European farming and post-2013 CAP measures

A quantitative impact assessment study

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LEI Report 2010-085
Alterrra Report 2103
December 2010
Project code 2221386000
LEI, part of Wageningen UR, The Hague

LEI is active in the following research areas:

European farming and post-2013 CAP measures; A quantitative impact assessment study

Helming, J.F.M., J., S. Jansen, H. van Meijl and A. Tabeau
LEI Report 2010-085
Alterra Report 2103
ISBN/EAN: 978-90-8615-469-2
Price € 19,25 (including 6% VAT)
95 p., fig., tab., app.

This study investigates the effectiveness of post-2013 CAP measures. In addition to the measures proposed in the Dutch Outlook (focusing on competitiveness, valuable areas and ecosystem services) the effectiveness of base premiums are considered, as this measure is proposed by some other Member States. This study can be seen as a first attempt to quantify the transition to a CAP with more targeted measures at the European level and reveals considerable methodological and data challenges. A key finding is that the impact of the various measures is very different with regard to various economic and environmental indicators. There is also a difference in the impact of a measure between regions, sectors and farm types.

In dit onderzoek wordt nagegaan in hoeverre de maatregelen van het GLB na 2013 effectief zullen zijn. Naast de effectiviteit van de maatregelen die zijn voorgesteld in de Houtskoolschets (die gericht zijn op het concurrentievermogen, de waardevolle gebieden en de ecosysteemdiensten) wordt ook gekeken naar de effectiviteit van eventuele basispremies, zoals voorgesteld door sommige andere lidstaten. Dit onderzoek kan worden gezien als een eerste poging tot het kwantificeren van de overgang naar een GLB met meer gerichte maatregelen op Europees niveau. Uit dit onderzoek komen grote uitdagingen op het gebied van methodologieën en data naar boven. Een van de belangrijkste bevindingen is dat de impact van de diverse maatregelen zeer verschillend is met betrekking tot verscheidene economische en milieu-indicatoren. Ook is er een verschil in impact van de maatregelen tussen regio's, sectoren en bedrijfssoorten.

Project (BAS nr); 'title project'

This research has been financed by the Dutch Ministry of Ministry of Economic Affairs, Agriculture and Innovation.

Photo: Peter Frischmuth/Hollandse Hoogte

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Preface

The perspectives of the Common Agricultural Policy (CAP) after 2013 have to be established. As Carlo Trojan said during the High Level Conference on the CAP in January 2010 in Scheveningen, this must be done against the background of huge new challenges at both European and global levels. Moreover, this undertaking must be done while we are still absorbing the consequences of the financial and economic crisis. The renewed CAP must provide food security for an ever growing population and accommodate changes in diet due to income growth in developing countries. The elaboration of European agricultural policy post-2013 has to deal with increasing demands for feedstocks from the biofuel industry and with competing claims on land and water. It has to deal with the consequences of climate change. It has to play an important role in mitigation policies and in preserving the environment and the countryside. At the same time, it has to face severe constraints on arable land and water, increasing climate variability and environmental degradation.

Against this background, the Dutch Ministry of Economic Affairs, Agriculture and Innovation presented the Dutch Outlook on the CAP of the European Union (EU). The Dutch Outlook proposes transforming the direct income support under the Single Payment Scheme (SPS) to more targeted payments to strengthen the competitiveness of the European agricultural sector as well as its contribution to public goods like nature, environment and bio-diversity. To accomplish such a reform, various so-called post-2013 CAP measures are defined in the Dutch Outlook. The Dutch Ministry of Economic Affairs, Agriculture and Innovation requested LEI to carry out an impact assessment of the various individual post-2013 CAP measures. The impact assessment should focus on economy and ecology at the level of the EU-27 as a whole. The results of this study were first presented at a European high level conference on the future of the CAP organised by the Dutch Ministry of Economic Affairs, Agriculture and Innovation in Scheveningen in January 2010.

The study was finished well before the Communication of the European Commission on the future of the CAP on 18 November 2010 entitled 'The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future'. According to the European Commission, the focus of the new CAP should be 'more on competitiveness and innovation, climate change and the environment'. As a full impact assessment is currently underway, we hope that this report will be helpful

for this. Moreover, we hope that this report will be helpful in the current consultation process between the European Commission and European stakeholders.

The study was carried out by Hans van Meijl (project manager, LEI, part of Wageningen UR), John Helming (LEI, part of Wageningen UR), Andrzej Tabeau (LEI, part of Wageningen UR) and Sander Janssen (Alterra, part of Wageningen UR) with contributions from David Verhoog (LEI, part of Wageningen UR), Geert Woltjer (LEI, part of Wageningen UR) and Torbjorn Jansson (SLU). The LEI project team was frequently assisted and challenged by an advisory committee consisting of Hans Brand, Pim Bruins, Roald Lapperre and Hayo Haanstra from the Ministry of Economic Affairs, Agriculture and Innovation. On behalf of the project team, I would like to thank the members of the advisory committee for their contributions.

Prof.Dr R.B.M. Huirne
Managing Director LEI

Summary

The Common Agricultural Policy (CAP) of the European Union will be reformed after 2013. Several proposals for changes and revisions to the CAP have been formulated by European Union Member States and the European Commission (EC). The objective of this study is to assess the EU-27 wide economic and ecological effectiveness of post-2013 CAP measures proposed in the Dutch Outlook of the CAP (Dutch Ministry of Economic Affairs, Agriculture and Innovation, 2008)[1] and of a basic premium system proposed by some other Member States.

Basically the Dutch Outlook proposes transforming the direct income support under the Single Payment Scheme (SPS) to more targeted payments (the so-called post-2013 CAP measures). The reform towards targeted payments should strengthen the competitiveness of the European agricultural sector and its contribution to public goods like nature, environment and bio-diversity. Such a reform should increase public support. However, it can be expected that such a reform will have a major effect on production and income possibilities in the various agricultural farms, sectors and regions, as well as on the environmental performance of agriculture.

This study can be seen as an initial attempt to quantify the transition to a CAP with more targeted measures at European level and reveals considerable methodological and data challenges. This study must therefore be considered as an initial exploratory study to try to assess *ex-ante* the impact of a CAP reform proposal through quantitative methods. All the required assumptions are therefore extensively described and the exploratory nature of this study must be borne in mind when interpreting the results of the study. The methodology used in this study is based on the combined use of different types of economic and environmental models. The methods are developed within the EUruralis project of the Dutch Ministry of Economic Affairs, Agriculture and Innovation (www.eururalis.eu) and in various studies for the EC (Nowicki et al., 2006, 2009a and 2009b).

A Stylised CAP Reform scenario is developed and the impact is measured relative to a reference scenario. The reference scenario gives a possible description of production and income in the European agricultural sector in 2020 given exter-

[1] The current Dutch Ministry of Economic Affairs, Agriculture and Innovation is a combination of the former Ministries of Economic Affairs and Agriculture, Nature and Food Quality.

nal trends and known policy changes. The counterfactual CAP policy scenario is stylised in the following manner. First, a base premium is introduced, although it is not part of the proposed measures in the Dutch Outlook. Second, the direct income support under the SPS per member state is redistributed equally over the four different targeted post-2013 CAP measures (competitiveness, socially valuable areas, ecosystem services and a base premium); each targeted post-2013 CAP measure receives 25% of the national direct income support under the SPS extra as compared to the reference scenario. This enables a direct comparison of the effectiveness of targeted measures individually. Finally, the Stylised CAP Reform scenario assumes that direct income support under the SPS is abolished to finance the post-2013 CAP measures. It should be clear that the reason for the assumed budget distribution over the different post-2013 CAP measures is purely technical for a straightforward comparison of the effectiveness of different post-2013 CAP measures. It does not directly reflect the ideas of the Dutch government.

The main conclusion of this study is that the effectiveness of the various post-2013 CAP measures varies considerably with respect to the different targets such as income, production, competitiveness, land use and biodiversity. Furthermore, the impact varies between individual farms, sectors and regions. Results are summarised in Tables S.1 and S.2.

Table S.1 **Effectiveness of different post-2013 CAP measures and total impact of the Stylised CAP Reform scenario on some selected economic and environmental variables**

	Production	Use of Variable inputs a)	Prices of Agricultural outputs	Land prices	GVA per farm
+25% competitiveness	↑	↓	↓	0	0
+25% valuable areas	0	0	0	↑	↑
+25% ecosystem services	0	↓	0	↑	↑
+25% base premium	↑	↑	↓	↑	↑
- abolition income support	0	0	0	↓	↓
= Total impact	↑	↓	↓	↓	0/↓

a) Mineral fertilisers, pesticides, etc.

Table S.2	Effectiveness of different post-2013 CAP measures and total impact of the Stylised CAP Reform scenario on some selected economic and environmental variables			
	Welfare	**Land used by agriculture**	**Labour**	**Biodiversity a)**
+25% competitiveness	↑	0	↓	(↑ / ↓)
+25% valuable areas	0	↑	0	(↑)
+25% ecosystem services	0	↑	0	(↑)
+25% base premium	0	↑	↑	(↑ / ↓)
- abolition income support	0	↓↓↓	0	(↑ / ↓)
= Total impact	↑	0/↓	↓	↑
a) ( ) based on a qualitative assessment.				

In more detail, the conclusions with respect to the effectiveness of post-2013 CAP measures are (see Table S1 and S2):

- *Competitiveness measures* stimulate production (especially in Eastern European countries) increase exports, reduce imports, reduce use of variable inputs and reduce agricultural prices, which is beneficial from a consumer point of view and leads to a higher national income. It will speed up the productivity growth of farms, maintaining their activity and consequently employing less labour inside agriculture. However those people who do not find agricultural employment would be likely to find a job outside agriculture because of the induced higher national income growth. If food security is an important motive, the Stylised CAP Reform is an effective policy as production increases.
- *Payments to valuable areas* keep resources (land and labour) dedicated to production in these areas. The overall impact is that these payments keep land in production and under good management, increase land prices and increase Gross Value Added (GVA) per farm located in the valuable areas. Impact on production, input use and national income is negligible at the level of the EU-27, but this can vary at regional level.
- *Payments to ecosystem services* effect production and income in the EU-27 more widely (less regional concentrated), reduce variable input use, keep land in production, increase land prices, increase GVA per average farm and increase biodiversity. Impact on production, trade and national income is negligible at the level of the EU-27, but this can vary at regional level.

- A *base premium* increases GVA per farm, keeps land in production and increases land prices. Impact on production, input use, biodiversity and national income is negligible or uncertain.
- *Abolition of direct income support under the SPS*, decreases agricultural production slightly, (slightly) increases imports, reduces exports, increases prices of agricultural products, reduces the average GVA per farm sharply, reduces the total area used for agricultural production and significantly reduces land prices.

Some policy recommendations can be drawn concerning the effectiveness of the various targeted measures:

1. The effectiveness varies between measures with regard to the various targets. Policy makers should therefore first identify the targets and consequently choose the measures that are most effective to reach the target.
2. Targeted investments in productivity and efficiency (measures to improve competitiveness) do have more effect on food security than the current system of decoupled income support.
3. This study indicates that targeted measures are able to affect production and biodiversity. However, it is important to set up a transparent system with low transaction costs; better insights into the transaction costs of a targeted payment system are needed.
4. Reallocation of direct income support under the Single Payment System (SPS) to more targeted measures and a base premium per hectare should be done gradually to give affected farmers more time to adjust. This complies with the Dutch Outlook that also wants to mitigate income effects by introducing an adequate transition period (Dutch Ministry of Economic Affairs, Agriculture and Innovation, 2008).
5. This research focuses on the food security aspect (food quantity). In this report, investments in competitiveness result in extra agricultural production and part of the gain is transferred to consumers via lower food prices. It is recommended to keep food quality standards and sustainable production techniques at a high level as well, as these types of investments could create more value added in the food production chain as a whole.
6. This explorative study has sought to explore the impact of the post-2013 CAP measures through the use of economic and biophysical models. This has revealed the considerable methodological and data challenges inherent in a complex policy evaluation exercise of this kind. This is particularly the case in specifying and quantifying the impact of spatial and targeted payments such as

competitiveness and sustainability payments, valuable area payments and ecosystem payments. Reliable *ex post* information is extremely scarce. Since these measures might be an expanding element of the CAP, it is recommended that further investment both in analytical tools and data collection (at different geographical levels) is prioritised at both Member State and EU levels. The availability of good quality, precise and comparable empirical evidence on the impact of these new measures at local, regional and Member State levels is critical to inform future policy evaluations.

Samenvatting

In 2013 zal er een hervorming plaatsvinden van het Gemeenschappelijk Landbouwbeleid (GLB) van de Europese Unie. De Europese Commissie (EC) en de lidstaten van de Europese Unie hebben verschillende voorstellen voor veranderingen en herzieningen van het GLB geformuleerd. Het doel van dit onderzoek is om de economische en ecologische effectiviteit van de maatregelen van het GLB na 2013 voor de EU-27 te bepalen, zoals voorgesteld in de *Houtskoolschets* van het GLB *(ministerie van Economische Zaken, Landbouw en Innovatie, 2008)*[1], en van de door een aantal andere lidstaten voorgestelde basispremie.

In de Houtskoolschets wordt een overgang voorgesteld van directe inkomenssteun krachtens de bedrijfstoeslagregeling (BTR) naar meer doelgerichte betalingen (de zogenoemde maatregelen van het GLB na 2013). Deze doelgerichte betalingen zouden moeten zorgen voor een beter concurrentievermogen van de Europese landbouwsector en een hogere bijdrage aan collectieve goederen, zoals de natuur, het milieu en de biodiversiteit. Een dergelijke hervorming van het GLB de publieke steun moeten verhogen. Naar verwachting zal een dergelijke hervorming echter van grote invloed zijn op de productie- en inkomensmogelijkheden in de verschillende landbouwsectoren en regio's en op de milieuprestaties van de landbouw.

Dit onderzoek kan worden gezien als een eerste poging tot het kwantificeren van de overgang naar een GLB met meer gerichte maatregelen op Europees niveau. Uit dit onderzoek komen grote uitdagingen op het gebied van methodologieën en data naar boven. Dit onderzoek moet daarom worden beschouwd als een eerste verkennend onderzoek om de ex-ante impact van de voorgestelde GLB-hervorming te beoordelen door middel van kwantitatieve methoden. Alle aannames die worden gemaakt, worden daarom uitgebreid beschreven en bij het interpreteren van de resultaten van dit onderzoek moet rekening worden gehouden met de verkennende aard van dit onderzoek. De methodologie die voor dit onderzoek is gebruikt, is gebaseerd op een combinatie van verschillende soorten economische en milieumodellen. De methodes zijn ontwikkeld binnen het Eururalis-project van het *ministerie van Economische Zaken, Landbouw en Innovatie* (www. eururalis.eu)

[1] Het huidige ministerie van Economische Zaken, Landbouw en Innovatie is een samenvoeging van het voormalige ministerie van Economische Zaken (EZ) en het voormalige ministerie van Landbouw, Natuur en Voedselkwaliteit (LNV).

en binnen verschillende onderzoeken voor de EC (Nowicki et al., 2006, 2009a en 2009b).

Er wordt een fictief GLB-hervormingsscenario ontwikkeld en de impact daarvan wordt vergeleken met de impact van een referentiescenario. Het referentiescenario geeft een mogelijke beschrijving van productie en inkomen in de Europese landbouwsector in 2020 op basis van externe trends en bekende beleidswijzigingen. Het fictieve GLB-beleidsscenario is op de volgende manier vormgegeven: ten eerste wordt er een basispremie geïntroduceerd, hoewel dit geen deel uitmaakt van de voorgestelde maatregelen in de *Houtskoolschets*. Ten tweede is het budget dat aan de vier verschillende maatregelen (concurrentievermogen, maatschappelijk waardevolle gebieden, ecosysteemdiensten en een basispremie) is toegekend, gelijk verdeeld binnen het fictieve GLB-hervormingsscenario om een directe vergelijking van de afzonderlijke effectiviteit van de gerichte maatregelen mogelijk te maken. Dit houdt in dat wordt aangenomen dat het extra budget per lidstaat voor elke maatregel na 2013 gelijk is aan 25% van de nationale directe inkomenssteun krachtens de BTR. Ten slotte gaat men er in het fictieve GLB-hervormingsscenario van uit dat de directe inkomenssteun krachtens de BTR wordt afgeschaft om de maatregelen van het GLB na 2013 te kunnen financieren. Let wel: de veronderstelde budgetverdeling over de verschillende maatregelen van het GLB na 2013 is uitsluitend bedoeld voor een rechtlijnige vergelijking van de effectiviteit van de verschillende maatregelen. Deze verdeling is geen exacte weergave van de ideeën van de overheid.

De belangrijkste conclusie van het onderzoek is dat de effectiviteit van de verschillende maatregelen van het GLB na 2013 zeer verschillend is met betrekkingen tot de verschillende doelgebieden, zoals inkomen, productie, concurrentievermogen, landgebruik en biodiversiteit. Bovendien varieert de impact tussen landbouwbedrijven, sectoren en regio's. De resultaten zijn samengevat in tabel S.1 en S.2.

Tabel S.1	**Effectiviteit van de maatregelen van het GLB na 2013 en de totale impact van het fictieve GLB-hervormingsscenario op bepaalde economische en milieuvariabelen**				
	Pro-ductie	**Gebruik van variabele inputs a)**	**Prijzen van landbouw-producten**	**Grond-prijzen**	**Btw per bedrijf**
+25% concurrentievermogen	↑	↓	↓	0	0
+25% waardevolle gebieden	0	0	0	↑	↑
+25% ecosysteemdiensten	0	↓	0	↑	↑
+25% basispremie	↑	↑	↓	↑	↑
- afschaffing inkomenssteun	0	0	0	↓	↓
= Totale impact	↑	↓	↓	↓	0/↓
a) Minerale meststoffen, pesticiden, enzovoort.					

Table S.2	**Effectiviteit van de maatregelen van het GLB na 2013 en de totale impact van het fictieve GLB-hervormingsscenario op bepaalde economische en milieuvariabelen**			
	Welvaart	**Grond gebruikt voor landbouw**	**Arbeid**	**Biodiversiteit a)**
+25% concurrentievermogen	↑	0	↓	(↑ / ↓)
+25% waardevolle gebieden	0	↑	0	(↑)
+25% ecosysteemdiensten	0	↑	0	(↑)
+25% basispremie	0	↑	↑	(↑ / ↓)
- afschaffing inkomenssteun	0	↓↓↓	0	(↑ / ↓)
= Totale impact	↑	0/↓	↓	↑
a) ( ) op basis van een kwalitatieve beoordeling.				

De gedetailleerde conclusies met betrekking tot de effectiviteit van de maatregelen van het GLB na 2013 zijn als volgt (zie tabel S1 en S2):

- *Maatregelen op het gebied van concurrentievermogen* stimuleren de productie (met name in Oost-Europese landen), verhogen de export, verlagen de import, verlagen het gebruik van variabele inputs en verlagen de landbouwprijzen, waar de consument van profiteert en wat een hoger nationaal inkomen tot gevolg heeft. Het versnelt de productiegroei van bedrijven die hun activiteiten voortzetten, waardoor er in de landbouwsector minder arbeid nodig is. Mensen die daardoor geen werk meer zouden vinden in de landbouwsector, zouden waarschijnlijk buiten de landbouwsector aan de slag kunnen vanwege de snellere

groei in het nationale inkomen. Bij een toename in de productie is de fictieve GLB-hervorming als beleid zeer effectief als er veel waarde wordt gehecht aan voedselveiligheid.

