The potential impact of a greener CAP on developing countries

Nicola Cantore

November 2012

Acknowledgements

This paper forms part of a wider research programme on CAP reform funded by the Bill & Melinda Gates Foundation. The findings and conclusions contained within are those of the author and do not necessarily reflect the positions or policies of the funder. The author is grateful got comments and suggestions from Alan Matthews, Dirk Willem te Velde, Michael Bruentrup and Sheila Page.

Author

Nicola Cantore
Overseas Development Institute
203 Blackfriars Road
London SE1 8NJ
United Kingdom

Overseas Development Institute
203 Blackfriars Road
London SE1 8NJ
United Kingdom

Tel: +44 (0)20 7922 0300
Fax: +44 (0)20 7922 0399
www.odi.org.uk

Contents

Tables & figures

Tables

Figures

Abbreviations

CAP	Common Agricultural Policy
CDM	Clean Development Mechanism
DECC	UK Department of Energy and Climate Change
DEFRA	UK Department for Environment, Food and Rural Affairs
EEA	European Environment Agency
EC	European Commission
EU	European Union
GAEC	Good Agricultural and Environmental Conditions
GDP	Gross Domestic Product
GTAP	Global Trade Analysis Project
IMF	International Monetary Fund
IPCC	Inter-governmental Panel on Climate Change
PEA	Potential Eligible Area
RDP	Rural Development Programme
SCC	Social Cost of Carbon
UK	United Kingdom
US	United States

Abstract

In the current context, it is vital to think about appropriate modalities to combat global warming and encourage sustainable growth over time. The recent discussion on reforming the Common Agricultural Policy (CAP) in order to protect biodiversity and preserve the rural environment requires us to consider whether coordinated agricultural policies in Europe can contribute to the provision of environmental common public goods, for example by reducing harmful emissions.

This paper examines the consequences of proposals to green the CAP for developing countries. When the new greening measures are binding and change the behaviour of EU farmers, this will reduce the production of European Union (EU) farmers in the short run, which could lead to increased commodity prices. This in turn would stimulate exports from developing country producers (by up to 3% for certain countries and commodities) but harm food-importing countries. In the medium to long term, a reduction in emissions would reduce damage resulting from climate change in developing countries.

Overall, the impacts are very uncertain, but we estimate that, in the most optimistic hypothesis, the environmental gain in 2014 from a CAP greening emission reduction would be about 3% of what the EU currently spends on aid; if farmers continue with CAP greening environment-friendly practices until 2023 it would represent around 25% of aid. Of course, given that the greening of the CAP is beneficial, this begs the question as to whether the greening of agriculture could be achieved without the CAP, and indeed whether the CAP is needed at all – because it is not the only or even the best instrument to achieve the goal of preserving the rural environment. Moreover, emission reduction activities could actually take place in developing countries, given that they have the world's highest potential for emissions abatement in agriculture. In this regard, the Clean Development Mechanism (CDM) could present a means to move beyond current activities to include most land-use activities.

1 Introduction and options for greening the CAP

The Common Agricultural Policy (CAP) is reformed from time to time. A new structure is expected to be agreed by the end of the year, outlining ways forward after 2013. While Cantore et al. (2011) focus on the general relationship between the CAP, CAP reform and development, this paper analyses options to green the CAP.

Many factors are driving proposals for the reform of the CAP from 2014 onwards. These include a concern regarding the legitimacy of Pillar 1 and an acceptance of the need to change the basis of Pillar 1 direct payments away from the current model, to reform crucial sectors such as the sugar market and to find ways of addressing the environmental challenges facing Europe to meet the European Union (EU)'s ambitious targets on biodiversity and climate. Possible green measures fall under both Pillar I and Pillar II of the CAP.

Possible greening measures in Pillar I fall under four categories (EC, 2011a):

Green cover: The term 'green cover' is used to describe a situation where arable land that would normally be bare at certain times of the year is given a temporary plant cover so as to avoid the negative environmental effects of leaving soil bare. The main functions of green cover are erosion control; improvement of soil quality and soil organic matter content; flood prevention; and prevention of nitrogen[1] runoff and pesticide drift and runoff. In addition, green cover helps avoid the loss of phosphorus from the soil surface, therefore avoiding depletion of phosphorus as a nutrient as well as water pollution by phosphorus.

Crop diversification is a planned and ordered sequence of cultivating species of different botanical families that are grown in succession in the same field. The first crop is often used to prepare and regenerate the soil (e.g. legumes or grasslands), and the second crop or sequence of crops benefits from the fertility of the regenerated soil. The current CAP proposal is that the main crop should not exceed 70% of the arable and open-air horticultural area, and the third most important crop should comprise not less than 5% (to ensure crop diversification). Crop diversification may not bring about the full environmental benefits of crop rotation, but is better suited to Pillar I than to Pillar II as an annual measure.

Permanent pasture: This measure could entail an obligation to maintain all permanent pasture or the ratio between permanent pasture and arable land at the individual farm level (EC, 2011a). Protecting permanent grassland is a priority for biodiversity policy and climate change mitigation, but it is also good for water quality (although less so in intensive dairy production with very high fertiliser use), flood prevention, protecting vulnerable soils from erosion and increasing organic matter in the soil. Considerable benefits for biodiversity (in particular on high nature value grassland) relate to water regulation and soil protection.

The new permanent pasture proposal would be an update of the previous European law establishing an obligation to maintain the ratio of permanent pasture at Member State/regional level under Article 6(2) of Regulation (EC) 73/2009. Its wording suggests that the new CAP reform should not increase the amount of land devoted to pasture grassland, but simply allow for more in-depth monitoring at the farm level rather than at the national level.

Set-aside is land left fallow for environmental purposes, for example a certain percentage of each holding. Leaving some land uncultivated can increase biodiversity (through more heterogeneous habitats, an increase in species, habitat connectivity), enhance natural resources (reducing diffuse pollution by nitrogen, phosphorus and plant protection products, preventing soil erosion, improving water quality) and help fight climate change (through a reduced need for fertilisers, increased soil organic matter and water retention).

The Ciolos proposal[2] of October 2011 excluded consideration of the green cover and expanded the set-aside option by incorporating a broader concept (ecological focus area), including field margins, hedges, trees, fallow land, landscape features, biotopes, buffer strips and afforested area.

As outlined by the EC (2011f), rural development policy, which comes under **Pillar II**, is currently the major EU funding instrument in support of environmental land management. It operates on the basis of multiannual programming with Member States/regions assuming responsibility for shaping the policy in their territory or territories. Under the framework of strategic guidelines that set out common priorities at EU level, Member

1 A negative side effect of legumes green cover could be the flushing of nitrogen into the groundwater.
2 See http://ec.europa.eu/agriculture/cap-post-2013/legal-proposals/index_en.htm

States design and co-finance rural development programmes (RDPs) tailored to their specific needs; there are 94 national and regional programmes operating in the current (2007–13) period.

Pillar II is composed of four axes:

- **Axis 1:** Improving the competitiveness of agriculture and forestry (e.g. farm investments, support to producer groups, training actions);
- **Axis 2:** Improving the environment and the countryside (e.g. agro-environment measures compensating land managers for the provision of eco-system services, measures targeting the sustainable use of forestry);
- **Axis 3:** Promoting economic diversification and quality of life in rural areas (e.g. basic services for the rural population, business creation and development); and
- **Axis 4:** The denominated LEADER initiative, aimed at implementing local development strategies through public–private partnerships ('local action groups') and inter-territorial or transnational cooperation projects. The strategies, which are applied to clearly designated rural areas, must achieve the objectives of at least one of the three preceding axes through such local action groups.

