AGRICULTURE AND THE GREEN ECONOMY

The global demand for food, feed and fibre is projected to grow by 70 % until 2050. Meeting this demand is likely to increase the pressures from agriculture on water, air and soils, with potentially big impacts on biodiversity and the climate. What does this mean for Europe? This paper analyses the options for gearing European agriculture to the future needs in view of the current reform of the EU Common Agricultural Policy (CAP).

European Environment Agency

Summary

Green economy is high on the policy agenda under the umbrella of the European Union's 2020 growth strategy and in the outcome of the Rio 2012 global conference on sustainable development (*). It is all about realising economic growth and maintaining social cohesion without damaging the environment. The unprecedented global demands for e.g. food, fibre, energy and water, makes it imperative to use our natural resources much more efficiently and maintain the ecosystems from which natural resources are sourced. A flagship initiative for increasing resource efficiency has been launched under the EU 2020 strategy that addresses these issues.

Agriculture production is naturally a big factor here. Covering roughly half of Europe's land territory, it is fundamental to dynamic rural communities and food security, while having substantial positive and negative impacts on soils, water and air quality, biodiversity and landscape amenity value. The consumption side of the green economy also has implications for agriculture production since the EU would be wise to reduce its meat consumption and food waste in view of growing global food demand and ethical concerns about wasteful consumption and the EU's high ecological footprint.

The reform of the EU Common Agricultural Policy (CAP) is a timely opportunity to provide a coherent set of interventions that address these challenges. The European Commission has proposed a number of 'greening measures', including obligatory crop rotation, grassland maintenance, and more specific agri-environment measures, aimed at climate change mitigation and biodiversity conservation. Whilst these proposals are a step in the right direction, they do not sufficiently address the resource efficiency of European agriculture in terms of productivity, water use, carbon capture, external inputs like nutrients and pesticides and ecosystem resilience.

The trade-offs between different CAP interventions and other policy areas (e.g. climate, nature protection) are complex and require careful consideration. A transition towards innovative low-input systems (employing e.g. organic and precision farming techniques) appears on balance the best way forward. Such a major transition will in any case require powerful policy interventions beyond the 2020 horizon in tandem with green economy, climate, ecosystem resilience and other policy actions.

* http://www.un.org/en/sustainablefuture/

Agriculture and the green economy

Introduction

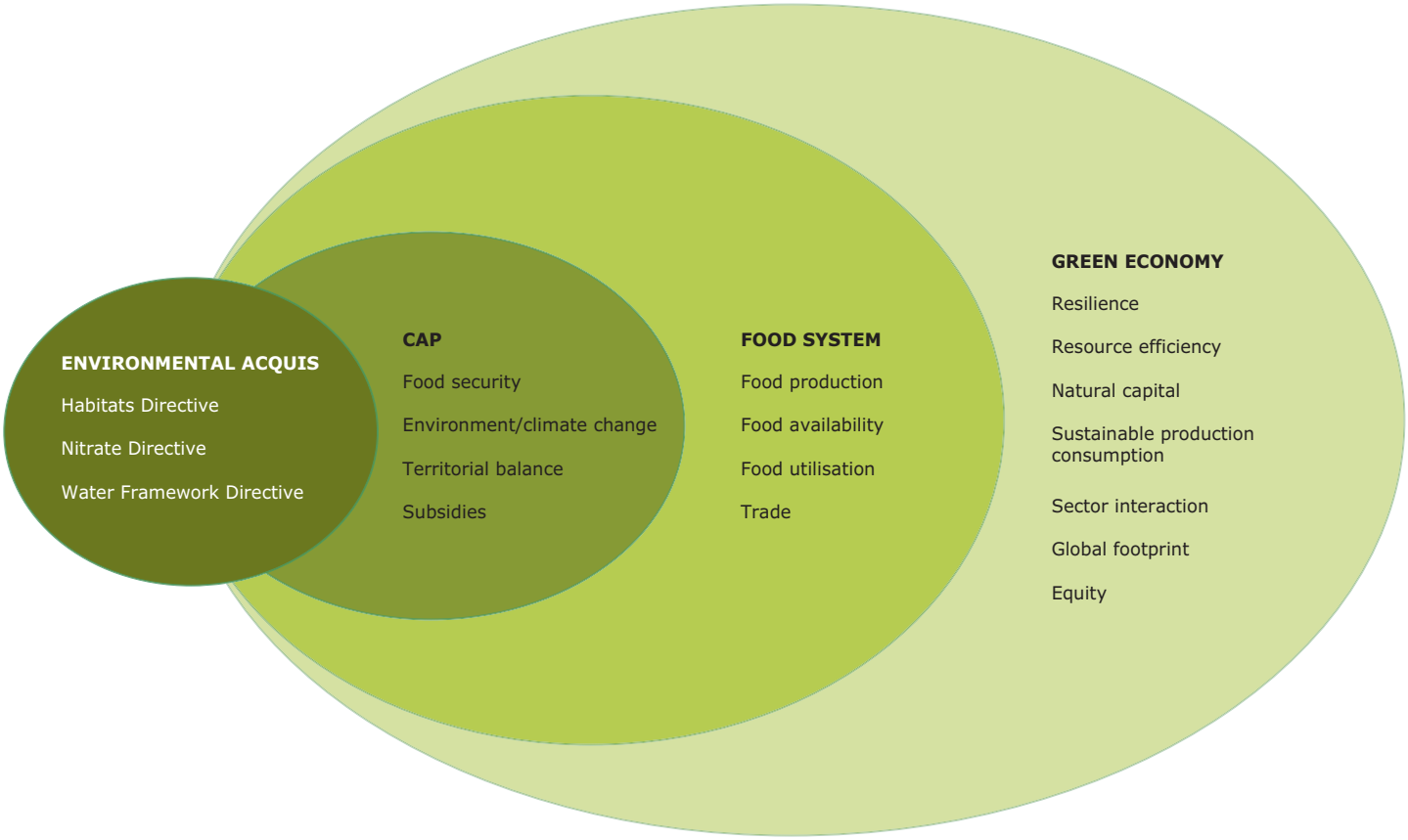
The concept of a green economy recognises that ecosystems, the economy and human well-being are intrinsically linked. At the core of a green economy are twin challenges; a) ensuring *ecological resilience* of natural systems and b) improving *resource efficiency*. Natural capital is not only of interest from an ethical point of view, but vital for the long-term sustainability of our economic activities. In turn, increasing resource efficiency is not only desirable from an economic point of view; it is also a necessity to reduce the pressure on the natural ecosystems that sustain us.