- *Betalingen voor waardevolle gebieden* zorgen ervoor dat de hulpbronnen (grond en arbeid) voor productie binnen deze gebieden blijven. De totale impact is dat deze betalingen zorgen voor een goede productie en een goed beheer van de grond, dat de grondprijzen stijgen en dat de btw per bedrijf in deze waardevolle gebieden toeneemt. De impact op de productie, het gebruik van inputs en het nationaal inkomen is verwaarloosbaar op het niveau van de EU-27, maar mogelijk is dit op regionaal niveau anders.
- *Betalingen voor ecosysteemdiensten* zijn in bredere zin van invloed op productie en inkomen in de EU-27 (minder regionaal geconcentreerd), verlagen het gebruik van variabele inputs, houden de grond in productie, verhogen de grondprijzen, verhogen de gemiddelde btw per bedrijf en verhogen de biodiversiteit. De impact op de productie, de handel en het nationale inkomen is verwaarloosbaar op het niveau van de EU-27, maar mogelijk is dit op regionaal niveau anders.
- Een *basispremie* verhoogt de btw per bedrijf, houdt de grond in productie en verhoogt de grondprijzen. De impact op de productie, het gebruik van inputs, de biodiversiteit en het nationale inkomen is verwaarloosbaar of niet bekend.
- *Afschaffing van de directe inkomenssteun krachtens de BTR* verlaagt de landbouwproductie enigszins, verhoogt de import (enigszins), verlaagt de export, verhoogt de prijzen van landbouwproducten, verlaagt de gemiddelde btw per bedrijf sterk, verlaagt het totale gebied dat wordt gebruikt voor landbouwproductie en verlaagt de grondprijzen significant.

Er kan een aantal beleidsaanbevelingen worden opgesteld met betrekking tot de effectiviteit van de verschillende gerichte maatregelen:

1. De effectiviteit verschilt per maatregel met betrekking tot de diverse doelen. Beleidsmakers moeten daarom eerst hun doelen vaststellen en op basis daarvan een keuze maken voor de maatregelen waarmee de betreffende doelen het beste kunnen worden bereikt.
2. Gerichte investeringen in productiviteit en efficiëntie (maatregelen om het concurrentievermogen te verbeteren) hebben wel degelijk meer effect op de voedselveiligheid dan het huidige systeem van ontkoppelde inkomenssteun.
3. Dit onderzoek toont aan dat gerichte maatregelen van invloed kunnen zijn op de productie en biodiversiteit. Het is echter belangrijk om een transparant

systeem op te zetten met lage transactiekosten; er is meer inzicht nodig in de transactiekosten van een gericht betalingssysteem.

4. Het is belangrijk dat de herverdeling van directe inkomenssteun krachtens de bedrijfstoeslagregeling (BTR) naar meer gerichte maatregelen en de invoering van een basispremie per hectare geleidelijk gebeurt, om de getroffen boeren meer tijd te geven om zich aan te passen. Dit sluit naadloos aan bij de *Houtskoolschets*, waarin ook is voorgesteld om een geschikte overgangsperiode te creëren om de effecten op het inkomen tot een minimum te beperken *(ministerie van Economische Zaken, Landbouw en Innovatie, 2008)*.
5. Dit onderzoek is gericht op het aspect van de voedselveiligheid (kwantiteit van voedsel). In dit rapport resulteren investeringen in het concurrentievermogen in extra landbouwproductie, waar de consument mede van profiteert dankzij lagere voedselprijzen. Het is bovendien aan te raden om de normen voor voedselkwaliteit en duurzame productietechnieken hoog te houden, omdat dergelijke investeringen de toegevoegde waarde van de voedselproductieketen als geheel vergroten.
6. Middels dit verkennende onderzoek is de impact bepaald van de maatregelen van het GLB na 2013 door middel van economische en biofysische modellen. Uit dit onderzoek zijn grote uitdagingen op het gebied van methodologieën en data naar boven gekomen, die inherent zijn aan complexe beleidsevaluaties als deze. Dit is met name het geval bij het specificeren en kwantificeren van de impact van ruimtelijke en gerichte betalingen, zoals betalingen voor concurrentievermogen, duurzaamheid, waardevolle gebieden en ecosysteemdiensten. Betrouwbare ex-post informatie is bijzonder schaars. Aangezien deze maatregelen in toenemende mate in het GLB kunnen worden geïntegreerd, is het aan te raden om prioriteit te geven aan verder onderzoek middels analytische hulpmiddelen en datacollectie (op verschillende geografische niveaus), zowel op lidstaat- als op EU-niveau. De beschikbaarheid van hoogwaardig, nauwkeurig en vergelijkbaar empirisch bewijs van de impact van deze nieuwe maatregelen op lokaal, regionaal en lidstaatniveau is essentieel voor toekomstige beleidsevaluaties.

1 Introduction

1.1 Background

The budget for the European Union's Common Agricultural Policy (CAP) has been planned until 2013. The next financial programming period is 2014 to 2020. Several proposals for changes and revisions to the CAP have been formulated by Member states and the European Commission. This study assesses the effectiveness of measures proposed in various CAP reform proposals.

This report focuses especially on the measures proposed in the Dutch Outlook regarding the CAP that was presented in September 2008 (Dutch Ministry of Economic Affairs, Agriculture and Innovation, 2008). In addition to the measures proposed in the Dutch Outlook, this report studies the effectiveness of a basic premium system proposed by some other Member States.

Currently the EU CAP is divided into two policy orientations, referred to as Pillar 1 and Pillar 2. On 26 June 2003, EU farm ministers adopted a fundamental reform of the CAP and introduced a new Single Payment Scheme (SPS) for direct income support to farmers in the EU-15 and the Single Area Payment Scheme (SAPS) in most of the new Member States. The SPS is based on (hectare based) payment entitlements that can be traded between farms. The SPS comes under Pillar 1. Expenditure of the EU under the Rural Development Regulation[1] is referred to as the second pillar of the CAP. Pillar 2 measures are aimed at helping rural communities to develop and diversify and helping farmers to maintain natural values and invest in human and social capital. The range of measures includes: agri-environment, farm modernisation, new forestry plantings, the processing and marketing of agricultural produce, training and development, Natura 2000 and Less Favoured Area (LFA) support.

In the Dutch Outlook, the policy framework for the new European agricultural policy will differ fundamentally from the current CAP structure. Two-thirds of CAP payments in the Netherlands (and many other member states) involve direct income support under the SPS (Dutch Ministry of Economic Affairs, Agriculture and Innovation, 2008). The SPS direct income support is allocated to individual

[1] Council Regulation (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD).

farmers according to the average receipts of subsidies in the years 2000-2002, the so-called 'historical' reference. There is no question of any link to socially desirable values. The current method consequently 'freezes' flows of subsidy money determined in the past and makes income support independent of future enterprise developments. Trade in payment entitlements results in money leaving the sector. This occurs through sales of payment entitlements by farmers exiting farming to farmers maintaining their activities (or permanent farmers). The current system of SPS direct income support does not contribute to the great dynamism of the Dutch agricultural sector and the country's rural areas.

The Dutch Government's view is that the future CAP of the EU must serve to strengthen the competitiveness and market orientation of an agricultural sector that produces in a safe and sustainable manner and that also supports socially desirable values that are not rewarded by the market. This means that the existing instruments of market and pricing policy and generic income support will be further reduced and replaced by a system to encourage even greater market orientation of the sector. This will be combined with rewards for socially desirable performance and compensation for significant impediments to agricultural operations or legal restrictions hampering agricultural operations on farms subject to more restrictive situations than other agricultural entrepreneurs within the EU. The key elements will be the following:

1. Incentives for a competitive, market-oriented Dutch and European agricultural/horticultural sector that can eventually produce competitively without support and with a focus on maintaining and reinforcing the current position both internally and on the world market. With this aim in mind, the Government proposes investment in the competitiveness and sustainability of agriculture and horticulture, particularly via knowledge and innovation.
2. The SPS direct support for agriculture and horticulture will gradually be converted into a system of market oriented payments to farmers and other rural enterprises with agricultural activities for creating and maintaining socially desirable values ('nature', 'environment', 'landscape' and/or 'animal welfare') by:
   - actively guaranteeing basic quality in socially valuable areas, and/or
   - active delivery of performance that goes beyond that required of every entrepreneur (i.e., that exceeds statutory minimum requirements), including in the area of animal health and welfare, as well as the support for the delivery of public goods.
3. The new objectives will be provided for from a single European agriculture/horticulture fund, with the distinction between the current pillars of the CAP (Pillar 1 and Pillar 2) no longer being relevant. The size of the CAP as a

proportion of the total EU budget will in part need to be determined in the light of the scope that is necessary with regard to financing other policy priorities.

1.2 Objective

Ex-ante explorations of the effectiveness of post-2013 CAP measures are information sources for discussions on the type of reform that will ultimately be agreed upon between Member States of the EU. Specifically, this study tries to answer the question: what is the economic and environmental impact of the post-2013 CAP measures at different levels of aggregation (e.g. EU, Member State, region and average farm)? This study investigates the effectiveness of post-2013 CAP measures. In addition to the measures proposed in the Dutch Outlook (focusing on competitiveness, valuable areas and ecosystem services), the effectiveness of base premiums are considered, as a measure for establishing them is proposed by some other Member States. Finally the different post-2013 CAP measures are combined and the total impact of a so-called Stylised CAP Reform scenario is calculated. It is stylised in the sense that the division of the budget across measures is chosen to be in equal shares. This enables the assessment of the effectiveness of individual post-2013 CAP measures.

1.3 Methodology

The methodology used in this study is based on the combined use of different types of economic and environmental models (Van Meijl et al., 2006; Nowicki et al., 2006; Verburg et al., 2008; Rienks et al., 2008; Nowicki et al., 2009a; Nowicki et al., 2009b). The methods are developed within the EUruralis project and used in many studies for the Dutch Government and the European Commission.

The models used in this study are LEITAP, CAPRI and DYNA-CLUE. Besides these models, farm level data from the European Farm Accountancy Data Network (FADN) is used to analyse gross value added (GVA) effects at farm level. In this study, the term gross value added is used in the context of CAPRI and FADN. GVA is therefore defined as revenues plus premiums minus variable costs. Fixed capital and labour costs are not included in GVA. FADN is a European-wide instrument to analyse effects on income indicators of *inter alia* changes in the CAP at farm level. LEITAP is a global computable general equilibrium model that covers the whole economy including factor markets. CAPRI is an EU-27 partial equilibrium model for

the agricultural sector at the NUTS-2 level.[1] Post-2013 CAP measures aimed at sub-regions and specific areas (e.g. LFA, Natura 2000), are always modelled using payment shares within a certain NUTS-2 region. In the final modelling stage, the spatially explicit land use model Dyna-CLUE (Conversion of Land Use and its Effects) is used. The Dyna-CLUE model takes information on the amount of agricultural land required by the different sectors from LEITAP at national level and allocates this over the land area according to location suitability, spatial policies (e.g. LFA, Natura 2000) and rules for natural succession. With regard to location suitability, environmental (biophysical) driving forces, which determine the allocation of land use, are accounted for in Dyna-CLUE.

The implementation of the targeted post-2013 CAP measures is a big challenge for current CAP policy models as the policies are rather new and limited ex post evidence is available (see, Nowicki et al., 2009a). Moreover, there are many measures possible and the impact depends on the specific Member States implementation. Finally, very detailed information is needed as the targeted measures are often location specific. The measures also aim at conceptually and especially empirical challenging aims such as public goods (e.g. landscape, biodiversity). The impact of the targeted post-2013 CAP measures therefore crucially depends on the implementation of policies and the assumptions taken. At this stage, many implementation details of the CAP reform proposals are unknown and assumptions are required to specify some of these gaps on implementation. This study must therefore be considered an initial exploratory study to try to ex-ante assess the impact of a CAP reform proposal through quantitative methods. All the assumptions required will be highlighted in the subsequent chapters and the exploratory nature of this study must be borne in mind when interpreting the results of the study. With new assumptions and different implementations of a proposal, the results could look differently.

Chapter 3 gives a detailed description of how the post-2013 CAP measures are implemented in CAPRI, LEITAP and Dyna-CLUE modelling system and the assumptions taken. The methodology builds forward on the methods developed in Nowicki et al. (2009a).

[1] On NUTS-2 level, the EU-27 consists of 264 regions, excluding the 4 French Overseas Departments. In the Netherlands, NUTS-2 corresponds with the province level.

1.4 Scenario set up

The purpose of the study is a quantitative impact assessment of the effects of measures proposed by the Dutch Outlook on the agricultural sector in the EU-27 for 2020. Two scenarios for 2020 were developed for this purpose: the reference scenario and the counterfactual policy scenario. The counterfactual policy scenario is referred to as the Stylised CAP Reform scenario, which represents the Dutch Outlook in a modified form. It is stylised because firstly, it introduces a base premium, although this is not a part of the proposals in the Dutch Outlook, as well as measures for competitiveness, socially valuable areas and ecosystem services. Secondly, the CAP budget for the different measures (i.e. competitiveness, socially valuable areas, ecosystem services and a base premium) is split equally in the Stylised CAP Reform scenario to enable a comparison of the effectiveness of targeted measures individually.

1.5 Outline

The different scenarios are discussed in more detail in Chapter 2. Chapter 3 presents the methodology and focuses on the modelling framework and the implementation of policy measures in a rather detailed manner. In paragraph 3.5 the difficulties of this innovative research and the strengths and weaknesses of the approach are critically discussed. The reader who is more interested in the results of the different scenarios can proceed to Chapter 4 immediately. Chapter 4 discusses the results. Results focus on the effects of the different scenarios on economic variables and environmental indicators. Economic variables taken into account are agricultural production in the EU-27 as a whole and at regional level, prices of agricultural products, trade balances, land prices and agricultural area and valued added per average farm and per region. Environmental indicators that will be discussed are land abandonment and indicators for biodiversity. This report ends with discussion and conclusion.

2 The scenarios

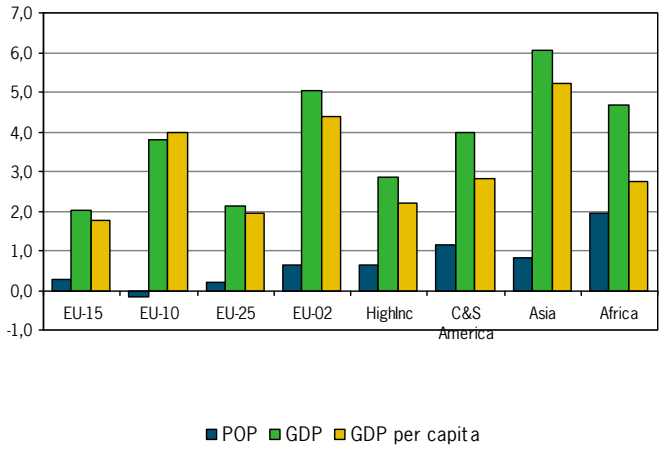
The different scenarios are discussed below. A summary of the scenarios is given in Table 2.1.

2.1 The reference scenario

The time horizon of the study is 2020. We distinguish between exogenous drivers and drivers that are more policy driven. Exogenous drivers include changes in population, income expenditure, technological change, etc. Data used here are borrowed from other studies such as Scenar 2020 and Scenar 2020-II or from projections of international institutes like OECD and FAO. With respect to policy variables, the reference scenario incorporates the 2003 CAP reform, including the sugar and dairy policy reform and the abolition of the milk quota system in 2015. We include the implementation of the Health Check, which among other things already foresees a 10% reduction in direct income support under the SPS and an increase in regional development payments until 2013. With respect to the budget of the CAP, we assume that this remains constant in nominal terms. No further WTO agreement or other trade liberalisation measures are included. With respect to the Renewable Energy Directive (RED), a 10% share of biofuels in the transport sector in 2020 in the EU is assumed.

Key macro assumptions (GDP and population growth):
Worldwide differences in production and consumption growth can partly be explained by differences in economic and population growth between countries and country groups (Figure 2.1). Population growth is negligible in the European Union, while it is projected to be still about 2% per year in Africa. A steady 2% income growth is expected within the EU. Central and Eastern European countries are expected to catch up and a growth rate of 4% is projected. GDP growth rates in Asia are expected to stay high for the 2007-2020 period (6% a year).

Figure 2.1 **World population, GDP and GDP/cap annual growth rates (2007-2020) a)**



a) Note for the reader:
Regional aggregations in the figures of the following sections are indicated as:
- HighInc: Nafta (Canada, USA, Mexico), Oceania (mainly New Zealand and Australia), Japan and South Korea.
- C&SAmerica: Central and South America (including Brazil) and the Caribbean countries.
- Africa: South Africa, all sub-Saharan countries and North Africa.
- Asia: China, East Asia (including India) and Middle East.

Not included in these figures:
- Turkey.
- Rest of Europe (Switzerland, Norway, Croatia and the other Western Balkan countries).
- All countries belonging to the bloc of the former Soviet Union.

Source: United States Department of Agriculture/Economic Research Service Database (2009), Scenar2020II (Nowicki et al., 2009b).

2.2 The Stylised CAP Reform scenario with targeted measures

In the current exploratory phase for CAP reform beyond 2013, the country and even region specific post-2013 CAP measures and corresponding farm management changes have not yet been formulated and cannot all be foreseen. Therefore assumptions on the possible implementation and exact definitions of post-2013 CAP measures are required to parameterise the models. As a matter of principle, current policy measures (e.g. LFA, Natura 2000, market innovation approaches under Pillar 2) are used as a blueprint for new measures with large increases in budget. This study at European level must therefore be seen as a first attempt to

analyse the transition to a CAP with more targeted measures at European scale, performed at a time when the specific implementation of measures or future budget allocations are not yet known. The most important ambitions of the Dutch outlook are incorporated in a Stylised CAP Reform scenario. The most likely post-2013 CAP measures and farm management adjustments that could be part of the proposed CAP reform are included in this scenario and translated to inputs of economic and environmental models used in this study.

The Stylised CAP Reform scenario analysed in this study includes five elements in which it differs from the reference scenario. The Stylised CAP Reform scenario makes a distinction between post-2013 CAP measures in four directions. As the fifth element, the direct income support under the SPS is abolished to finance the post-2013 CAP measures. No extra national co-financing is assumed and the available budget to support the sector is similar to the reference scenario (budget neutral). As the focus on the effectiveness of measures is one of the key concerns of this study, we have assumed that each member state allocates 25% of the direct income support under the SPS to each of the four measures. Thus the impact of various measures can be compared for various indicators. This stylised division is not a realistic division as the budget for some measures might be too high in some countries. The effectiveness of measures is our key aim and with this equal division the effectiveness can best be compared.