The current proposal repackages the existing four axes into six priorities (fostering knowledge transfer and innovation; enhancing competitiveness; promoting food chain organisation and risk management; restoring/preserving and enhancing ecosystems; promoting resource efficiency and the transition to a low-carbon economy; and promoting social inclusion/poverty reduction/economic development in rural areas) and proposes the allocation of 25% of funds to Pillar II over the 2014–20 period (EC, 2011g).

EC (2011c) examines the possible impacts of the CAP reform on developing countries, identifying three aspects in this respect: domestic support, export subsidies and restrictions on access. It does not mention the possible impacts of the greening measures. This paper fills this gap; in particular, on the basis of the EC's CAP reform impact analysis, we investigate the economic and environmental impacts of the CAP's greening and their effects on growth in poor and/or developing countries. While recent contributions analyse the impact of the greening of the CAP on greenhouse gas emissions and biodiversity (Westhoek et al., 2012) and the policy implications of the greening of the CAP (Matthews, 2012), this paper focuses on the economic effects of the greening of the CAP in developing countries.

The structure of this paper is as follows. Section 2 discusses the EC's impact assessment scenarios. Section 3 analyses the impact of green Pillar I measures on developing countries and Section 4 the ways in which Pillar II measures could affect developing countries. Section 5 concludes.

2 The EC impact assessment of green measures

Both Pillar I and Pillar II CAP proposal reforms contain environmental measures. Annex 2 of the CAP reform impact assessment clearly explains the differences between Pillar I and Pillar II green measures: 'In selecting the measures for the greening component consideration is needed to strike the right balance between what is best achieved by broad-brush effective and easy to control annual requirements in Pillar I and the more targeted, multi-annual and locally tailored approach of rural development' (EC, 2011a). Another crucial distinction is that Pillar II requires co-financing by Member States.

The EC considers four scenarios: the status quo; the Integration Scenario; the Adjustment Scenario; and the Refocus Scenario as summarised in Table 1. The status quo is a baseline.

Table 1: Impact assessment analysis – salient greening characteristics of EC scenarios

Scenario	Explanation
Status quo	Baseline scenarios
Integration Scenario	1. Enhanced cross-compliance, including improvements in the Good Agricultural and Environmental Conditions (GAEC) to better address climate change, as well as inclusion of the Water Framework Directive. 2. Introduction of green Pillar I measures (crop diversification, green cover, permanent pasture, set-aside), including a specific top-up for Natura 2000. 3. Reinforced strategic targeting in Pillar II, with the environment and climate change as guiding considerations.
Adjustment Scenario	1.Enhanced cross-compliance, including improvements in the GAEC to better address climate change, as well as inclusion of the Water Framework Directive once implemented. 2. Moderate increase in the Pillar II budget with the additional resources available for the same 'new challenges' as in the Health Check (climate change, water, biodiversity, renewable energy and innovation).
Refocus Scenario	1. Doubling of Pillar II payments targeted at climate change.

Source: EC (2011a).

The Adjustment Scenario is particularly relevant for the analysis of the direct payments system and is subdivided into three further sub-scenarios, defined as the EU flat rate and the Min 80% and the Min 85% scenarios. In the EU flat rate scenario, an EU flat rate for payments per hectare is calculated by dividing the total available budget for direct payments by the total potential eligible area (PEA). This is the maximum redistribution among member countries. The Min 80% and Min 85% scenarios assume less radical redistributions of direct payments across Member States.

In the Integration Scenario, the proposal is that 30% of the direct payments budget will be used for payments to farms undertaking greening measures. Payments would be granted at a flat rate per hectare of PEA. To assess whether a farm meets the criteria for payment, the EC takes into consideration the four green measures: green cover, crop diversification, ecological set-aside and preservation of grassland. Additionally, farms in Natura 2000[3] areas must prevent any deterioration of species and habitats of Community importance. For example, there are strict limits on how much farmers can intensify their production systems. The EC impact assessment contains estimates of the costs and other market consequences for the EU market, price, etc., related to this scenario. In particular, the Integration Scenario contains specific estimates of the impact of Pillar I green measures. This paper focuses on Pillar I greening through a numerical analysis complementing the EC's modelling of the scenario.

Under the Refocus Scenario, the EC assumes additional Pillar II payments would be partly offset by additional costs for the implementation of environmental measures. Simulation results of the scenario are difficult to use in complementary analyses because they also derive from the further assumption that direct payments are phased out. Analysis of Pillar II is conducted here through a conceptual discussion.

3 The Natura 2000 network – the EU-wide network of Special Areas of Conservation under the Habitats Directive and Special Protection Areas under the Birds Directive – is the centrepiece of EU nature and biodiversity policy. It is not a network of strictly protected areas but one of areas providing space for species and habitats of Community importance.

The orientation of the Ciolos reform towards the redistribution of direct payments across Member States and the consideration of green measures suggests the EC is interested in the Adjustment Scenario and the Integration Scenario.

3 Impact on developing countries of greening measures under Pillar I of CAP

EC (2011d; 2011e) analysis of the green measures highlights two main effects: economic and environmental.

3.1 Economic effects of Pillar I greening

The economic effect of implementing the greening of Pillar I is the sum of two effects:

- The effect on markets;
- The effects from implementation costs (either direct costs or the costs of non-realised profits).

Agricultural markets: *Ecological set-aside* forces farmers to reduce production, which leads to a drop in supply and an increase in prices. *Crop diversification* also affects prices because farmers have to adapt their crop production patterns, which also leads to a change in the level of prices and in relative prices. The effect of crop diversification, however, is more limited because the total cultivated area is not changed overall. According to the EC (2011b), before taking into account the direct cost of the greening measure, the market effect of its implementation is an increase of European farm income by 0.6%, as the price increase more than compensates for lower production.

Greening costs: Matthews (2011a) suggests that the cost of greening will amount to €33/ha of PEA in 2020 (Table 4 below). Of this, half is the opportunity cost of permanent grassland (€17/ha PEA). This suggests that the total cost of greening to EU farmers would amount to approximately €5 billion, assuming a PEA of around 160 million ha. Matthews estimates that greening measures would be equivalent to an increase in input costs of a little over 2% on average. The cost increase is greater than the income increase. The EC (2011a) estimates that the greening initiative would result in a decrease in average income per worker[4] of between 3.2% and 1.4%.

The EC (2011e) also estimates that EU15 wheat prices might increase by 3%, beef prices by 7%, barley prices by 12% and rice prices by 39%.[5] The relatively large increase in the price of rice owes to the ecological set-aside requirement, which would result in a reduction in the area planted with rice by around 8%.

The EC impact assessment does not discuss in depth the consequences of these European price changes at world level, and in particular those for developing countries. As Figure 1 illustrates, an increase of commodity prices in Europe increases the world price and therefore the incentive to export for producers in developing countries.

We adopt a simple methodology to estimate the broad impact on exports. For the sake of simplicity, we consider the group of low-income countries to analyse the extent to which the poorest countries could gain from the CAP greening. We estimate the impact of price increases deriving from greening measures on exports on the basis of country-specific export supply elasticities as provided by Tokarick (2010)[6] and on the basis of world price variations deriving from European price changes as estimated by the EC. We assume that European prices do not influence other export prices, so the impact on the world price is simply the weighted average of the share of European exports at world level and the change in EU prices P_{EU} $\Delta P_{world} = \Delta P_{EU} * \frac{EXP_{EU}}{EXP_{world}}$.