In line with the findings of the European Environment Agency's (EEA) most recent 'State of the environment report' in late 2010, increasing resource efficiency and maintenance of natural capital are core elements of the EU 2020 growth strategy. The corresponding Resource Efficiency Roadmap provides milestones to be reached by 2020, including a 20 % reduction in the food chain's resource inputs by 2020.

The agricultural sector is obviously an important player here and can be expected to become more so in the future in the face of increased demands for food, fibre and energy. Covering roughly half of Europe's land territory, agriculture production has a substantial impact on soils, water and air quality, biodiversity and landscape amenity value. The on-going reform of the Common Agricultural Policy (CAP) provides an opportunity to increase the sector's resource efficiency and environmental performance. As a policy addressing the agricultural sector, the CAP can be seen to sit within a wider framework consisting of wider food system and green economy consideration on one side, and environmental legislation (notably the Bird and Habitats Directives and the Water Framework Directive) on the other (see Figure 1).

This paper discusses the potential of the current CAP reform in view of the wider context of Figure 1 and how that can steer a transition towards sustainable agriculture in Europe in the face of unprecedented global megatrends. The analysis takes a system perspective with natural resources as a starting point, zooming in on food security and environmental concerns, and ultimately reflecting on long-term intervention strategies.

Figure 1 Agricultural policy in context



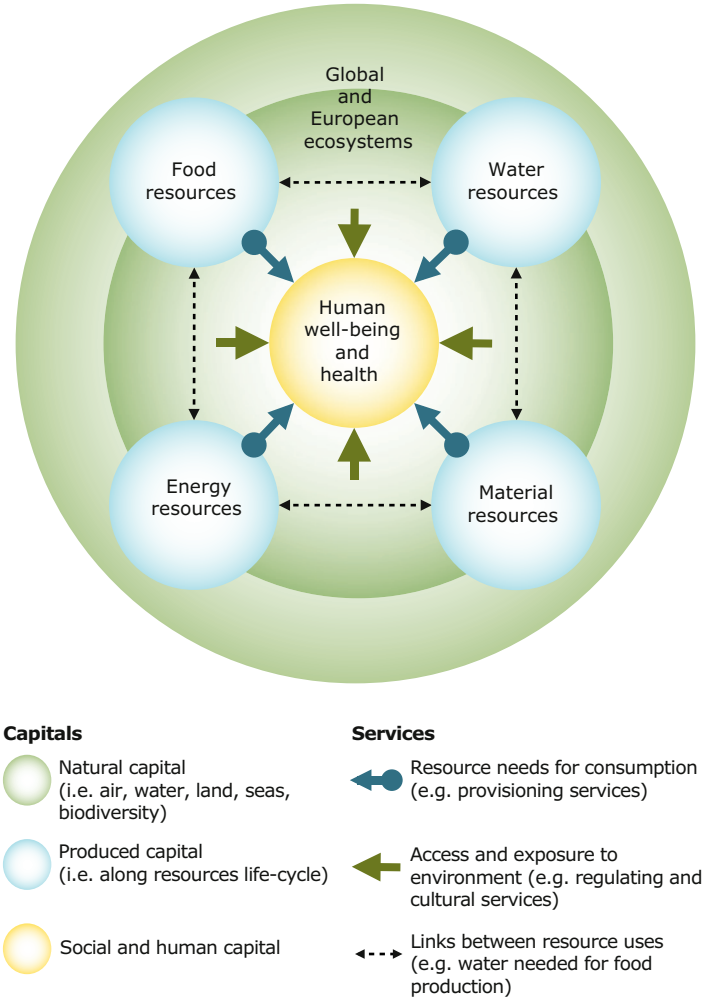
Natural resources

Human society relies for its health and well-being on four basic categories of natural resources: food, water, energy and other materials including fibre, minerals and synthetic chemicals. Increasing resource efficiency is high on the EU political agenda ([1, 2]). At the global level, food, water and energy systems are becoming increasingly vulnerable. Global demand for energy and water is projected to rise by 40 % over the next 20 years if no major policy changes are implemented. The food system may well be the most vulnerable of all. Total demand for food, feed and fibre is projected to grow by 70 % until 2050, with the area of arable land per person decreasing by 1.5 % per year if no major policy changes are initiated ([3]).

