'impact analysent les risques et les avantages pour la santé humaine et pour l'environnement de l'utilisation et de la non-utilisation d'une nouvelle technologie, et notamment les risques et les avantages liés au maintien des technologies actuelles. Elles tiennent compte de la nécessité de garantir la durabilité ainsi que la sécurité et la sûreté de l'alimentation humaine et animale.

(1) Des informations détaillées sur l'évaluation prospective de la technologie proposée ici figurent dans l'avis n° 22 du GEE.

Le groupe propose que ces évaluations d'impact tiennent compte des questions de sécurité (agroalimentaire et environnementale) et traitent également des implications sociales telles que la manière dont les technologies agricoles affecteront les structures sociales, économiques et institutionnelles, en accordant une attention particulière à la justice (accès égal et participation à la prise de décision) et à la distribution équitable des produits. Le groupe suggère, par ailleurs, que la Commission continue, entre autres, à financer des études sur les conséquences sociales des technologies agricoles. Ces travaux de recherche devraient également porter sur les tendances macroéconomiques, les implications commerciales et les éventuels problèmes internationaux et examiner, en particulier, le risque de fracture technologique qui pourrait creuser l'écart existant entre les pays développés et les pays en développement.

10.3. Recommandations concernant l'introduction et la promotion de technologies agricoles

Le GEE est conscient de la grande diversité des méthodes de production primaire des produits agricoles d'origine végétale et du fait que plusieurs régions de l'UE ont toujours recours à des méthodes traditionnelles de production agricole. Le groupe reconnaît la nécessité de respecter la diversité de la production primaire de l'UE, mais sait également qu'il est indispensable d'assurer la compétitivité de la production primaire européenne de denrées alimentaires, d'aliments pour animaux et de fibres d'origine végétale sur le marché mondial et donc d'innover dans ce secteur.

Le groupe soutient les efforts actuels de l'UE en vue de promouvoir l'innovation dans l'agriculture, mais demande que des efforts spécifiques soient accomplis pour soutenir principalement les technologies propices à la sécurité alimentaire, la sûreté alimentaire et la durabilité, afin de garantir une production agricole (techniques et méthodes) écologiquement et socialement saine, basée sur un traitement équitable tant de l'environnement que des agriculteurs.

Le GEE reconnaît également que l'agriculture présente à la fois des avantages et des inconvénients, en particulier pour l'environnement, et que toutes les technologies pourraient comporter des risques aux effets irréversibles. Le groupe estime, dès lors, qu'il est indispensable, avant d'envisager l'utilisation d'une technologie dans l'agriculture, d'en étudier soigneusement les effets et de les mesurer en se basant sur une évaluation d'impact qui procède d'une évaluation comparative des technologies

actuelles et nouvelles. Cette évaluation devrait être guidée par une approche intégrée de l'agriculture qui tient compte des implications tant environnementales que sociales. Le groupe invite instamment l'UE à encourager la sécurité alimentaire, la santé et la qualité en tant que conditions préalables essentielles: 1) à la production et la commercialisation des produits alimentaires de l'UE issus de cultures arables et 2) aux importations de ces produits en provenance de pays hors UE; il invite également la Communauté européenne à axer ses efforts sur la recherche dans les secteurs susmentionnés.

10.3.1. Biodiversité agricole

Le groupe est conscient que toute diminution de la diversité génétique limite les possibilités de croissance et d'innovation nécessaires au renforcement de l'agriculture à une époque marquée par l'envolée des prix agricoles et l'éventualité de futures pénuries alimentaires. Il est également conscient que tout déclin de la biodiversité agricole utilisée dans l'alimentation et l'agriculture a un impact sur la durabilité de l'agriculture (notamment sa capacité de s'adapter au changement climatique ou aux pénuries d'eau). Il soutient par conséquent toute action visant à protéger cette biodiversité, tels le traité international sur les ressources phylogénétiques et le plan d'action mondial pour la conservation et l'utilisation durable des ressources phylogénétiques pour l'alimentation et l'agriculture. Cela implique la mise sur pied de systèmes permettant de stocker des informations génétiques et des semences, afin de maintenir la diversité des cultures.

10.3.2. Protection du sol et de l'eau

Le groupe n'ignore pas que plusieurs produits actuellement utilisés dans l'agriculture pourraient présenter un risque pour la santé humaine ou animale et pour l'environnement, en particulier à des concentrations élevées. Il conviendrait de favoriser les technologies qui réduisent la nécessité de recourir à des produits chimiques dangereux tout en préservant le rendement et la qualité. La protection de la santé humaine ⁽²⁾ et animale par une réduction de l'exposition aux produits chimiques devrait en particulier être encouragée. Comme mentionné précédemment, le groupe insiste pour qu'une évaluation d'impact soit effectuée à la lumière des objectifs du présent avis pour toutes les nouvelles technologies utilisées dans l'agriculture, en accordant la priorité à la sécurité alimentaire, à la sûreté alimentaire et à la durabilité.

⁽²⁾ En particulier celle des travailleurs agricoles qui peuvent être victimes de mauvaises conditions de travail.

Le groupe a conscience que l'érosion des sols et la pollution de l'eau sont des conséquences de l'agriculture et il souligne dès lors l'importance des techniques de culture sans labour et des plans améliorés de gestion des eaux qui ont été élaborés au cours des dernières décennies afin de mettre en œuvre de meilleures pratiques de préservation, conformément à sa recommandation sur une approche intégrée de l'agriculture. Il encourage le recours à toutes les technologies et méthodes visant à accroître la productivité des sols, à prévenir leur érosion (détérioration de la qualité des sols) et la pollution de l'eau et à promouvoir le recyclage des déchets (par exemple, biomasse cellulosique pour la production d'éthanol). Dans ce contexte, le groupe soutient l'utilisation:

- 1) *de techniques avérées (telles que la culture suivant les courbes de niveau et la culture sans labour), là où elles conviennent pour l'utilisation durable du sol;*
- 2) *de l'ingénierie biologique pour les besoins de durabilité susmentionnés (par exemple, réduction de la pollution par la pulvérisation, des substances actives des herbicides et des émissions de CO₂);*
- 3) *de la génétique moderne, lorsque celle-ci apparaît appropriée et sûre, en vue d'améliorer et de sélectionner des variétés de cultures adaptées à des conditions environnementales spécifiques — par exemple, dans le cas de la sélection assistée par marqueurs (SAM) (voir le point 3.2.2) en ce qui concerne la tolérance des végétaux à une forte salinité;*
- 4) *d'outils des technologies de l'information et de la communication (TIC) pour l'optimisation de produits végétaux agricoles (système de positionnement mondial et système d'information géographique ou outils TIC permettant d'optimiser l'irrigation et de surveiller les caractéristiques physiques des sols comme la topographie, la salinité, etc.);*
- 5) *de toutes les technologies et méthodes qui pourraient contribuer à une meilleure gestion de l'eau et à la prévention de la pollution de l'eau. L'UE devrait allouer des fonds à la mise en œuvre de l'utilisation optimale des ressources en eau.*

Le groupe encourage et sollicite le développement et la promotion des technologies susmentionnées au sein de l'UE et au niveau mondial. Afin de réduire la fracture technologique, il promeut le développement de mesures spécifiques, tant au sein de l'Europe qu'à

l'échelle internationale. Les plans de développement et les plans technologiques devraient toutefois garantir le libre choix des méthodes de production ⁽³⁾ par les agriculteurs et les producteurs et la promotion des nouvelles technologies pour une production locale concurrentielle. Le groupe soutient également l'agriculture de précision au sein de l'UE et dans les pays en développement lorsqu'elle est susceptible d'être plus avantageuse par rapport à l'agriculture traditionnelle.

Le groupe souligne l'importance de la convention des Nations unies sur la protection et l'utilisation des cours d'eau transfrontières et des lacs internationaux (convention sur l'eau) qui vise à renforcer les mesures nationales de protection et la gestion écologiquement saine des eaux de surface et des eaux souterraines transfrontalières ⁽⁴⁾. Il soutient également les initiatives internationales telles que le programme hydrologique international (PHI) de l'Organisation des Nations unies pour l'éducation, la science et la culture (Unesco) pour la recherche hydrologique, la gestion des ressources en eau, l'éducation et le renforcement des capacités, qui a notamment pour objectif d'évaluer le développement durable des ressources en eau vulnérables et de servir de plate-forme pour mieux sensibiliser aux problèmes de l'eau au niveau mondial.

10.3.3. Biocarburants et agriculture

Le groupe est conscient que les avis concernant l'impact des biocarburants sur l'utilisation des terres arables divergent fortement. Il reconnaît que l'introduction des biocarburants en Europe pourrait réduire la dépendance du continent à l'égard des importations de carburants et présenter un intérêt pour certains agriculteurs. Il estime, par conséquent, que la production de biocarburants en Europe pourrait être encouragée, pour autant qu'elle n'interfère pas avec la production alimentaire, que l'utilisation de ces carburants n'entraîne pas une augmentation des émissions de gaz à effet de serre et, au niveau mondial, que plus aucune terre ne soit défrichée (par exemple, par la voie de la déforestation) pour la production de biocarburants. Le développement de biocarburants de la deuxième génération est important.

⁽³⁾ Un outil réglementaire intéressant pour protéger la production locale et sauvegarder les méthodes locales de production est l'«appellation d'origine contrôlée» (AOC) et l'«indication géographique protégée» (IGP) qui offrent une protection à un nom spécifique et limitent l'utilisation de celui-ci à certains produits fabriqués dans une zone restreinte et suivant une méthode spécifique.

⁽⁴⁾ Voir <http://www.unece.org/env/water/>.

En conséquence, le groupe recommande que l'infrastructure nécessaire à la production durable de ceux-ci soit mise en place au sein de l'Union européenne. Il recommande par conséquent que:

- 1) *la plantation de cultures pour la production de biocarburants n'interfère pas avec la production alimentaire comme dans le cas des terres mises en jachère ou des terres marginales;*
- 2) *des mesures soient prises pour recycler à la fois les déchets de cultures et les déchets alimentaires dans la chaîne de production, en utilisant le biocarburant tiré de la production végétale afin d'améliorer considérablement le bilan énergétique de la production de biocarburants ⁽⁵⁾;*
- 3) *la recherche visant à obtenir du biocarburant à partir de déchets, de parties non comestibles des végétaux ou d'espèces végétales qui ne concurrencent pas la production alimentaire ou des ressources telles que l'eau et les terres qui sont utilisées pour produire des denrées alimentaires soit financée au niveau de l'UE et des États membres;*
- 4) *la réduction de l'utilisation des combustibles fossiles soit encouragée, en particulier dans les transports;*
- 5) *l'infrastructure pour les biocarburants de la seconde génération soit encouragée, financée et développée au niveau de l'Union européenne.*

10.3.4. Cultures génétiquement modifiées

Tandis que les agronomes débattent du rôle des cultures génétiquement modifiées en matière de sécurité alimentaire (augmentation des rendements de production et de la capacité nutritionnelle des produits alimentaires), le groupe reconnaît que la question de l'utilisation de cultures génétiquement modifiées est controversée au sein de l'UE. Dans ce débat, des inquiétudes ont été exprimées concernant les risques éventuels du monopole

⁽⁵⁾ Turley e.a. (2002), «Liquid Biofuels — Prospects and potential impacts on UK agriculture, the farmed environment, landscape and rural economy», rapport établi pour le compte du ministère de l'environnement, de l'alimentation et des questions rurales du Royaume-Uni, division «Organics, Forestry and Industrial Crops».

économique et les risques pour la biosécurité. Le groupe reconnaît que la législation de l'UE et les traités internationaux imposent à l'Union européenne l'obligation d'entreprendre une évaluation scientifique des risques. Il insiste pour que le principe de précaution soit pris en compte, afin de s'assurer que toutes les technologies évitent le risque de «dommages graves ou irréversibles», comme le prévoit le principe 15 de la déclaration de Rio sur l'environnement et le développement ⁽⁶⁾, et d'effets pléiotropes non désirés. Le groupe recommande que les procédures de gestion des risques soient revues, afin de tenir pleinement compte de la nécessité d'une évaluation d'impact de toutes les nouvelles technologies (voir le point 10.2.4). La sécurité alimentaire et l'évaluation environnementale doivent dès lors constituer des conditions préalables essentielles à l'approbation. Le groupe estime, d'une manière générale, que toutes les technologies agricoles ⁽⁷⁾ ne devraient être soutenues au sein de l'UE que si elles contribuent à la réalisation des objectifs du présent avis et répondent aux critères éthiques qui y sont mentionnés.