4 Income per worker is measured with using farm net value added per annual work unit. For further details see EC (2011a).
5 Even though not explicitly explained in EC (2011e), these numbers refer to output value per ha, which we interpret as price, as greening will have only a very minimal impact on yields.
6 We acknowledge that our simple methodology is rough because it adopts elasticities of exports supply that do not differentiate across commodities but only across countries. This is because of constraints in the information contained in the literature. We take values of elasticity calculated by Tovarick (2010) on the basis of an average of the 2001 and 2004 Global Trade Analysis Project (GTAP) parameter values used to feed his model.

The share of European exports is calculated on the basis of estimates of European and world exports in 2014 obtained using simple linear trends of historical data over the period 1997–2009. Table 2 presents results concerning the two countries that, according to FAOSTAT, showed the highest level of exports in the group of least-developed countries in 2009 for a specific commodity. Tovarick (2010) suggests that all countries have a positive elasticity of exports to world prices, with values increasing according to gross domestic product (GDP) per capita (a 0.63 mean in low-income countries vs. a 1.19 mean in high-income countries). These findings show that all countries would gain from the EU price increase deriving from the CAP greening, even though low-income countries would gain relatively less than high-income countries. The numbers in Table 2 are useful for understanding (albeit approximately) the magnitude of these gains for poor countries.

Figure 1: The link between green European agricultural policies and economic effects in developing countries

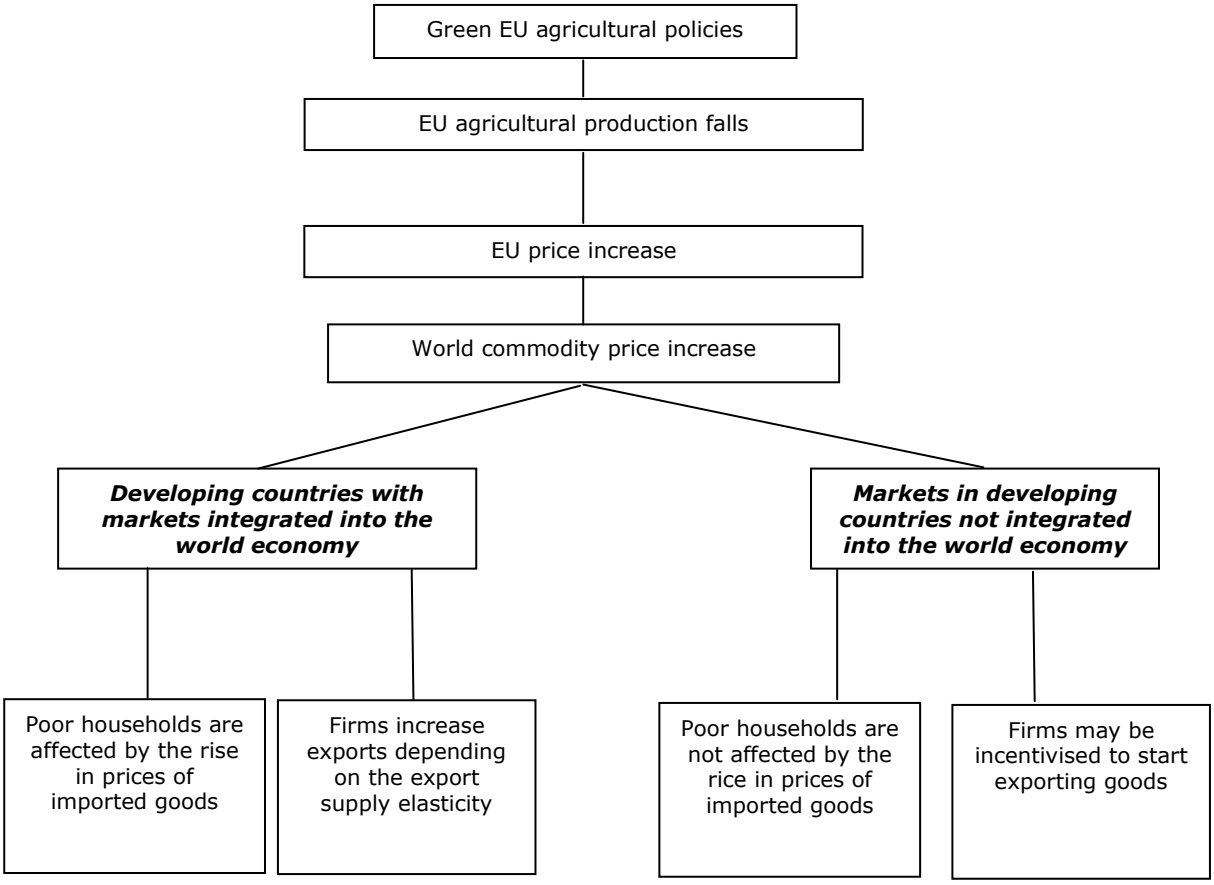


Table 2: Change in exports from low-income country markets compared with the baseline scenario resulting from European price rises from the CAP greening

	Tanzania	**Uganda**
Export supply elasticity	0.63	0.71
Barley exports increase	2.58%	2.91%
	Nepal	Guinea
Export supply elasticity	1.16	0.28
Wheat exports increase	0.82%	0.39%
	Senegal	Myanmar
Export supply elasticity	0.55	0.31
Rice exports increase	1.17%	0.66%
	Senegal	Nepal
Export supply elasticity	0.55	1.16
Beef exports increase	1.42%	3.00%

Source: Author's elaboration.

These results suggest that the impacts vary considerably across commodities, but the estimates for exports are never higher than 3%. This owes only partly to the limited effect of the CAP reform green proposals on prices. Even for rice, where the EC impact assessment forecasts a 39% raise in European price, the impact on exports is below 1.5%, as the market share of the EU15 in global trade is 10%. A 39% European price rise leads to only a 2% increase in the world price.

On the other hand, the increase in prices will affect countries that depend on the import of goods affected by the CAP greening price rise. Table 3 shows the 10 countries with the highest level of imports per capita in the FAOSTAT group of least-developed countries. Small countries and island states are particularly vulnerable to import price raises.

Table 3: Imports per capita in different countries ranked in descending order, 2009 (kg per habitant)

Barley		**Wheat**		**Rice**		**Beef**	
Mauritania	0.286	Djibouti	137.600	Cape Verde	189.473	Maldives	4.331
Tanzania	0.095	Mauritania	121.129	Samoa	113.431	Djibouti	4.196
Uganda	0.048	Yemen	119.979	Gambia	89.004	Tuvalu	2.244
Yemen	0.027	Cape Verde	46.216	Maldives	84.715	Samoa	1.919
Djibouti	0.006	Sudan	41.674	Kiribati	82.498	São Tomé and Príncipe	0.935
Solomon Islands	0.006	Lesotho	34.897	São Tomé and Príncipe	64.591	Cape Verde	0.832
Maldives	0.003	Senegal	34.576	Senegal	63.676	Senegal	0.593
Sudan	0.002	Afghanistan	33.955	Vanuatu	50.293	Solomon Islands	0.326
Malawi	0.001	Bangladesh	27.576	Timor-Leste	48.240	Comoros	0.312
Sierra Leone	0.000	Haiti	24.289	Comoros	46.840	Yemen	0.210

Source: Author's elaboration from FAOSTAT and World Development Indicators.