The use of these different resources is strongly interdependent, with food and bio-energy production for example requiring land, energy and water resources. Indirect linkages through pressures on the environment also occur, for example where pesticides and fertilisers used in agriculture pollute drinking water reservoirs. Footprint issues come into play where production processes are outsourced to areas outside Europe, with global environmental feedbacks, such as climate change. Our multiple resource requirements thus often involve complicated trade-offs (Figure 2).

Increasing resource efficiency potentially has economic as well as environmental benefits. The profitability of the agricultural sector may be increased if the reliance on costly resources (land, water, energy, chemicals) can be reduced. The environment may also benefit, for example from reduced chemical and nutrient surpluses, itself with potential economic spin-offs (reduction of external costs). Such a 'win-win' is particularly obvious for phosphorus fertilisers, which are produced from phosphate rock, a non-renewable resource that may become limiting in a few decades ([4]).

Figure 2 Use of natural resources



Note: Food, water, energy and material resources are vital to human society. The way they are secured affects human health and well-being directly, as well as indirectly through impacts on the environment.

Food security

To meet a growing global food and fodder demand, one can opt for increasing yields through intensification and/or for extending the land base for agricultural cultivation. Intensification and concentrating food production in the most productive regions may appear the most efficient way to use the land. However, risks to food security may be increased, because supply chains become more vulnerable and because of pollution. Loss of crop diversity, decline of pollinators and increased vulnerability of monocultures to diseases are additional stress factors. On the other hand, regional or local self-sufficiency and the reliance on extensive farming systems would require more cultivated land at the expense of natural habitats.

It is not enough to only increase total food production. The food must also be locally available, affordable and meet quality standards. The distribution channels and trade patterns are key in this respect. As long as we can afford to import food from other parts of the world, European food security may not seem to be at immediate risk, regardless of our support to European agriculture. But the choices we make will affect trade and global food security, as well as availability of local food products, with implications for chain control, food safety and other quality concerns. Currently, the EU is by and large self-sufficient for cereals, butter and beef ([5]), but a big net-importer of fodder for domestic livestock production.

([1]) http://europa.eu/rapid/pressReleasesAction.do?reference=SPEECH/10/118.
([2]) http://europa.eu/press_room/pdf/complet_en_barroso___007_-_europe_2020_-_en_version.pdf.
([3]) http://www.eea.europa.eu/soer/europe-and-the-world/megatrends.
([4]) http://www.pbl.nl/sites/default/files/cms/publicaties/PBL-EU-Resource-Efficiency-Perspectives_web.pdf.
([5]) http://ec.europa.eu/agriculture/capexplained/record/index_en.htm.

