Agriculture and the Environment:
Lessons Learned from a Decade of OECD Work

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PREAMBLE

This report provides a concise summary of the main lessons learned from a decade (1993-2003) of work on agriculture and environmental policy issues in the OECD, and identifies the main emerging issues and challenges in order to assist policy makers in the on-going design and implementation of effective and efficient policies. When the OECD created the Joint Working Party on Agriculture and the Environment (JWP) in 1993, the aim was to increase understanding of these policy issues by

- providing a forum for a broad exchange of views, analysis and information on agri-environmental relationships in the context of sustainable development, the reform of agricultural and trade policies, and the implementation of multilateral environmental agreements; and

- undertaking the monitoring and evaluation of agriculture's environmental performance and policies with the aim of contributing to the design and implementation of policies and actions to facilitate sustainable agriculture and the management of natural resources in agriculture.

The activities of the JWP have made progress in

- identifying key policy issues and the linkages between agriculture and the environment;

- developing indicators to track conditions and trends in the state of the environment in agriculture for policy purposes;

- providing an inventory of policies addressing environmental issues in agriculture; and

- examining in depth specific environmental issues and policies of importance to agriculture.

The analysis has taken into consideration the wide range of agri-environmental conditions and policies across OECD countries, and the results have been published on a regular basis.[1] A list of the publications from the work of the JWP, together with a list of other OECD publications that draw on or contribute to the work on agriculture and the environment, are presented at the end of this report. In these publications readers can find detailed supporting analysis, data, and further information on lessons learned from the work achieved to date.

Over the past decade the JWP has provided a solid foundation for policy analysis. It has highlighted the complexity of the linkages between agri-environmental and agricultural policies and environmental outcomes and showed that there is no general "one-size-fits-all" policy formula for dealing with environmental concerns, although work on the above activities is still in progress. Further understanding of these linkages will be a central focus of future work in the JWP, with the aim of helping policy makers in the design, monitoring and evaluation of their policies.

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EXECUTIVE SUMMARY

The main policy lessons learned from the OECD work on agriculture and the environment are:

- There has been an overall improvement in the environmental performance of agriculture, but this masks a number of severe local and regional problems, while future global pressures on land and water resources will be significant.
- There is evidence of some environmental improvements resulting from agri-environmental measures, but in certain cases there is a lack of policy coherence in a number of OECD countries where these measures and commodity production-linked support policies are pulling in opposite directions.
- Environmental improvement in agriculture has involved costs that would be lower in the absence of commodity production-linked support measures, which may provide incentives to adopt environmentally harmful practices (including the more intensive use of chemicals), and expand commodity production to environmentally sensitive land.
- Although environmental cross-compliance conditions associated with commodity production-linked payments to farmers may mitigate some environmental pressures, there are other ways of effectively reducing the inconsistencies between agricultural and environmental policy objectives,
- It is not sufficient to show that the policies in place have been effective; it is also necessary to establish the costs of such an achievement, and to identify the policies and market actions that would achieve the same or better environmental outcomes at a lower cost.
- There is scope for looking for ways to take greater account of agriculture's environmental costs and benefits in farmers' production decisions, and for a more comprehensive application of the polluter-pays-principle in agriculture.
- There is unlikely to be a general "one-size-fits-all" formula for dealing with environmental concerns and achieving an optimal policy mix, including market approaches, because agro-ecological conditions and public preferences vary across countries.

In all OECD countries public awareness and concern with the impact of agriculture on the environment are increasing. Markets have not always delivered the environmental outcomes that society demands. In response, there is a growing emphasis on policies to address these concerns or demands from society. This trend looks likely to continue in the future. But, while a wide range of policies are in place to address agri-environmental issues, some measures simply offset the environmental pressure from other agricultural policies. A decade of work in the OECD has provided a forum for member countries to better understand and analyse the relationship between diverse policies, agriculture and the environment.

What has been the environmental performance of agriculture in recent years? According to the work on developing agri-environmental indicators there has been some reduction in the pressure on the environment in agriculture across OECD countries, but progress has been mixed since the mid-1980s. Land used for agriculture and soil loss have decreased, but water use has increased. Nutrient surpluses have decreased in many countries, easing pressure on water quality, but significant pockets of high concentrations remain. Pesticide use on average across the OECD has shown a slight increase throughout the 1990s, but there is insufficient evidence as to the environmental risks of pesticides. On average, greenhouse gas emissions have increased, but there were considerable reductions in some countries. The long-term decrease in biodiversity and the deterioration of landscape features appears to have slowed, or even improved in some cases. But if OECD and global future food and raw material needs are to be met, agricultural production will need to expand, which in some OECD countries will generate further environmental pressure, particularly on land and water resources.