10.3.5. Recherche en sciences agricoles

Le groupe encourage l'UE à augmenter le budget de la recherche en agronomie, en biotechnologies vertes et dans tous les autres secteurs de la recherche agricole orientés vers la durabilité dans le cadre du septième programme-cadre de recherche et développement de l'UE (PC7), afin d'atteindre les objectifs qu'il soutient dans le présent avis. Parallèlement, le groupe estime que l'Europe doit garantir les normes de connaissance les plus élevées dans ces domaines (notamment la sécurité alimentaire, la technologie alimentaire, les sciences nutritionnelles) de façon à pouvoir surveiller l'introduction de nouveaux produits destinés à la consommation publique. La recherche dans ces domaines devrait être encouragée au niveau tant de l'Europe que des États membres, au profit des consommateurs et des agriculteurs européens.

⁽⁶⁾ «Pour protéger l'environnement, des mesures de précaution doivent être largement appliquées par les États selon leurs capacités. En cas de risque de dommages graves ou irréversibles, l'absence de certitude scientifique absolue ne doit pas servir de prétexte pour remettre à plus tard l'adoption de mesures effectives visant à prévenir la dégradation de l'environnement.»

⁽⁷⁾ Les autres technologies pouvant améliorer la sécurité alimentaire sont, par exemple, les technologies qui visent à améliorer les rendements des récoltes, telles que les systèmes de double culture, etc.

La recherche agricole moderne devrait opter pour une approche intégrée. En conséquence, la recherche portant sur le système agricole, y compris l'interaction entre différentes cultures et l'environnement (sociologie végétale), l'écologie du paysage, etc., devrait avoir pour objectif global de parvenir à une récolte nette optimale de l'énergie solaire dans des formes qui profitent tant à l'humanité qu'à l'environnement. Des mesures spécifiques devraient également être mises en œuvre afin d'enrayer l'exode des chercheurs européens dans ce domaine. Le groupe recommande en particulier le financement de la recherche portant sur:

- *les cultures importantes tant pour la sécurité alimentaire que pour les agriculteurs européens qui ont besoin de fonds publics, notamment le blé ou les espèces horticoles méditerranéennes. L'impact éventuel du changement climatique devrait être évalué et la priorité devrait être accordée aux approches permettant de lutter contre celui-ci;*
- *les cultures qui sont importantes dans les parties du monde où la sécurité alimentaire n'est pas encore assurée et sur les caractéristiques qui présentent un intérêt pour l'accroissement du rendement de ces cultures dans ces régions. Le rôle que jouent les connaissances locales dans ces cas devrait être reconnu;*
- *la préservation de la biodiversité des espèces végétales qui sont importantes en agriculture et de l'équilibre environnemental qui est perturbé par l'agriculture. L'Union européenne doit, en particulier, soutenir les banques de semences qui existent en Europe et à travers le monde, afin de préserver la biodiversité existante;*
- *l'étude de nouvelles sources d'énergie (par exemple, le biogaz et d'autres sources d'énergie renouvelables) mieux adaptées aux scénarios prévisibles de baisse des quantités de pétrole disponible pour les machines qui sont utilisées actuellement dans l'agriculture et qui sont très tributaires des combustibles fossiles.*

10.4. Prise de décision politique responsable en matière de cultures arables

Le groupe est conscient que la sécurité alimentaire et la durabilité sont des questions hétérogènes qui requiè-

rent l'interaction de multiples facteurs pour parvenir à des solutions efficaces. Il est difficile de trouver des solutions concrètes, notamment technologiques, et il est indispensable de les tester scientifiquement, mais les moyens technologiques pourraient conduire à des améliorations durables en matière de sécurité alimentaire s'ils sont conjugués à des décisions politiques responsables et à une mise en œuvre responsable de ces décisions. La crise alimentaire actuelle et le retard enregistré dans les progrès vers la concrétisation des objectifs du millénaire pour le développement des Nations unies concernant la faim dans le monde mettent en évidence la nécessité de promouvoir différentes méthodes agricoles d'une manière plus efficace au profit de la sécurité alimentaire dans l'UE et au-delà.

Le groupe recommande que l'UE encourage l'accès à l'infrastructure et aux technologies adéquates dans les régions où une augmentation de la production alimentaire contribuerait à résoudre les problèmes de faim et de malnutrition, et ce dans le respect de la culture et des connaissances locales. La conception, la mise en œuvre et la promotion d'une politique éthiquement saine concernant la production primaire de produits végétaux agricoles constituent un processus complexe impliquant de nombreux acteurs différents (des décideurs politiques aux consommateurs et des organismes internationaux aux États membres), qui ont chacun des droits et des responsabilités.

10.4.1. Commerce mondial de produits agricoles: commerce libre et équitable et aide au commerce

En agriculture, les technologies mais aussi les échanges et le cadre des échanges ont des implications éthiques importantes. L'Union européenne représente 60 % de l'aide au développement officielle dans le monde ⁽⁸⁾ et pourtant, la sécurité alimentaire ne peut être garantie pour un milliard de personnes environ. Le groupe soutient le rôle essentiel joué par l'UE dans la promotion de l'aide mondiale en faveur de la sécurité alimentaire à travers l'UE et dans le monde. Il appuie la décision du G20 de trouver un accord constructif afin d'amener le cycle de Doha de l'Organisation mondiale du commerce (OMC) à une conclusion heureuse, rapide et propice au développement. Le groupe est également conscient que l'Union européenne a jusqu'à présent été un acteur mondial dans les échanges agricoles, en

⁽⁸⁾ En juin 2008, le Conseil européen a réaffirmé que l'UE atteindrait l'objectif collectif de 0,56 % du revenu national brut d'ici à 2010 et de 0,7 % en 2015.

tant qu'importateur et qu'exportateur de produits agricoles, et il demande instamment à l'UE de fixer comme principes éthiques, dans le cadre du rôle qu'elle joue dans l'économie mondiale, les priorités de sécurité alimentaire, de sûreté alimentaire et de durabilité.

Pour atteindre les objectifs définis, les échanges agricoles mondiaux ont besoin d'un cadre éthique. La solidarité, la justice et le commerce libre et équitable des produits et technologies agricoles sont des priorités. Le groupe plaide dès lors auprès de l'UE pour qu'elle encourage un système de marché qui inclue une aide aux échanges, au commerce équitable (protégé) et au commerce libre ⁽⁹⁾ et il souligne l'importance de l'aide au développement technologique, conformément aux objectifs du millénaire pour le développement des Nations unies. Pour tenter de parvenir à ces objectifs, le groupe recommande de réfléchir à un nouveau cadre pour les échanges de produits agricoles et demande instamment aux décideurs politiques, aux parties concernées et à la communauté internationale de tenir compte des principes éthiques et des droits humains énoncés dans les déclarations de l'Union européenne et des Nations unies et de fixer, conformément aux recommandations du GEE, les priorités de sécurité alimentaire, de sûreté alimentaire et de durabilité comme objectifs éthiques pour le marché agricole mondial.

Selon le principe de justice, tel qu'il est décrit au point 9.12, le groupe recommande que la révision de la politique agricole commune, et notamment des subventions, tienne compte des effets des politiques européennes sur: a) les échanges avec l'Europe; b) la production agricole locale dans les pays qui ne produisent pas assez et ont un accès insuffisant à l'alimentation. L'UE pourrait ainsi jouer un rôle important dans la promotion du commerce équitable.

Le groupe estime non seulement que les normes sanitaires et phytosanitaires applicables aux produits agricoles importés devraient être équivalentes à celles qui sont imposées par le cadre réglementaire de l'UE, mais propose aussi que les mesures prévues dans la PAC, telles que le respect des choix des consommateurs, le bien-être animal, la biodiversité et la protection socio-environnementale, servent également de base pour

⁽⁹⁾ Le commerce équitable et libre est une approche basée sur le marché qui soutient les producteurs de pays en développement et encourage la durabilité, tandis que la circulation des marchandises et la prestation de services ne sont pas entravées par des restrictions imposées par le gouvernement.

les importations de produits agricoles dans l'UE. Cela devrait être mis en œuvre progressivement au niveau multilatéral ou bilatéral.

10.4.2. Système des droits de propriété intellectuelle

Le groupe soutient la promotion de l'innovation dans l'agriculture, mais est préoccupé par l'impact des brevets sur les cultures agricoles. La tendance au contrôle de l'utilisation des semences par le biais d'accords de licence est également inquiétante. Le GEE recommande que l'UE analyse l'évolution de la protection des obtentions végétales du régime de l'Union internationale pour la protection des obtentions végétales (UPOV) vers un système de brevet et détermine si ce système constitue effectivement un frein à l'innovation.

Le groupe est également conscient que les brevets sont associés (essentiellement) aux nouvelles technologies et que leur adoption risque dès lors d'être entravée par le coût élevé, en particulier dans les pays en développement. Conformément à l'article 16 de la directive 98/44/CE du Parlement européen et du Conseil, les conséquences des brevets en agriculture (produits et technologies) pour les pays en développement devraient être prises en compte. Afin de diffuser les nouveaux développements utiles dans ce domaine, il conviendrait d'envisager le regroupement des brevets de manière à garantir leur mise à la disposition des agriculteurs dans les pays en développement.

À court terme, le groupe recommande que les droits accordés aux agriculteurs de conserver des semences et de les utiliser lors des saisons suivantes soient, dans la mesure du possible, maintenus, compte tenu de l'article 9 du traité international sur les ressources phyto-génétiques pour l'alimentation et l'agriculture ⁽¹⁰⁾.

10.4.3. Concurrence équitable et «monopoles verticaux»

Le groupe demande l'examen des mécanismes européens et internationaux en matière de concurrence loyale entre entreprises privées dans le secteur des produits agricoles, afin de s'assurer que l'impact des accords sur le partage des brevets et le contrôle vertical sont dûment pris en compte.

Il demande, en particulier, l'examen des effets de la concentration d'industries dans les secteurs des

⁽¹⁰⁾ <http://www.planttreaty.org/>.

semences, du transport de céréales et de la distribution alimentaire sur des produits alimentaires spécifiques et leurs prix au consommateur. Des mesures devraient être prises contre les «monopoles verticaux» de fait dans lesquels une entreprise contrôle la production, la transformation et la distribution de certains produits.

Il n'est par ailleurs pas certain que la concurrence libre et équitable au sein de l'Europe ou au niveau international soit toujours garantie, comme indiqué au point 9.15. Le GEE invite, dès lors, à surveiller le segment agricole et encourage à évaluer l'efficacité des réglementations actuelles en ce qui concerne les monopoles susmentionnés.