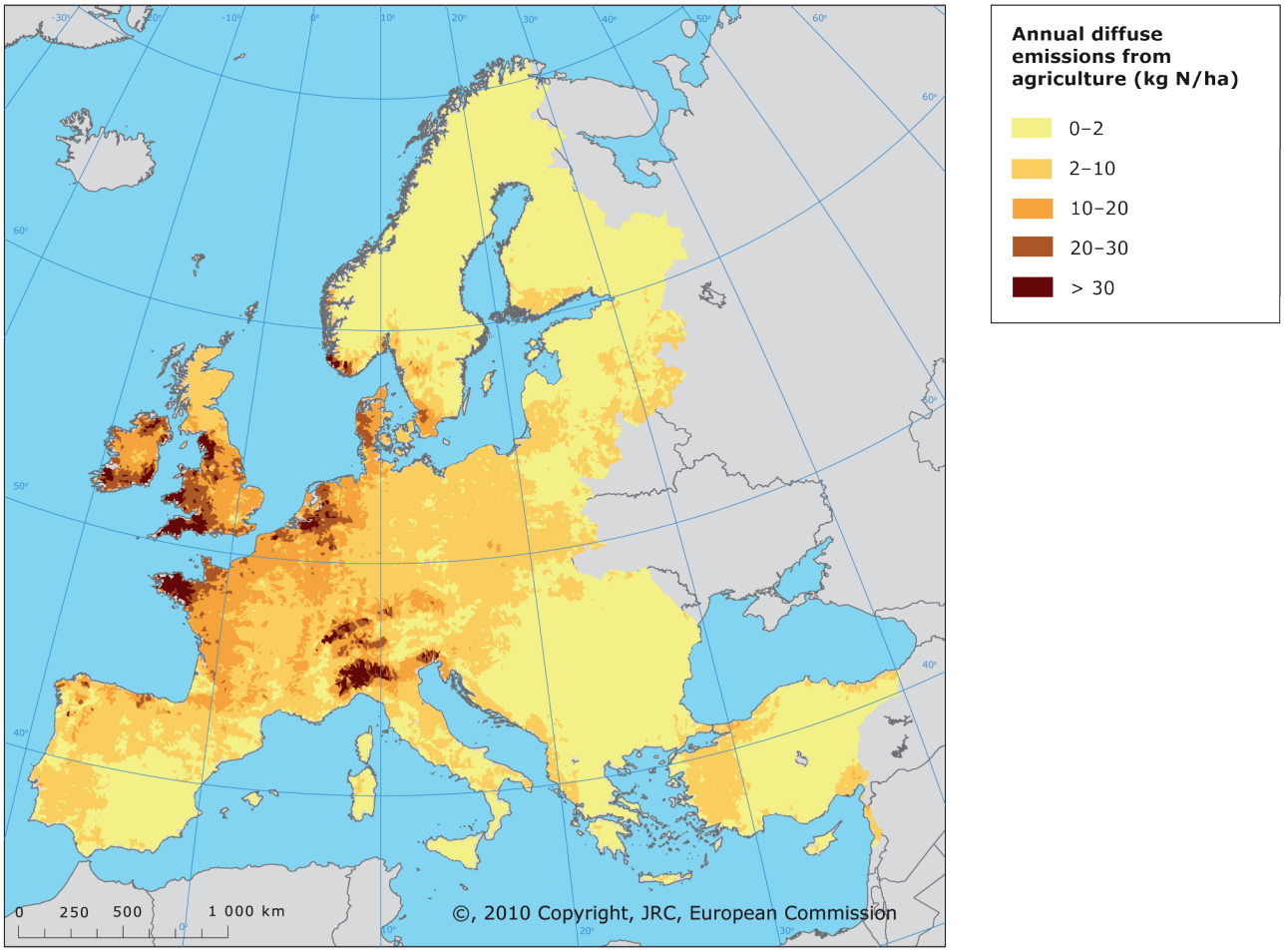
Finally, food security can be tackled from the consumption perspective, for example by looking at the efficiency gains from changing diets. Livestock production is more than six times as inefficient as crop production in terms of protein output, and hence meat diets are associated with higher land take and nutrient losses ([6]). Efficiency gains can also be achieved through waste reduction in households and in the distribution chain. Based on data from Eurostat and national data, it has been estimated that around 89 million tonnes or 181 kg per person of food waste was generated in the EU-27 in 2006, of which 42–43 % was from households, 39 % from manufacturing and the rest from other sources including retailers, wholesale and the food service sector (but excluding agricultural waste). A recent study showed that in the United Kingdom an estimated 137 kg/person or 25 % of food purchased by households ends up as waste ([7]).

Environmental concerns

Agriculture is one of the main sectors affecting the environment through its direct impacts on land cover and ecosystems, and on global and regional cycles of carbon, nutrients and water ([8, 9]). At the global level, agriculture contributes to climate change through emission of greenhouse gases and reduction of carbon storage in vegetation and soil. Locally, agriculture reduces biodiversity and affects natural habitats through land conversion, eutrophication, pesticide inputs, irrigation and drainage. Unsustainable agricultural practices may also lead to direct environmental feed-backs such as soil erosion and loss of pollinators (because of excessive pesticide application).

Nutrient loading (mainly by phosphorus and nitrogen) is a major and increasing cause of biodiversity loss and ecosystem dysfunction ([10]). Most detailed information

Map 1 **Diffuse emissions of nitrogen to freshwater from agriculture**



Source: EEA 2010. *The European environment — state and outlook 2010: freshwater quality*, European Environment Agency.