The first post-2013 CAP measure included is improved competitiveness and sustainability. A quarter of the direct income support under the SPS is used for this. The extra budget for measures related to competitiveness is invested evenly over all the agricultural and horticultural sectors, regardless of the sector of origin. Measures to improve competitiveness are included in our models by assuming a relationship between physical and human capital investments and productivity and efficiency gains in the agricultural sector (Nowicki et al., 2009a). Section 3.2.2 discusses the assumptions in more detail.

The second post-2013 CAP measure included is a direct payment to farmers in valuable areas. LFA and Natura 2000 areas are included as valuable areas. The payments are linked to agricultural land located in these areas. The share of LFA and Natura 2000 areas in a region is therefore crucial for the budget distribution among regions. Possible differences in the share of grassland and arable land in LFA and Natura 2000 regions compared to the regional average also play a role in the distribution of the budget (see Section 3.2.3).

The third post-2013 CAP measure is the increased provision of ecosystem services through extra agri-environmental payments. This is included in the models by supporting more extensive type of production methodologies, as for these low

input farming types there is a relationship between production intensity and the possibilities of delivering public goods and/or ecosystem services. Nevertheless, high(er) input farming systems also have great potential for the delivery of public goods and and/or ecosystem services. These are not yet included in this study. The initial distribution of agri-environmental payments over different type of farms and regions as found in FADN is used to distribute the extra budget for ecosystem services over regions and agricultural activities in the economic models (Nowicki et al., 2009a). In the Dyna-CLUE model zones, it is defined where these payments would be higher in future. Section 3.2.4 discusses the assumptions in more detail.

The fourth measure is a base premium paid as a flat rate per hectare per Member State. A base premium is NOT part of the Dutch outlook, but it fits into a possible CAP reform and the effectiveness of this measure relative to other measures is an important element in the current CAP reform discussions. To pay for all these payments, the Stylised CAP Reform scenario assumes a 100% abolition of the direct income support under the SPS/SAPS. The results of the Stylised CAP Reform scenario and the effectiveness of individual measures are presented as percentage changes compared to the reference scenario.

Table 2.1	Summary of the reference and the Stylised CAP Reform scenario	
	Reference	**Stylised CAP Reform**
Autonomous developments with respect to exogenous drivers (demographics, macro-economic growth, consumer preferences, technological change, world markets)	As in Reference scenario in Scenar 2020-II (Nowicki et al., 2009)	As in Reference scenario in Scenar 2020-II (Nowicki et al., 2009)
CAP	CAP reform 2003, sugar and dairy (abolition of dairy quota) Implementation of the Health Check (10% modulation of direct farm payment, full decoupling, no set aside, etc.) EU CAP budget constant in nominal terms	25% of the national direct income support under the SPS is allocated to: - competitiveness and sustainability - valuable areas - ecosystem services - to a base premium at member state level The direct income support under the SPS is abolished
Trade Issues	Abolition of export subsidies; no WTO agreement	Abolition of export subsidies; no WTO agreement
Biofuel policies	10% share of biofuels in the transport sector	10% share of biofuels in the transport sector

3 Methodology[1]

The purpose of this study is to analyse and quantify the effectiveness of post-2013 CAP measures on markets and income in the agricultural sector in the EU-27. In order to do so, different types of economic and environmental data and models are used. However, the purpose of this study is a big challenge for current models that focus on both the market and income effects at the level of the agricultural sector in the EU-27. The main reason for this is the general lack of empirical data and hard evidence concerning the impact of direct payments and targeted measures on farmers' behaviour. Consequently, the translation of the reference and post-2103 CAP measures included in the Stylised CAP reform scenario to the variables that ultimately drive the results of the models is largely based on theory and assumptions. These will be discussed in detail in this chapter.

3.1 Approximation of post-2013 CAP policy measures

The three broad categories of post-2013 CAP measures (competitiveness measures, valuable areas payments and agri-environmental payments to improve ecosystem services (the latter is also referred to as payments to ecosystem services)) are difficult to model as the precise specification of the measures is unknown. We therefore focus on the economic intervention logic of broad categories of measures. To implement the policies, we use existing rural development measures as proxies for the new measures to obtain some empirical information to implement these measures in the modelling framework. However, these analyses cannot reasonably be performed separately for each of the 46 rural development measures and are thus grouped according to fundamental similarities in the economic mechanisms and how these are handled by each of the models. As an elaboration of this principle, Table 3.1 presents the groupings of measures, the models used for their analysis and the relationship between the models. Further elaboration of the information obtained for each of the groupings is presented in respective subsections in the text that follows.

[1] Large parts of this chapter are taken from Nowicki et al. (2009a).

Table 3.1	Treatment of post-2013 CAP measures a) in quantitative models	
	Treated in model	**How implemented (information needed from other models/case studies)**
A Competitiveness		
01 - Human Capital Investment [111-115, 131-133]	LEITAP	Payments influencing the total factor productivity in agriculture. Rate of return on investment is 40% (Evenson, 2001).
	CAPRI	Via link with LEITAP.
02 - Physical Capital Investment [121-126]	LEITAP	Payments which influence the total factor productivity due to capital investments in all agricultural sectors. Rate of return on investment is 30% (Wolff, 1996; Gittleman, Ten Raab and Wolff, 2006).
	CAPRI	Via link with LEITAP.
B. Valuable areas		
03 - LFA Land Use Support [211, 212]	LEITAP	Income payment linked to land in agricultural sector. FADN data are used to distribute payments across sectors.
	CAPRI	Regional direct support. Distribution over sectors and regions based on FADN data and Dyna-CLUE results.
	Dyna-CLUE	LFA support adds to the relative preference for the location for arable land or grassland (only for current agricultural land within LFA regions).
04 - Natura 2000 [213]	LEITAP	Income support linked to land in agricultural sector FADN data are used to distribute payments across sectors.
	CAPRI	Regional direct support. Distribution over sectors and regions based on FADN data and DYNA-CLUE results. Conditional on the use of extensive technology.
	Dyna-CLUE	Agricultural land in Natura 2000 areas receives a higher relative preference (as compared to no support) for agriculture (only for current HNV agricultural land within LFA regions).
a) The RD measure numbers are indicated between square brackets [#].		

Table 3.1	Treatment of post-2013 CAP measures a) in quantitative models (continued)	
	Treated in model	**How implemented (information needed from other models/case studies)**
C: Ecosystem services		
05 - Agri-Environment measures [214-216]	LEITAP	On the one hand, income support linked to land in the agricultural sector and on the other hand a yield and labour productivity loss. FADN data are used to distribute payments across sectors.
	CAPRI	Regional direct support. Distribution over sectors and regions based on FADN data. 50% of the support directed towards TF8 farm types 1, 2, 3, 4 and 8 is conditional on the use of extensive technology, for remaining amounts extensive as well as intensive technology is eligible. See Table 3.6 for a description of TF8 farm types.
	Dyna-CLUE	Areas that currently receive payments for agri-environmental measures have a higher additional preference for staying in agriculture (i.e. arable or pasture) compared to areas that do not receive these payments.
06 - Forestry [221-227]	LEITAP	Investment support for non-agricultural activities that increase productivity. Rate of return on investment is 30% (Wolff, 1996; Gittleman, Ten Raa and Wolff, 2006).
07 - Diversification [311-313]		
08 - General rural development [321-323, 331, 341]	CAPRI	Via link with LEITAP.
09 - Leader [411-413, 421, 431]		
10 - Technical assistance [511, 611]		

a) The RD measure numbers are indicated between square brackets [#].

3.2 General modelling framework

3.2.1 Schematic overview

In order to model the economic and environmental impact of the CAP, it is necessary to find a means of linking agricultural commodity parameters with regional/territorial aspects. Table 3.2 presents an overview of the geographical and sectoral coverage of the models used in this study. The global economy-wide dimension is covered by the economic model, LEITAP. CAPRI provides more agricultural detail for the EU-25 countries and distributes this impact to the regional (NUTS-2) level. Dyna-CLUE provides a detailed analysis of land cover change, thereby giving a spatial representation of the economic modelling outcomes.

Table 3.2 Overview of the models: geographical and sectoral coverage

	Agricultural	Rest of economy
Global	LEITAP	
EU/national	LEITAP-CAPRI	LEITAP
NUTS-2	CAPRI	
FARM	FADN	
Grid	Dyna-CLUE	

To perform the analysis, a modelling framework is constructed, consisting of two economic models (LEITAP, CAPRI) and a land use allocation model (Dyna-CLUE) to disaggregate the outcomes spatially. In this modelling framework, the economic and environmental consequences of the different scenarios are quantified and analysed up to 2020.

LEITAP is a global computable general equilibrium model that covers the whole economy including factor markets and is often used in WTO analyses (Francois et al., 2005) and CAP analyses (Meijl and Tongeren, 2002). More specifically, LEITAP is a modified version of the global general equilibrium Global Trade Analysis Project (GTAP) model. Agricultural policies are treated explicitly (e.g. production quotas, intervention prices, tariff rate quotas, (de)coupled payments). Information is used from the OECD's Policy Evaluation Model (PEM) to improve the production structure (Hertel and Keening, 2003) and a new land allocation method that takes into account the variation of substitutability between different types of land (Huang et al., 2004) as well as a new land supply curve have been introduced (Meijl et al., 2006b; Eickhout et al., 2007). A key feature of the post-2013 CAP reform propos-

als is that some measures directed at competitiveness, such as physical and human capital investment, have a dynamic impact. For example, training increases labour productivity and increased labour productivity has a positive impact on yields; an investment in one year has cumulative effects over following years. To include these dynamics, the LEITAP model has been extended to include a recursive dynamic version with endogenous technological change by specifying a relationship between investments and productivity change (Nowicki et al., 2009a).

CAPRI is an EU-27 partial equilibrium model for the agricultural sector at NUTS-2 level. An important feature of CAPRI is that agricultural activities are divided into an extensive (low input, low yield) and an intensive type (high input, high yield). The main function of CAPRI (Britz et al., 2008) is to assess detailed agricultural policies and the regional impact of post-2013 CAP reform measures (NUTS-2 level). Within CAPRI, RD measure groupings 'valuable areas' (e.g. LFA, Natura 2000) and 'ecosystem services' (e.g. Agri-environment) are assumed to have a direct impact on agricultural land use. The remaining measures are assumed to work indirectly by influencing factor productivity and costs. This is accomplished by linking the costs and production technology of CAPRI to the simulated results of LEITAP, where those other measures are explicitly implemented.

As stated above, FADN is a European-wide instrument used to analyse the GVA and family farm income effects of *inter alia* changes in the CAP at the farm level. Family farm income differs from GVA as the fixed labour and capital costs are included in farm income. FADN is the annual collection of accountancy data from a sample of the agricultural farms in the European Union. Derived from national surveys, FADN is the only source of micro-economic data that is harmonised, i.e. the bookkeeping principles are the same in all countries. Holdings are selected to take part in the survey on the basis of sampling plans established at the level of each region in the EU. The survey does not cover all the agricultural holdings in the EU, but only those which could be considered 'commercial' due to their size. The methodology applied aims to provide representative data along three dimensions: region, economic size and type of farming[1]).

In the final modelling stage the spatially explicit land use model Dyna-CLUE (Dynamic Conversion of Land Use and its Effects) is used (Verburg and Overmars, 2009). The Dyna-CLUE model disaggregates the outcomes of LEITAP - CAPRI to a temporal resolution of two years and a spatial resolution of 1 km^2. Dyna-CLUE models a range of land use types, including forests, nature and urban land use,

[1] http://ec.europa.eu/agriculture/rica/index_en.cfm

while LEITAP - CAPRI mainly address agricultural land use. Dyna-CLUE models the changes and conversions between these land use types between 2000 and 2020 for the EU-27. The Dyna-CLUE model takes information provided by the economic models on the amount of agricultural land used by the different sectors at national level and allocates this over the land area according to location suitability, spatial policies (LFA, Natura 2000) and rules for natural succession. With regard to location suitability, environmental (biophysical) characteristics (e.g. soil type, climate, distance to roads, which determine the allocation of land use, are explicitly accounted for. In the economic model chain, these factors are not taken into account. Dyna-CLUE enables a comprehensive analysis of land use dynamics, as all relevant land use types, trends and policies are included in the model, simulating developments in nature conservation, peri-urban development, forestry, recreation and agriculture.

The Dyna-CLUE model downscales in land use simulated to a local use pattern and visualises the impact of CAP changes on local land use. It is possible to identify critical regions (hot spots) impacted by the effects of changes in total agricultural area and possible land abandonment. Moreover, the spatially explicit results allow an assessment of the changes within geographically delineated areas where some measures are targeted, including LFA and Natura 2000 areas.

The Dyna-CLUE model simulates the impact of several Rural Development measures in Pillar 2 of the CAP that concern specific aspects of valuable areas and ecosystem services, including measures:

211: Natural handicap payments to farmers in mountain areas;
212: Payments to farmers in areas with handicaps, other than in mountain areas;
213: Natura 2000 payments and payments linked to the Water Framework Directive;
221: First afforestation of agricultural land;
224: Natura 2000 payments for forestry.

3.2.2 Links between the models

The models are linked to each other to obtain consistent results. The LEITAP model uses information on policy changes from a common budget model that distributes the budget across measures. It provides the changes in national income (GDP) to the other models, along with consumer price index (CPI) and factor prices and the change in land use for Dyna-CLUE (i.e. arable land and permanent pasture) at Member State level. Table 3.3 shows the items of LEITAP that are linked top-down to parameters of CAPRI.

Table 3.3	Link between LEITAP and CAPRI
LEITAP	**CAPRI**
Consumer expenditure	Consumer expenditure
Price index of consumption	Consumer price index of non-agricultural goods
Price index of tradable inputs that are not agricultural and not services	Prices of fertilisers and other variable inputs
Price of services	Price of maintenance and service inputs
Prices of capital and skilled and Unskilled labour	Shift of the behavioural term of the producers' objective function
Total factor productivity (Hicks neutral technical change)	Yield increase 50%, input reduction 50%

LEITAP translates the competitive measures (human and physical capital investment measures) into (Hicks-neutral) technical change, which implies an expansion of the entire production function. As this turns out to be key to the impact of the second pillar, it is important to link CAPRI's technical progress[1] in LEITAP in a way that captures its essence. In LEITAP, the (Hicks-neutral) technical change does not distinguish 'producing more output with the same inputs' from 'requiring less inputs for producing the same output'. In contrast, CAPRI assumes a micro-economic model where the producer decides about the allocation of land and numbers of animals, but not about tons or Euros of final product. Most technical input/output coefficients in CAPRI, such as yield and input use, are on a 'per hectare' or a 'per animal' basis and the production structure is more rigid (essentially 'Leontieff'). Simply increasing yields and leaving the input coefficients unchanged (per hectare or head) would formally imply the proper sort of technical progress, but the rigid Leontieff structure would prevent the 'CAPRI-farmer' from moving along the production possibilities frontier to a position where some of the output increase is traded for less input use per hectare. In reality, technical progress consists of a multitude of small improvements, many of which are input saving (per hectare or animal). In order to reflect this in CAPRI, an interpretation of the result from LEITAP was chosen where technical progress is partly neutral (a yield increase) and partly a biased input saving in such a way that fewer inputs per hectare or animal are required. Since LEITAP does not provide detailed information

[1] 'Technical progress' is explained later in the paragraph.

about the details of technical change, a blanket assumption of 50% yield increase and 50% input saving was applied across all activities and inputs in CAPRI.

Labour and capital are not explicitly modelled in CAPRI. It is assumed that in a calibration point or reference point, the difference between total revenue and observed costs, including shadow costs of all the restrictions in the model (e.g. land) per activity per region, is equal to the costs of labour and capital per activity per region. Next, this difference is included as one non-linear term in the producers' objective function of CAPRI. The linking of the scenario-specific changes in prices and quantities of capital and labour from LEITAP to changes in this activity and region-specific term in CAPRI is obtained in two steps. In the first step, the approximate use of labour and capital in the production of CAPRI goods is computed to divide the above mentioned non-linear term. This is done using a special aggregation of the GTAP[1] database, where agricultural products are disaggregated as finely as possible and the regions are aggregated in a way similar to CAPRI. The shares of labour and capital in total expenditure in the agricultural sectors of GTAP are computed and mapped to the CAPRI products, where they are multiplied by the sum of market revenues plus premiums for the corresponding agricultural activities. The resulting numbers are termed 'quasi-input-coefficients' and are interpreted as the use of capital and labour in constant euro. In the second step, LEITAP is run for any scenario and the percentage change in the prices and quantities of capital and labour is computed. These percentage changes are used to shift the non-linear or behavioural term of the CAPRI objective function, i.e. to change the marginal cost of each production activity in direct proportion to its quasi-input-coefficients.

3.3 Treatment of current Pillar 1 and Pillar 2 measures and post-2013 CAP measures within the models

In order to be able to assess the reliability of the outputs of models effectively, it is necessary to elaborate on the way in which the current Pillar 1 and Pillar 2 and post-2013 CAP measures have been treated in the quantitative models. The economic tools, as they currently stand, are more useful tools for analyses on the first pillar of the CAP, but less so for the analyses of effects of Pillar 2 and post-2013 CAP measures. However, modelling the reductions in SPS direct income support

[1] Remember, the connection with LEITAP is that LEITAP is a modified version of the GTAP model.

within the first pillar is not without its problems either, as the impact of decoupling is not yet empirically known. Pillar 2 and post-2013 CAP measures are difficult to analyse mainly because of the range of different measures with different objectives which can be implemented in many different ways in individual Member States or regions. In addition, any attempt at modelling competitiveness measures - such as physical and human capital investments - needs to include dynamic effects.

3.3.1 Reducing first pillar payments

There are two methodological issues to be dealt with in relation to reducing first pillar revenue. The first is the issue of how to model decoupled payments and the second is how to model the implementation of the reduction of the direct payments themselves (see Table 3.4). Decoupling of first pillar revenue from production is difficult in agricultural commodity models, as the impact of decoupling is not yet empirically known. The way that direct payments have been dealt with within the models for this study is based on the general logic of intervention for direct payments, accompanied by available literature which considers the effects of these payments on production factors.

In our 2020 reference scenario, we assume that all SPS direct income support is decoupled from production. There is, however, a weak direct production link still in place, via restrictions that the land corresponding to the payment entitlements must be kept in 'good agricultural and environmental condition', i.e. land cannot be abandoned and farmers may not leave agriculture. Furthermore, there may be an indirect effect via GVA and income: theoretically, a lump sum payment has no influence on production decisions if farmers operate in a perfect market with no risk and uncertainty. But these are rather strong assumptions. Therefore the following five lines of argument are observed which imply some effect of decoupled income support on production:

Firstly, because direct decoupled income support is a rather fixed and reliable income component, farmers may go for more risky production in agriculture, with higher levels of input use and output. This would be a reason for a positive production effect of direct decoupled income support (Sckokai, 2005; Roche and McQuinn, 2004).

Secondly, farmers might be liquidity constrained and - because of differences in interest rates for debts and savings - the availability of direct decoupled income support can stimulate investment (Vercammen, 2003; Sckokai, 2005; Bezlepkina et al., 2005; Hennessy and Thorne, 2005).