The EC analysis does not assess any impact on prices from green cover and maintaining permanent pasture. The impact of the latter may be ambiguous. If the permanent pasture clause is interpreted as preventing the conversion of grassland to cropland, it could reduce production of arable crops and increase prices beyond the effect generated by set-aside depending on relative price incentives for arable crops in the future. A simple obligation to maintain current levels of permanent pasture (as seems to be the case in the EC's interpretation) would not change the cultivated area and therefore not affect prices in the short run. If changes in relative prices lead farmers to change land from pasture to crops in the future, this measure will affect future production and therefore prices.

Table 4: Implementation of the greening measures (average cost per ha of PEA by Member State)

	Green cover	Grassland preservation	Ecological set-aside	Crop diversification	Total measures
Austria	6	22	5	1	34
Belgium	8	78	13	2	102
Bulgaria	6	0	6	5	18
Cyprus	12	0	23	16	52
Czech Republic	7	24	8	0	38
Denmark	5	3	14	1	24
Germany	4	37	6	2	49
Greece	9	0	7	6	22
Spain	11	9	3	8	30
Estonia	11	3	4	1	20
France	4	22	5	1	32
Hungary	10	2	11	3	26
Ireland	1	20	1	0	23
Italy	7	2	8	13	30
Lithuania	7	1	4	1	12
Luxembourg	6	47	3	0	57
Latvia	5	0	2	1	7
Malta	19	0	42	90	151
Netherlands	10	98	11	2	120
Poland	8	20	10	1	40
Portugal	7	4	2	7	20
Romania	9	0	7	9	25
Finland	16	1	3	1	21
Sweden	6	17	4	0	28
Slovakia	7	6	6	0	19
Slovenia	5	99	8	3	114
UK	1	27	4	1	33
EU27	6	17	6	44	33

Source: EC (2011b).

McKinsey recently estimated abatement costs and also the effects on greenhouse gases of different management practices (Table 5). Interestingly, the greening CAP reform options do not include those practices the study indicates as the most cost effective, such as no-till farming and better nutrient use management. Meanwhile, Keenkeyside et al. (2011) count 65 typologies of environmentally friendly management practices currently contained in 88 RDPs in Europe. The authors call for more flexible CAP greening proposals targeted more at regional climatic, agronomic and structural characteristics. A different implementation of the greening of the CAP would generate different impacts from those presented in this paper.

Table 5: Global greenhouse gas abatement cost curve for the agriculture sector

Option	€/tonne CO2 equivalent
Cropland nutrient management	-40 /-50
Tillage and residue management	-30/-40
Grassland nutrient management	-30/-40
Rice and nutrient management	-10/0
Livestock – anti-methanogen vaccine	0/+10
Grassland management	0/+10
Organic soil restoration	0/+10
Degraded land restoration	0/+10
Agronomy practices	0/+10
Livestock feed supplements	+30/+40

Source: McKinsey (2009).

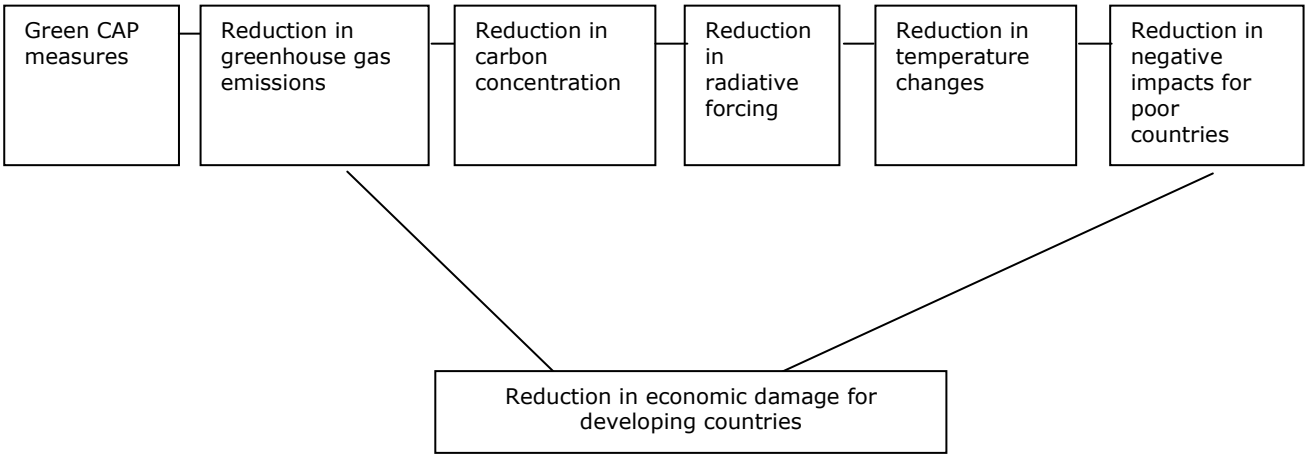
3.2 Environmental effects of Pillar I CAP measures

From an environmental point of view, the Pillar I CAP measures could generate three types of benefits:

1 A reduction in emissions that contribute to climate change;
2 Greater biodiversity; and
3 Avoidance of damage from pollution and erosion.

Of these, the effect with an external impact, and therefore the one that is potentially of interest to developing countries, is climate change. Figure 2 represents the link between agricultural policy in Europe and impacts in developing countries. Green measures may reduce emissions, and therefore atmospheric carbon concentration and thus increases in temperature. A reduction in the rate of temperature increase is especially beneficial for developing countries as damage is concentrated mostly in the regions with the lowest levels of GDP per capita (Cantore et al., 2008 Tol et al., 2004).

Figure 2: The link between green agricultural policies and climate change effects in developing countries



Even though from a conceptual point of view the link is clear, the quantification of this effect is much more complicated. Matthews (2011b) points out that the EC fails to quantify the environmental benefit of green CAP measures, and therefore it is not possible to compare benefits with costs for Europe.

However, the EC (2011d) provides estimates of the potential benefit in terms of greenhouse gas emissions derived from each green CAP measure expressed in CO_2 equivalent per hectare (Table 6) and the hectares of land that could be affected by these measures (Table 7).

Table 6: Area affected by green measures and mitigation potential

CAP measure	Mitigation potential (tonnes CO2 equivalent/ha/year)
Green cover	+0.07/+1.25
Crop diversification	+0.29/+0.88
Permanent pasture	+0.84/+ 2.75
Ecological set-aside	-0.07/+7.9

Source: CLIMSOIL (2008); EC (2011d).

Table 7: Area affected by green measures according to the EC

	Grassland preservation	Winter cover	Crop diversification	Ecological set-aside
	Area preserved (ha)	Area where application is ensured (ha)	Area to be diversified (ha)	Additional area (ha)
EU12	3,175,000	7,196,000	404,000	1,465,000
EU15	9,804,000	13,525,000	1,360,000	2,171,000
EU27	12,978,000	20,721,000	1,764,000	3,636,000

Source: EC (2011b).