10.4.4. Prix de l'alimentation

Compte tenu de la volatilité des prix de l'alimentation, l'accès aux denrées alimentaires de base est devenu difficile pour des millions de citoyens dans l'UE comme dans le monde. En fait, la volatilité et le déséquilibre des prix de l'alimentation ont engendré une instabilité sociale et politique au niveau planétaire. C'est pourquoi le groupe invite la Commission à :

- 1) *recueillir des informations sur les éléments déterminants des fluctuations du prix de l'alimentation (de la production à la commercialisation) et sur l'impact des coûts de transport et de distribution;*
- 2) *recourir à des mécanismes financiers transparents pour stabiliser les prix de l'alimentation (tant les augmentations que les diminutions) et concevoir des mesures visant à réduire les prix chaque fois qu'une augmentation radicale se produit;*
- 3) *étudier les relations entre sécurité alimentaire et durabilité dans la gouvernance du marché financier, et notamment examiner si la spéculation financière a influé sur les fluctuations actuelles du prix des aliments. Dans l'affirmative, la Commission devrait étudier les mesures à prendre pour promouvoir la transparence ainsi que la stabilité et la durabilité du marché et des devises, afin d'améliorer la concrétisation des objectifs du millénaire pour le développement (par exemple, en instaurant une taxe sur les transactions financières).*

10.5. Aspects sociétaux

L'agriculture est l'un des principaux secteurs politiques de l'UE et joue un rôle important sur le plan de l'économie, de l'emploi et de la fourniture de biens sociaux ⁽¹¹⁾. La conception de la politique pour ce secteur doit concorder avec les besoins, les biens et les attentes de la société. Les différences qui se marquent dans les produits alimentaires et les habitudes nutritionnelles caractérisent la diversité européenne (et mondiale) et reflètent la demande du consommateur et les différentes méthodes de production. Les besoins et le choix des consommateurs revêtent dès lors une importance fondamentale pour la promotion et la conception des technologies agricoles. La politique agricole commune de l'UE ayant renforcé l'approche orientée vers le consommateur, le groupe appelle à la participation active de la société civile, des agriculteurs et des autres parties prenantes à la conception de la politique et des décisions de l'UE concernant le commerce des produits de base agricoles aux niveaux européen et international. Il insiste également pour que les considérations de santé humaine et de sécurité (au profit tant des citoyens de l'UE que des agriculteurs et des travailleurs intervenant dans le système de production et de distribution alimentaires) soient dûment surveillées et évaluées par les organes compétents de l'UE, comme le stipule l'article 152 du traité d'Amsterdam.

Le groupe estime également que le commerce des produits de base agricoles doit impliquer tous les acteurs et être transparent (implication active des consommateurs), qu'il doit être équitable (respect des droits des travailleurs et prise en compte du principe de justice) et qu'il doit respecter la diversité culturelle. Une attention particulière devrait également être accordée aux droits des travailleurs migrants, au travail des enfants — voir la convention internationale sur la protection des droits de tous les travailleurs migrants et des membres de leur famille ⁽¹²⁾ et la convention des Nations unies relative aux

⁽¹¹⁾ Le secteur agroalimentaire représente environ 7 % de l'ensemble de l'économie de l'UE, occupe environ 5 % de la population de l'UE et génère 20 % des dépenses moyennes de consommation des ménages de l'UE et une grande part du commerce intérieur et des exportations de l'UE.

⁽¹²⁾ Convention internationale sur la protection des droits de tous les travailleurs migrants et des membres de leur famille (1990), <http://www.un.org/documents/ga/res/45/a45r158.htm>.

droits de l'enfant ⁽¹³⁾ — et à d'autres documents pertinents en matière de protection des droits de l'homme.

10.5.1. Participation publique

Vu la gravité des problèmes de sécurité alimentaire et de pénurie des ressources, le groupe affirme qu'il est important, sur le plan éthique, que toutes les parties prenantes travaillent ensemble. Une large participation aux politiques et programmes, et notamment l'encouragement de la participation démocratique des représentants de la société civile aux négociations sur le commerce mondial de produits agricoles (dans le cadre de l'OMC), s'impose.

Le groupe invite les États membres à prendre des mesures spécifiques pour accroître la participation publique à la conception de la politique en matière de production primaire d'aliments d'origine végétale. Ce débat devrait être lié aux campagnes d'information sur les conséquences des habitudes alimentaires pour la durabilité alimentaire (la consommation de viande en particulier), et notamment à :

- 1) *la prévention des déchets de produits alimentaires;*
- 2) *la promotion d'un mode de vie sain;*
- 3) *la sensibilisation de l'opinion publique aux méthodes et technologies agricoles.*

Le groupe demande aux entreprises intervenant dans la production, le transport et la distribution de denrées alimentaires de tenir davantage compte, dans les politiques de responsabilité sociale des entreprises (RSE), des valeurs mises en évidence dans le présent avis.

Le groupe voit dans l'implication de la société civile la possibilité d'augmenter le sens des responsabilités des consommateurs et, donc, la chance d'orienter le marché alimentaire de l'UE vers un système plus durable. Cet effort pourrait porter, par exemple, sur l'enseignement de l'éthique en rapport avec les questions agricoles, sur des cours de jardinage et de cuisine dans les écoles, sur des stages et des visites dans les exploitations ainsi que sur la prévention et le recyclage des déchets.

Le groupe suggère que la solidarité avec le milliard d'êtres humains les plus pauvres (the «bottom billion») qui ne disposent pas des biens de base oriente davantage les politiques et l'action et joue un rôle important à ce niveau. Cette évolution devrait être encouragée et reconnue en public et mise en avant par les médias, de manière à atteindre l'objectif d'une société globale (voir également le point 9.1).

10.5.2. Responsabilité des citoyens de l'UE

Les habitudes alimentaires affectent la durabilité de l'agriculture. Ainsi, selon une récente étude de la FAO ⁽¹⁴⁾, la consommation élevée de produits à base de viande influence la production agricole primaire, l'utilisation des sols ainsi que la pollution de l'eau et de l'environnement. Dans ce contexte, l'éducation des consommateurs sur les questions de santé publique (habitudes alimentaires saines), de qualité alimentaire et de durabilité agricole (par exemple, importations d'aliments non saisonniers, déchets alimentaires, etc., tel que le décrit le point 4.7) serait bénéfique et contribuerait de façon importante à la sécurité alimentaire et à la durabilité. Le groupe souligne, par conséquent, les responsabilités spécifiques dont sont investis les consommateurs pour orienter le marché.

10.5.3. Déchets alimentaires

Le concept de déchets alimentaires concerne différents niveaux (production, stockage, transport, distribution et consommation) et a d'importantes implications éthiques en matière de justice sociale et distributive. Comme l'indique le point 4.8 du présent avis, le phénomène des déchets alimentaires a probablement pris de très grandes proportions. Le groupe est conscient que ces déchets constituent un problème important dans le contexte de la sécurité alimentaire, de la sûreté alimentaire et de la durabilité. Des technologies adéquates devraient être développées et appliquées dans l'agriculture moderne, afin de réduire ou de recycler les déchets alimentaires. Le GEE propose également une analyse quantitative et qualitative de la dynamique des déchets aux niveaux national et supranational, ainsi que la réalisation de recherches sur l'optimisation du recyclage des déchets.

⁽¹³⁾ Voir la convention des Nations unies relative aux droits de l'enfant (1989), <http://www2.ohchr.org/french/law/crc.htm>.

⁽¹⁴⁾ <http://www.fao.org/newsroom/fr/news/2006/1000448/index.html> et <ftp://ftp.fao.org/docrep/fao/010/A0701E/A0701E00.pdf>.

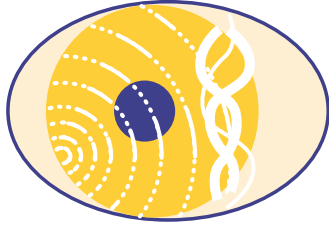
11. Remarques finales

Dans le présent avis, le GEE a traité de questions éthiques essentielles en rapport avec les développements modernes des technologies agricoles qui sont d'ores et déjà soit visibles soit prévisibles.

Afin d'accéder à la demande du président Barroso, le GEE a élaboré un cadre éthique. Le groupe est conscient qu'il existe dans ce domaine des questions spécifiques qui nécessitent un examen plus approfondi et plus détaillé.

Le GEE soutient pleinement la déclaration sur la sécurité alimentaire mondiale adoptée lors du sommet de la FAO en 2008 ⁽¹⁵⁾ et invite l'UE et les citoyens à mettre en place une base saine pour la conception de politiques agricoles durables et responsables.

⁽¹⁵⁾ Voir l'annexe I du présent avis.



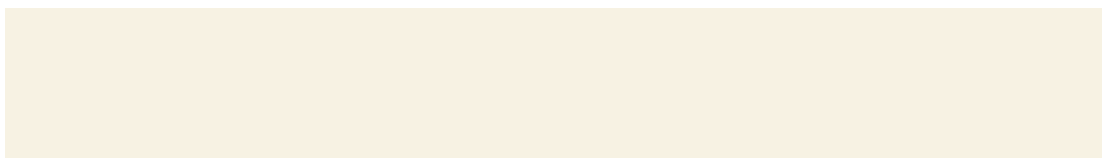
**Europäische Gruppe
für Ethik in Naturwissenschaften
und neuen Technologien
bei der Europäischen Kommission**

STELLUNGNAHME DER EUROPÄISCHEN
GRUPPE FÜR ETHIK
IN NATURWISSENSCHAFTEN
UND NEUEN TECHNOLOGIEN
BEI DER EUROPÄISCHEN KOMMISSION

Ethik moderner Entwicklungen der Agrartechnologie

Bezug: Ersuchen von **Präsident Barroso**
Berichterstatter: **E. Agius, D. Banati, J. Kinderlerer**

Nur der Originaltext auf Englisch ist authentisch.



10. Empfehlungen

10.1. Einleitung

Die Erzeugung, Verarbeitung und Verteilung von landwirtschaftlichen Erzeugnissen und Lebensmitteln werden allgemein als Selbstverständlichkeiten unseres Alltags akzeptiert. Lebensmittel und Landwirtschaft sind Mittel zu einem Zweck, der nicht nur technischer, wirtschaftlicher oder politischer Art ist, sondern auch eine ethische Dimension besitzt, nämlich die Versorgung der Weltbevölkerung mit Lebensmitteln bei gleichzeitiger Berücksichtigung des Bedarfs und der Erwartungen künftiger Generationen in Bezug auf Ernährungssicherung, Lebensmittelsicherheit und Nachhaltigkeit.

Die derzeit laufende Revision der Gemeinsamen Agrarpolitik, Ernährungssicherung und Lebensmittelsicherheit, Klimawandel, nachhaltige Landwirtschaft und globaler Handel mit Agrargütern sind Themen, die in den letzten Jahren die Medien, die politischen Entscheidungsträger und die Zivilgesellschaft stark beschäftigt haben. Laut dem letzten Anfang Dezember 2008 veröffentlichten Bericht der FAO litten 2008 aufgrund gestiegener Lebensmittelpreise 963 Millionen Menschen in der Welt Hunger, das waren 40 Millionen Menschen mehr als 2007. Durch die anhaltende Finanz- und Wirtschaftskrise könnten Hunger und Armut in der Welt sogar noch weiter zunehmen. Es gibt daher eine leidenschaftlich geführte Debatte darüber, wie diesen Herausforderungen begegnet werden kann, wobei viele Menschen hohe Erwartungen hegen, dass neue Agrartechnologien zur Lösung der Probleme beitragen könnten. Wegen dieser neuen Herausforderungen und Chancen für die europäische Landwirtschaft hat Kommissionspräsident Barroso die EGE beauftragt, eine Stellungnahme zu den ethischen Aspekten der modernen Entwicklungen bei den landwirtschaftlichen Technologien abzugeben. Die Gruppe hat diese schwierige Aufgabe akzeptiert und entschieden, sich vor allem auf die Agrartechnologien und -methoden für die Primärerzeugung von Lebensmitteln pflanzlichen Ursprungs zu konzentrieren.

Die Gruppe weiß, dass Innovationen in der Landwirtschaft gefördert werden müssen, sie weiß aber auch, dass sich mit Technologien allein keine endgültigen Lösungen für die Herausforderungen finden lassen, denen sich die moderne Landwirtschaft in der EU

und weltweit gegenübersteht. Die Gruppe unterstützt jedoch alle Agrartechnologien, insoweit sie den in dieser Stellungnahme aufgezeigten Zielen und Prioritäten dienlich sind. Die Gruppe betont außerdem die Notwendigkeit einer integrierten Sicht und eines integrierten Ansatzes in Bezug auf die Agrartechnologien, damit bei der Bewertung der ethischen Folgen einer neuen Technologie die Produktions-, Lagerhaltungs- und Verteilungsprozesse gemeinsam betrachtet werden.