Thirdly, decoupled direct income support leads to an increase in income and wealth (either directly or via asset prices). This income and wealth effect may reduce the labour time of farm households in agricultural production (Ooms and Hall, 2005; Ahituv and Kimhi, 2006; Kimhi and Rapaport, 2004).

Fourthly, decoupled income support may influence the structure of agricultural production by keeping more farms in business than would be the case in the absence of support (a freezing effect), but also by increasing the number of small and medium sized farms that give up farming and sell land and quota (including the rights to direct income support) to larger and more efficient farms. Often large farms generate more production per hectare. The structural effects of direct income support is ambiguous and a subject for further research (Schunk, 2001).

Finally, decoupled direct income support can easily leak away to other parts of the economy, for example by being capitalised in agricultural land rent of land owners (Burfisher and Hopkins, 2003). As usual with agricultural policy measures, the rent element leaks away during change of farm ownership or farm assets.

Sckokai and Moro (2009) investigated econometrically the effects of the SPS compared to the level of intervention prices and area payments on investment, insurance and wealth for crop farms in Italy. They used data for specialised Italian arable crop farms taken from the EU FADN database for the period 1994-2002. There are about 3,800 annual individual observations, which means about 34,000 individual observations in 9 years. The outcome was that changing intervention prices and/or area payment level had a stronger effect on investment, insurance and wealth than the SPS. The effect of the SPS on investment and production was found to be very limited, but different per crop and also dependent on the farmer's individual situation (wealth level). Moreover, the effect also depends on the market conditions (price levels and price volatility). Rude (2007) also concludes that each of the above mentioned indirect effects appear to have only minimum potential to distort production decisions. 'Collectively these indirect production effects may not be negligible but the impact will be nonetheless small' (Rude, 2007).

Given these considerations, in CAPRI the SPS direct income support at the level of the regional farm is modelled as a decoupled direct payment linked to land, but where the amount paid is the same regardless of how the land is used, as long as it is not abandoned. Thus, the payment has the effect of increasing land rents (compared to no policy), increasing agricultural income and preventing land abandonment, but has no effect on the choice between eligible crops (as the direct payment (€ per ha) is equal for all eligible crops). In the reference scenario, we assume that all land use classes distinguished in CAPRI are eligible, except fallow land. Wealth and insurance effects are not modelled, nor is the potential effect

on farm viability, since neither risk nor single farms are explicitly modelled in CAPRI.

A similar approach has been chosen for the general equilibrium model LEITAP. In LEITAP, decoupled direct payments are also modelled as payments to land. It is assumed that land in all the agricultural sectors that are eligible for single farm payments receive the same payment rate. Therefore, the payment does not affect the choice between eligible crops within agriculture or the choice of production factor to use in production. In this economy-wide model, however, the payment favours agricultural sectors relative to both the manufacturing and service sectors. Due to the payments, farm income increases and more production factors stay within the agricultural sector. Consequently, land abandonment will be less, for example.

Table 3.4	**Treatment of Direct Payments (Pillar 1) in models**	
	Treated in Model	**Implementation**
Direct Payments (1st pillar)	LEITAP	Farm payments are implemented as land payments in the various agricultural sectors. Coupled payments are directly coupled to sectors. Decoupled payments are implemented as an equal payment rate to the production factor land in all eligible sectors and therefore do not provide an incentive to switch between eligible sectors. Of course, changes in decoupled payments will result in changes in the allocation of production factors between eligible sectors (e.g. agriculture) and non-eligible sectors (e.g. non-agricultural sectors).
	CAPRI	Analyses the effects of changes in farm payments at regional farm and sector level. CAPRI distinguishes between many types of premiums. Decoupled premiums like milk and sugar premiums are distributed over the eligible crops of the regional farm. Coupled premiums are linked to agricultural activities at regional level.

3.3.2 Competitiveness measures

Proxies for competitiveness measures are provided by human and physical capital investments, which are only relevant for the CAPRI and LEITAP models and are processed in Dyna-CLUE by using the outputs of LEITAP and CAPRI as inputs.

Human capital investments

Investments in human capital (7% of the total EAFRD budget) are likely to lead to an overall increase in productivity; higher levels of knowledge may lead to better use of machinery and handling of cattle, better fertiliser, pesticide and feed use, more efficient organisation of work and more efficient use of land (for example through better timing, producing higher quality products). Thus, human capital investments result in a general productivity increase. The LEITAP model is extended by including a direct link between human capital payments and technological change. As we have no empirical information from the literature about the factor bias or effectiveness of human capital expenditure within the rural development programmes, we assume that they have a similar rate of return as other general human capital investments and we therefore assume a Hicks neutral rate of technological change (all production factors and inputs will be reduced with the same rate of technological change). A review of other sources of literature suggests that the rate of return on investment in education is 0.40, implying that investment of one dollar per unit of output increases output productivity by 0.40% (Evenson, 2001). So, if the investment in education is €1,000 and if the total output value is €1,000,000, then the total output productivity increases by 1,000/1,000,000*0.4%, which is 0.001*0.4% and the result is 0.0004%.

Nowicki et al. (2009a) indicate that in some cases (for example in relation to the early retirement measure), investments may also have been undertaken in the absence of Pillar 2 funding for human capital. In economic terms, there is a crowding out or deadweight effect. Precise estimates on the magnitude of this do not exist and we have therefore taken a crude assumption that 50% of the funds used for investments in human capital will in fact fund investments that would have been carried out anyway. The deadweight element of the payments for human capital investments are considered as an income payment. In LEITAP, this part of the payment has no consequences for behaviour, but increases GVA and family farm income.

The CAPRI model includes the impact of human capital investments by a link with the LEITAP model. The measure '01 - Human capital investment' is implemented in LEITAP to produce a Hicks neutral technical change. This implies that

with a given input mixture, more output is produced and is obtained by increasing the whole production function (per sector) in LEITAP by some factor 'ao'.

CAPRI reads 'ao' from LEITAP and uses it on the one hand to increase yield by 50% of 'ao' and on the other hand to reduce input requirement by 50% of 'ao'. This ad-hoc division of the effect is necessary in CAPRI since the production technologies essentially work with fixed input/output coefficient, in contrast to a smooth production function as in LEITAP.

How does it work in the model? The effect of the human capital investments on production is driven by the ratio between the extra budget for investments in human capital and the output value; if the value of output is relatively low (high), the ratio between human capital investments and output will be high (low) and the effect on productivity and efficiency will also be high (low). Possible regional differences in human capital investments within a Member State are not taken into account.

Physical capital investments

Extra capital investment may renew the capital stock and therefore achieve an increase in productivity because of capital embodied technology. In the implementation, we performed a very simple experiment. We assumed that extra capital goods replace 15 year old capital goods and that output augmenting capital embodied technological change is 3% per year. This implies that the productivity of the new machines is 55% (=1.03^{15}) higher than the productivity of the replaced machines and about half as high again as the average machines (the newest machine is 55% more productive than the oldest one, so roughly speaking 0.5*55% more productive than the average machine). So we assume that an extra investment of 1% of the capital stock generates an increase in output productivity of 0.5*0.55*1%=0.275%. This implies that an investment of one dollar per 100 dollars of physical capital stock increases output productivity by 0.275%. Moreover, we also assumed that 50% of the subsidies generated extra capital goods (deadweight effect). Therefore in LEITAP output, productivity will be increased by 50% (because 50% of the payments are assumed to be effective) of 0.275%. The other part of the payment has no consequences for behaviour, but increases farm income.

The CAPRI model includes the impact of physical capital investments by a link with the LEITAP model similar to human capital investments. The Stylised CAP Reform scenario assumes that the budget for competitiveness measures increases with 25% of the national budget for direct income support under the SPS. The total productivity shock from competitive measures in the Stylised CAP Reform

scenario as included in CAPRI is presented in Table 3.5. Table 3.5 shows that in general the productivity shock is relatively high in countries of the EU-10 (new member states) and relatively low in countries of the EU-15 (old member states). However, also within the EU-10 and EU-15 there are big differences between the member states included in the analysis in this study. Further research is necessary to validate these differences. Moreover, in this research productivity shocks are equal between sectors and regions. Further research is necessary to find out whether differences in productivity shocks are possible between regions and sectors. Given the approach in CAPRI as presented above, due to the extra budget for competitiveness the percentage change in efficiency per agricultural activity per member state, is equal to the productivity change (see Table 3.5).

In economic terms, the differences in productivity and efficiency shocks between member states stemming from the competitiveness measures will have a production and allocation effect, so that the member states in CAPRI that achieve the highest percentage changes in productivity and efficiency may expand their production at the expense of other member states.

Table 3.5	**Percentage changes in main output per agricultural activity (sector) due to an increase of the budget for competitive measures with 25% of the national budget for direct income support**				
EU-27	1.2	Portugal	0.8	Hungary	4.6
EU-25	1.2	Spain	0.8	Lithuania	4.4
EU-15	1.0	Greece	0.6	Latvia	4.4
EU-10	2.6	Italy	0.7	Poland	2.0
Belgium and Luxembourg	0.3	Ireland	1.9	Slovenia	1.7
		Finland	1.7	Slovak Republic	3.2
Denmark	0.5	Sweden	1.5		
Germany	1.5	United Kingdom	0.7	Cyprus	0.9
Austria	1.6			Malta	0.9
Netherlands	0.2	Czech Republic	1.6	Bulgaria	0.9
France	1.0	Estonia	4.4	Romania	0.9
Source: CAPRI, derived from LEITAP results.					

3.3.3 Valuable area payments

The proxies for valuable area payments are provided by LFA and Natura 2000 payments.

LFA land use support

LFA payments provide compensation for producing under less efficient circumstances, with the aim of keeping land in marginal areas under production. Pufahl and Weiss (2009) have analysed the effects of LFA payments schemes in Germany by comparing similar farms with and without LFA payments. They find that the effect of LFA payments is especially to keep land in production and that these payments only have a small positive production effect.

In CAPRI, the LFA measure was implemented as a direct payment to arable cropping and grassland. The first challenge encountered when implementing the LFA premiums is that the regions do not coincide with the administrative regions used in CAPRI. It is important to remember that CAPRI only has one single representative firm in each NUTS-2 region. Thus, in reality, only a share of the land in a NUTS-2 region - generally much less than 100% - is eligible for LFA payments and it may very well be the case that the specialisation of farms operating on that land is different from the regional average. For example, one may expect that a mountainous LFA area contains more grassland than the surrounding agricultural areas on flat land in the same NUTS-2 region. In order to capture a possible bias of this nature, data from Dyna-CLUE was used to compute the shares Sij of LFA in broadly different land use classes $j \in$ {non-irrigated arable land, irrigated arable land, pasture, permanent crops} in each region i. Those shares were multiplied by a nominal premium rate A to compute an average premium amount Pij for crops belonging to each class j in each region i. These computed amounts were taken to reflect the biased distribution of crops inside and outside LFA regions. Since Dyna-CLUE does not distinguish 'Mountainous' and 'Other' LFA, the nominal amount A to which the shares S were applied was assumed to be the same everywhere: €250, the maximum amount in mountainous LFA regions.

$$Pij = ACSij$$

where P: Premium per hectare, i: Region, j: Group of crops (land class)
A: Maximum amount per hectare, €250
S: Share of LFA in all land of class j
C: Premium cut factor

In the above equation, the variable C represents the cut-off factor in case the value ceiling of the premium is overshot. A value ceiling for the premium was computed by adding the budgets for the component measures, coming from the LEI budget model. Text box 3.1 gives an example of the calculation of the NUTS-2 average LFA premium per crop per hectare

Textbox 3.1	**Numerical example of the calculation of the NUTS-2 average LFA premium per crop per hectare**				
Pij	Average LFA premium per NUTS-2 region i and crop group j				
i	Region (1,2)				
j	group of crops (land class) (grass, arable crops)				
A	Maximum amount per ha premium				
Sij	Share LFA in all land of class j in region i				
C	Premium cut factor				
Region 1			Region 2		
		Pij=ACSij			Pij=ACSij
A	250		A	250	
S1, grass	0.5		S2, grass	1	
S1, arable crops	0.2		S2, arable crops	1	
C	0.9		C	0.9	
P1, grass	250*0.9*0.5=	112.5	P2, grass	250*0.9*1=	225
P1, arable crops	250*0.9*0.2=	45	P2, arable crops	250*0.9*1=	225

In economic terms, the potentially different premium rates for different groups of crops have a production effect so that the activities in CAPRI in receipt of the higher LFA payments may expand at the expense of other activities in case of an increase of the LFA budget. The interpretation would be that more farmers in the LFA areas will apply for the payment and modify their production plans and management in order to comply with the criteria within these areas. Nevertheless, the production effect of changes in LFA payments will be small. This is especially true as the differences in average LFA payments per hectare per region between arable crops are small. The average LFA payment for grassland in a NUTS2 region is relatively high, indicating that grassland in LFA has a higher share of total grassland in a NUTS2 region, compared to arable crops in LFA in total acreage of arable crops in a NUTS2 region. This could potentially result in substitution of arable

crops for grassland in CAPRI. However, this is circumvented as the total acreage of grassland is fixed at regional level in CAPRI.

In LEITAP a payment to land is used as a proxy for LFA payments. Information on the distribution of the payment across sectors from FADN (2005 data) is used to distribute payments across sectors (e.g. pork and poultry and horticulture receive no LFA payments and relatively more payments are distributed to grassland than crop land).

For Dyna-CLUE, which gives spatially explicit output on a 1x1km grid, the delineations and subsidy payments for LFA are used as model inputs to define the socially valuable areas. In contrast with CAPRI, not only the share per region is relevant, but also the position in the region. Dyna-CLUE simulates land use change between land use types (i.e. forest, urban, agriculture, semi-natural area, etc.) and the probabilities of conversion from one land use type to another on the basis of biophysical and environmental characteristics. Whether an area is designated as LFA or not influences these probabilities of conversion. Agricultural areas (i.e. arable, permanent pasture, permanent perennials and irrigated crops) have a lower probability (by 0.1) to convert to non-agricultural land use (i.e. urban, semi-natural area, forest) if they fall in LFA areas. Conversions of non-agricultural areas that are designated as LFA are not affected by this designation. This implies that agricultural areas that are in LFA can still convert to other land use, but that these are less likely to do so.

Natura 2000 payments on agricultural land

In CAPRI the Natura 2000 premiums are modelled in a similar way to the LFA premiums, but with the additional assumption that the payments are conditional on extensification, thereby reflecting management restrictions. This was implemented using the two alternative technologies included in CAPRI. Thus, only the technological alternative with a yield 20% below the NUTS-2 average and lower input requirements (following a yield function) was made eligible for the payment. This is based on no empirical investigation, but is a pure assumption based on the fact that the Natura 2000 payments are conditional on extensive management practices.

The interpretation is the following: if more money is spent on the measure, more farmers within the designated areas may switch to extensive agriculture OR maintain existing extensive management practices. The average payment per hectare of the NUTS-2 region would then increase, reflecting that a larger share of the farmers now participate in the measure. Today, it is indeed the case that not all farms within a Natura 2000 area receive support.

In LEITAP a land payment is used as a proxy for Natura 2000 payments as in the case of LFA payments.

For Dyna-CLUE, which gives spatially explicit output on a 1x1km grid, the delineations for Natura 2000 are used as model inputs to define the socially valuable areas. In contrast with CAPRI, not only the share per region is relevant, but also the position in the region. Whether an area is designated as Natura 2000 or not influences the probabilities of conversion between land use types in Dyna-CLUE in a similar way as for LFA. Agricultural areas (i.e. arable, permanent pasture, permanent perennials and irrigated crops) have a lower probability (by 0.1) of converting to non-agricultural land use (i.e. urban, semi-natural area, forest) if they fall in Natura 2000 areas.

3.3.4 Ecosystem services

Proxies for ecosystem services are provided by agri-environmental payments. Agri-environmental measures aim to encourage farmers and other land managers to introduce or maintain production methods compatible with the protection of the environment, the landscape and its features, natural resources, the soil and genetic diversity that go beyond mandatory standards. In terms of public funding, it accounts for the largest proportion of expenditure within Pillar 2. It provides compensation for GVA and family farm income foregone as a consequence of lower land productivity, extra labour and other costs. Pufahl and Weiss (2009) show that agri-environment payments can generate an increase in land use, in general concerning marginal land that might otherwise have gone out of production. Furthermore, the share of grassland increases.

The use of the agri-environment measure results in a very diverse set of schemes and management options being implemented in individual Member States. In CAPRI, in contrast with how the LFA and Natura 2000 measures are treated, it would not have been meaningful to model a uniform implementation across Member States. Instead, a way of capturing the national or regional preferences within the agri-environment schemes needed to be devised.

The method for doing this has been to distribute the sum of agri-environmental payments to agricultural sectors using as the key the receipts by farm types according to FADN in 2005. This is obtained by dividing the single agri-environmental measure 05 (see Table 3.1) into eight different types of agri-environmental measures, which do not correspond directly to real agri-environmental measures but which are intended to correspond with the types of farming (if any) targeted. The translation from the 'TF8' farm types and the types of agri-environmental measures

in terms of CAPRI production activities is given in Table 3.6. Given the linkage between farm types, different types of agri-environmental payments and crops in Table 3.6, it can be concluded that in this study some crop activities in CAPRI are excluded from agri-environmental payments. These include activities referred to as 'fodder on arable land' (e.g. temporary grassland) and fodder root crops. Again, in economic terms, the potentially different agri-environmental payments for different groups of crops have a production effect, so that the activities in CAPRI in receipt of the higher agri-environmental payments may expand at the expense of other activities in case of an increase of the budget for agri-environmental payments. As before, the interpretation would be that more farmers will apply for the agri-environmental payment and modify their production plans and management accordingly. For example, the effect of an increase in agri-environmental payments (payment to ecosystem services) in the UK is a re-allocation of land from fodder on arable land (e.g. temporary grassland) to cereals. This will be discussed in more detail in Chapter 4.

Table 3.6 **Mapping from aggregated farm types in FADN (TF8) to different types of agri-environmental (AE) measures to activity groups in CAPRI**

TF8 type	Farm type	Type of AE measure	Group of activities in CAPRI
1	Field crops	Agri-environmental payments for field crops	Grandes Cultures (cereals, oil seeds, pulses)
2	Horticulture	Agri-environmental payments for horticulture	Vegetables
3	Wine	Agri-environmental payments for wine	Wine
4	Permanent crops	Agri-environmental payments for permanent crops	Permanent crops
5	Milk	Agri-environmental payments milk	Dairy cows including pastures
6	Grazing animals	Agri-environmental payments grazing livestock	Suckler cows, sheep and goats, including pastures
7	Pigs and poultry	Agri-environmental payments pigs and poultry	Pigs and poultry
8	Mixed	Agri-environmental payments for mixed farms	All agricultural activities

The Impact of Modulation study (Nowicki et al., 2009a) suggests that a farm is more likely to participate in an agri-environmental scheme if it is located in a LFA region. Taking this into account for each region, using FADN (data of 2005), the average agri-environmental payment per hectare per TF8 farm type (Table 3.6) conditional on a farm being inside or outside of LFA is computed (step (1). Next, the average payment per hectare per farm type in the whole NUTS-2 region is calculated by multiplying the expected payment per hectare computed in step (1) with the share of the land type primarily used by that farm type that is inside or outside LFA, as spatially determined by Dyna-CLUE. Finally, the agri-environmental payments per farm type are linked to activities in CAPRI (Table 3.6).