Given the estimates of mitigation potential per hectare and the number of hectares affected by green measures, it is possible to calculate rough estimates of the overall mitigation potential of the CAP's green measures. The estimates are approximate because:

4 The estimates are uncertain.
5 The same hectare of land could be subject to more than one of the interventions, and it is not clear from the EC document if the interaction among measures would alter the mitigation potential for each hectare (positively or negatively).
6 From Tables 6 and 7, it is not clear how much of the total amount of land that, under the CAP reform umbrella, would really be additional if compared with a hypothetical baseline where the CAP is not introduced. For set-aside, the EC explicitly mentions 'additional area', suggesting that the CAP reform would generate new set-aside land as described in Table 7.
7 The EC reform proposal now includes the concept of an ecological focus area, which is broader than ecological set-aside.
8 Most importantly, we calculate only the direct impact of the CAP on European emissions and do not estimate any indirect land-use change effects in non-European effects. A reduction of food production in EU could increase food production and emissions in non-European countries by a typical carbon leakage effect.

Green cover measures have already been removed from the EC draft proposal. The permanent pasture measure will probably not entail new conversion from cropland to grassland. Van Zeijts et al. (2011) implement a modelling exercise to analyse the impact of CAP reform[7] on the environment and claim that the impacts of the greening measures on total grassland area are positive but limited: 'Under the Baseline Scenario, the total grassland area in 2020 is 94% compared with the 2005 level, and under the Greening Scenario this is 95%'. This is consistent with the EC (2011a) aim 'to maintain all permanent pasture' rather than increasing it. Van Zeijts et al. construct the Baseline Scenario so that arable land area will increase and permanent croplands and grasslands will decrease. These changes are driven by a larger global demand for food, which influences food and feed production.

Finally, on crop diversification, Erjevic (2012) points out the reluctance of many Member States to define standards that would affect income and the 'freedom to farm'. However, crop rotation (including crop diversification, sequence and break crops) is present in 20 RDPs in 9 member states with premiums from €20–30 to €300 (EC, 2011a). Even if crop diversification is not added to the Pillar I umbrella, farmers can already choose to adopt crop diversification strategies when it is profitable or under the Pillar II umbrella in those regions where the RDPs include this measure. It is not easy to estimate how much land subject to crop diversification would really be additional compared with a no reform scenario. Erjavec (2012) points out that some Member States (but not all), including some new ones, for example Slovenia, have already more than fulfilled the condition proposed for Pillar I. For this reason, we may speculate that the additional land subject to crop diversification under the reform is within the range 0–70% of that indicated by the EC. Given the lack of information on the issue, the 70% upper boundary is chosen merely as a illustrative number.

Westhoek et al. (2012) justify the low impact of the crop diversification measure by claiming the measure will impact only around 2% of EU arable areas. From FAOSTAT data, we calculate that 2% of the EU arable area (2009 last available data) is equivalent to about 2,180,000 ha, well above the 1,764,000 ha indicated in Table 7 as area potentially subject to crop diversification. Hence, the estimate of additional land subject to crop diversification within the range 0–70% of 1,764,000 ha may already be considered a prudent calculation.

Overall, we are assuming that the additional land subject to green measures induced by the CAP reform will be the amount assumed by the EC for set-aside, a smaller amount than assumed for crop diversification, with no additional land for permanent pasture.

If we also consider the impact of green measures on the EU27 as expressed in Table 7, we find that the emissions reduction impact of the Pillar I green CAP measures corresponds to about – 350,000/+41,000,000 tonnes CO_2 equivalent, equal to about 0.04 gigatonnes CO_2 equivalent in the optimistic case. The effect could be negative because, as outlined by the EC (2011d), set-aside may increase emissions depending on soil and production conditions. This is a range consistent with findings from Westhoek et al. (2012), who argue that the greening of the CAP will generate a 7 million tonnes CO_2 equivalent reduction in emissions, a value included in our range. Westhoek et al. also stress that uncertainty may affect this estimation, and for

7 Van Zeijts et al. do not replicate the EC proposals exactly, so we can use their results only approximately.

this reason we provide a range of values in our paper. If we consider the global context, 41 million tonnes CO_2 equivalents represents only 0.1% of global emissions (about 40/45 gigatonnes CO_2 equivalent according to the Inter-governmental Panel on Climate Change (IPCC) Fourth Assessment Report) in 2015. However, 41 million tonnes CO_2 equivalent would represent 3% of the emissions reduction required to match the 20% EU target.[8]

What impact would there be on the economy of low-income countries that are identified as the most vulnerable to climate change? To answer this question, we need to introduce the concept of the social cost of carbon (SCC). According to the UK Department for Environment, Food and Rural Affairs (DEFRA, 2007), the SCC measures the full global cost discounted to today of an incremental unit of carbon (or the equivalent amount of other greenhouse gases) emitted now. It varies depending on which emissions and concentration trajectory the world is on: the higher the concentration, the higher the SCC, since there will be more damage from climate change. The Stern Review suggests that the optimum stabilisation goal requires the world to aim for atmospheric concentration somewhere in the range of 450–550 parts per million. DEFRA adopts an SCC consistent with a global trajectory of 550 parts per million corresponding to £29.2/tonne CO_2 equivalent[9] in 2014. We assume that the CAP measures will be fully implemented in 2014.

A final conceptual problem is that the £29.2 SCC expresses the total damage avoided for the world as a result of a reduction of 1 tonne CO_2 equivalent of greenhouse gas emissions, but not specifically for low-income countries.

The RICE99[10] climate change model baseline of Nordhaus and Boyer (1999) contains eight groups of countries (the US, other high-income countries, Europe, Eastern Europe, middle-income countries, low-middle-income countries, China, low-income countries), differentiated on the basis of GDP per capita paths (see Annex). Nordhaus and Boyer estimate that, in 2015, only four regions will suffer climate change damages (low-income countries, low-middle-income countries, middle-income countriesand Europe); the other regions will enjoy benefits earlier on and then suffer damages in the medium to long term. Elaborations of Nordhaus and Boyer's baseline estimates[11] suggest that only the low-income countries group[12] suffers more than 100% of the value of global damage, as many other regions enjoy benefits in 2015 (0.021 of damages in the RICE low-income countries region vs. 0.015 of net damages[13] at world level of $1,990 trillion). Over the period 2015–2205, the cumulated damages for low-income countries represent about 44% of world damages. However, as the uncertainty surrounding scientific evidence on climate change damages estimations, we interpret the £29.2 SCC as the upper boundary price of the damage from 1 ton of emissions in low-income countries.

If we multiply £29.2 by the extremes of our range (-350,000/+41,000,000 tonnes CO_2 equivalent representing our pessimistic and optimistic scenarios), we obtain the economic effects of the CAP greening. For low-income countries, this would be in the range of -17 million/+2.0 billion in 2010 US dollars, corresponding to

8 According to the annual EU Greenhouse Gas Inventory 1990–2010 (EEA, 2012), EU27 greenhouse gas emissions were at 5,583 million tonnes of CO2 equivalent in 1990. As the emissions reduction target by 2020 is 20% of 1990 emissions, the EU27 should reach a 1,116 million tonnes CO2 equivalent emissions reduction target by 2020. 41 million tonnes CO2 equivalent, deriving from the most optimistic scenario of emissions reduction from CAP greening, would represent about 3% of this target.

9 This methodology has been updated by the Department of Energy and Climate Change (DECC, 2009) suggesting the approach, based on estimates of the SCC, should be replaced with a target-consistent approach, based on estimates of the abatement costs that will need to be incurred to meet specific emissions reduction targets. The case for change has been motivated by the considerable uncertainty that exists surrounding estimates of the SCC, and also by the UK's need to find the most appropriate tools to reach European emissions reduction targets. For this reason, the UK government is interested in using a SCC related to the concept of marginal abatement costs rather than to damages avoided. This study continues to use the old SCC as our discussion is not centred on abatement costs motivating UK policy action to reach an abatement target, but rather on trying to evaluate avoided damage from the reduction in greenhouse gas emissions from agriculture. In any case, the DECC report stresses that the difference between the two approaches is tiny.