10.2. Der ethische Ansatz der EGE für die Landwirtschaft

Nach Ansicht der Gruppe sind die Ziele

1. *Ernährungssicherung,*
2. *Lebensmittelsicherheit und*
3. *Nachhaltigkeit*

die obersten Prioritäten und Grundsätze, an denen sich jede Agrartechnologie messen lassen muss.

Daher empfiehlt die Gruppe einen integrierten Ansatz für die Landwirtschaft, der sich auf ein System stützt, dessen einzelne Bestandteile nicht nur auf technischer Ebene ausgewogen sind (wo eine kontinuierliche Bewertung des Verhältnisses zwischen dem erforderlichen Input, d. h. den Ressourcen, der Energie usw., und den Ergebnissen stattfindet, mit denen diese Ziele erreicht werden sollen), sondern auch auf ethischer Ebene (wo die Menschen auf der Grundlage gemeinsamer Werte agieren und interagieren).

Die EGE fordert eine explizite Einbeziehung ethischer Grundsätze in die Agrarpolitik (ob bei der konventionellen oder der innovativen Landwirtschaft) und vertritt die Auffassung, dass die beiden grundlegenden ethischen Grundsätze Respekt vor der Würde des Menschen und Streben nach Gerechtigkeit auch bei der Produktion und der Verteilung von Lebensmitteln Geltung haben müssen (siehe Abschnitt 8.1). Zusätzlich fordert die EGE eine Folgenabschätzung der Agrartechnologien, wie in Abschnitt 10.2.4 dieser Stellungnahme beschrieben.

10.2.1. Das Recht auf Nahrung

Ausgangspunkt für jede ethisch fundierte Agrarpolitik muss sein, dass sich die Staaten und die internationale Gemeinschaft verpflichten, das Recht eines jeden Menschen auf Nahrung zu sichern. Oberstes Ziel der Agrarpolitik auf nationaler, europäischer und internationaler Ebene muss es daher sein, den Zugang zu Nahrung auf regionaler, nationaler und internationaler Ebene zu sichern, damit sich alle Menschen ausreichend mit einwandfreien und gesunden Lebensmitteln versorgen können, die kulturellen Gewohnheiten und den neuesten wissenschaftlichen Erkenntnissen entsprechen.

10.2.2. Agrartechnologien und Nachhaltigkeit

Die Notwendigkeit, weltweit eine produktive Landwirtschaft zu erhalten, wird noch durch die Tatsache unterstrichen, dass ein hoher Prozentsatz der Weltbevölkerung keinen gesicherten Zugang zu Nahrung hat, und findet ihre Bestätigung in der Nahrungsmittelkrise im Jahr 2007 und Anfang 2008. Die starken Umweltauswirkungen der Landwirtschaft zeigen aber auch, dass wir künftig ein anderes Landwirtschaftsmodell benötigen: eine nachhaltige und multifunktionale Landwirtschaft, in der neben der Versorgung aller Menschen mit sicheren Lebensmitteln auch die Umweltfreundlichkeit der Produktionsmethoden, die Erhaltung der Ressourcenbasis, die Gesundheit der landwirtschaftlichen Arbeitskräfte, die Erhaltung kleiner Biota mit ihrer großen Artenvielfalt, der Wert der ländlichen Gemeinschaften und der Wert der Kulturlandschaft einen wichtigen Stellenwert einnehmen.

Unter ethischen Gesichtspunkten sollten nachhaltige Agrartechnologien helfen, die Nutzung der natürlichen Ressourcen zu optimieren, sie aber gleichzeitig vor Erschöpfung zu schützen und damit ihre natürliche Regeneration zu ermöglichen. Um dies zu erreichen, fordert die Gruppe Folgendes:

1. Die Prozesse, die bei der Primärerzeugung, der Verteilung und der Lagerung von Lebensmitteln eine Rolle spielen, müssen optimiert werden.
2. Die Nutzung der Ackerflächen muss optimiert werden, und es müssen Mittel und Wege gefunden werden, um derzeit aufgrund ungünstiger Um-

weltbedingungen nicht genutzte Flächen landwirtschaftlich nutzen zu können.

3. Alle übrigen Prozesse in der Kette vom Erzeuger bis zum Verbraucher müssen optimiert und vereinfacht werden (um Ernteverluste und Verschwendung zu reduzieren und, wo möglich, Abfallverwertungssysteme aufzubauen).

10.2.3. Lebensmittelsicherheit

Nach Einschätzung der Gruppe ist die Lebensmittelsicherheit eine Voraussetzung für die Erzeugung und Vermarktung von Lebensmitteln pflanzlichen Ursprungs, einschließlich der Einfuhren von Agrargütern und Agrarprodukten aus Drittländern; sie fordert die zuständigen Behörden daher auf, die Durchsetzung der Vorschriften über die Lebensmittelsicherheit zu überwachen.

Die Gruppe unterstützt die Arbeit der EU, der Mitgliedstaaten und der zuständigen Einrichtungen, insbesondere der Europäischen Behörde für Lebensmittelsicherheit (EFSA), im Bereich der Umsetzung von Sicherheitsstandards und hält Folgendes für erforderlich:

- *Die EU-Standards für Lebensmittelsicherheit dürfen sich ausschließlich auf wissenschaftliche Daten stützen.*
- *Weichen die EU-Standards für die Sicherheit von Lebensmitteln pflanzlichen Ursprungs von den internationalen Standards ab, so sind diese Abweichungen wissenschaftlich zu begründen.*

Außerdem fordert die Gruppe die EU auf, zur Verhinderung von Betrug die bestehenden Rechtsvorschriften und Bestimmungen über die Rückverfolgbarkeit durchzusetzen, und fordert weiterer Forschungen über neue Technologien für die Lebensmittelsicherheit.

10.2.4. Folgenabschätzung der Agrartechnologien

Im Bereich der neuen Agrartechnologien besteht zusätzlich zur Risikobewertung die Notwendigkeit einer Folgenabschätzung auf nationaler und europäischer Ebene (¹). Bei Folgenabschätzungen werden die Risiken und Vorteile des Einsatzes bzw. des Nicht-Einsatzes einer

(¹) Für Einzelheiten der vorgeschlagenen prospektiven Technologiebewertung siehe die Stellungnahme Nr. 22 der EGE.

neuen Technologie für die menschliche Gesundheit und die Umwelt geprüft, aber auch die Risiken und Vorteile einer Beibehaltung der derzeitigen Technologien. Sie berücksichtigen die Notwendigkeit, Nachhaltigkeit, Ernährungssicherheit sowie Lebens- und Futtermittelsicherheit zu gewährleisten.

Die Gruppe empfiehlt, bei diesen Folgenabschätzungen nicht nur Fragen der Sicherheit (Lebensmittelsicherheit und ökologische Sicherheit) zu untersuchen, sondern auch die sozialen Auswirkungen neuer Agrartechnologien, also z. B. die Frage, wie sie sich auf die sozialen, wirtschaftlichen und institutionellen Strukturen auswirken werden; dabei sollten die Aspekte Gerechtigkeit (gleicher Zugang und Teilhabe an den Entscheidungsprozessen) und gerechte Güterverteilung besondere Beachtung finden. Ferner schlägt die Gruppe vor, dass die Kommission auch künftig u. a. Forschungen über die sozialen Folgen von Agrartechnologien finanzieren sollte. Diese Forschungen sollten sich auch mit makroökonomischen Trends, den Auswirkungen auf den Handel und möglichen internationalen Problemen sowie insbesondere mit dem Risiko befassen, dass eine Technologieklüft entsteht, die den Abstand zwischen Industrie- und Entwicklungsländern vergrößern könnte.

10.3. Empfehlungen zur Einführung und Förderung von Agrartechnologien

Die EGE ist sich der großen Vielfalt der Methoden der Primärerzeugung von landwirtschaftlichen Erzeugnissen pflanzlichen Ursprungs genauso bewusst wie der Tatsache, dass in verschiedenen Regionen der EU immer noch traditionelle landwirtschaftliche Produktionsmethoden zum Einsatz kommen. Die Gruppe erkennt an, dass die Verschiedenartigkeit der Primärerzeugung in der EU respektiert werden muss, sie weiß aber auch, dass die EU-Erzeugung von Lebensmitteln, Futtermitteln und Fasern pflanzlichen Ursprungs auf dem globalen Markt wettbewerbsfähig werden muss und dass daher in diesem Sektor ein Innovationsbedarf besteht.

Die Gruppe unterstützt die derzeitigen Bemühungen der EU, Innovation in der Landwirtschaft zu fördern, fordert aber besondere Anstrengungen, damit vorrangig Technologien gefördert werden, die der Ernährungssicherung, der Lebensmittelsicherheit und der Nachhaltigkeit dienen, um eine ökologisch und sozial verträgliche landwirtschaftliche Erzeugung (Techniken und Methoden) auf der Grundlage eines fairen Umgangs mit der Umwelt und den Landwirten zu gewährleisten.

Die EGE erkennt auch an, dass die landwirtschaftliche Tätigkeit Vorteile ebenso wie Nachteile vor allem für die Umwelt mit sich bringt und dass alle Technologien Risiken mit unumkehrbaren Auswirkungen bergen können. Nach Ansicht der Gruppe sollten daher vor dem Einsatz einer neuen Technologie in der Landwirtschaft die möglichen Auswirkungen im Wege einer Folgenabschätzung sorgfältig untersucht und bewertet werden, die eine vergleichende Bewertung der derzeitigen und der neuen Technologien umfasst. Diese Bewertung sollte auf der Grundlage eines integrierten Ansatzes für die Landwirtschaft erfolgen, der die ökologischen ebenso wie die sozialen Auswirkungen berücksichtigt. Die Gruppe fordert die EU auf, Lebensmittelsicherheit, Gesundheit und Qualität als Voraussetzung 1. für die Erzeugung und Vermarktung von Lebensmitteln pflanzlichen Ursprungs und 2. für Einfuhren solcher Erzeugnisse aus Nicht-EU-Ländern zu fördern, und empfiehlt der Gemeinschaft, ihre Bemühungen auf Forschungen in diesen Bereichen zu konzentrieren.

10.3.1. Biodiversität in der Landwirtschaft

Die Gruppe ist sich bewusst, dass jeder Verlust an genetischer Vielfalt die Chancen für Wachstum und Innovation verringert, die notwendig sind, um die Agrarproduktion angesichts explodierender Lebensmittelpreise und möglicher künftiger Nahrungsmitteldefizite zu steigern. Die Gruppe ist sich ebenfalls bewusst, dass jeder Verlust an Biodiversität in der Landwirtschaft Auswirkungen auf die Nachhaltigkeit der landwirtschaftlichen Tätigkeit hat (u. a. auf ihre Fähigkeit, sich an Klimawandel und Wasserknappheit anzupassen). Die Gruppe unterstützt daher Initiativen zum Schutz der biologischen Vielfalt, wie den internationalen Vertrag über pflanzengenetische Ressourcen für Ernährung und Landwirtschaft und den globalen Aktionsplan für die Erhaltung und nachhaltige Nutzung pflanzengenetischer Ressourcen für Ernährung und Landwirtschaft. Hierzu gehört auch der Aufbau von Gen- und Saatgutbanken, damit es gelingt, die Sortenvielfalt für die Zukunft zu sichern.

10.3.2. Schutz von Boden und Wasser

Die Gruppe weiß, dass viele derzeit in der Landwirtschaft eingesetzte Produkte ein potenzielles Risiko für die Gesundheit von Mensch und Tier sowie für die Umwelt darstellen, vor allem, wenn sie in hohen Konzentrationen verwendet werden. Technologien, durch die sich der Einsatz gefährlicher Chemikalien verringern lässt, ohne dass die Erträge oder die Qualität leiden, sollten gefördert werden. Dabei sollte der Schutz der

Gesundheit von Mensch ⁽²⁾ und Tier durch die geringere Exposition gegenüber chemischen Stoffen im Mittelpunkt stehen. Wie bereits erwähnt, drängt die Gruppe darauf, dass für alle in der Landwirtschaft eingesetzten neuen Technologien eine Folgenabschätzung durchgeführt wird, die sich an den in dieser Stellungnahme genannten Zielen orientiert, wobei Ernährungssicherung, Lebensmittelsicherheit und Nachhaltigkeit Vorrang haben sollten.