A numerical example of the average agri-environmental payment per farm type per hectare per NUTS-2 region is given in Textbox 3.2.

Appendix 2 discusses the distribution of agri-environmental payments in the reference scenario in 2020. Applying the methodology described above and using FADN, the share of cattle activities in total agri-environmental payments equals about 70% in Ireland and in the UK. In the EU-12, field crops receive the largest share of the agri-environmental payments, namely about 40% of the available budget (Appendix 2).

Textbox 3.2	**Numerical example of the calculation of the NUTS-2 average agri-environmental payment per farm type per hectare**				
$Pif=\Sigma_j C*(Sij*Aif+(1-Sij)*Bif)$	Average agri-environmental premium per type f per group of crops j and region i				
I	Region (1,2)				
F	Farm types (milk, field crops)				
J	group of crops (land class) (grass, arable crops) (linked to farm types)				
Aif	Agri-environmental payment *in* LFA in region í on farm type f (euro per ha)				
Bif	Agri-environmental payment *outside* LFA in region í on farm type f (euro per ha)				
Sij	Share LFA in all land of class j in region i				
Cf	Premium cut factor				
Region 1			Region 2		
S1, grass	0.5		S2, grass	1	
S1, arable crops	0.2		S2, arable crops	1	
A1, milk	200		A2, milk	400	
B1, milk	100		B2, milk	0	
Cmilk	0.9		C milk	0.9	
A1, field crop	50		A2, field crop	200	
B1, field crop	25		B2, field crop	0	
C field crop	1		C field crop	1	
		Pif			Pif
P1,milk	0.9*(0.5*200+(1-0.5)*100)	135	P2, milk	0.9*(1*400+(1-1)*0)	360
P1,field crop	1*(0.2*50+(1-0.2)*25)	30	P2, field crop	1.0*(1*200+(1-1)*0)	200

Based on the French and the UK case studies done in Nowicki et al. (2009a), it was concluded that support directed toward different subsectors tends to have different technical constraints. In particular, it was assumed that measures applied in field crops or involving arable land frequently have an element of extensification (buffer strips that reduce the area of land available for cropping, maintenance of hedgerows that may otherwise be removed, less fertiliser use etc), whereas for the livestock production sectors (especially in the French case study), the key issue is to maintain existing extensive systems of production. The element of extensification of agri-environmental payments can be included in CAPRI. An important feature of CAPRI is that agricultural activities are divided into an extensive (low input, low yield) and an intensive technology (high input, high yield). It is assumed that the average agri-environmental payment per hectare per crop per region for the extensive technology exceeds the comparable payment for the extensive technology with a factor 3. For dairy cows, this is a factor 2. Table 3.7 shows agri-environmental payments per ha/head per activity per technology for a selected number of activities in Gelderland (NL). The last column of Table 3.7 shows the increase in agri-environmental payment per activity per technology if the budget of agri-environmental payments increases by one euro. Given our assumptions, the majority of the extra budget for agri-environmental payments to support ecosystem services goes to extensive technologies in CAPRI. In economic terms this will have a production effect, so that the extensive technologies will increase if agri-environmental payments expand. This will be at the expense of other, more intensive activities and consequently, the total production will decline.

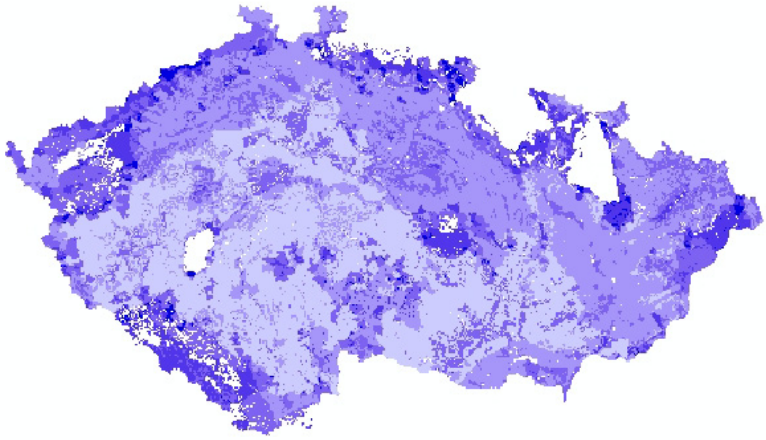
In LEITAP a payment to land has been used as a proxy for agri-environment payments. In contrast with the LFA payments, the agri-environment measure can also reduce labour and output productivity. Information of the current distribution across sectors from FADN is used to distribute payments across sectors (e.g. pork, poultry and horticulture receive no agri-environment payments and relatively more payments are distributed to grassland than crop land). In addition, to capture the extra labour effect, labour productivity decreases (10% of increase in land payment rate).

Table 3.7	Main output in reference scenario and ecosystem payment (agri-environmental payment) for selected activities in Reference and Stylised CAP Reform scenario in Gelderland (NL) in 2020					
		Main output				
		(kg per ha, kg per head)	Ecosystem payment (Euro per ha/head)			
		reference	reference	stylised cap reform	absolute difference	Euro per Euro of agri-environmental payment
Dairy cow	High yield	1,0351	23.3	50.7	27.5	0.33
	Low yield	6,263	46.5	101.4	54.9	0.67
Soft wheat	High yield	9,527	38.8	83.2	44.4	0.25
	Low yield	6,351	116.3	249.6	133.3	0.75

Source: CAPRI.

For Dyna-CLUE, current agri-environmental payments are used to define zones. In these zones, it is assumed that future agri-environmental payments and subsequent provision of ecosystem services will also be higher, since there seems to be some added value now attracting agri-environmental zone payments. For these zones it is assumed that the probability of conversion away from agriculture is lowered, i.e. zones that receive a high share of agri-environmental payments are less likely to convert to land uses other than agriculture and are more likely to stay agricultural. The zones are classified in three classes, i.e. zones that receive high levels of agri-environmental payments (probability is lowered by 0.15), zones that receive reasonable levels of agri-environmental payments (probability is lowered by 0.1) and zones that receive low to no agri-environmental payments (probability is not affected). In Figure 3.1 an example is shown for such zones for the Czech Republic, in which agri-environmental payments, LFA and Natura 2000 are accounted for. The darker blue the colour, the more likely the areas are to stay in agriculture if they are currently agricultural and thus the lower are the calculated probabilities (by max. 0.35) of conversion to other land use types. The light blue to non-coloured areas are those that are not affected by LFA, Natura 2000 and agri-environmental payments, or only marginally. These can also be areas currently under another land use, such as urban.

Figure 3.1.	Socially valuable areas and ecosystem services defined according to current payments for agri-environmental subsidies, LFA and Natura 2000 delineations. Czech Republic. The darker blue the colour, the more socially valuable and/or relevant for ecosystem services



3.4 Average GVA per permanent farm

Farm level bookkeeping data as found in the EU Farm Accountancy Data Network (FADN) are used to analyse the effects of the reference and the Stylised CAP Reform scenarios on the average GVA per permanent farm inside and outside LFA in the EU-27. LEITAP and CAPRI give GVA effects at the more aggregate level of the sector and region (NUTS-2), while the effect on the farm level is lacking. Another reason for using FADN is that LEITAP and CAPRI make no distinction between the effects of GVA in or outside LFA. This difference is important, as the Stylised CAP Reform scenario re-allocates a large part of the SPS direct income support via post-2013 CAP measures - especially valuable area payments - to farms in LFA regions. This is done directly by ha payments to farmers in valuable regions. But this allocation also occurs indirectly, as farmers in LFA regions receive a relatively large part of the agri-environmental payments. It will be discussed below how results from CAPRI are used to shock the different components of the average GVA per permanent farm.

CAPRI delivers percentage changes in GVA (excluding Pillar 1 and Pillar 2 payments) from agriculture per region and Member State. This percentage change is linked to the average GVA (excluding Pillar 1 and Pillar 2 payments) per farm inside and outside LFA in FADN. Next, three types of premiums are distinguished at farm level: (a) agri-environmental payments, (b) LFA payments and (c) direct income support under the SPS. The three types of premiums distinguished in FADN correspond with the three types of premiums included in CAPRI. The percentage changes in premiums per Member State per scenario in CAPRI are simply linked to the premiums per farm per region (inside LFA and outside LFA) in FADN.

Average percentage changes in GVA per permanent farm also depend on the size of the permanent farms in the different scenarios. Endogenous farm growth is not included in our model systems. Assumptions with respect to the effectiveness of abolition of the SPS direct income support and targeted measures on the size of the average farm growth are therefore necessary. First, we assume a negative relationship between farm size and land prices: as land prices go down, the farm size goes up. Based on this assumption, we assume that in the scenario with full abolition of the SPS, the direct income support, the farm growth per year will exceed the farm growth in the reference scenario. In the scenario with full abolition of the SPS direct income support, we assume that in the period 2014-2020 farm growth will increase 1 percentage point extra per year in the EU-27 compared to the reference scenario. It is also assumed that, compared to the reference scenario, extra investments in competitiveness and sustainability will increase the size of the average farm yearly by an extra 0.5% in the EU-15 and by an extra 1% in the EU-12 in the period 2014-2020. It is assumed that valuable area payments, agri-environmental payments to support ecosystem services and the base premium will not affect the average size of the farm. The total impact of the Stylised CAP Reform scenario on the size of the farm is therefore an extra yearly increase of 1.5% points in the EU-15 and 2% points in the EU-12 during the period 2014-2020.

3.5 Issues regarding the methodology

The strengths of the methodology presented above can be summarised as follows:

- The whole budget for different kinds of EU income support is accounted for.
- Differences in the initial distribution of the budget for RD measures (Pillar 2) over farm types and regions are translated to activities and regions in the market models (CAPRI, LEITAP). This is achieved by the extensive use of data from FADN and Dyna-CLUE.

- Integrated and EU wide approach. The approach takes into account changes in prices and quantities at sectoral and regional level. Moreover, changes in economic variables at market level are translated to the regional and the farm levels.

General conclusions about the analysis of the impact of a reduction of SPS direct income support payments under Pillar 1 are feasible across the EU-27. However, a generalised assessment of impact across Member States of post-2013 CAP measures is far more problematic. This is due to the fact that many of the effects depend on how Member States choose to use the funds and how they have designed and implemented the specific RD measures. Some difficulties of the research and the approach are discussed below.

1. Empirical or *ex post* information for estimating the impact of post-2013 CAP measures, as might be available through measuring the current impact of second pillar measures, is very scarce. Therefore, the simulations of impact of post-2013 CAP measures require some assumptions on what these effects could be. This, combined with the strong dependence on the current second pillar measures for the modelling, highlights the current exploratory character of this study.
2. Post-2013 CAP measures to improve competitiveness are translated in such a way that they affect production. However, in the financial programming period 2007 to 2013, part of this budget can also be used for on-farm capital investments that should reduce emissions from agricultural production to the environment. This is the case in the Netherlands, for example, where almost 67% of the budget of measure 121 (physical capital investments, see Table 3.1) should be used for this type of capital investments (Dutch Ministry of Economic Affairs, Agriculture and Innovation, 2007). The production effects of these investments are limited. In general, as investments in competitiveness are more directed to stimulating more environmentally sustainable production techniques as mentioned above or food quality rather than food quantity, the production and price effects as presented in this report might be overestimated.
3. Due to a lack of data, the rate of return on investments is assumed equal per sector and Member State. This implies that agricultural production increases most in Member States with a relatively high ratio between the value of extra investments and the value of production or physical capital (see Table 3.5). In reality, structural, institutional and other differences between Member States might result in differences in the rate of return on investments mentioned

above. Moreover, the investments might vary per sector and region. These differences are not taken into account.

4. Public goods are not included in the modelling, although they are an important part of the post-2013 CAP measures.
5. Environmental impact is difficult to generalise and to assess, as the impact
6. varies locally, the mechanisms leading to the impact are often poorly understood or extremely diverse. The pressure indicators (e.g. level of nitrogen use) and output indicators (e.g. expenditure on agri-environmental schemes) are often known, but not the result indicators (e.g. biodiversity achieved, nitrogen leaching). *Ex-ante* assessment for the EU-27 therefore relies on crude methods and strong assumptions to calculate at least some effects, but these must be interpreted with caution.
7. Transaction costs have not been addressed. These costs may influence the structural changes at farm level that are assumed in the different scenarios.
8. Due to the lack of a model that accounts for investments and structural
9. changes at farm level, structural changes at farm level are based on assumptions.

4 Results

In paragraph 4.1 we start with a discussion of some selected results of the reference scenario in 2020. We focus on shares of SPS direct income support and rural development payments per sector and region in GVA per sector and region in the EU-27, using CAPRI. This especially helps to understand the changes in production and GVA under the Stylised CAP Reform scenario. In paragraph 4.2 the results of the Stylised CAP Reform scenario are presented. Results focus on the effectiveness of individual measures and on the total effects of the Stylised CAP Reform on economic variables and environmental indicators, compared to the reference scenario in 2020.

4.1 The reference scenario

Price developments until 2020 in the reference scenario are important as they also determine GVA and the share of the SPS direct income support in total GVA. This in turn affects the GVA and production effects of abolition of the SPS direct income support. The average changes in real producer prices of agricultural products in the EU-27 in the reference scenario are in line with price developments as presented in the reference scenario in Nowicki et al. (2009b). Differences can be explained by differences in models used, the base year and definition of the reference scenario.

Tables A1.1 and A1.2 in Appendix 1 show the shares in total GVA of direct income support under the SPS per activity and per region, respectively, in 2020 in the reference scenario. CAPRI models agricultural production in a region as one regional farm. In the 2020 reference scenario all premiums are decoupled and as SPS direct income support they are allocated to eligible crops[1] on the regional farm. This also accounts for the milk premium, cattle premiums and other premiums linked to cattle. Table A1.1 shows that in 2020 under the reference scenario, the average EU-27 share of SPS direct income support in GVA per hectare is relatively low for potatoes and vegetable crops and relatively high for all other crop ac-

[1] In 2020 in the reference scenario all crops are assumed eligible for SPS direct income support, excluding fallow land.

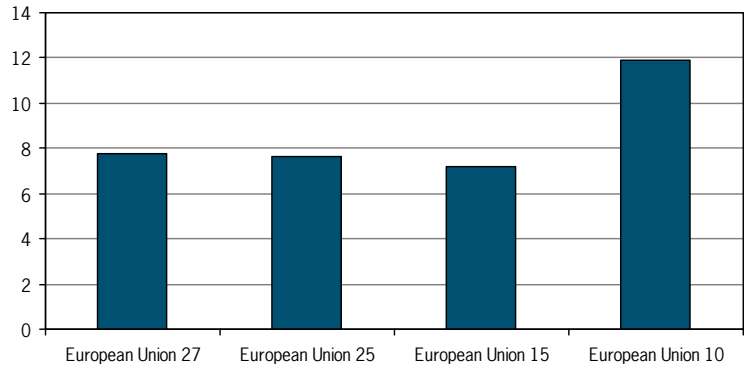
tivities, including fodder crop activities. This is explained by the fact that SPS direct income support per ha per crop is relatively low in regions with a high share of potatoes and/or vegetable crops in their cropping plan. Livestock farms have a high share of fodder crop activities in their cropping plan. Consequently the SPS direct income support per ha per fodder crop activity is relatively high in regions with a high share of milk and cattle production in total agricultural production. From the data shown in Table A1.1 it can be concluded that GVA and production effects of abolition of the SPS direct income support are highest in regions with a large share of cereals, oilseeds, pulses and fodder activities.

Table A1.1 also shows the share of Pillar 2 payments in GVA per hectare or head in 2020 in the reference scenario. This share varies from more than 100% for other cows, including suckler cows, to nothing for laying hens and poultry fattening.

Table A1.2 in Appendix 1 shows that in 2020 under the reference scenario, at Member State level the share of the direct income support under the SPS in GVA ranges from more than 30% in the Czech Republic, Latvia and the Slovak Republic to 5% in the Netherlands. The differences between regions within Member States can be considerable. In France, this share ranges from more than 24% in Ile de France, Champagne-Ardenne, Picardie, Centre and Lorraine to around 10% in Bretagne, Languedoc-Roussillon and Provence-Alps-Cote d'Azur.

Finally Table A1.2 shows that shares of regional development payments in regional GVA are relatively high in Austria, Ireland, Finland, Sweden and average in the EU-12. At regional level, this share can also be rather different from the national average. In regions in the middle and west of Ireland, this share is about 25%, whereas in the south and the east of Ireland this share is about 15%.

Figure 4.1 **Share of SPS direct income support in total output value in the reference scenario (percentages)**



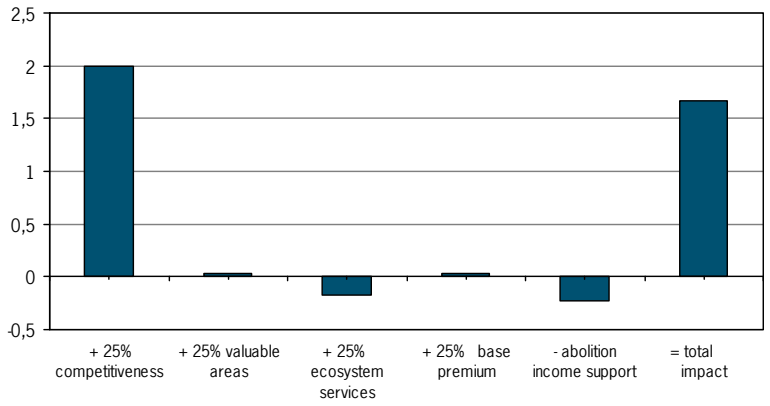
Source: CAPRI.

Figure 4.1 shows that in the 2020 reference scenario in percentages of the total output, the SPS direct income support is especially large in the EU-10 and relatively low in the EU-15. In our modelling system, the ratio between the budget and the value of agricultural production in case of human capital, as well as the ratio of the budget versus the value of the capital stock for physical capital, is important for the level of the productivity and efficiency gains. The higher these ratios are, the greater the effect of competitiveness measures on agricultural production and efficiency. Figure 4.1 already suggests that the largest production effect of extra investment in human and physical capital will be in the EU-10.

4.2 The stylist CAP Reform scenario with targeted measures

4.2.1 Agricultural production in the EU-27

Figure 4.2 **Effectiveness of individual measures and the total impact of the Stylised CAP Reform scenario on agricultural production in the EU-27 (% change compared to the reference scenario)**



Source: LEITAP.