10 For a full description of the RICE99 model, see http://www.econ.yale.edu/~nordhaus/homepage/web%20table%20of%20contents%20102599.htm

11 The Annex gives figures on climate change damages and GDP per capita across different regions in RICE.

12 The RICE low-income countries regional aggregation includes 68 countries from Asia, Africa and America. It does not coincide with the World Bank low-income countries aggregation as it includes countries such as India and Vietnam, which are incorporated in the World Bank low-middle-income countries list. For further information, see Nordhaus and Boyer (1999).

13 The word 'net damage' should be interpreted as the difference between damages (+) and benefits (-) of the eight country groups. At world level, the balance is negative (+0.15 trillion in 1990 US dollars).

about 3% of European aid (about 70 billion in 2010 US dollars).[14] However, the reader should be aware that the climate change impacts of 1 tonne CO_2 equivalent will be spread over 100 years (Watkiss, 2006) and the environmental gain should be interpreted as a net present value of future stream flows. EU aid refers to current aid flows. Moreover, we are not considering the medium- to long-term effects of emissions reduction of the CAP greening, which will be generated if farmers continue to maintain environmental measures over time. Using a set of assumptions,[15] we estimate that low-income countries could enjoy a net present value in 2014 of the CAP greening measures (in particular set-aside and crop diversification) representing an economic impact of up to 25% of European aid in 2010.

With a constant emissions reduction equivalent to that calculated by van Zeijts et al. (2011) and Westhoek et al. (2012) (i.e. 7 million tonnes CO_2 equivalent), we estimate that the environmental gain for low-income countries would be 4% of European aid, which remains a relevant value.

Beyond the uncertainties we have already outlined with regard to the emissions reduction potential of different measures and the SCC, there are factors that could cause our calculation to underestimate the environmental benefits. Van Zeijts et al. (2011) argue that there are other environmental benefits of the greening of CAP that should be taken into account (Table 8). Estimates suggest that the CAP greening would reduce the biodiversity loss in EU farmland by 3%.[16] If we believe that biodiversity is a global public good, we should also incorporate those benefits into the estimate of the effects of the CAP greening on developing countries. Hart and Baldock (2011) provide an overview of the overall set of environmental effects in the EU for a number of environmental measures (some of which, such as soil cover, are no longer in the list of proposed CAP reform measures). Table 8 does not incorporate the negative effects that could arise in developing countries, such as an increase in land use and food production that the CAP greening and the EU food price increase could encourage.

Table 8: Potential environmental benefits of different CAP reform options

Option	Natura 2000	Semi-permanent pasture	Permanent pasture	Crop diversity	Soil cover	Ecological set-aside	Organic maintenance
Biodiversity	√	?	√	√	√	√	√
Water quality	?	√	√	?	√	√	√
Water quantity	?	√	?	?	√	√	√
Soil functionality	?	√	√	√	√	√	√
Climate mitigation	?	?	?	√	√	√	√
Climate adaptation	?	?	?	?	√	?	?
Landscape	√	√	√	?	X	√	?
Resilience to fire	?	√	√	?	X	X	?
Resilience to flooding	?	√	√	?	X	X	?

Note:= option applies, ? = unclear if option applies, X = options does not apply.

Source: Hart and Baldock (2011).

14 The environmental gain is calculated using a SCC expressed in 2007 pounds sterling. We then apply a UK deflator on the basis of International Monetary Fund (IMF) statistics to obtain 2010 UK values and then an exchange rate of £1 (2010) to $1.5 (2010).
15 We assume that 1) farmers we will continue to keep the CAP greening environmental practices over the period 2014 – 2023, 2) The SCC increases until 2023 as estimated by DEFRA (2007) with a value in 2023 equivalent to 34.9 2007 GBP 3) a 5% discount rate 4) the emissions reduction remains constant over time
16 Van Zeijts et al. do not incorporate possible biodiversity losses in developing countries, which could be driven by higher land use and food production encouraged by the CAP greening and the EU price rise.

But in terms of climate change impacts, if we exclude optimistic assumptions, this study is in line with van Zeijts et al. in terms of the conclusion that the environmental economic benefit of green CAP measures is small if we consider that in this study we also incorporate the emissions reduction effects of the crop diversification measure, which the van Zeijts et al. scenario analysis does not incorporate (Table 9).

Table 9: The CAP greening scenario according to van Zeijts et al.

Within direct payments: compulsory additional aid for specific 'greening' of public goods through simple, generalised, annual and non-contractual agri-environmental actions	C. Greening the first pillar via a premium in permanent grassland, with an annual maximum of €100 per hectare. D. Greening the first pillar via a premium with an annual maximum of €100 per hectare of arable land, on the condition of a 5% ecological set-aside being implemented on this land. The greening payments are restricted to a ceiling of 30% of the first pillar budget of each Member State.

Source: Van Zeijts et al. (2011).

4 Pillar II CAP measures

Most of the six Pillar II priorities measures serve more than one objective or priority. Therefore, it is not easy to identify exactly what share of Pillar II will be devoted to environmental issues. However, it is likely that Member States will still be required to maintain 25% of their Pillar II budget for issues relating to land management and the fight against climate change (Matthews, 2011a).

However, analysis of the effect of these measures is very difficult. The EC (2011f) argues that such complexity is often necessary to achieve high quality environmental results. These are often measures that consist of multiple obligations to be implemented in different farming locations and where compliance must be continuous or at different points in time.

Moreover, some aspects of the CAP reform proposal are still not clear. For example, the EC (2011a) explains that organic farming would not qualify as a Pillar I measure because the relevant commitments are multiannual, complex, undertaken on a voluntary basis and subject to detailed controls. In spite of these aspects, the EC envisages that farms (or part thereof) with organic farming certification (around 7.6 ha hectares, half of which is permanent grassland) would automatically receive the greening component since the environmental benefits (and in most cases climate action) from organic farming are at least as high as from the greening measures combined. In the case of organic farming, there is clearly a risk of paying organic farmers twice as they could enjoy Pillar II payments and simultaneously satisfy the conditions necessary to receive Pillar I payments.

The EC's analysis of the Refocus Scenario is not helpful for assessing its impact on developing countries. The EC (2011f) explains that the doubling of Pillar II funds under this scenario and the clear focus on measures for the improvement of the environment and climate change actions should ideally result in significant positive impacts in relation to these areas of concern. However, the EC impact assessment does not provide quantitative evidence on the impact of Pillar II climate change measures.

From an economic point of view, it is important to evaluate whether any proposed new agri-environmental schemes generate less/more production and higher/lower prices than a 'business as usual' scenario in Europe. The literature has already had a great to say on these aspects. For example, Bagdley et al. (2007) compared yields of organic versus conventional or low-intensive food production for a global dataset of 293 examples and estimated the average yield ratio (organic to non-organic) of different food categories for the developed and the developing world. For most food categories, the average yield ratio was slightly smaller than 1.0 for studies in the developed world and greater than 1.0 for studies in the developing world. These results suggest that a higher penetration of organic farming in Europe under the Pillar II umbrella would not have a substantial impact on prices, even though we acknowledge that the literature is still uncertain on the productivity of organic farming (Connor, 2008).