Die Gruppe weiß, dass Bodenerosion und Wasserverschmutzung Folgen der landwirtschaftlichen Tätigkeit sind, und betont daher die Bedeutung einer reduzierten Bodenbearbeitung und verbesserter Wasserbewirtschaftungspläne, die in den letzten Jahrzehnten entwickelt wurden, um, in Übereinstimmung mit der Empfehlung der Gruppe zu einem integrierten Ansatz für die Landwirtschaft, Böden und Gewässer besser zu schützen. Die Gruppe befürwortet den Einsatz aller Technologien und Methoden, die geeignet sind, die Bodenproduktivität zu erhöhen, die Bodenerosion (Verschlechterung der Bodenqualität) und die Wasserverschmutzung zu verhindern und die Verwertung von Abfallmaterialien (z. B. die Verwendung von zellulosehaltiger Biomasse für die Erzeugung von Ethanol) zu fördern. In diesem Zusammenhang unterstützt die Gruppe:

1. *den Einsatz bewährter Techniken (wie Konturanbau oder reduzierte Bodenbearbeitung), wo dies für die nachhaltige Bodennutzung sinnvoll ist;*
2. *den Einsatz von Biotechnologie für die Erreichung der oben genannten Nachhaltigkeitsziele (z. B. Verringerung der Verschmutzung durch das Versprühen von Pflanzenschutzmitteln, Verringerung der aktiven Wirkstoffe in Herbiziden und Verringerung der CO₂-Emissionen);*
3. *den Einsatz moderner gentechnischer Verfahren, wenn diese geeignet und sicher sind, um Pflanzensorten zu verbessern und zu selektieren, die an spezifische Umweltbedingungen angepasst sind [wie z. B. im Falle der markergestützten Selektion (siehe Abschnitt 3.2.2) zur Verbesserung der Salztoleranz von Pflanzen];*

⁽²⁾ Vor allem die Gesundheit der landwirtschaftlichen Arbeitskräfte, die unter krank machenden Arbeitsbedingungen zu leiden haben.

4. *den Einsatz von IKT-Instrumenten für die Optimierung der landwirtschaftlichen Pflanzenproduktion (globales Positionierungssystem und geografisches Informationssystem oder IKT-Instrumente zur Optimierung der Bewässerung und zur Überwachung der physikalischen Bodeneigenschaften wie Topografie oder Salinität usw.);*
5. *den Einsatz aller Technologien und Methoden, die geeignet sind, die Wasserbewirtschaftung zu verbessern und Wasserverschmutzung zu verhindern. Die EU sollte Mittel für die Realisierung einer optimalen Nutzung der Wasserressourcen bereitstellen.*

Die Gruppe begrüßt und fordert die Entwicklung und Förderung der oben genannten Technologien in der EU und weltweit. Um die Technologiekluft zu verringern, fordert die Gruppe die Entwicklung spezifischer Maßnahmen sowohl innerhalb Europas als auch auf globaler Ebene. Die Entwicklungs- und Technologieprogramme sollten jedoch Landwirten und Produzenten die freie Wahl der Produktionsmethoden ⁽³⁾ garantieren und neue Technologien für eine wettbewerbsfähige lokale Erzeugung fördern. Die Gruppe unterstützt auch die Präzisionslandwirtschaft in der EU und in den Entwicklungsländern, wo ihre Vorteile gegenüber der konventionellen Landwirtschaft besonders groß sein können.

Die Gruppe betont die Bedeutung des UN-Übereinkommens zum Schutz und zur Nutzung grenzüberschreitender Wasserläufe und internationaler Seen (Wasserübereinkommen), das die nationalen Maßnahmen für den Schutz und die umweltverträgliche Bewirtschaftung der grenzüberschreitenden Oberflächengewässer und Grundwasservorkommen ⁽⁴⁾ verstärken soll. Die Gruppe unterstützt darüber hinaus internationale Initiativen wie das internationale hydrologische Programm (IHP) der Unesco, das Themen wie die hydrologische Forschung, die nachhaltige Bewirtschaftung der Wasserressourcen, Aus- und Fortbildungsmaßnahmen sowie Maßnahmen zum Kapazitätsaufbau enthält und

⁽³⁾ Ein wertvolles Regulierungsinstrument für den Schutz der lokalen Erzeugung und die Erhaltung lokaler Produktionsmethoden sind die „geschützten Ursprungsbezeichnungen“ (gU) und die „geschützten geografischen Angaben“ (ggA), durch die bestimmte Bezeichnungen geschützt und die Verwendung dieser Bezeichnungen nur für bestimmte Erzeugnisse gestattet wird, die auf eine bestimmte Art und Weise in einem bestimmten Gebiet hergestellt werden.

⁽⁴⁾ Siehe <http://www.unec.org/env/water/>

u.a. darauf abzielt, Möglichkeiten der nachhaltigen Entwicklung gefährdeter Wasserressourcen zu bewerten, und das als Plattform für Maßnahmen zur weiteren Sensibilisierung der Öffentlichkeit für die globalen Wasserprobleme dienen kann.

10.3.3. Biokraftstoffe und Landwirtschaft

Die Gruppe weiß, dass die Meinungen über die Folgen der Biokraftstoffe für die Nutzung von Ackerflächen stark auseinandergehen. Die Gruppe erkennt an, dass die Einführung von Biokraftstoffen in Europa die Abhängigkeit Europas von Kraftstoffimporten verringern und für bestimmte Landwirte von Interesse sein könnte. Die Gruppe vertritt daher die Auffassung, dass die Erzeugung von Biokraftstoffen in Europa gefördert werden könnte, vorausgesetzt, sie wirkt sich nicht negativ auf die Lebensmittelerzeugung aus, der Einsatz von Biokraftstoffen führt nicht zu einem Anstieg der Treibhausgasemissionen und es werden nirgendwo auf der Welt neue Flächen für die Produktion von Biokraftstoffen gerodet (z. B. durch Abholzen von Wäldern). Die Entwicklung von Biokraftstoffen der zweiten Generation ist wichtig. Daher empfiehlt die Gruppe, die notwendige Infrastruktur für die nachhaltige Produktion von Biokraftstoffen der zweiten Generation innerhalb der Europäischen Union zu schaffen. Die Gruppe empfiehlt dazu Folgendes:

1. *Der Anbau von Pflanzen für die Produktion von Biokraftstoffen sollte sich nicht nachteilig auf die Lebensmittelerzeugung auswirken, also vor allem auf stillgelegten Flächen oder Marginalstandorten erfolgen.*
2. *Es sollten Maßnahmen getroffen werden, um Pflanzen- und Lebensmittelabfälle in der Produktionskette wiederzuverwerten und die aus Pflanzen gewonnenen Biokraftstoffe zu nutzen, um die Energiebilanz der Biokraftstoffherstellung⁽⁵⁾ deutlich zu verbessern.*
3. *Auf Ebene der EU und auf Ebene der Mitgliedstaaten sollten Forschungen finanziert werden, um Bio-*

kraftstoffe aus landwirtschaftlichen Rückständen, nicht essbaren Pflanzenteilen oder Pflanzen zu gewinnen, die nicht für die Nahrungsmittelerzeugung verwendet werden und nicht um Ressourcen wie Wasser und Land für die Nahrungsmittelerzeugung konkurrieren.

4. *Die Verringerung des Einsatzes fossiler Brennstoffe vor allem im Verkehrsbereich sollte gefördert werden.*
5. *Infrastrukturen für die Produktion von Biokraftstoffen der zweiten Generation sollten in der EU gefördert, finanziert bzw. ausgebaut werden.*

10.3.4. Gentechnisch veränderte Kulturpflanzen

Während die Agrarwissenschaftler über die Rolle von gentechnisch veränderten Kulturpflanzen für die Ernährungssicherung diskutieren (zur Ertragssteigerung und zur Steigerung des Nährwerts von Lebensmitteln), erkennt die Gruppe an, dass der Anbau gentechnisch veränderter Kulturpflanzen in der EU auf starke Widerstände stößt. In dieser Debatte wurden Befürchtungen wegen der Gefahren monopolistischer Marktstrukturen und der Risiken für die biologische Sicherheit geäußert. Die Gruppe erkennt an, dass die europäischen Rechtsvorschriften und die internationalen Verträge die EU zu einer wissenschaftlichen Risikobewertung verpflichten. Die Gruppe fordert eindringlich, dass dabei das Vorsorgeprinzip zum Tragen kommt, um sicherzustellen, dass bei allen Technologien die Gefahr „schwerer oder irreversibler Schäden“ gemäß dem 15. Grundsatz der Erklärung von Rio über Umwelt und Entwicklung vermieden wird⁽⁶⁾ und auch keine unerwünschten pleiotropen Effekte eintreten. Die Gruppe empfiehlt, die Verfahren für das Risikomanagement zu überarbeiten, um die Notwendigkeit einer Folgenabschätzung für alle neuen Technologien in vollem Umfang zu berücksichtigen (siehe Abschnitt 10.2.4). Bewertungen der Lebensmittelsicherheit und der Umweltverträglichkeit sollten daher Voraussetzung für die Genehmigung sein.

⁽⁵⁾ In Anlehnung an Turley et al. (2002) „Liquid Biofuels – Prospects and Potential Impacts on UK Agriculture, the Farmed Environment, Landscape and Rural Economy“, Bericht für das Ministerium für Umwelt, Ernährung und ländliche Angelegenheiten des Vereinigten Königreichs, Organics Forestry and Industrial Crops Division.

⁽⁶⁾ „Die Staaten müssen im Zweifelsfall dem Umweltschutz – auf breiter Front und entsprechend ihren Möglichkeiten – Vorrang geben. Besteht die Gefahr von schweren oder irreversiblen Schäden, so darf das Fehlen von letzter wissenschaftlicher Gewissheit nicht als Grund dafür benutzt werden, kosteneffektive Maßnahmen des Umweltschutzes aufzuschieben.“

Im Allgemeinen vertritt die Gruppe die Auffassung, dass landwirtschaftliche Technologien (?) in der EU nur dann unterstützt werden sollten, wenn sie zur Erreichung der in dieser Stellungnahme genannten Ziele beitragen und den hier genannten ethischen Kriterien genügen.

10.3.5. Forschung im Bereich der Agrarwissenschaften

Die Gruppe fordert die EU auf, die Mittel für Forschungen in den Bereichen Agrarwissenschaften, grüne Biotechnologien und in allen sonstigen Bereichen der nachhaltigkeitsorientierten Agrarforschung im Rahmen des Siebten Rahmenprogramms der Europäischen Gemeinschaft für Forschung (RP7) aufzustocken, um die von der Gruppe in dieser Stellungnahme unterstützten Ziele zu erreichen. Gleichzeitig glaubt die Gruppe, dass Europa die höchsten Wissensstandards in diesen Bereichen gewährleisten sollte (in den Bereichen Lebensmittelsicherheit, Lebensmitteltechnologie, Ernährungswissenschaft u. a.), um die Markteinführung neuer Produkte überwachen zu können. Die Forschung in diesen Bereichen sollte sowohl auf europäischer als auch auf Ebene der Mitgliedstaaten zum Nutzen der europäischen Verbraucher und Landwirte gefördert werden.