The Stylised CAP Reform scenario (total impact with all measures combined) leads to an increase in EU primary production of about 1.5% (Figure 4.2). This is especially due to increased productivity because of investments in measures to improve competitiveness. Figure 4.2 also shows the effectiveness of the different measures individually on agricultural production. The measures to improve competitiveness will increase agricultural production by about 2%. The effects of other targeted measures on production are limited. Payments to ecosystem services lead to more extensive production methods, which lower yields per unit of input. As a result the agricultural production will decrease slightly (Figure 4.2). Area payments and the base premium keep extra land in production that would otherwise be abandoned. The effect of this is a slight increase in agricultural production. Compared to the area payment and the base premium, the 100% abolition of decoupled SPS direct income support shows an opposite effect on agricultural production. The negative production effect of the latter is limited, but indicates that, in

our system of models, SPS direct income support is fairly decoupled from production.

4.2.2 Agricultural production at regional level in the EU-27

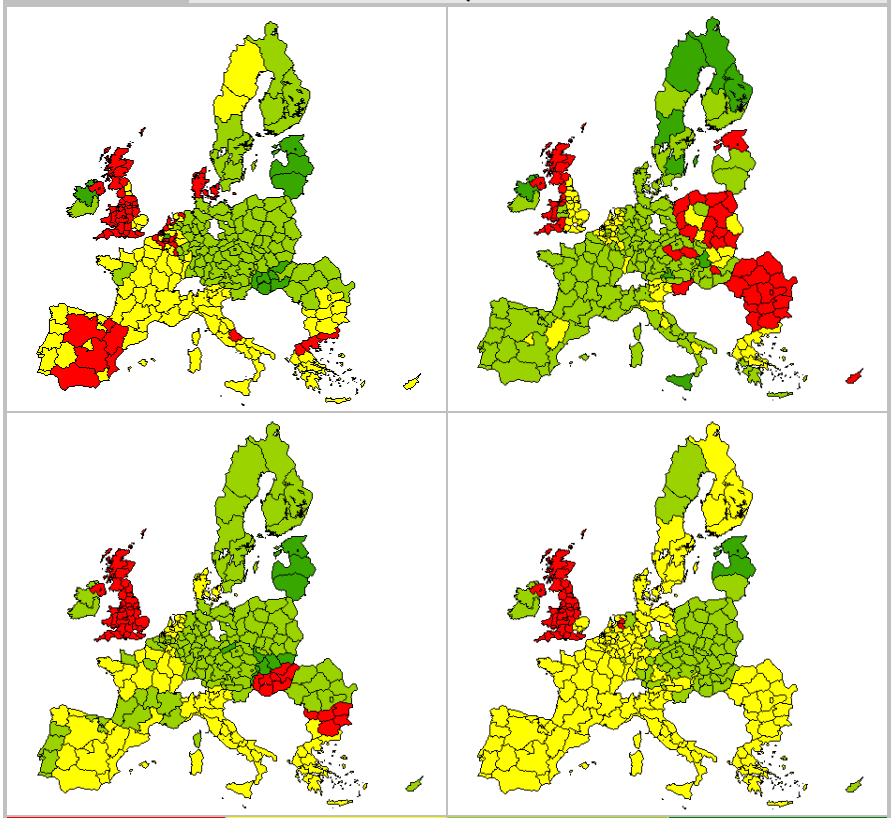
Effects of investments in competitiveness

As we have seen above, the greatest effect on agricultural production stems from measures to improve competitiveness. Below we show the effect of measures to improve competitiveness on regional supply of some selected agricultural products within the EU-27.

Map 4.1 shows that supply of agricultural products increases particularly in the EU-10 and especially for cereals, meat and other animal products (milk and eggs). As explained above, the value of the additional budget for physical and human capital investments in the EU-10 to increase competitiveness is relatively high compared to the current production level and capital stock. As a result, there is a relatively large increase in productivity and efficiency in the EU-10 (see Chapter 3 and Figure 4.1).

The extra budget to improve competitiveness enhances productivity and therefore induces extra production (first order effect). The higher production level leads to market effects as prices decline (second order effect). Lower prices lead to lower production. As a result, the total of the first and the second order effects of competitive measures on agricultural production can be negative in some regions. This is the case when competitive investments in a region are relatively low and negative market and price effects offset the relatively limited positive productivity and efficiency effects. This occurs with regard to cereal production in Denmark and in regions within the UK, the Netherlands, Belgium, Spain, Greece and Italy. The overall decline in allocation of land to cereals and other arable field crops in the United Kingdom corresponds with an increase in the allocation of land to low productive fodder crop activities. The increase in land prices and the decrease in the prices of other arable field crops in Poland together offset the positive impact of the measures to improve competitiveness. As a result, the production of arable field crops decreases in some regions within Poland.

Map 4.1	Effectiveness of competitiveness measures on regional supply of cereals (upper left corner), other arable field crops (upper right corner), meat products (lower left corner) and other animal products [milk and eggs] (lower right corner) in comparison with the EU-27 average (% change compared to the reference scenario)



Less than 0%	Between 0% and 1.5%	Between 1.5% and 5%	More than 5%

Map 4.1 also shows the effect of competitive measures on meat products. The tendency with respect to the changes in the regional production of meat can be compared with the regional effect on the production of cereals. Production of meat increases especially in Eastern Europe, Germany, Sweden, Finland, Ireland and in regions in France and Portugal. The production of meat decreases in the United

Kingdom and in Hungary. The decline in meat production in Hungary is especially due to the slight decline of pork production in Hungary. This is explained by changes in prices of inputs and outputs, which affects competitiveness for fixed resources within Hungary and the competitiveness of Hungary on export markets. Changes in market prices of meat relative to the increase in productivity and efficiency also explain the decline in meat production in the United Kingdom.

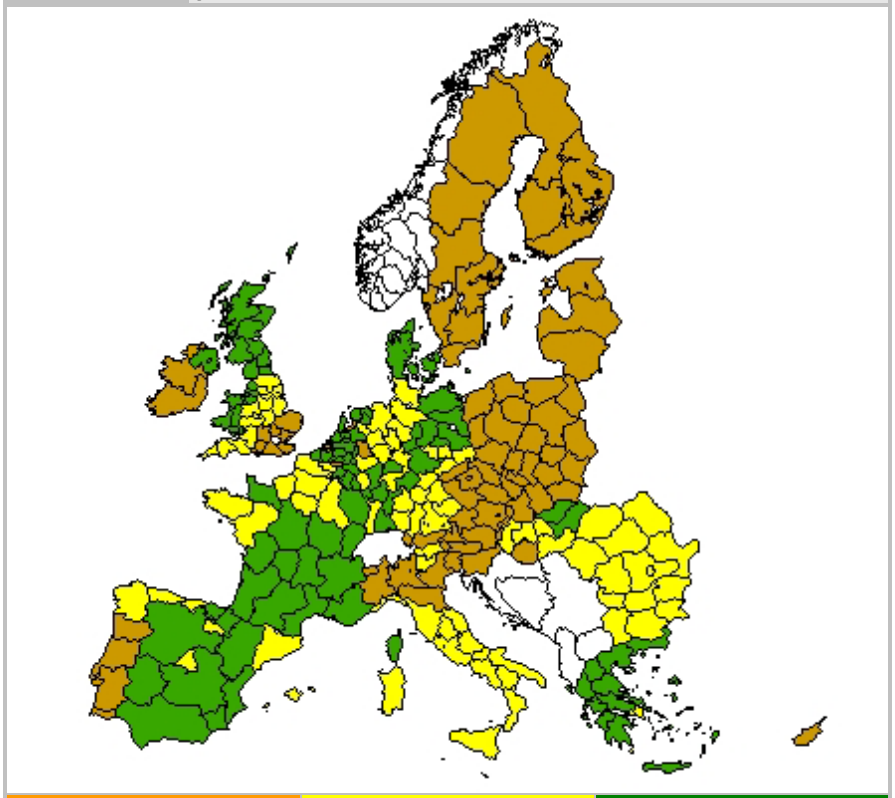
The effects of measures to improve competitiveness stimulate the production of other animal products in Eastern Europe, Ireland and parts of Sweden (Map 4.1). The effect on other animal products is also slightly positive in the rest of Europe, with the United Kingdom and some regions within the Netherlands as exceptions.

Impact of agri-environmental payments to improve ecosystem services and valuable area payments on production

To understand the total impact of the Stylised CAP Reform scenario on regional agricultural production, it is important to understand the impact of payments to ecosystem services and valuable area payments on land use and production.

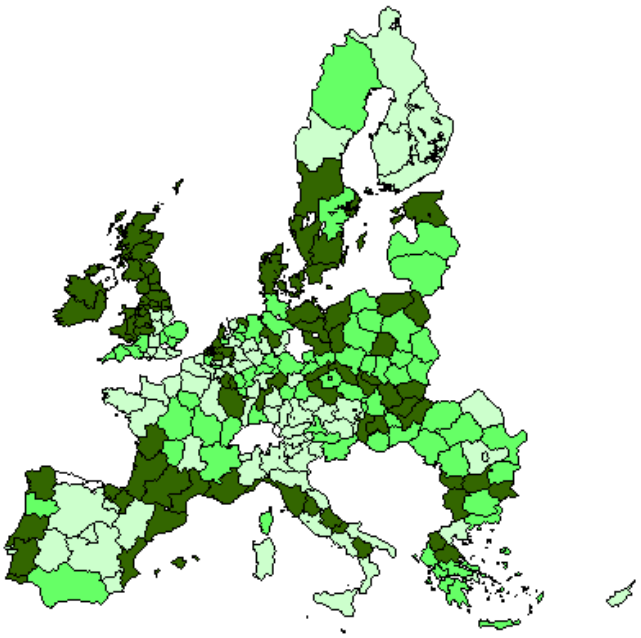
Map 4.2 shows the percentage changes in agri-environmental payments and valuable area payments per region in the Stylised CAP Reform scenario as compared to the reference scenario. Percentage changes in environmental payments and valuable area payments are relatively large in regions with relatively low environmental and valuable area payments in the reference (e.g. the Netherlands, Scotland, Spain and regions in the south-west of France). Especially in these regions, agri-environmental payments and valuable area payments reduce land abandonment and increase agricultural production (Map 4.3). Percentage changes in environmental and valuable area payments are relatively small in regions with high environmental and valuable area payments in the reference (e.g. Finland, Austria and Ireland).

Map 4.2	Percentage changes in agri-environmental payments (payments to ecosystem services) and valuable area payments per NUTS-2 region in the Stylised CAP Reform scenario compared to the reference scenario



Less than 140%	Between 140% and 200%	More than 200%

Map 4.3	Impact of agri-environmental payments to improve ecosystem services and valuable area payments under the Stylised CAP Reform scenario on fallow land (% change compared to the reference scenario)



More than -9%	Between -9% and -3.5%	Between -3.5% and 0%

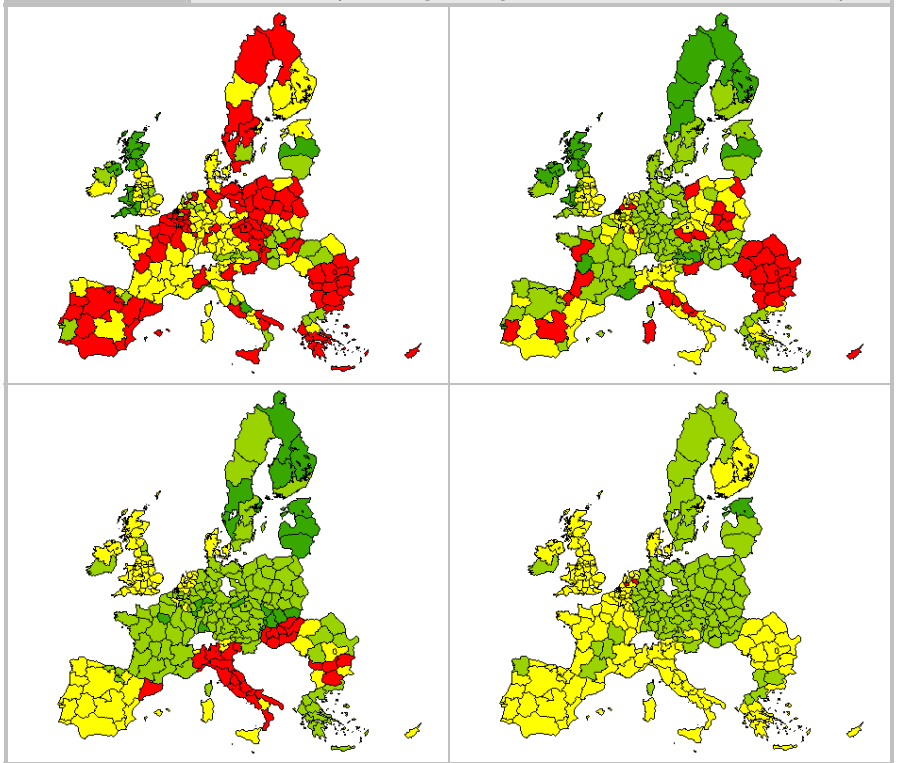
Agri-environmental payments and valuable area payments also affect production, as they are unequally distributed over agricultural activities and land use classes. More specifically, fallow land is not eligible for agri-environmental and valuable area payments, so the payments mentioned above help to keep more land into production. Map 4.3 shows the regional impact of agri-environmental payments and valuable area payments on fallow land. Map 4.3 shows that large reductions in land area of fallow land (and related increases in production), due to extra agri-environmental payments and valuable area payments, can be found all over Europe. Fallow land declines especially in the United Kingdom, Ireland, the south-west of France, Portugal and regions within Sweden, Italy, Greece, the Netherlands, Belgium and the EU-12 (Map 4.3).

Total impact of the Stylised CAP Reform scenario

At the regional level, the total impact on agricultural production of the Stylised CAP Reform scenario, including the price and market effects, can be quite different from the average effect for the EU-27 as a whole. This is especially explained by differences in the regional composition of agricultural production, the ratio between the extra investment in competitiveness compared to the value of the human and physical capital in a region and finally differences in behaviour of the farmers. Moreover, abolition of the direct income support through the SPS and the distribution of agri-environmental payments and valuable area payments also affect allocation of land to agricultural activities and regional production, as these payments are unequally distributed over agricultural activities and land use classes, including fallow land.

Map 4.4 shows the total effect of the Stylised CAP Reform scenario on regional agricultural production. The effect of the Stylised CAP Reform scenario on regional production of cereals and other field crops is diverse. Production of cereals declines in the Czech Republic, Bulgaria and in regions within Germany, Poland, Romania, Italy, Spain, Belgium, the Netherlands, Finland and Sweden. The explanation for this decline in the regional production of cereals is that the decline in land prices and the increase in post-2013 payments in the Stylised CAP Reform scenario in the regions concerned are not enough to compensate for a decline in cereal output prices, lower yields per hectare and the abolition of the SPS direct income support. As a result, there is a relatively strong substitution from cereals to more extensive fodder crop activities and fallow land. The decline in the cereal supply in Castilla-Leon (SP) is explained by a decline in the yield per hectare that is not compensated by an increase in the acreage of cereals. Moreover, land prices in Catilla-Leon (SP) increase and there is a relative substitution from land allocated to low productive crops to high productive crops. The decline in the production of other field crops in Lódzkie in central Poland, for example, is explained by the reductions in output prices and direct income support through the SPS that are not fully compensated by the decline in land prices, the increase in yield and efficiency per hectare and the increase in post-2013 targeted payments.

Map 4.4	Total impact of the Stylised CAP Reform scenario on regional supply of cereals (upper left corner), meat products (upper right corner) other animal products [milk and eggs] (lower left corner) and other arable field crops (lower right corner) in the EU-27 (% change compared to the reference scenario)



Less than 0%	Between 0% and 1.5%	Between 1.5% and 5%	More than 5%

The effect of the Stylised CAP Reform scenario on the production of cereals and other arable field crops in the United Kingdom, with all measures combined, is much more positive compared to the isolated effect of the measures to improve competitiveness (compare Map 4.1 and Map 4.4). This is especially explained by the fact that in the Stylised CAP Reform scenario, with all measures combined, the price declines of marketable products such as cereals and other field crops due to measures to improve competitiveness and production are dampened by the negative production effects of other measures, especially the abolition of the SPS

direct income support and the agri-environmental measures. Moreover, the post-2013 targeted payments per hectare are relatively high in the United Kingdom for cereals and other field crops compared to low productive fodder crop activities competing for the same amount of land. The decline in the production of meat in Italy (Map 4.4) in the Stylised CAP Reform scenario is explained by the fact that the increase in premiums and the decline in feeding costs, in particular for cattle activities, are relatively limited compared to the rest of Europe.

4.2.3 Prices of agricultural products

Figure 4.3 **Effectiveness of individual measures and total impact of the Stylised CAP Reform scenario on consumer prices of primary agriculture in the EU-27 (% change compared to the reference scenario)**

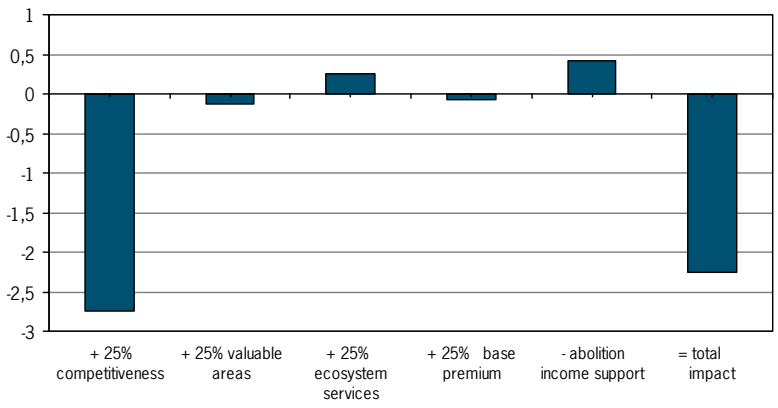


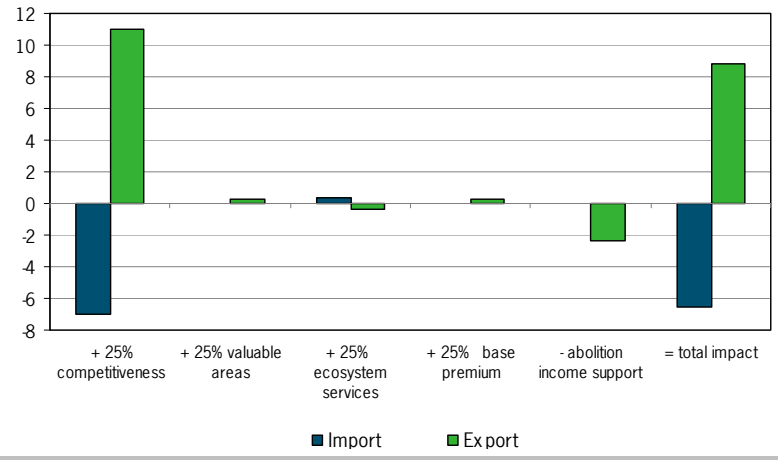
Figure 4.3 shows the effects of individual measures and total impact of Stylised CAP Reform scenario on consumer prices of primary agriculture products in the EU-27. The Stylised CAP Reform scenario leads to a decline in the consumer price of EU primary production of about 2% (Figure 4.3). This is especially due to increased productivity because of investments in measures to improve competitiveness. The measures to improve competitiveness will reduce agricultural prices by about 2.7%. Compared to this average for all agricultural commodities, prices of meat are more affected compared to cereal prices. The effects of other targeted measures on production are limited. Payments to ecosystem services lead to

more extensive production methods, which reduce yields per unit of input. This corresponds with a limited decline in supply and somewhat higher prices for agricultural commodities. Area payments and the base premium are a kind of subsidy that leads to a small increase in agricultural land and production and consequently to a small decline in consumer prices. Compared to the area payment and the base premium, the 100% abolition of decoupled SPS direct income support shows an opposite effect on consumer prices, as subsidies are reduced in this case.