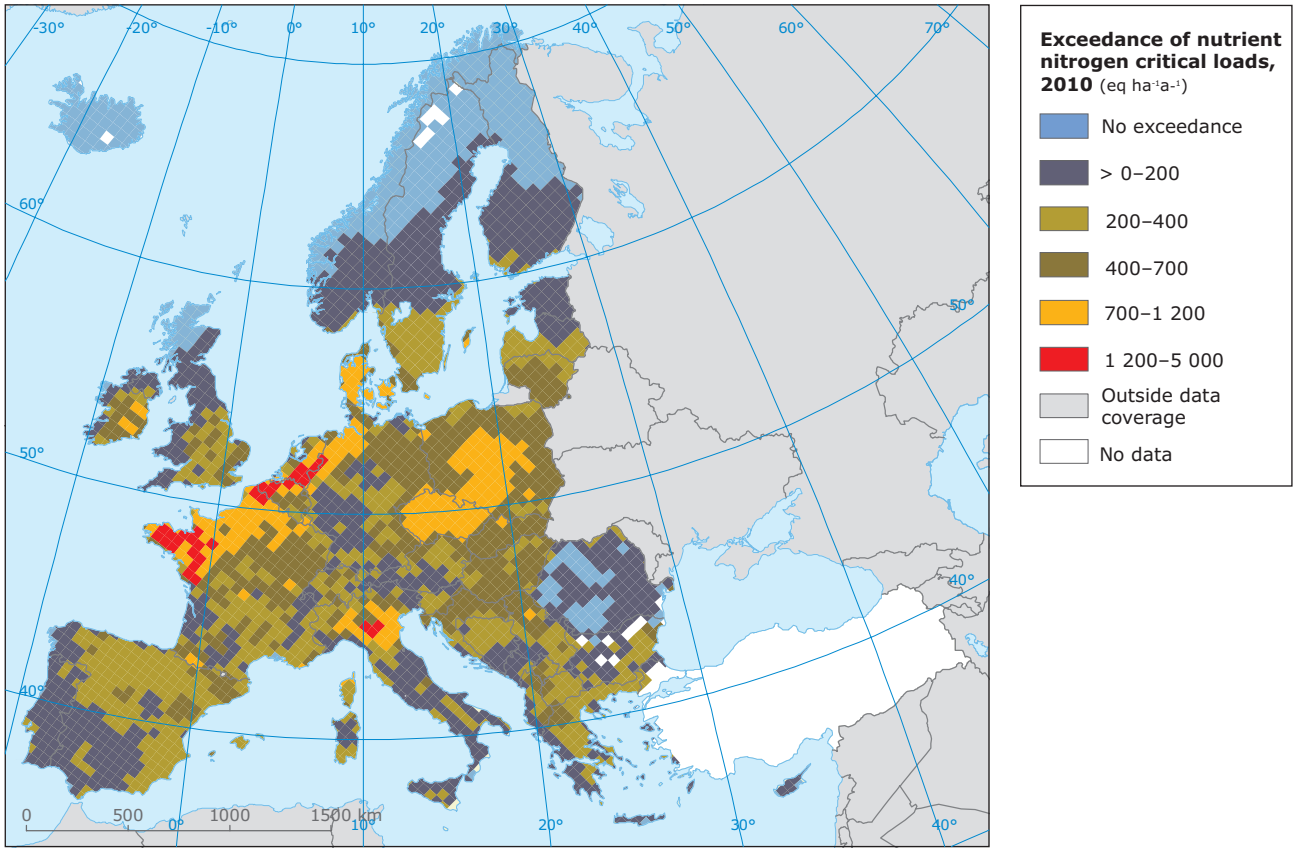
([6]) PBL, 2011. The protein puzzle. The consumption and production of meat, dairy and fish in the European union.
([7]) http://www.eea.europa.eu/soer/europe/consumption-and-environment.
([8]) http://www.eea.europa.eu/publications/eea_report_2006_2.
([9]) http://www.eea.europa.eu/soer/synthesis/synthesis.
([10]) http://www.eea.europa.eu/publications/eu-2010-biodiversity-baseline.

is available for nitrogen. Estimates show that the total amount of reactive nitrogen in the environment has doubled globally since the pre-industrial era, and more than tripled in Europe ([10]). This is primarily due to fossil fuel combustion and the application of industrially produced nitrogenous fertilisers. Excess reactive nitrogen causes air pollution and eutrophication of terrestrial, aquatic and coastal ecosystems. Agriculture contributes 50–80 % of the total nitrogen load transported into Europe's freshwater ecosystems and, ultimately, coastal waters and seas (Map 1) ([11]).

Despite substantial reductions in nitrogen pollution from key polluting sectors and sources over the last two decades, critical nitrogen loads are still being exceeded throughout much of Europe. It is estimated that in 2010 more than 40 % of sensitive terrestrial and freshwater ecosystem areas were subject to atmospheric nitrogen deposition above the critical loads (Map 2) ([12]).

The environmental pressures from agriculture are reflected in loss of natural capital. The conservation status of agricultural habitats protected under the Habitats Directive is worrying and considerably worse than average. Only 7 % of the assessments showed a favourable conservation status compared to 17 % for all habitat types. Half of the agricultural habitats are considered to be in a bad status. Lake and river ecosystems fare slightly better, but their conservations status is also worse than average. As for the marine environment, all habitats in the North Sea and the Baltic Sea are considered to be in a bad or inadequate state ([13]).

Map 2 **Exceedance of the critical nitrogen loads for eutrophication in Europe (as average accumulated exceedances)**