Die moderne Agrarforschung sollte einem integrierten Ansatz folgen. Dementsprechend sollte oberstes Ziel der Forschung im Bereich der Agrarsysteme einschließlich der Forschungen über die Interaktion zwischen den verschiedenen Feldfrüchten und der Umwelt (Pflanzensoziologie), über Landschaftsökologie usw. darin bestehen, einen optimalen solaren Nettoertrag in einer Form zu erzielen, die für Mensch und Umwelt von Vorteil ist. Besondere Maßnahmen sollten auch dazu dienen, die Abwanderung europäischer Forscher in diesem Bereich zu stoppen. Die Gruppe empfiehlt insbesondere, Mittel für Forschungen in folgenden Bereichen bereitzustellen:

- *Forschungen über Feldfrüchte, die für die Ernährungssicherung und für die europäischen Landwirte, die auf öffentliche Mittel angewiesen sind, wichtig sind, wie z. B. Weizen oder bestimmte Gemüsesorten des Mittelmeerraums. Dabei sollten die möglichen Auswirkungen des Klimawandels*

bewertet und vorrangig Ansätze gefördert werden, die dem Klimawandel entgegenwirken;

- *Forschungen über Feldfrüchte, die in Teilen der Welt wichtig sind, in denen die Ernährungssicherheit noch nicht gewährleistet ist, und über Merkmale, durch die sich in diesen Weltregionen Ertragssteigerungen erzielen lassen. Dabei sollte die wichtige Rolle, die die lokalen Kenntnisse in diesen Fällen spielen, anerkannt werden;*
- *Forschungen über die Erhaltung der biologischen Vielfalt von Pflanzenarten, die in der Landwirtschaft und für die Erhaltung des durch die Landwirtschaft gestörten ökologischen Gleichgewichts wichtig sind. Insbesondere sollte die Europäische Union die in der Welt und in Europa vorhandenen Saatgutbanken unterstützen, um die bestehende biologische Vielfalt zu erhalten;*
- *Forschungen über die Nutzung neuer Energien (z. B. Biogas und andere erneuerbare Energien) für landwirtschaftliche Maschinen und Geräte, die derzeit noch überwiegend mit fossilen Brennstoffen betrieben werden, als Antwort auf die vorhersehbaren Szenarien einer abnehmenden Verfügbarkeit von Erdöl.*

10.4. Verantwortungsbewusste Politikentscheidungen für den Pflanzenbau

Die Gruppe weiß, dass Ernährungssicherung und Nachhaltigkeit heterogene Fragen sind, bei denen zahlreiche Faktoren zusammenspielen müssen, um effiziente Lösungen zu erzielen. Eindeutige Lösungen, auch auf technischem Gebiet, sind schwer zu finden und müssen wissenschaftlich überprüft werden, aber Technologien können die Ernährungssicherung nachhaltig verbessern, wenn sie mit verantwortungsbewussten Politikentscheidungen und einer verantwortungsbewussten Umsetzung dieser Entscheidungen einhergehen. Die derzeitige Ernährungskrise und die zögerlichen Fortschritte bei der Erreichung der Millenniums-Entwicklungsziele der Vereinten Nationen in Bezug auf den Hunger in der Welt zeigen, wie wichtig es ist, alternative landwirtschaftliche Methoden zu fördern, mit denen sich die Ernährungssicherheit in der EU und in den anderen Weltregionen besser verwirklichen lässt.

(?) Andere Technologien, die die Ernährungssicherheit verbessern können, sind z. B. Technologien zur Steigerung der Ernteerträge, z. B. durch Doppelernte-Systeme usw.

Die Gruppe empfiehlt, dass die EU den Zugang zu geeigneten Infrastrukturen und Technologien in den Regionen fördert, in denen ein Anstieg der Nahrungsmittelherzeugung zur Lösung der Probleme von Hunger und Fehl- bzw. Mangelernährung beitragen würde. Wichtig ist, dass dabei die lokalen Gepflogenheiten und Kenntnisse respektiert werden. Die Konzeption, Durchführung und Förderung einer an ethischen Grundsätzen ausgerichteten Politik für die Primärerzeugung pflanzlicher Erzeugnisse ist ein komplexer Prozess, an dem viele verschiedene Akteure beteiligt sind (von den politischen Entscheidungsträgern bis zu den Verbrauchern und von internationalen Gremien bis zu den Mitgliedstaaten), von denen jeder Rechte und Pflichten hat.

10.4.1. Der globale Handel mit Agrarerzeugnissen: fairer und freier Handel und Handelshilfen (aid for trade)

In der Landwirtschaft haben nicht nur die Technologien starke ethische Implikationen, sondern auch der Handel und die handelspolitischen Rahmenbedingungen. Die Europäische Union leistet 60 % der öffentlichen Entwicklungshilfe weltweit ⁽⁸⁾, und trotzdem gibt es für etwa eine Milliarde Menschen auf der Welt keine Ernährungssicherheit. Die Gruppe unterstützt die wichtige Rolle, die die EU bei der Förderung der weltweiten Hilfe für die Ernährungssicherung in der gesamten EU und weltweit spielt. Die Gruppe unterstützt die Forderung der G20, an einer konstruktiven Einigung mitzuwirken, um die Doha-Runde im Rahmen der WTO zu einem erfolgreichen, raschen und entwicklungsfreundlichen Abschluss zu bringen. Die Gruppe ist sich auch bewusst, dass die EU bisher ein weltweiter Akteur im Agrarhandel sowohl als Importeur als auch als Exporteur von Agrarerzeugnissen war, und fordert sie daher dringend auf, bei ihrem weltwirtschaftlichen Agieren die Prioritäten Ernährungssicherung, Lebensmittelsicherheit und Nachhaltigkeit als ethische Prinzipien zugrunde zu legen.

Um die genannten Ziele zu erreichen, muss der globale Agrarhandel in einen ethischen Rahmen eingebunden werden. Dabei haben Solidarität, Gerechtigkeit sowie freier und fairer Handel mit Agrarerzeugnissen und Technologien Vorrang. Die Gruppe setzt sich daher dafür ein, dass die EU ein Marktsystem fördert, das Handelshilfen, fairen (geschützten) Handel und freien

Handel ⁽⁹⁾ umfasst, und betont die Bedeutung von Hilfen für die technologische Entwicklung entsprechend den Millenniums-Entwicklungszielen der Vereinten Nationen. Um diese Ziele zu erreichen, plädiert die Gruppe dafür, über einen neuen Rahmen für den Handel mit Agrarerzeugnissen nachzudenken, und fordert die politischen Entscheidungsträger, die Akteure und die internationale Gemeinschaft auf, die in den Erklärungen der EU und der VN verankerten ethischen Grundsätze und Menschenrechtsprinzipien zu berücksichtigen und entsprechend den Empfehlungen der EGE die Prioritäten Ernährungssicherung, Lebensmittelsicherheit und Nachhaltigkeit als ethische Ziele für den globalen Agrarmarkt vorzugeben.

Gemäß dem Gerechtigkeitsgrundsatz (siehe Abschnitt 9.12) empfiehlt die Gruppe, dass bei der Überarbeitung der Gemeinsamen Agrarpolitik einschließlich der Subventionen die Auswirkungen der europäischen Politik auf a) den Handel mit Europa und b) die lokale Agrarerzeugung in Ländern mit ungenügender Lebensmittelerzeugung und ungesichertem Zugang zu Lebensmitteln berücksichtigt werden sollten. Auf diese Weise könnte die EU eine wichtige Rolle bei der Förderung des fairen Handels spielen.

Die Gruppe ist nicht nur der Auffassung, dass die tier- und pflanzengesundheitlichen Standards für importierte Agrarerzeugnisse den im EU-Recht vorgesehenen Standards entsprechen sollten, sondern schlägt außerdem vor, dass die Grundsätze der GAP, wie Respekt der Verbraucherentscheidungen, Tierschutz, Erhaltung der biologischen Vielfalt sowie Umwelt- und Sozialverträglichkeit, auch als Grundlage für die Einfuhren von Agrarerzeugnissen in die EU dienen sollten. Dies sollte schrittweise auf multilateraler oder bilateraler Ebene umgesetzt werden.

10.4.2. System zum Schutz der Rechte an geistigem Eigentum

Die Gruppe unterstützt die Förderung von Innovation in der Landwirtschaft, äußert sich jedoch besorgt über die Auswirkungen der Patentierung landwirtschaftlicher Kulturpflanzen. Auch die Bestrebungen, die Verwendung von Saatgut durch Lizenzvereinbarungen zu kontrollieren, sind besorgniserregend. Die EGE emp-

⁽⁸⁾ Im Juni 2008 hat der Europäische Rat erneut bestätigt, dass die EU bis 2010 das gemeinsame Ziel von 0,56 % des BIP und bis 2015 das Ziel von 0,7 % des BIP erreichen wird.

⁽⁹⁾ Fairer und freier Handel ist ein marktbasierter Ansatz, bei dem Erzeuger aus Entwicklungsländern unterstützt und die Nachhaltigkeit gefördert werden, während der Handels- und Dienstleistungsverkehr nicht durch staatliche Eingriffe behindert wird.

fiehl, dass die EU eine Analyse der Verlagerung des Sortenschutzes von der UPOV-Regelung auf ein System von Patenten vornimmt und prüft, ob dies unter Umständen Innovationen effektiv blockiert.

Die Gruppe ist sich auch bewusst, dass Patente (vor allem) für neue Technologien vergeben werden und dass die Einführung dieser Technologien vor allem in Entwicklungsländern durch die hohen Kosten behindert werden könnte. Gemäß Artikel 16 der Richtlinie 98/44/EG des Europäischen Parlaments und des Rates sollten daher die Folgen berücksichtigt werden, die sich durch Patente in der Landwirtschaft (Produkte und Technologien) für die Entwicklungsländer ergeben. Um nützliche neue Entwicklungen in diesen Bereichen zu verbreiten, sollten gegebenenfalls Patentpools gebildet werden, die die Verfügbarkeit für die Landwirte in den Entwicklungsländern sicherstellen.

Kurzfristig empfiehlt die Gruppe, dass die Rechte der Landwirte, Saatgut zurückzubehalten und es, wo dies möglich ist, in den folgenden Jahren zu verwenden, geschützt werden, wobei Artikel 9 des Internationalen Vertrags über pflanzengenetische Ressourcen zu berücksichtigen ist ⁽¹⁰⁾.

10.4.3. Fairer Wettbewerb und „vertikale Monopole“

Die Gruppe fordert eine Überprüfung der europäischen und internationalen Mechanismen, die den fairen Wettbewerb zwischen privaten Unternehmen im Sektor Agrarerzeugnisse sicherstellen sollen, um die Auswirkungen von Vereinbarungen über den Austausch von Patenten und die vertikale Kontrolle in geeigneter Weise berücksichtigen zu können.

Insbesondere fordert die Gruppe eine Prüfung der Auswirkungen von Zusammenschlüssen von Unternehmen aus den Bereichen Saatguterzeugung, Getreidetransport und Lebensmittelhandel auf spezifische Lebensmittel und die Verbraucherpreise für diese Lebensmittel. Die Gruppe fordert Maßnahmen gegen faktische „vertikale Monopole“, bei denen ein Unternehmen die Erzeugung, Verarbeitung und Verteilung bestimmter Produkte kontrolliert.

Außerdem ist nicht klar, ob in diesem Fall der freie und faire Wettbewerb innerhalb Europas oder international weiterhin gewährleistet ist, wie in Abschnitt 9.15 ausgeführt. Die EGE fordert daher eine Überwachung des Agrarsegments und unterstützt eine Bewertung der Wirksamkeit der für derartige Monopole geltenden Regelungen.

⁽¹⁰⁾ <http://www.planttreaty.org/>.