4.2.4 Trade

Trade is mainly influenced by competitiveness measures that increase productivity and reduce product prices relative to the prices of competitors. Exports increase by more than 10% and imports decrease by 7%. The introduction of the base premium and valuable area payments increase exports slightly, as EU prices decline slightly. Abolition of income support has the opposite effect. Ecosystem services lead to a small decline in exports as EU prices increase slightly. Overall the trade balance improves substantially for the EU.

Figure 4.4 **Effectiveness of individual measures and the total impact of Stylised CAP Reform scenario on agricultural imports and exports in the EU-27 (% change compared to the reference scenario)**



4.2.5 GVA per farm, region and group of agricultural activities

Average GVA per permanent farm

Using farm level data from the Farm Accountancy Data Network and results from CAPRI, the effect of the different measures and scenarios on average GVA per permanent farm can be analysed. GVA is defined as revenues plus premiums minus variable costs. FADN allows the observer to distinguish between farm GVA on permanent farms inside LFA and outside LFA. This is important as, for example, valuable area payments are translated into a direct income support for farmers inside LFA regions.

Figure 4.5 **Effectiveness of individual measures and the total impact of the Stylised CAP Reform scenario on average GVA per permanent farm for all farms and for farms inside LFA and outside LFA in the EU-27 (% change compared to the reference scenario)**

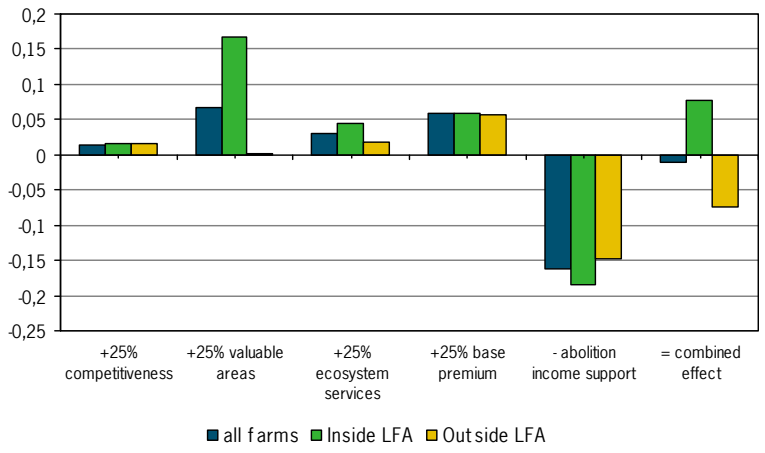


Figure 4.5 shows that, averaged over all permanent farms, the effect of the individual measures on GVA per permanent farm can vary considerably. Valuable area payments and the base premium have the biggest positive effect on GVA on the average farm in the EU-27. This is understandable, as these payments are transferred to farmers as fully decoupled payments with no constraints attached to them. A large part of the positive effect of competitiveness measures on GVA is transferred to consumers through lower prices of agricultural commodities.

We assume that the payment to improve competitiveness also increases the average size of the permanent farms (paragraph 3.3). This positively affects average GVA per permanent farm. Agri-environmental payments to improve ecosystem services also have a limited effect on GVA per farm, as the agri-environmental payments are associated with extra costs or lower revenues per head or ha. The isolated effect of the base premium is a direct increase in GVA per farm. However, the base premium also increases land prices. Permanent and expanding farms therefore experience higher prices for additional land. The extra land costs resulting from these higher prices are not included in the GVA per farm.

The full abolition of decoupled income support reduces average GVA per permanent farm in the EU-25 by about 16%. Averaged over all farms, the effect of the Stylised CAP Reform scenario on GVA per permanent farm is slightly negative. However, the differences between farms in the different regions can be considerable.

Figure 4.5 shows that the Stylised CAP Reform scenario has a positive effect on the average GVA per permanent farm inside LFA. The effect on the average farm GVA is negative for farms outside LFA. The farms inside LFA are more than compensated for the loss of GVA due to the full abolition of the direct income support under the SPS. This is not the case for the average farm outside LFA.

Discussion

It is assumed that measures to improve competitiveness increase the size of permanent farms. This positively affects GVA per permanent farm. However, transaction costs related to the structural changes are not accounted for.

The full abolition of the direct income support under the SPS will also affect the number of farms and the average size of permanent farms. Structural changes are necessary to establish a return to the average farm income, including fixed payments, which is equal to the reference scenario.

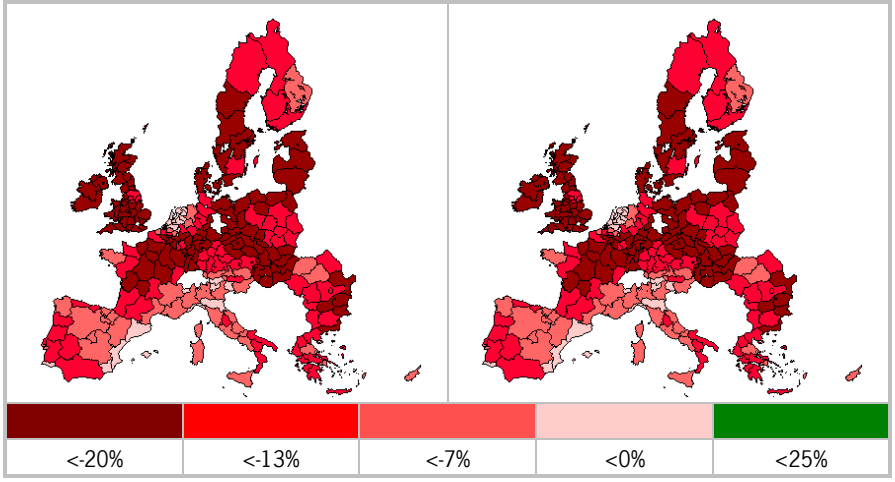
The impact of the Stylised CAP Reform scenario on farm GVA inside and outside LFA very much depends on the distribution of the direct income support under the SPS over the different targeted measures. In the Stylised CAP Reform scenario, each measure receives 25% of the available budget, independent of the number of farms in LFA zones. Effects on GVA per farm per region can be influenced by choosing different percentages for the various measures.

Average GVA per region in the EU-27

Compared to other measures included in the Stylised CAP Reform scenario, full abolition of the decoupled direct income support as provided by the SPS has the

greatest impact on GVA per NUTS-2 region. The effect of the abolition of direct income support as provided by the SPS on GVA per NUTS-2 region is presented in the left figure of Map 4.5. The decline of the GVA per NUTS-2 region as a result of the abolition of the direct income support as provided by the SPS varies from more than minus 20% in regions within France, Germany, United Kingdom, Austria, Sweden and in the EU-12 countries to a range between -7 and 0% in the Netherlands. These differences are explained by the differences in the regional share of the income support provided by the SPS in total GVA in agriculture, including horticulture, in 2020 in the reference scenario.

Map 4.5 **The impact of abolition of direct income support (left map) and the GVA from agriculture (right map) in the Stylised CAP Reform scenario, given as a percentage change compared to the reference scenario per NUTS-2 in the EU-27**



In the Stylised CAP Reform scenario, despite the full abolition of the direct income support as provided by the SPS, GVA increases in the south-east of France, in Austria and in some Eastern European regions. These regions either receive a large amount of post-2013 targeted payments, including the base premium per hectare, or they gain more than average from productivity, efficiency and consequently production changes due to the extra investments in human and physical capital are relatively large. Moreover, the share of direct income support under the SPS in regional GVA is relatively low. The largest decline in GVA can be found in regions that receive a relatively large amount of income support under the SPS in

the reference scenario and relatively low post-2013 targeted payments in the Stylised CAP Reform scenario. These are, in particular, regions in the north-east of France, the south of the United Kingdom and some regions in Poland, Czech Republic and Slovakia.

Total GVA per group of activities

The changes in total GVA per average permanent farm and per NUTS-2 region are presented above. The differences however, can be large between the types of farms and within NUTS-2 regions. This depends on the changes in the GVA per group of activities and the share of the activity group in the total production of the farm or region. Table 4.1 gives the effectiveness of post-2013 CAP measures on total GVA per group of activities. Table 4.1 shows that the effectiveness of measures to improve competitiveness on total GVA is generally small but negative for the indicated activity groups (sectors). Moreover, Table 4.1 shows that valuable area payments especially affect total GVA for the group of fodder plus all cattle activities. This can be explained by the relatively high share of fodder crops in LFA and Natura 2000 regions. Payments to ecosystem services and the base premium are more widely spread and especially affect the total GVA of the group of all arable activities (cereals, oilseeds and other arable crops) and the group of fodder plus all cattle activities. On the other hand, abolition of income support provided through the SPS reduces total GVA by 37.1% and 34.8% for the group of all arable activities and fodder plus all cattle activities respectively. The total impact of the Stylised CAP Reform scenario on GVA per group of activities in the EU-27 is negative for the group of activities distinguished in Table 4.1.

Discussion

Effectiveness of post-2013 CAP measures on GVA per permanent average farm, region and group of activities (sector) differs from the effectiveness on family farm income per permanent farm, region and sector. This is because the effect of changes in factor prices related to the agricultural sector, especially land prices and accompanying lower investment costs, is not included in the GVA.

It is found that measures to improve competitiveness reduce GVA, at least at regional and sectoral levels. The positive effect of measures to improve competitiveness on production and GVA in agriculture is largely passed on to the consumers through lower product prices. However, possible lower investment costs and costs of fixed inputs are not included in the GVA. Moreover, there is quite a lot of uncertainty with respect to the data. As a result, the real changes in production, ef-

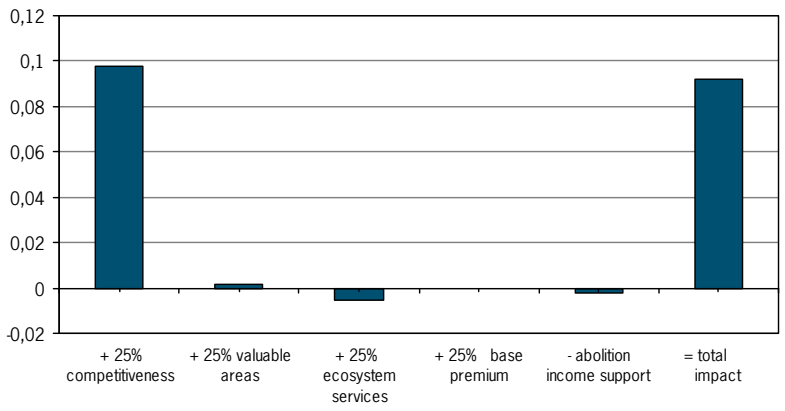
ficiency, prices and GVA, coming from improved competitiveness might differ from the results presented in Table 4.1.

Table 4.1	**Effectiveness of individual measures and the total impact of Stylised CAP Reform scenario on total GVA per group of agricultural activities in the EU-27 (% change compared to the reference scenario)**					
	+25% competi-tiveness	**+25% valuable areas**	**+25% ecosystem services**	**+ 25% base premium**	**- abolition income support**	**= total impact**
Cereals, oilseeds plus other arable crops	-1.3	11.4	11.1	13.3	-37.1	-12.9
Vegetables and Per-manent crops	0.6	0.3	1.7	0.9	-4.0	-0.7
fodder activities plus all cattle activities	-3.7	16.1	10.8	12.2	-34.8	-9.3
Other animals	-3.0	0.7	1.0	0.1	-1.2	-2.4

Lower land prices and further structural changes at farm level will have a positive impact on the average family farm income per permanent farm in the Stylised CAP Reform scenario. As a result, the average family farm income per permanent farm in the Stylised CAP Reform scenario might be equal to the average family farm income per permanent farm in the reference scenario. The corresponding structural effects (effects on the size of the farms and the number of farms) of the Stylised CAP Reform scenario will, however, differ from the reference scenario. Structural effects corresponding to the CAP Reform scenario will also be different per individual farm, region and sector.

4.2.6 Gross Domestic Product

Figure 4.6 **Effectiveness of individual measures and the total impact of the Stylised CAP Reform scenario on annual GDP growth in EU-27 (% change compared to the reference scenario)**



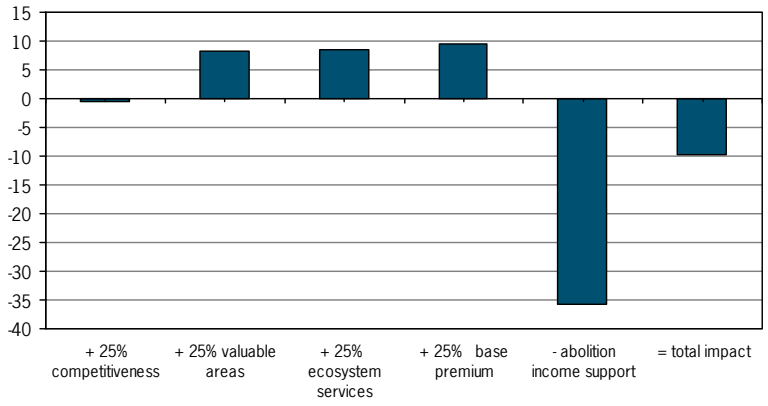
GDP or national income growth is mainly influenced by competitiveness measures, which increase productivity and free up endowments to be used for other more economically beneficial purposes. The lower agricultural product prices imply that consumers can buy more of other commodities, which enhances their welfare. The impact of ecosystem services is just negative with regard to GDP growth, as it reduces productivity by stimulating extensive production methods. We have to stress that our normal GDP measure does not take into account the social value of the services delivered (public goods, valuable areas, green and blue services).

4.2.7 Land prices

Land prices are higher due to valuable area payments, ecosystem service payments and a base premium, as the economic rent (i.e. subsidy) is partly taken by the fixed production factor, land. The impact of competitiveness measures on land is negligible, as on the one hand production increases and therefore demand for land is higher while on the other hand less land input is needed to produce one unit of output…and therefore less land is needed. In this case, both effects more or

less cancel each other out. The overall impact of the Stylised CAP Reform scenario is negative, as the abolition of the direct payments dominates the effect. Abolition of direct payments implies substantially lower land prices. This is also an important mechanism to explain why production is not going down very much due to the abolition of direct payments. The lower land prices keep EU production competitive.

Figure 4.7 **Effectiveness of individual measures and the total impact of the Stylised CAP Reform scenario on real land prices in the EU-27 (% change compared to the reference scenario)**

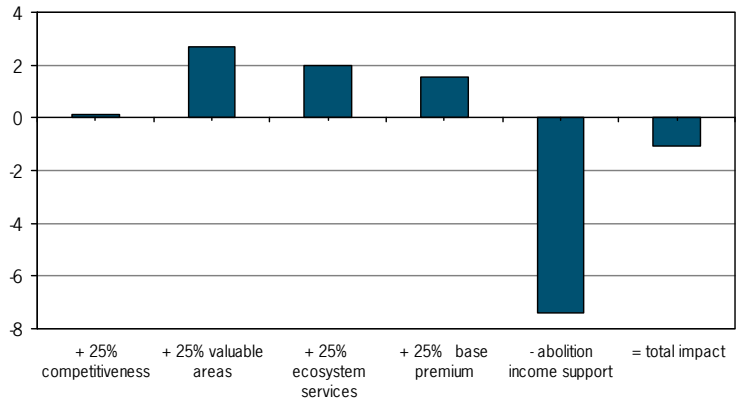


4.2.8 Total agricultural area

The impact on the total area of agricultural land is related to the development of land prices. Valuable area payments, ecosystem service payments and a base premium keep agricultural land in production under agriculture. The effect is largest for valuable area payments, as productivity is often lowest in these areas and therefore from an area point of view most land is kept in production by payments specifically targeting these areas (see Figure 4.8). The effect is also high for ecosystem services, as they stimulate extensive production methods. Subsidies to competitiveness have a marginal impact on land use, as they stimulate production on the one hand, but on the other hand use less input per unit of output. Abolition of income support, without giving money back to other measures, has a negative impact on the agricultural area in production (-7%), as land does not need to be

kept in good agricultural practice and marginal areas are abandoned. Overall, the Stylised CAP Reform scenario just has a negative effect.

Figure 4.8 **Effectiveness of individual measures and total impact of Stylised CAP Reform scenario on total agricultural area in the EU-27 (% change compared to the reference scenario)**



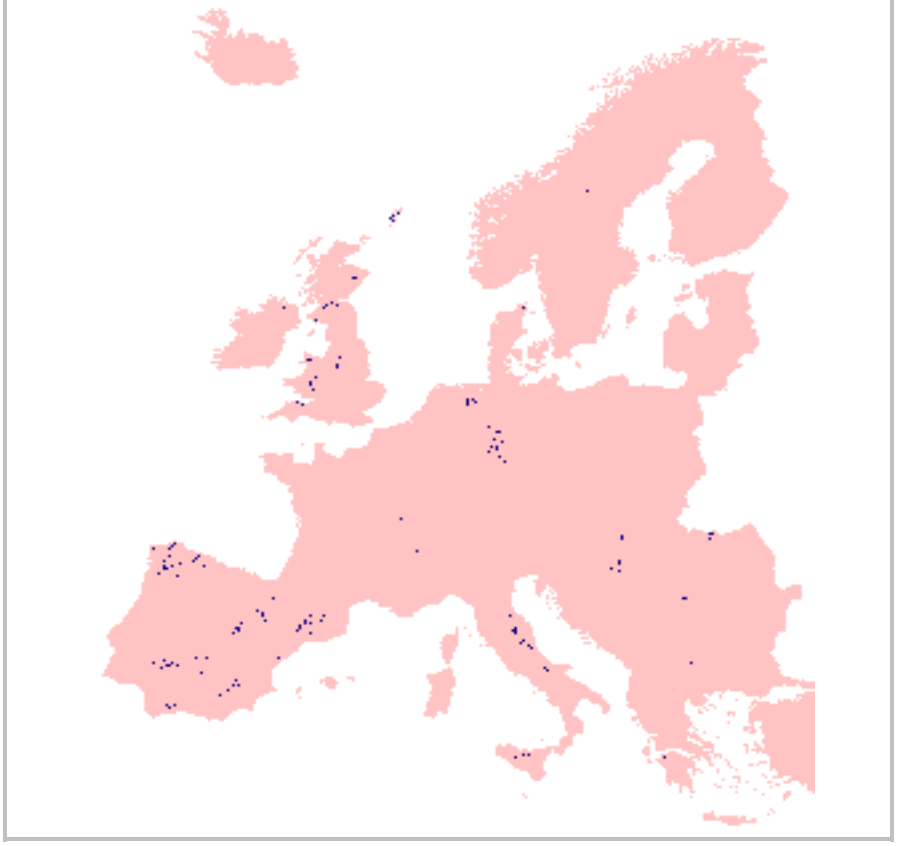
4.2.9 Land abandonment

Land abandonment is an indicator calculated through a post-processing of the simulated land use results of the Dyna-CLUE model and its values are presented in a map of 1x1 grid cells (Figure 4.9). Land abandonment refers to land extracted from agriculture (i.e. arable, pasture) and converted to semi-natural vegetation and ultimately forest. For land abandonment, only results are shown comparing the reference and the Stylised CAP Reform scenarios, without the individual effect of the four measures discussed previously. The individual effects of the measures are subject to a high level of uncertainty, given the strong assumptions necessary to make such maps of land abandonment and therefore maps with such individual effect could become too arbitrary.