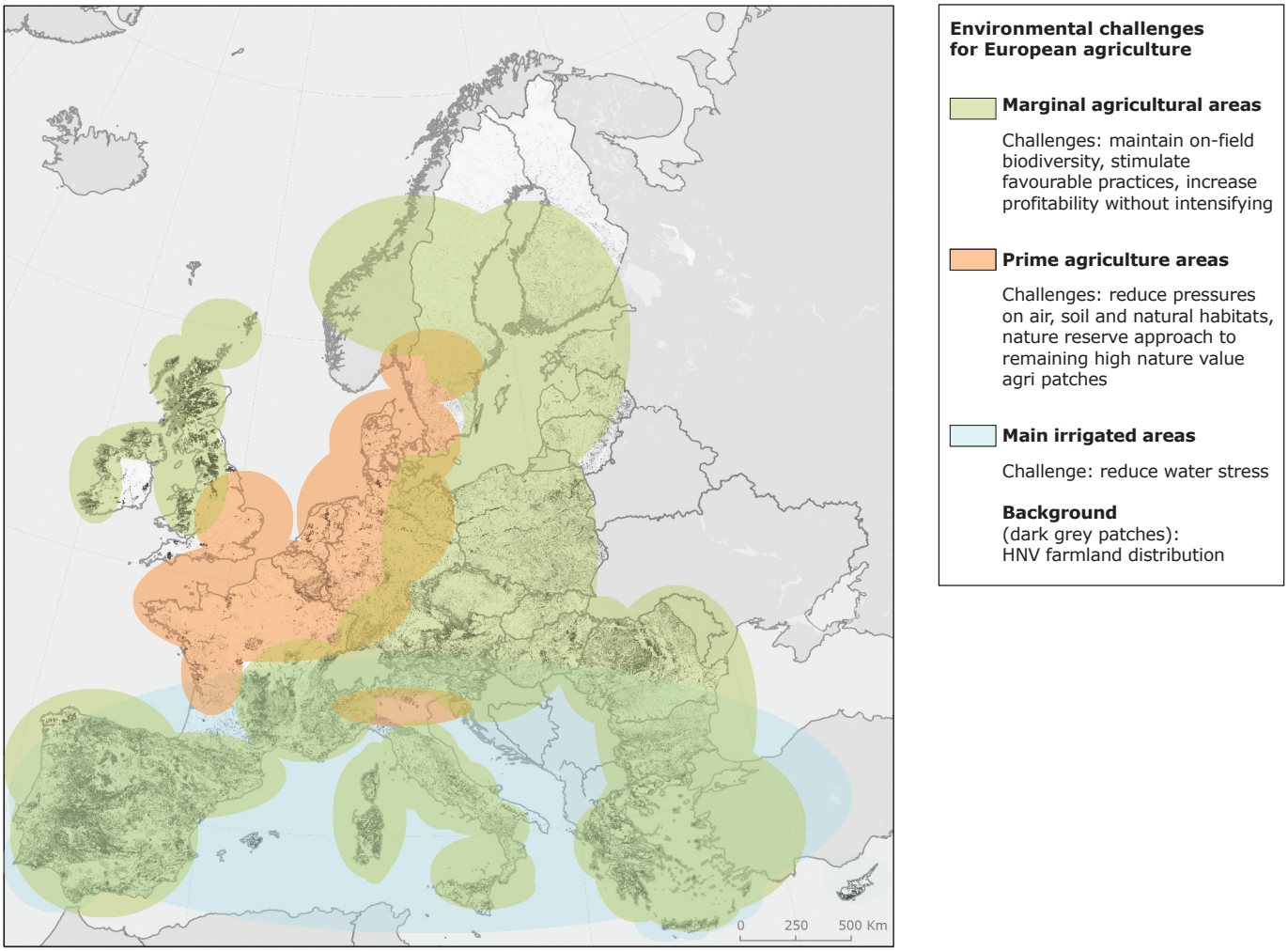
Note: Figures for 2010 are model based and were computed using the 2008 Critical Loads Database hosted by the Coordination Centre for Effects (CCE).

A critical load is defined as 'a quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge' (UNECE, 2004, http://www.unece.org/env/lrtap/WorkingGroups/wge/definitions.html).

Source: CSI-005 indicator, based on Hettelingh et al., 2008 (http://www.pbl.nl/en/publications/2009/Critical-load-dynamic-modelling-and-impact-assessment-in-Europe-CCE-Status-Report-2008).

([11]) http://www.eea.europa.eu/soer/europe-and-the-world/megatrends.
([11]) http://www.eea.europa.eu/soer/europe/freshwater-quality.
([12]) A critical load is defined as 'a quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge' (UNECE, 2004).
([13]) http://www.eea.europa.eu/publications/eu-2010-biodiversity-baseline/.

Map 3 Environmental challenges for European agriculture



On the other hand, agriculture may also contribute to the maintenance of species-rich semi-natural habitats. Conservation of this 'high nature value farmland', primarily found in mountainous areas and other regions of low productivity, is an explicit goal of EU biodiversity and agriculture policy ([14]). Many of the species listed under the Bird and Habitat Directives occur on farmland (some almost exclusively) and many of the targeted habitats are semi-natural and depend on continued (extensive) agricultural management. Conserving these extensive farming systems is increasingly difficult because of socio-economic constraints (lifestyle changes, demographic trends, economic marginalisation).

'**Greening**' the CAP

The pressures and benefits from agriculture pose an intervention dilemma. Extensification would benefit semi-natural habitats and reduce local pressures on soil, water and air but increase the area needed for agricultural production. Intensification would achieve the opposite. At the global level, an average yield increase would help to avoid further deforestation, but if the yield increases would be associated with further increasing pollution and disturbance of the nutrient cycle (by mineral N fertiliser inputs), the overall situation might still deteriorate. There is thus a trade-off between reducing environmental pressures at field level through extensification and maintenance of natural (uncultivated) areas at landscape level. This has direct implications for biodiversity (notably semi-natural and natural habitats), and indirectly for delivery of ecosystem services (including carbon capture and water retention).