If Pillar II is reformed by increasing the funds oriented towards climate change and green measures, it is plausible to assume that the outcomes for developing countries will be similar to those we described in the section on Pillar I, with possible price and environmental effects. However, a quantification of these effects is difficult given uncertainty about the weight that climate change measures will have within Pillar II.

5 Conclusions

From an economic point of view, the greening of the CAP represents an opportunity to increase exports (up to 3% for a selection of countries and commodities in our study), and therefore growth, for low-income countries, but also a danger for food-importing countries. Green measures, in particular set-aside, reduce production and raise prices. From an environmental point of view, green measures tend to reduce gas emissions, and therefore curtail temperature increases and climate change damage for low-income countries. However, the magnitude of these effects is uncertain, albeit relevant in the most optimistic scenario (up to 3% of what EU currently spends in developing countries on aid and 25% of this if EU farmers maintain environmentally friendly measures until 2023).

Of course, in economic terms, a greened CAP is still worse than a no-CAP situation for developing countries, as analysed in Cantore et al. (2011). McKinsey (2009) claims that, currently, the highest abatement potential from agriculture comes from developing countries; Africa, Latin America and Asia now represent 76% of world emissions in agriculture. Bowen and Fankhauser (2011) highlight that many of these abatement opportunities are low in cost. These findings bring into question whether it is appropriate to target mitigation policies for agriculture in Europe through the CAP rather than in developing countries.

An innovative policy solution could be to extend the experience of the Clean Development Mechanism (CDM) to the agriculture sector. The CDM, defined in Article 12 of the Kyoto Protocol, allows a country with an emission reduction or emission limitation commitment under the Protocol (Annex B Party) to implement an emission reduction project in developing countries. The mechanism allows developed countries under an international emission constraint to buy emissions reduction units at a low price, and allows developing countries to receive foreign investments. In Copenhagen, new language was introduced into the draft chapter on land use, land-use change and forestry under the Kyoto Protocol to expand the remit of the CDM beyond afforestation and reforestation to include most land use. Under these proposals, the CDM would be extended to cover ‘revegetation, forest management, cropland management, grazing land management, wetland management, soil carbon management in agriculture and other sustainable land management activities’. But the road towards the effective integration of agriculture into the CDM is still long.

The Environment Council meeting on 19 December 2011 refused to endorse the EC’s greening proposals in its legislative proposals for CAP reform. The results of our study are consistent with comments by Matthews (2011c), who argues that this refusal ‘has been interpreted as a victory for agricultural interests attempting to water down the greening element in these proposals. But this interpretation may underestimate the extent to which there is genuine doubt about the effectiveness and environmental value of the measures that the Commission proposes’. The recent policy debate calling for more flexible CAP greening menu options targeted to the characteristics of single EU Member States does not cancel out doubts about the effectiveness of the CAP reform in terms of improving environmental indicators.

References

Badgley, C., Moghtader, J, Quintero, E., Zakem, E., Chappell, J., Vázquez, K., Samulon, A. and Perfecto, I. (2007) 'Organic Agriculture and the Global Food Supply'. *Renewable Agriculture and Food Systems* 22: 86–108.

Bowen, A. and Fankhauser, S. (2011) 'Low Carbon Development for Least Developed Countries'. Discussion Paper. Oxford: Oxfam.

Cantore, N., Di Maria, C. and Canavari, M. (2008) 'Distributional Implications of Climate Change from Integrated Assessment Models'. EAEPE Conference on Labour, Institutions and Growth in a Global Knowledge Economy, Rome, 6–8 November.

Cantore, N., Kennan J. and Page, S. (2011) 'CAP Reform and Development: Introduction, Reform Options and Suggestions for Further Research'. London: ODI.

CLIMSOIL (2008) 'Review of the Existing Information on the Interrelations between Soil and Climate Change'. Brussels: EC.

Connor, D. (2008) 'Organic Agriculture Cannot Feed the World'. *Fields Crops Research* 106: 187–90.

De Arce, R., Mahía, R. and Escribano, G. (2003) 'Global Effect on International Prices of EU–Mediterranean Partner Countries' Bilateral Agricultural Liberalisation'. FEMISE Meeting, Marseille, 4 December.

DECC (Department for Environment, Food and Rural Affairs) (2009) 'Carbon Valuation in UK Policy Appraisal: A Revised Approach'. London: DECC.

DEFRA (Department for Environment, Food and Rural Affairs) (2007) 'The Social Cost of Carbon and the Shadow Price of Carbon: What They Are, and How to Use Them in Economic Appraisal in the UK'. London: DEFRA.

EEA (European Environment Agency) (2012) 'Annual European Union Greenhouse Gas Inventory 1990–2010 and Inventory Report 2012'. Brussels: EEA.

EC (European Commission) (2011a) 'CAP Impact Assessment – Annex 2: Greening the CAP'. Brussels: EC.

EC (European Commission) (2011b) 'CAP towards 2020 Impact Assessment – Annex 10: Impact of Scenarios on the Distribution of Direct Payments and Farm Income'. Brussels: EC.

EC (European Commission) (2011c) 'CAP Impact Assessment – Annex 12: Policy Coherence on Development. Brussels: EC.

EC (European Commission) (2011d) 'Assessment of Selected Measures under the CAP for Their Impact on Greenhouse Gas Emissions and Removals, on Resilience and on Environmental Status of Ecosystems – Annex 2b. Brussels: EC.

EC (European Commission) (2011e) 'Greening – Results of Partial Analysis on Impact on Farm Using FADN – Annex 2d'. Brussels: EC.

EC (European Commission) (2011f) 'Rural Development – Annex 4. Brussels: EC.

EC (European Commission) (2011g) 'Proposal for a Regulation of the European Parliament and of the Council on Support for Rural Development by the European Agricultural Fund for Rural Development'. COM(2011) 627 final/2. Brussels: EC.

Erjevic, E. (2012) 'The Greening of the CAP: Is the Emperor Naked?' Capreform.eu blog, 31 January: http://capreform.eu/greening-of-agricultural-policy-is-the-%e2%80%9cemperor-naked%e2%80%9d/

Hart, K. and Baldock, D. (2011) 'Greening the CAP: Delivering Environmental Outcomes through Pillar I'. Working Paper 1. London: IEEP.

IPCC (Inter-governmental Panel on Climate Change) (2007) 'Fourth Assessment Report'. Geneva: IPCC.

Keats, S., Wiggins, S. Compton, J. and Vigneri, M. (2010) 'Food Price Transmission: Rising International Cereals Prices and Domestic Markets' Briefing Paper 48. London: ODI.

Keenleyside, C., Allen, B., Hart, K., Menadue, H., Stefanova, V., Prazan, J., Herzon. I., Clement, T., Povellato, A., Maciejczak, M. and Boatman, N. (2011) 'Delivering Environmental Benefits through Entry-level Agri-environment Schemes in the EU'. London: IEEP.

Kumar, S. (2011) 'Estimating Export Demand Equations in Selected Asian Countries'. *Journal of Chinese Economic and Foreign Trade Studies* 4(1): 5–16.

Matthews, A. (2011a) 'Post-2013 EU Common Agricultural Policy, Trade and Development'. Issue Paper 39. Geneva: ICTSD.