In Figure 4.9, the blue spots indicate hot spots of agricultural land abandonment where land abandonment occurs in the Stylised CAP Reform scenario, but where it does not occur in the reference scenario. In such a blue spot, land abandonment is more concentrated then elsewhere. In the rest of European agriculture, land abandonment may also occur, but much more sparsely than in the hotspots.

The map clearly shows that land abandonment is a local issue occurring to a various extent in the different Member States. Here it should be remarked that currently the implementation of the policy measures in the Stylised CAP Reform scenario does not yet specifically target the prevention of land abandonment and that this is a required improvement for the future, if there is to be a clearer vision of what the proposed policy measures (i.e. competitiveness, ecosystem services and valuable areas) entail.

Figure 4.9 **Hot spots of agricultural land abandonment that do not occur in the reference scenario and do occur in the Stylised CAP reform scenario**



Discussion

To understand the occurrences of hot spots in certain locations in the Stylised CAP Reform scenario, we need to consider a small area in some more detail. Figure 4.9 zooms in on the hot spot of land abandonment in Northern Germany (in yellow) against a background of socially valuable areas and/or areas attractive for ecosystem services (in light to dark blue). The hot spot is located outside the areas classified as highly socially valuable or relevant for ecosystem services (dark blue in Figure 4.10). It still overlaps with areas that are low in terms in social value or ecosystem services, but apparently this is not enough to counter agricultural abandonment. In conclusion, the hot spot areas are typically characterised by:

- relatively high initial SPS direct income support in the reference scenario, and
- relatively few post-2013 CAP measures related to targeted payments in the Stylised CAP Reform scenario.

In these areas a lot of money is taken away in the Stylised CAP reform, while little money comes back in the new policy measures.

These differences between the reference scenario and Stylised CAP Reform scenario must be understood as indicative of what type of circumstances could occur in areas that could be abandoned (bearing the current assumptions in mind) and not as realistic portrayals of what will actually happen. Certainly a refinement of these assumptions is required to find more realistic results. Also, even without a CAP reform, land abandonment occurs in the reference scenario towards 2020 because of the declining role of agriculture along with the intensification of agriculture, requiring less land for a similar production level.

Figure 4.10	Part of northern Germany, Denmark, the Netherlands and southern Sweden, with in (light to dark) blue areas which are designated as socially valuable or attractive for ecosystem services and in green/yellow an overlay of hot spots of abandonment

4.2.10 Biodiversity

Biodiversity is expressed as Mean Species Abundance (MSA), which is an indicator comparing the abundance of species in pristine conditions to the abundance of species at the actual or simulated intensity of land use. The biodiversity indicator is calculated on the basis of a post-processing of the Dyna-CLUE simulated land use maps per grid cell according to the GLOBIO approach (Alkemade et al., 2009). The biodiversity map at NUTS-2 region level (Figure 3.11) does not show the indicator values themselves, but relative increases or decreases of the MSA between a reference scenario and a Stylised CAP Reform.

Some regions benefit as shown by the light to dark green colour in Figure 4.11, while others have a reduction in biodiversity. In each region, the dynamics are slightly different either causing a relative increase or a decrease in biodiversity. Most of the regions are relatively unaffected in their biodiversity-

response, but this might be due to the implementation of the measures in the Stylised CAP Reform scenario. The implementation of ecosystem services and valuable areas is mostly based on existing policies like LFAs, current payments in agri-environmental subsidies and Natura 2000 areas. With different implementations of these measures, the biodiversity responses could become more or less pronounced.

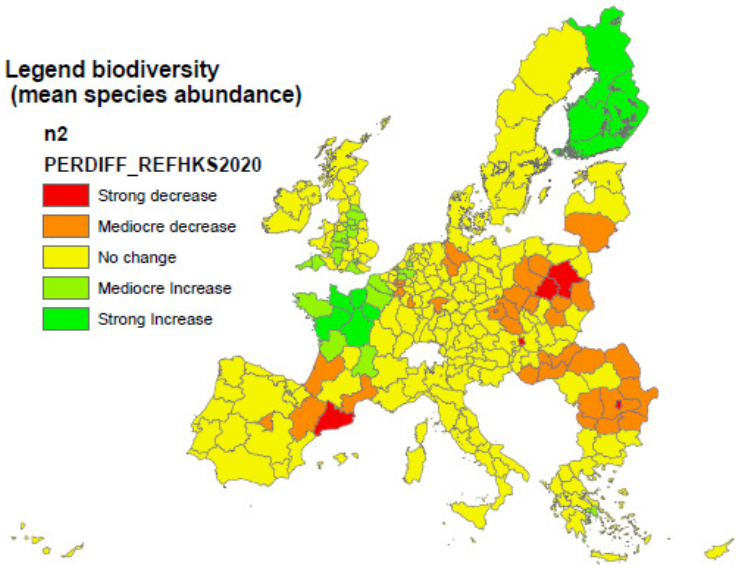
Nevertheless, when investigating the causes for change in biodiversity, either an increase or a decrease can be informative. For example, Finland shows an increase in biodiversity performance, which is due to the already large share of LFA regions and regions with agri-environmental payments and the high initial value for MSA. There is a lot of relatively untouched biodiversity available and this is promoted a bit more. In the French regions with an increase, the biodiversity is relatively low at the moment, as these areas are large cereal producing areas. By switching to more extensive technologies and changes in land use (from arable to grassland), the state of biodiversity can be improved relatively easily, although these effects might be an artefact of the modelling. The modelling does not consider the behaviour of farmers here, for which such a change to extensive practices might not be acceptable or might not reflect their mind set.

Most reductions in biodiversity occur in Eastern and Central Europe. These reductions are caused by the more intensive production techniques especially due to increased number of animals and increased intensity of crop production, which have a negative impact on biodiversity. Furthermore, a lot of land stays in production here.

Discussion

In this assessment study, an initial attempt was made to calculate a biodiversity indicator as a result of a CAP reform. Given that mostly current policies were used to parameterise the models, the results in terms of the biodiversity indicator are not as pronounced as they might be with a more elaborated or more differentiated policy design. At this stage, the relationship between investments in ecosystem services and socially valuable areas and biodiversity is not yet quantified in an advanced way and only the likelihood of a type of land use is affected with investments. This implies that, if this relationship between investments and biodiversity results is quantified, it might give a better understanding of the (positive and negative) impact of CAP reform. However, literature on this relationship is lacking and this suggests that a strong link between policies and measurable biodiversity effects has not yet been found. With more detailed policy specifications being elaborated in the coming years, this relationship can be ameliorated.

Figure 4.11	Difference in results for biodiversity (Mean Species abundance) between the reference and Stylised CAP Reform scenarios



5 Conclusions and policy recommendations

This study investigates the effectiveness of post-2013 CAP measures. In addition to the measures proposed in the Dutch Outlook (focusing on competitiveness, valuable areas and ecosystem services), the effectiveness of base premiums is considered, as this measure is proposed by some other Member States. To finance the post-2013 CAP measures, the direct income support under the SPS is abolished and the effectiveness of this measure is also investigated. Finally the different post-2013 CAP measures, including the abolition of the direct income support under the SPS, are combined and the total impact of a so-called Stylised CAP Reform scenario is calculated. It is stylised as the division of the budget across the four measures mentioned above, coming from the national budget for direct income support provided by the SPS, and is chosen to be equal to enable an assessment of the effectiveness of individual post-2013 CAP measures. It is also called stylised as the scenario does not reflect the ideas or wishes of the Dutch government.

Although the new policy framework after 2013 and the corresponding budgets are not yet known, the main conclusion of this study is that the effectiveness of the various post-2013 CAP measures varies considerably with respect to objectives such as income, production, competitiveness, land use and biodiversity. Furthermore, the impact varies between individual farms, sectors and regions. This research of the effectiveness of a selected number of targeted measures has given the following indicative results (see also Table 5.1 and 5.2 for a summary of the results):

- *Competitiveness measures* stimulate production (especially in Eastern European countries), increase exports, reduce imports, reduce use of variable inputs and decrease agricultural prices, which is beneficial fin terms of the consumer and leads to a higher national income. It will speed up the growth of permanent farms, resulting in less labour being used in agriculture. However, the people concerned may find work outside agriculture because of the induced higher national income growth. If food security is an important motive, this is an effective policy as production increases.
- *Payments to valuable areas* keep resources (land and labour) dedicated to production in these areas. The overall impact is that these payments keep land in production, increase land prices and increase Gross Value Added (GVA) per farm located in the valuable areas. Impact on production, input use and national

income is negligible at the level of the EU-27, but this can be different at regional level.

- *Payments to ecosystem services* affect production and income in the EU-27 more widely (less regional concentrated), reduce variable input use, keep land in production, increase land prices, increase GVA per average farm and increase biodiversity. Impact on production, trade and national income is negligible at the level of the EU-27, but this may be different at regional level.
- A *base premium* increases GVA per farm, keeps land in production and increases land prices. Impact on production, input use, biodiversity and national income is negligible or uncertain.
- *Abolition of the direct income support under the SPS*, slightly reduces agricultural production, (slightly) increases imports, reduces exports, increases prices of agricultural products, sharply reduces the average GVA per farm, reduces the total area used for agricultural production and decreases land prices.

Table 5.1 **Effectiveness of different post-2013 CAP measures and total impact of the Stylised CAP Reform scenario on some selected economic and environmental variables**

	Production	Use of variable inputs a)	Prices of agricultural outputs	Land prices	GVA per farm
+25% competitiveness	↑	↓	↓	0	0
+25% valuable areas	0	0	0	↑	↑
+25% ecosystem services	0	↓	0	↑	↑
+25% base premium	↑	↑	↓	↑	↑
- abolition income support	0	0	0	↓	↓
= Total impact	↑	↓	↓	↓	0/↓

a) Mineral fertilisers, pesticides, etc.

Table 5.2	Effectiveness of different post-2013 CAP measures and total impact of the Stylised CAP Reform scenario on some selected economic and environmental variables			
	Welfare	**Land used by Agriculture**	**Labour**	**Biodiversity a)**
+25% competitiveness	↑	0	↓	(↑ / ↓)
+25% valuable areas	0	↑	0	(↑)
+25% ecosystem services	0	↑	0	(↑)
+25% base premium	0	↑	↑	(↑ / ↓)
- abolition income support	0	↓↓↓	0	(↑ / ↓)
= total impact	↑	0/↓	↓	↑
a) ( ) based on a qualitative assessment.				

The study has sought to explore the impact of post-2013 CAP measures through the use of economic models. This has revealed the considerable methodological and data challenges inherent in a complex policy evaluation exercise of this kind (see the discussion in Section 3.5). This is particularly the case in seeking to specify and quantify the impact of targeted payments, such as competitiveness payments, valuable area payments and ecosystem payments (conforming to the current rural development policies in Pillar 2). Reliable *ex post* information is extremely scarce. Since these measures might be an expanding element of the CAP, it is recommended that further investment both in analytical tools and data collection (at different geographical levels) is prioritised at both the Member State and EU levels. The availability of good quality, precise and comparable empirical evidence on the impact of these new measures at local, regional and Member State levels is critical to inform future policy evaluations.

If modelling is to be used with greater confidence to predict the impact of different policy scenarios in relation to new more targeted measures, then empirical evidence of the efficiency and effectiveness of these measures is once again crucial. For example, information about the rates of return to human and physical capital investments is needed, the level of deadweight or crowding out effects, transaction costs and the impact of environmental measures on yields. Europe-wide economic models need to be developed further in order to enable them to reflect more locally differentiated impact, including by farm type, based on the different ways in which measures are implemented in different locations. The work currently being undertaken in EUruralis 3.0 and the FP7 project 'CAPRI-RD' is a good start in this regard. Another large area of research is the conceptualisation,

modelling and monetisation of public goods. In doing so, both economic and biophysical data models are needed. Moreover, linking these different types of data and models will increase both the range and the reliability of the results.

From the effectiveness of the different targeted measures, some policy recommendations can be drawn:

1. The effectiveness differs between measures with regard to the various targets. Policy makers should therefore first identify the targets and consequently choose the measures that are most effective for reaching the target.
2. Targeted investments in productivity and efficiency (measures to improve competitiveness) do have more effect on food security than the current system of decoupled income support.
3. This study indicates that targeted measures can affect production and biodiversity. However, it is important to set up a transparent system with low transaction costs; better insights into the transaction costs of a targeted payment system are needed.
4. Reallocation of direct income support under the SPS to more targeted measures and a base premium per hectare should be done gradually to give affected farmers more time to adjust.
5. This research focuses on the quantity of the agricultural production and part of the gain is transferred to consumers via lower food prices. Investment in food quality is also recommended, as this could create more value added in the food production chain as a whole.
6. Finally it is recommended that further investment both in analytical tools and data collection (at different geographical levels) is prioritised at both Member State and EU levels. The availability of good quality, precise and comparable empirical evidence on the impact of these new measures at local, regional and Member State level is critical to inform future policy evaluations.

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- www.eururalis.eu/

Appendix 1

Some selected results of the reference scenario

Table A1.1	Average share of total premiums, direct income support under the SPS and regional development payments in GVA per ha or head per activity in the EU-27 in 2020 in the reference scenario (percentages)		
	Total premiums (Pillar 1 and Pillar 2)	**Direct income support under the SPS (Pillar 1)**	**Regional development payments (Pillar 2)**
Cereals	65	51	14
Oilseeds	72	59	13
Other arable crops	14	13	1
Pulses	95	79	16
Potatoes	8	7	1
Sugar Beet	49	47	2
Vegetables/Permanent crops	4	3	1
Fodder activities	112	91	22
Set aside and fallow land	117	115	3
All cattle activities	10	1	9
Dairy Cows	10	1	8
Dairy Cows high yield	7	2	5
Dairy Cows low yield	17	1	16
Other Cows	>100	0	>100
Heifers breeding	11	0	11
Heifers fattening	29	0	29
Heifers fattening high weight	15	0	15

Table A1.1	Average share of total premiums, direct income support under the SPS and regional development payments in GVA per ha or head per activity in the EU-27 in 2020 in the reference scenario (percentages) (continued)		
	Total premiums (Pillar 1 and Pillar 2)	**Direct income support under the SPS (Pillar 1)**	**Regional development payments (Pillar 2)**
Heifers fattening low weight	227	0	227
Male adult cattle	3	0	3
Male adult cattle high weight	1	0	1
Male adult cattle low weight	8	0	8
Raising male calves	1	0	1
Raising female Calves	1	0	1
Fattening male calves	1	0	1
Fattening female calves	1	0	1
Other animals	1	0	1
Pork	1	0	1
Pig Breeding	0	0	0
Milk Ewes and Goat	31	0	31
Sheep and Goat fattening	1	0	1
Laying hens	0	0	0
Poultry fattening	0	0	0

Table A1.2	Average share of total premiums, direct income support under the SPS and regional development payments in GVA per region and member state in 2020 in the reference scenario (percentages)		
	Total premiums (Pillar 1 and Pillar 2)	**Direct income support under the SPS (Pillar 1)**	**Regional development payments (Pillar 2)**
European Union 27	20	15	5
European Union 25	20	15	5
European Union 15	19	14	4
European Union 10	36	26	10
Bulgaria and Romania	23	18	5
Belgium and Luxembourg	17	14	3
Denmark	21	19	3
Germany	23	19	5
Austria	33	14	19
Netherlands	7	5	1
France	22	18	4
Portugal	18	13	5
Spain	12	10	2
Greece	20	16	3
Italy	11	8	3
Ireland	43	25	19
Finland	61	26	36
Sweden	44	26	18
United Kingdom	31	26	6
Czech Republic	46	32	14
Estonia	44	26	18
Hungary	36	29	7
Lithuania	42	27	15
Latvia	51	34	17
Poland	32	23	9
Slovenia	29	14	14
Slovak Republic	48	30	18
Cyprus	19	11	8

Table A1.2	Average share of total premiums, direct income support under the SPS and regional development payments in GVA per region and member state in 2020 in the reference scenario (percentages)		
	Total premiums (Pillar 1 and Pillar 2)	**Direct income support under the SPS (Pillar 1)**	**Regional development payments (Pillar 2)**
Malta	13	5	8
Bulgaria	27	21	6
Romania	21	16	5

Appendix 2

Initial distribution of agri-environmental payments over sectors and regions

Table A2.1 shows the initial share of the different sectors in total agri-environmental payments averaged over a group of Member States. The data are taken from FADN. Member States are grouped to take into account a lack of data in some Member States especially in the EU-12. Moreover, in the initial situation the average agri-environmental payment per ha is higher inside LFA compared to outside LFA (Nowicki et al., 2009a). This is also taken into account in our analysis. As a result NUTS-2 regions in CAPRI with a high share of LFA also receive a relative high share of the national additional agri-environmental payments for ecosystem services. This is, however, not always confirmed by the data found in FADN.[1] To solve this problem, individual Member States are grouped to calculate the share in total agri-environmental payment per sector and to calculate the average share of agri-environmental payments in LFA and outside LFA.

Table A2.1 **Average share of different sectors in agri-environmental payments per group of Member States in the initial situation**

	Field crops	Cattle	Pigs and poultry	Rest
BE,DK,DE,NL	26	52	1	22
IR,UK	23	70	0	7
AT	39	48	2	11
EL,ES,FR,IT,PT	42	46	1	12
SE,FI	40	43	2	16
EU-12	40	28	1	30

Source: FADN.

[1] In the Netherlands for example, in FADN all agri-environmental payments are paid to farmers outside LFA. This means that NUTS-2 regions in CAPRI with a relative high share of LFA in total agricultural area would receive very little agri-environmental payments whereas regions with a low share of LFA would receive a relative large amount of agri-environmental payments.

Distribution of additional national agri-environmental payments over agricultural activities and regions in CAPRI are based on the share of LFA in a NUTS-2 region and on the distribution of agri-environmental payments over farms and regions in the initial situation as found in FADN (Nowicki et al., 2009a). The payments to individual farms in the initial situation are translated to activities and sectors in CAPRI (see Table A2.1). Table A2.1 shows that in the EU-15 a relatively large share of agri-environmental payments to support ecosystem services is paid to cattle activities.