The current CAP reform proposals up to 2020 address environmental challenges by coupling agricultural subsidies to stricter cross-compliance with environmental legislation and 'greening measures': compulsory crop diversification and maintenance of permanent grassland and ecological landscape elements. These measures would cover approximately 7 % of the farmland ('ecological focus areas') and would be financed under

([14]) http://www.eea.europa.eu/publications/distribution-and-targeting-of-the-cap-budget-from-a-biodiversity-perspective.

the first (production-oriented) pillar. This general regime would be flanked by specific agri-environment measures under the second pillar (rural development) ([15]).

Ex-ante studies indicate a mildly positive effect on the environment, and much will depend on the actual implementation of the measures. Annual European greenhouse gas emissions are estimated to go down by 2 %, but this figure does not take any compensatory mechanisms (increase imports) into account. The crop rotation and permanent grassland measures are not expected to affect agricultural practice much, as many farmers already apply the prescribed crop rotation and much grassland is not suitable for ploughing up anyway ([16]). The grassland measure could even be counter-productive in the short time if farmers anticipate the new regulations by ploughing up some existing grassland before 2014 (the baseline year for grassland maintenance). On top of that, the current implementation of cross-compliance and agri-environment schemes is criticised by the EU Court of Auditors ([17, 18]), pointing out that goals and measures are weakly related and that the environmental benefits are unclear.

Long-term perspectives

A more ambitious and long-term approach would explicitly address resource efficiency of the agricultural sector in terms of productivity, land take, carbon capture, water use and dependence on mineral fertilisers and pesticides. This would imply an overarching logic regarding the desired intensity of agriculture, with regional differentiation where appropriate. 'Green' agriculture — relying on the use of on-farm resources rather than on external mineral inputs — is advocated by the UNEP as a general development model, combining productivity increase with economic and environmental gains. This appears particularly relevant for developing countries, where the potential for further productivity gains in low-input systems is considerable ([19]). Transforming the major food production areas in the world into low-input systems, however, would be a major operation, affecting productivity and food prices and potentially impacting global food security. For example, only about 4% of European farmland is currently under organic production ([20]), and its average yield loss compared to conventional systems is estimated at around 20–25 % ([21]).

([15]) http://ec.europa.eu/agriculture/cap-post-2013/index_en.htm.
([16]) http://www.pbl.nl/en/publications/2012/greening-the-cap-an-analysis-of-the-effects-of-the-european-commission%E2%80%99s-proposals-for-the-common-agricultural.
([17]) http://eca.europa.eu/portal/pls/portal/docs/1/1918222.PDF.
([18]) http://eca.europa.eu/portal/pls/portal/docs/1/8772726.PDF.
([19]) http://www.unep.org/greeneconomy/Portals/88/documents/ger/GER_2_Agriculture.pdf.
([20]) EEA SEBI 020 indicator.
([21]) PBL, 2011. The protein puzzle. The consumption and production of meat, dairy and fish in the European union. http://www.fao.org/fileadmin/user_upload/animalwelfare/Protein_Puzzle_web_1.pdf.

A long-term transition towards more sustainable agriculture systems, employing innovative production methods and emission reduction measures, seems nevertheless called for ([22, 23]). Precision farming and organic practices, combining crop rotation and non-chemical crop protection, could increase overall efficiency in terms of land take, water use and nutrient management. Still being aimed at optimising yields, such an approach would improve the quality of soil, water and air with indirect benefits for biodiversity. Further improvements in the ecological infrastructure of the farmed landscape would result from measures already included in the CAP reform proposals, such as small-scale set-aside, conservation headlands and hedgerow maintenance. Long-term benefits regarding, for example, pollination and biological disease control may outweigh the immediate overall productivity loss of such measures.

Maintaining high nature value farming is a special challenge in this context. Due to socio-economic pressures, many of the remaining high nature value (HNV) farmland areas can be expected to lose much of their character in the coming decades, despite current levels of financial support. A more targeted intervention may prevent such decline, at least regionally. Areas combining geophysical constraints (preventing intensification) with a varied rural economy (providing alternative sources of income, e.g. from tourism, and options for part-time employment) appear to offer the best perspectives for HNV farmland conservation.

The consumption side of the equation should not be neglected here. Dietary shifts, more effective distribution chains, and food waste prevention, for example, could potentially compensate for yield penalties associated with more sustainable production methods. Support to low-input (e.g. organic) farming would thus have to be flanked by measures to promote consumption changes and efficiency gains in the food chain.

Towards a new intervention logic

Suggestions for change:

1 **Increase the resource efficiency of European agriculture**
Food security is best protected by reducing the overall ecological impact of European agriculture. This implies a fundamental shift towards more ecological approaches and an increase of overall resource efficiency in terms of external chemical inputs, water and energy use, land take and waste generation. CAP support and other measures should provide incentives for such efficiency gains.

2 **Use the diversity of European agriculture**
The diversity of European agriculture provides different opportunities. There is scope for intensive and innovative production systems (particularly in peri-urban settings) as well as extensive systems with high associated natural and cultural values. Different situations require different tools and approaches. The CAP should therefore be firmly embedded in a broader rural development perspective.