Matthews, A. (2011b) 'What Is the Likely Cost of Greening Pillar I?' CAPreform.eu blog, 27 September: http://capreform.eu/what-is-the-likely-cost-of-greening-pillar-1/

Matthews, A. (2011c) 'Environment Ministers Fail to Endorse Commission`s Greening Proposals'. Capreform.EU blog, 26 December: http://capreform.eu/environment-ministers-fail-to-endorse-commissions-greening-proposals/

Matthews, A. (2012) 'Greening the CAP: Ways Forward'. 126th EAAE Seminar on New Challenges for the EU Agricultural Sector and Rural Areas: Which Way for Public Policy, Capri, 27–9 June.

McKinsey (2009) 'Pathways to a Low Carbon Economy: Version 2 of the Greenhouse Gas Abatement Cost Curve'. London: McKinsey.

Minot, N. (2011) 'Transmission of World Price Changes to Markets in Sub-Sahara Africa'. Discussion Paper 01059. Washington, DC: IFPRI.

Nordhaus, W.D. and Boyer, J. (1999) 'Roll the DICE Again: Economic Models of Global Warming'. Harvard, MA: MIT.

Olofin, S. and Babatunde, M. (2003) 'Estimating Price and Income Elasticities of Sub-Saharan African Exports'. *African Journal of Economic Policy* 16(2).

Rao, B. and Singh, R. (2005) 'Estimating Export Equations'. *Applied Economics Letters* 14(11): 799–802.

Tokarick, S. (2010) 'A Method for Calculating Export Supply and Import Demand Elasticities'. Working Paper 10/180. Washington, DC: IMF.

Tol, R.S.J., Downing, T.E., Kuik, O.J. and Smith, J.B. (2004) 'Distributional Aspects of Climate Change Impacts'. *Global Environmental Change* 14(3): 259–72.

Van Zeijts, H., Overmars, K., van der Bilt, W., Schulp, N., Notenboom, J., Westhoek, H., Helming, J., Terluin, I. and Janssen, S. (2011) 'Greening the Common Agricultural Policy: impacts on Farmland Biodiversity on an EU scale'. The Hague: PBL.

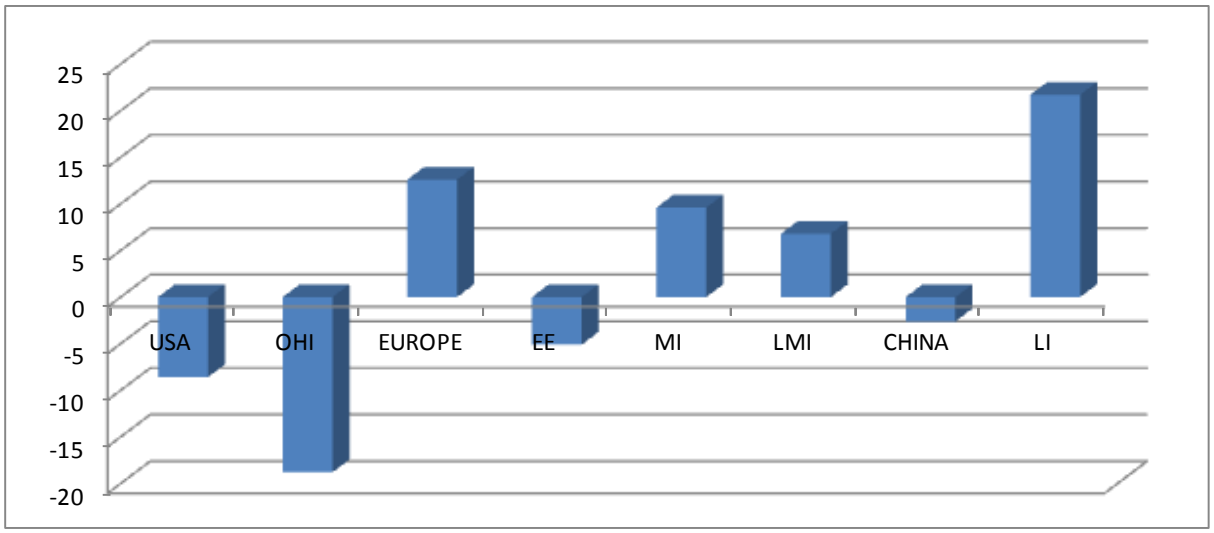
Watkiss, P. (2006) 'The Social Cost of Carbon'. Paris: OECD.

Westhoek, H., van Zeijts, H., Witmer, M., van den Berg M., Overmars, K., van der Esch, S. and van der Bilt, W. (2012) 'Greening the CAP: An Analysis of the Effects of the European Commission's Proposal for the Common Agricultural Policy 2014-2020'. The Hague: PBL.

Witzke, H., Britz, W. and Borkowski, N. (2011) 'Literature Review in Modelling Price Transmission in Partial Equilibrium Models'. CAPPRI-RD Deliverable 3.3.1.

Annex: Climate change damages and GDP per capita according to RICE99

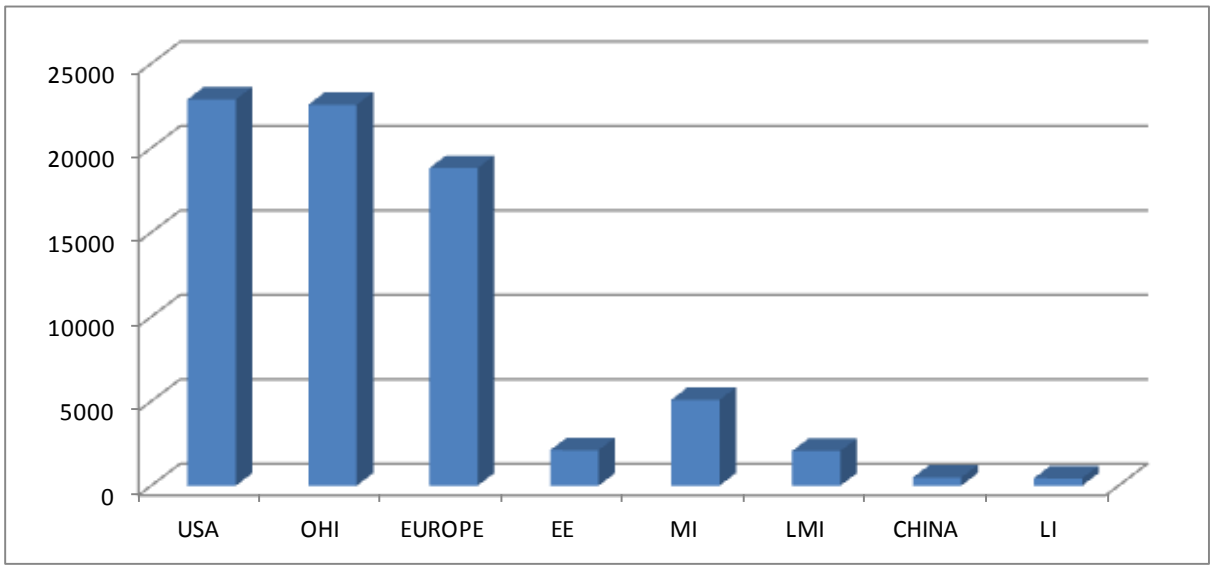
Climate change damages in 2015 (1990 US$ billions)



Note: Negative values are benefits, positive values are damages.

Source: Author's elaboration from Nordhaus and Boyer (1999).

GDP per capita in 2015 ($ per capita)



Source: Author's elaboration from Nordhaus and Boyer (1999).