10.4.4. Nahrungsmittelpreise

Als Ergebnis der Volatilität der Nahrungsmittelpreise ist der Zugang zu Grundnahrungsmitteln für Millionen von Bürgern in der EU und weltweit schwierig geworden. Die Volatilität und das Ungleichgewicht der Nahrungsmittelpreise haben weltweit zu sozialer und politischer Instabilität geführt. Die Gruppe fordert die Kommission daher auf:

1. *Daten über die für Preisschwankungen bei Nahrungsmitteln verantwortlichen Faktoren (von der Produktion bis zur Vermarktung) und über den Einfluss der Transport- und Distributionskosten zusammenzutragen;*
2. *transparente Finanzierungsmechanismen für die Stabilisierung der Lebensmittelpreise (sowohl nach oben als auch nach unten) zu nutzen und Maßnahmen zu konzipieren, um Preise bei einem drastischen Anstieg senken zu können;*
3. *die Interrelation zwischen Ernährungssicherung und Nachhaltigkeit in den Finanzmarktregelungen zu untersuchen und insbesondere zu prüfen, ob Finanzspekulationen die derzeitigen Schwankungen bei den Lebensmittelpreisen mit verursacht haben. Falls dies der Fall war, sollte die Kommission über Maßnahmen nachdenken, um mehr Transparenz zu verwirklichen und Nachhaltigkeit sowie stabile Märkte und Währungen zu garantieren, um die Millenniums-Entwicklungsziele besser zu erreichen (z. B. durch Einführung einer Steuer auf Finanztransaktionen).*

10.5. Gesamtgesellschaftliche Aspekte

Die Landwirtschaft ist einer der wichtigsten Politikbereiche in der EU und spielt für die Volkswirtschaften, den Arbeitsmarkt und die Bereitstellung sozialer Güter ⁽¹¹⁾ eine große Rolle. Die Politikgestaltung für diesen Sektor muss den gesellschaftlichen Bedürfnissen, Gütern und Erwartungen entsprechen. Unterschiedliche

⁽¹¹⁾ Die Agrar- und Ernährungswirtschaft trägt rund 7 % zur EU-Gesamtwirtschaft bei und beschäftigt rund 5 % der EU-Bevölkerung; auf Agrarerzeugnisse und Lebensmittel entfallen durchschnittlich 20 % der Verbrauchsausgaben der privaten Haushalte in der EU sowie ein hoher Prozentsatz des innergemeinschaftlichen Handels und der EU-Ausfuhren.

Lebensmittel und Ernährungsgewohnheiten sind exemplarisch für die Vielfalt in Europa und in der Welt und reflektieren die Verbrauchernachfrage sowie unterschiedliche Produktionsmethoden. Die Bedürfnisse und Entscheidungen der Verbraucher sind daher von zentraler Bedeutung für die Förderung und Entwicklung von Agrartechnologien. Da durch die Gemeinsame Agrarpolitik der EU der verbraucherorientierte Ansatz gestärkt wurde, fordert die Gruppe eine aktive Teilhabe der Zivilgesellschaft, der Landwirte und der übrigen Akteure an der Gestaltung der Politik und den Entscheidungen der EU für den Handel mit Agrargütern auf europäischer und internationaler Ebene. Die Gruppe fordert außerdem, dass die Belange des Gesundheitsschutzes und der Sicherheit (für die Bürger der EU, die Landwirte und die in der Lebensmittelproduktion und -verteilung beschäftigten Arbeitskräfte) von den zuständigen Einrichtungen der EU, wie in Artikel 152 des Vertrags von Amsterdam gefordert, in geeigneter Weise überwacht und bewertet werden.

Die Gruppe ist außerdem der Auffassung, dass der Handel mit landwirtschaftlichen Rohstoffen alle Akteure einbeziehen und transparent sein sollte (aktive Beteiligung der Verbraucher), dass er fair sein sollte (Respekt der Rechte der Arbeitnehmer und Beachtung des Gerechtigkeitsgrundsatzes) und dass er auf kulturelle Unterschiede Rücksicht nehmen sollte. Besondere Aufmerksamkeit sollte auch den Rechten der Wanderarbeitnehmer, der Kinderarbeit (siehe die Internationale Konvention zum Schutz der Rechte aller Wanderarbeitnehmer und ihrer Familienangehörige⁽¹²⁾) und das UN-Übereinkommen über die Rechte des Kindes⁽¹³⁾) sowie anderen Konventionen und Übereinkommen zum Schutz der Menschenrechte geschenkt werden.

10.5.1. Beteiligung der Öffentlichkeit

Ernährungssicherung und Ressourcenknappheit sind besorgniserregende Probleme. Nach Auffassung der Gruppe ist es daher ethisch wichtig, dass alle Akteure zusammenarbeiten. Erforderlich sind eine breite Beteiligung an der Politik und den Programmen und eine verstärkte demokratische Teilhabe von Vertretern der Zivilgesellschaft an den Verhandlungen über

den Welthandel mit Agrarerzeugnissen im Rahmen der WTO.

Die Gruppe fordert die Mitgliedstaaten auf, gezielte Maßnahmen zu ergreifen, um die Beteiligung der Öffentlichkeit an der Gestaltung der Politik für die Primärerzeugung von Nahrungsmitteln pflanzlichen Ursprungs zu erhöhen. Diese Debatte sollte mit Informationskampagnen über die Folgen von Ernährungsgewohnheiten (insbesondere des Fleischkonsums) für eine nachhaltige Lebensmittelproduktion verbunden werden, bei denen es um Themen wie

1. *Maßnahmen gegen die Verschwendung von Lebensmitteln,*
2. *die Förderung einer gesunden Lebensweise und*
3. *die verstärkte Sensibilisierung der Öffentlichkeit für landwirtschaftliche Produktionsmethoden und Technologien*

gehen sollte.

Die Gruppe fordert die in der Produktion, dem Transport und der Verteilung von Lebensmitteln tätigen Unternehmen auf, den in dieser Stellungnahme angesprochenen Werten bei ihren Maßnahmen im Bereich der Übernahme sozialer Verantwortung im und durch das Unternehmen (CSR-Maßnahmen) verstärkt Rechnung zu tragen.

Die Gruppe ist der Auffassung, dass die Einbeziehung der Zivilgesellschaft die Möglichkeit bietet, das Verantwortungsbewusstsein der Verbraucher zu stärken, und damit die Chance einer Beeinflussung des europäischen Lebensmittelmarktes in Richtung auf ein nachhaltigeres System eröffnet. Diese Bemühungen könnten z. B. die Behandlung landwirtschaftlicher Probleme im Ethikunterricht, Gärtner- und Kochkurse an den Schulen, Praktika und Besuche landwirtschaftlicher Betriebe sowie die Vermeidung und Wiederverwertung von Abfällen umfassen.

Die Gruppe empfiehlt, dass die Solidarität mit der „untersten Milliarde“, den Menschen also, denen nicht genügend Güter des Grundbedarfs zur Verfügung stehen, bei der Politikgestaltung und beim politischen Handeln auch künftig eine wichtige Rolle spielen sollte. Dies sollte in der Öffentlichkeit gefördert und anerkannt und in den Medien behandelt werden, damit es uns gelingt,

⁽¹²⁾ Internationale Konvention zum Schutz der Rechte aller Wanderarbeitnehmer und ihrer Familienangehörigen (1990), <http://www.un.org/documents/ga/res/45/a45r158.htm>.

⁽¹³⁾ UN-Übereinkommen über die Rechte des Kindes (1989) <http://www2.ohchr.org/english/law/crc.htm>.

das Ziel des Aufbaus einer Weltgesellschaft (siehe auch Abschnitt 9.1) zu erreichen.

10.5.2. Verantwortung der EU-Bürger

Ernährungsgewohnheiten beeinflussen die Nachhaltigkeit der Landwirtschaft. So hat nach einer neueren Studie der FAO ⁽¹⁴⁾ der hohe Verbrauch von Fleischprodukten Einfluss auf die primäre Agrarerzeugung, die Landnutzung sowie die Verschmutzung von Wasser und Umwelt. In diesem Kontext wäre die Aufklärung der Verbraucher über Gesundheitsfragen (gesunde Ernährungsgewohnheiten), die Qualität der Lebensmittel sowie Fragen der landwirtschaftlichen Nachhaltigkeit (Einführen von nichtsaisonalen Obst und Gemüse, Verschwendung von Lebensmitteln usw., siehe Abschnitt 4.7) nützlich und könnte einen wichtigen Beitrag zu Ernährungssicherung und Nachhaltigkeit leisten. Die Gruppe unterstreicht daher die besondere Verantwortung, die den Verbrauchern für die Ausrichtung des Marktes zukommt.

10.5.3. Verschwendung von Lebensmitteln

Das Konzept der Verschwendung von Lebensmitteln bezieht sich auf verschiedene Ebenen (Erzeugung, Lagerung, Transport, Verteilung und Verbrauch) und hat gravierende ethische Folgen für die soziale und distributive Gerechtigkeit. Wie in Abschnitt 4.8 dieser Stellungnahme angedeutet, hat das Phänomen der Verschwendung von Lebensmitteln besorgniserregende Ausmaße angenommen; die Gruppe ist sich bewusst, dass die Verschwendung von Lebensmitteln im Kontext der Ernährungssicherung, der Lebensmittelsicherheit und der Nachhaltigkeit eine wichtige Rolle spielt. Daher sollten geeignete Technologien entwickelt und in der modernen Landwirtschaft eingesetzt werden, um die Verschwendung von Lebensmitteln zu reduzieren und/oder Abfälle wiederzuverwerten. Die EGE schlägt außerdem die Durchführung quantitativer und qualitativer Analysen der Abfalldynamik auf nationaler und supranationaler Ebene vor und empfiehlt die Durchführung von Forschungen über die Optimierung der Abfallwiederverwertung.

11. Schluss

In dieser Stellungnahme hat die EGE wichtige ethische Fragen im Zusammenhang mit den modernen Entwicklungen in der Agrartechnologie erörtert, die bereits heute sichtbar oder vorhersehbar sind.

Entsprechend dem Ersuchen von Präsident Barroso hat die EGE einen ethischen Rahmen erarbeitet. Die Gruppe ist sich bewusst, dass es in diesem Bereich spezifische Themen gibt, die weiter und detaillierter erörtert werden müssen.

Die EGE unterstützt uneingeschränkt die auf dem Welternährungsgipfel der FAO 2008 angenommene Erklärung über Ernährungssicherheit ⁽¹⁵⁾ und fordert die EU und die Bürger auf, eine tragfähige Basis für eine nachhaltige und verantwortliche Agrarpolitik zu schaffen.

⁽¹⁴⁾ <http://www.fao.org/newsroom/en/news/2006/1000448/index.html> und <ftp://ftp.fao.org/docrep/fao/010/A0701E/A0701E00.pdf>.

⁽¹⁵⁾ Siehe Anhang I dieser Stellungnahme.

Annex I: 2008 FAO World Food Security Summit Declaration

DECLARATION OF THE HIGH-LEVEL CONFERENCE ON WORLD FOOD SECURITY:
THE CHALLENGES OF CLIMATE CHANGE AND BIOENERGY

We, the Heads of State and Government, Ministers and Representatives of 181 countries and the European Community, have met in Rome at this High-Level Conference convened by the Food and Agriculture Organization of the United Nations, together with the United Nations World Food Programme, the International Fund for Agricultural Development and Bioversity International on behalf of the CGIAR system, to seek ways of achieving world food security and, in this context, to address challenges of higher food prices, climate change and bioenergy.

1. We reaffirm the conclusions of the World Food Summit in 1996, which adopted the Rome Declaration on World Food Security and the World Food Summit Plan of Action, and the objective, confirmed by the World Food Summit: five years later, of achieving food security for all through an ongoing effort to eradicate hunger in all countries, with an immediate view to reducing by half the number of undernourished people by no later than 2015, as well as our commitment to achieving the Millennium Development Goals (MDGs). We reiterate that food should not be used as an instrument for political and economic pressure. We also recall the Voluntary Guidelines to Support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security. We reiterate that it is unacceptable that 862 million people are still undernourished in the world today.

2. We are here to address the challenges of bioenergy and climate change, and the current situation of soaring food prices that is having adverse impacts on food security, particularly in developing countries and countries in transition, all the more because the indications are that food prices will remain high in the years to come.

3. We are convinced that the international community needs to take urgent and coordinated action to combat the negative impacts of soaring food prices on the world's most vulnerable countries and populations. We are further convinced that actions by national governments, with the support of the international community, are required in the short, medium and long term, to meet global and household food security needs. There is therefore an urgent need to help developing countries and countries in transition expand agriculture and food production, and to increase investment in agriculture, agribusiness and rural development, from both public and private sources.

In adopting this Declaration, we pledge to embrace food security as a matter of permanent national policy, renew our commitment to achieving the World Food Summit objectives and the Millennium Development Goals, and commit ourselves to the following measures.