3 **Pay farmers for ecosystem services**
The clarity and direction of the CAP can be improved by paying farmers for the delivery of ecosystem services, rather than providing unspecified direct payments and only compensating them for costs incurred in mitigating environmental impacts.

4 **Support a shift in consumption patterns**
Big efficiency gains can be expected from dietary shifts (less meat consumption) and food waste reduction. The CAP should be embedded in a wider food system perspective, also addressing distribution and consumption. The food distributors and retailers play a key role here. Tax incentives and consumer campaigns can be appropriate instruments.

The bottom line

The current CAP reform proposals are a step in the right direction in support of a green economy transition, but their positive effects will probably remain limited in the face of a wide range of social, economic and environmental global megatrends. A more ambitious approach to the resource efficiency of European agriculture is needed that will, inter-alia, deliver benefits for many other policies like nature protection, climate change mitigation, sustainable consumption, and human health. Precision-farming techniques and organic practices have a lot of potential in this respect. In view of growing global demand for food, fibre and energy, reducing our meat consumption and food waste is probably also wise to support transition to these more sustainable production methods. Such a transition will require powerful and coherent policy interventions beyond the horizon of the 2014–2020 CAP.

([22]) http://ec.europa.eu/research/agriculture/scar/pdf/scar_feg3_final_report_01_02_2011.pdf.
([23]) Jonathan A. Foley, Navin Ramankutty, Kate A. Brauman, Emily S. Cassidy, James S. Gerber, Matt Johnston, Nathaniel D. Mueller, Christine O'Connell, Deepak K. Ray, Paul C. West, Christian Balzer, Elena M. Bennett, Stephen R. Carpenter, Jason Hill, Chad Monfreda, Stephen Polasky, Johan Rockström, John Sheehan, Stefan Siebert, David Tilman & David P. M. Zaks, 2011. Solutions for a cultivated planet. Nature, Vol. 478, pp. 337–342.

TH-31-12-196-EN-N
doi:102800/6337

The Green CAP project

EEA's Green CAP project has addressed two main challenges underlying the current reform of the CAP reform: 'greening' the agriculture sector (reducing environmental impacts) and ensuring food security. A panel of external experts was invited to reflect on these challenges and to explore long-term intervention strategies. The panel discussions were organised as a participatory workshop, facilitated by Prospex and with content support and reporting contributions by the Stockholm Environment Institute. The expert panel outcomes are summarised in a highlights report ([a]).

Apart from the expert panel outcomes, the project has built on analyses by EEA and JRC (in particular the FATE project ([b]), SOER 2010 ([c]) and HNV farmland analyses ([d]), a discussion paper for the EEA Management Board ([e]), and a background study by the Stockholm Environment Institute ([f]).

The project findings as presented in this paper are informed by the expert panel discussions, but they are published under the sole responsibility of the EEA and cannot be attributed to the expert panel as a collective, nor to individuals.

Invited experts:

Ariel Brunner (Birdlife International, Belgium), **Henriette Christensen** (Pesticide Action Network Europe, Denmark), **Claire Collyer** (Country Land and Business Association. United Kingdom), **Sanne van den Dungen** (Environmental Protection and Encouragement Agency, Germany), **Koen Overmars** (PBL, the Netherlands), **Nat Page** (Fundatia Adept, Romania), **Laszlo Podmanizcky** (Svent Istvan University, Hungary), **Andrea Povellato** (National Institute of Agricultural Economics, Italy), **Jaroslav Pražan** (Research Institute of Agricultural Economics, Czech Republic), **Tanja Runge** (COPA-COGECA, Germany), **Peter Smeets** (WUR, the Netherlands), **Vyara Stefanova** (ENFCP, Bulgaria), **Jean-Michel Terres** (JRC, Italy) , **Mark Thomasin-Foster** (European Landowners Organisation, United Kingdom)

Facilitators:

Marc Gramberger and Martin Watson (Prospex, Belgium)

Content support and reporting:
Marcus Carson, Neil Powell and Kim Andersson (SEI, Sweden), Tommaso Chiamparino (Prospex, Belgium)

Note:
([a]) http://www.eea.europa.eu/themes/agriculture/greening-agricultural-policy/green-cap-expert-panel-highlights
([b]) http://fate.jrc.ec.europa.eu/rational/home.
([c]) http://www.eea.europa.eu/soer.
([d]) http://agrienv.jrc.ec.europa.eu/publications/pdfs/HNV_Final_Report.pdf
http://www.eea.europa.eu/publications/distribution-and-targeting-of-the-cap-budget-from-a-biodiversity-perspective.
([e]) http://www.eea.europa.eu/themes/agriculture/greening-agricultural-policy/green-cap-first-phase-report
([f]) Available on request.

European Environment Agency
Kongens Nytorv 6
1050 Copenhagen K
Denmark

Tel.: +45 33 36 71 00
Fax: +45 33 36 71 99

Web: eea.europa.eu
Enquiries: eea.europa.eu/enquiries

ISBN 978-92-9213-340-5

European Environment Agency