Immediate and Short-Term Measures

4. The global food situation calls for a strong commitment from governments as well as from all other stakeholders. We call upon all donors and the United Nations system to increase their assistance for developing countries, in particular least developed countries and those that are most negatively affected by high food prices. In the immediate future it is essential to proceed along two main lines.

5. The first line of action is to respond urgently to requests for assistance from affected countries.

- a) The relevant United Nations agencies should be assured the resources to expand and enhance their food assistance and support safety net programmes to address hunger and malnutrition, when appropriate, through the use of local or regional purchase.
- b) The appropriate regional organizations which have emergency food security arrangements should enhance their cooperation with a view to effectively cope with soaring food prices.
- c) All efforts by governmental and non-governmental organizations to strengthen immediate humanitarian and development assistance should be synergized with those of the multilateral organizations, and made coherent, to deal with the continuum from urgent to longer term assistance.
- d) All national and international efforts should be made to ensure that international emergency food assistance is delivered as quickly and efficiently as possible to populations in distress.
- e) To facilitate adjustment to higher food prices, donors and international financial institutions, in accordance with their mandates and in consultation with recipient countries, should provide in a timely manner, balance of payments support and/or budget support to food-importing, low-income countries. Other measures should be considered as necessary to improve the financial situation of the countries in need, including reviewing debt servicing as necessary. We also call on the relevant international institutions to simplify the eligibility procedures of existing financial mechanisms to support agriculture and environment.

6. The second line of action is immediate support for agricultural production and trade.

- a) All relevant organizations and cooperating countries should be prepared to assist countries, on their request, to put in place the revised policies and measures to help farmers, particularly small-scale producers, increase production and integrate with local, regional, and international markets. South-south cooperation must be encouraged.
- b) Development partners are invited to participate in and contribute to international and regional initiatives on soaring food prices and, in particular, under the FAO initiative launched on 17 December 2007, in support of country-led measures to give farmers in low-income food-deficit and the most affected countries access to appropriate locally adapted seeds, fertilizers, animal feed and other inputs, as well as technical assistance, in order to increase agricultural production.
- c) Development partners are called upon to undertake initiatives to moderate unusual fluctuations in the food grain prices. In particular, we call on relevant institutions to assist countries in developing their food stock capacities and consider other measures to strengthen food security risk management for affected countries.
- d) Members of WTO reaffirm their commitment to the rapid and successful conclusion of the WTO Doha Development Agenda and reiterate their willingness to reach comprehensive and ambitious results that would be conducive to improving food security in developing countries. Implementing an aid for trade package should be a valuable complement to the Doha Development Agenda to build and improve the trading capacity of the developing countries.

- e) We will strive to ensure that food, agricultural trade and overall trade policies are conducive to fostering food security for all. For this purpose we reaffirm the need to minimise the use of restrictive measures that could increase volatility of international prices.

Medium and Long-Term Measures

7. The current crisis has highlighted the fragility of the world's food systems and their vulnerability to shocks. While there is an urgent need to address the consequences of soaring food prices, it is also vital to combine medium- and long-term measures, such as the following:

- a) We urge national governments, all financial institutions, donors and the entire international community to fully embrace a people-centred policy framework supportive of the poor in rural, peri-urban and urban areas and people's livelihoods in developing countries, and to increase investment in agriculture.
- b) It is essential to address the fundamental question of how to increase the resilience of present food production systems to challenges posed by climate change. In this context, maintaining biodiversity is key to sustaining future production performance. We urge governments to assign appropriate priority to the agriculture, forestry and fisheries sectors, in order to create opportunities to enable the world's smallholder farmers and fishers, including indigenous people, in particular in vulnerable areas, to participate in, and benefit from financial mechanisms and investment flows to support climate change adaptation, mitigation and technology development, transfer and dissemination. We support the establishment of agriculture systems and the sustainable forest management practices that positively contribute to the mitigation of climate change and ecological balance.
- c) In addition, we reaffirm the Mauritius Strategy for the sustainable development of small island developing states and call for its implementation in the context of the challenges of climate change and food security.
- d) We urge the international community, including the private sector, to decisively step up investment in science and technology for food and agriculture. Increased efforts in international cooperation should be directed to researching, developing, applying, transferring and disseminating improved technologies and policy approaches. We urge Member States to establish, in accordance with the Monterrey Consensus, governance and policy environments which will facilitate investment in improved agricultural technologies.
- e) We encourage the international community to continue its efforts in liberalizing international trade in agriculture by reducing trade barriers and market distorting policies. Addressing these measures will give farmers, particularly in developing countries, new opportunities to sell their products on world markets and support their efforts to increase productivity and production.
- f) It is essential to address the challenges and opportunities posed by biofuels, in view of the world's food security, energy and sustainable development needs. We are convinced that in-depth studies are necessary to ensure that production and use of biofuels is sustainable in accordance with the three pillars of sustainable development and takes into account the need to achieve and maintain global food security. We are further convinced of the desirability of exchanging experiences on biofuels technologies, norms and regulations. We call upon relevant intergovernmental organizations, including FAO, within their mandates and areas of expertise, with the involvement of national governments, partnerships, the private sector, and civil society, to foster a coherent, effective and results-oriented international dialogue on biofuels in the context of food security and sustainable development needs.

Monitoring and Review

8. We request the Food and Agriculture Organization of the United Nations, in close partnership with WFP and IFAD and other relevant international organizations, including those participating in the High-Level Task Force on the Global Food Crisis and in collaboration with governments, civil society and the private sector, to monitor and analyse world food security in all its dimensions — including those addressed by this Conference — and to develop strategies to improve it.

9. In realizing the contents of the measures above, we stress the importance of the effective and efficient use of the resources of the United Nations system, and other relevant international organizations.

We firmly resolve to use all means to alleviate the suffering caused by the current crisis, to stimulate food production and to increase investment in agriculture, to address obstacles to food access and to use the planet's resources sustainably, for present and future generations.

We commit to eliminating hunger and to securing food for all today and tomorrow.

Rome, 5 June 2008

This Declaration was adopted by the High-Level Conference on World Food Security: the Challenges of Climate Change and Bioenergy, on 5 June 2008. On the adoption of the Declaration, statements were made by Argentina, Cuba and Venezuela, which will be included in the Report of the High-Level Conference.

Annex II: History of WTO negotiations on agricultural commodities

Doha Round negotiations (DDA)
<p>2003 in Cancún: Talks to forge agreement on the objectives of this round failed, due to a deep North/South divide on agricultural issues. Developing nations gained strength, forming two new negotiating groups — the G20, consisting of middle-income developing countries, and the G90 group of poorer developing countries — and finally rejecting the deal which they viewed as unfavourable.</p>
<p>2004 in Geneva: WTO members agreed a framework for continuing talks. The EU, USA, Japan and Brazil agreed to end all agricultural export subsidies, reduce trade-distorting subsidies and lower tariff barriers. Developing nations consented to reduce tariffs on manufactured goods, reserving the right to protect key industries.</p>
<p>2005 in Hong Kong: The initial objective was to conclude a final agreement at this conference, but too little progress was made by then to do so. Instead, a deal was struck in which rich nations agreed to allow quota- and tariff-free imports from all least developed countries (LDCs) and 2013 was set as the deadline for ending agricultural export subsidies.</p>
<p>2006 in Geneva: Last-ditch talks in July 2006 failed to produce an agreement on reducing farm subsidies and lowering tariffs, prompting WTO chief Pascal Lamy formally to suspend the Doha Round.</p>
<p>2007 in Davos: Trade ministers from around 30 key nations agreed, on 27 January, to restart negotiations.</p>
<p>2008 in Geneva: Trade ministers failed to reach agreement on global trade in agricultural products.</p>

(http://ec.europa.eu/commission_barroso/mandelson/speeches_articles/sppm214_en.htm)

Annex III: Most common GMOs

GM soybean

The first genetically modified (herbicide-resistant) soybeans were planted in the United States in 1996. Ten years later, GM soybeans were planted in nine countries covering approximately 58.6 million hectares. Over half of the world's 2007 soybean crop (64 %) was genetically modified, a higher percentage than for any other crop. Every year, the EU Member States import approximately 15 million tonnes of soy material, primarily for use as feed. Soybeans are also used to produce tofu, miso, soy sauce and many food additives. In 2006, 236 million tonnes of soybeans were produced worldwide. The world's leading soybean producers are the United States (37 %), Brazil (25 %), Argentina (20 %) and China (7 %). Large-scale, commercial plantations of genetically modified soybeans can also be found in India, Paraguay, Canada, Romania and South Africa.

GM maize and MON810

Bt maize is maize that has been genetically modified to produce an insecticide (the Bt toxin). The transferred gene comes from the soil bacterium *Bacillus thuringiensis* (Bt) and produces a non-toxic protein that, once ingested by certain insects, is converted into a toxic form that kills the pest. Unlike many chemical insecticides, Bt toxin is harmless to humans and is broken down fairly quickly. In organic farming Bt preparations are frequently used to protect plants by spraying them rather than introducing a genetic modification in the plants themselves.

The main Bt maize varieties used around the world are those with resistance to the corn borer. This small grey-brown moth is a major maize pest found in all maize-growing areas in southern and south-eastern European countries. Since the 1960s the corn borer has been spreading northwards and has now reached the Baltic coast. In regions with high levels of corn borer infestation farmers can avoid using plant protection products to combat the corn borer by introducing the appropriate GM maize variety. Another effect of Bt maize is that it has a lower contamination rate with fungal toxins. Research has shown that Bt maize plants usually contain fewer mycotoxins than conventional maize plants.

Bt maize is cultivated on a large scale mainly in the USA, where in 2007 the area under Bt maize rose to 18.4 million hectares. Bt maize is also grown on an appreciable scale in Canada, Argentina, South Africa and the Philippines. In Europe cultivation of Bt maize has increased steadily in recent years, covering 110 000 hectares in 2007, which equals around 1 % of the total area under maize.

Annex IV: The causes of food price increases

Causes of price fluctuations/increases
<p>Rapidly growing demand in developing countries and emerging market economies ⁽¹⁾. For example, world coarse grain production grew by an average rate of 1.24 % a year from 1997 to 2006, but consumption in developing countries grew by 2.37 % a year over the same period. High global GDP growth increases consumption (demand for more meat and dairy consumption, which is grain-intensive). Coarse grain consumption for livestock feed increased by 2.54 % a year in the developing world, compared with just 0.43 % in the developed world.</p>
<p>Crop shortfalls in 2005/06 due to droughts in some major producer countries (Australia and USA) led to low stocks ⁽²⁾ in 2006/07. Also, with climate change and changes in weather patterns, some researchers forecast an increase in the variability of crop output and a gradual decline in some regions.</p>
<p>Demand for biofuels is often perceived as a major driving force behind prices. Further substantial increases in demand are projected, however, in the next 10 years or so under the existing biofuels mandates, to around 110 million tonnes of maize for US biofuels and 45 million tonnes for the EU. Other countries have also introduced, or plan to introduce, biofuels mandates.</p>
<p>The introduction of export taxes in major exporting countries, especially for rice and wheat, has been a major factor in the rapid escalation of prices ⁽³⁾.</p>
<p>Price volatility on food markets has attracted speculative investors, with commodity and hedge funds becoming leading players.</p>
<p>Agricultural prices have become more linked to energy prices. First, energy price-sensitive products such as fertilisers, pesticides and machinery are key inputs into the production process. Second, the growing importance of biofuels is tending to strengthen the correlation between energy and food prices. This structural link between food and energy markets is likely to continue and to gain strength in future.</p>
<p>The long-term decline of food prices relative to other products over the last couple of decades has caused a shift in investment away from agriculture and into other sectors.</p>

(1) OECD/FAO projections forecast a slowdown in consumption growth, especially in developing countries; that remains uncertain, however.

(2) Although crop production recovered in 2007, this was barely enough to meet the increased demand and left little to replenish stocks. As a result, the stock situation remains precarious for most agricultural commodities with world corn and barley inventories at 20+-year lows and wheat inventories at 31-year lows.

(3) If a significant exporter announces an export tax, it reduces supply on the market and makes the situation more difficult for other market operators and increases their incentive also to introduce an export tax.

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