In what way have policies contributed to these developments and how can they help to ease future environmental pressures from agriculture? Agricultural support provided by commodity production-linked measures remains the predominant form of support in OECD countries, despite reforms. OECD work shows that this raises land and other fixed-asset values and provides incentives to adopt environmentally harmful practices (including the more intensive use of chemicals) and expand production onto environmentally sensitive land, thereby aggravating pressure on the environment. Constraints on production (*e.g.* production quotas and set-aside land) limit the impacts of commodity production-linked support on the environment, but may impede structural adjustment, and lock-in environmental impacts. However, the linkages between policies and environmental performance are complex and may vary across regions, countries, and time. Therefore, there is a need to link the measurement of environmental performance (indicators) to the characteristics of different policy measures.

There is a plethora of measures in OECD countries to address a wide range of environmental issues in agriculture. While there is evidence of some environmental improvements resulting from these measures, in certain cases they reveal a lack of policy coherence, with agri-environmental measures and commodity production-linked support policies pulling in opposite directions. Where support is provided through commodity production-linked measures, the provision of environmental services must be weighed against the cost of the environmental damage generated by those measures.

It is notable that countries with relatively low levels of commodity production-linked support are those that tend to rely more on market-related and co-operative approaches. On the other hand, those countries that make the greatest use of agri-environmental payments also tend to have relatively high levels of commodity production-linked support, making the attainment of environmental objectives less certain and more costly than would be the case in the absence of such support.

In some countries, environmental cross-compliance conditions associated with commodity production-linked payments to farmers are seen as a means of reducing some of the inconsistencies between agricultural and environmental policy objectives and thus mitigating environmental pressures. A key limitation is that those farmers who receive payments with cross-compliance conditions are not necessarily those farming the most environmentally sensitive land. Moreover, cross compliance conditions apply only when both support measures and environmental pressure are in place. Phasing out policy measures linked to commodity production – which often exacerbates environmental pressure – would therefore lessen the reason for cross compliance in these cases, although not the need for targeted environmental measures.

There is scope for a wider consideration of agriculture's environmental costs in production decisions, through identifying polluters, and monitoring and enforcing actions. The relative absence of environmental taxes and charges, and the dominance of agri-environmental incentive payments in OECD countries are symptoms of the fact that farmers in some countries have retained broad implicit or "presumptive" rights in the use of natural resources.

There is also a need for clearer definitions of property rights in agriculture. This would help policy makers decide whether farmers should be liable at their own cost for environmental damage, and where they could be remunerated for providing environmental services over and above those rewarded through the market. In addition, while there are often difficulties in applying the polluter-pays-principle in agriculture, there is scope for a more comprehensive application in the sector.

Demonstrating the various environmental effects of agricultural trade liberalisation is a difficult task. However, available evidence suggests that it has resulted in some shift in production from higher to lower-cost and input-using systems. It has reduced production intensity in countries with historically high levels of fertiliser and pesticide application, relieving environmental stresses in these areas, but has raised environmental pressure in those countries where production has increased. There is little evidence whether the abandonment of farming that generates environmental benefits is due to trade liberalisation, or whether environmental regulations significantly affect trade competitiveness for producers. Nevertheless, potential environmental gains from trade liberalisation will be greater where targeted measures are in place to deal with harmful and beneficial environmental effects.

Policy intervention should promote rather than hinder favourable agri-environmental outcomes and the policy mix should be the most cost-effective possible. There is a role for regulatory frameworks, information-based strategies and economic instruments in the policy mix. In determining appropriate policy intervention it will always be prudent to first establish if markets alone will fail to deliver the environmental outcomes desired.

In the future, evaluating ways to achieve better environmental outcomes at lower cost requires a deeper understanding and measurement of the linkages between policy causes and environmental effects. Analysis of the linkages between policies and environmental performance is complex, but policy should be directed to the cause, rather than the symptom, of any problem or objective to be addressed. Therefore, there is a need to develop methods and tools to analyse these complex interactions and spatial differences to enhance the understanding, measurement and analysis of linkages between policies and environmental outcomes. And sharing the experiences in OECD countries of what has or has not worked is an essential ingredient in determining the most cost-effective mix of policies and market approaches.

What is shaping the environmental performance of agriculture? [2]

There is a need to improve environmental performance in agriculture, . . .

There is a general recognition of the need to improve environmental performance in agriculture, through enhancing the beneficial – and reducing the harmful – environmental effects to ensure the sustainability of resource use. However, agriculture has a complex relationship with natural resources and the environment, and attributing specific environmental effects to agriculture is difficult and not fully understood. Agriculture is a major user of land and water resources yet needs to maintain the quantity and quality of those resources in order to remain viable. Agriculture generates waste and pollution yet it also conserves and recycles natural resources, and changes landscapes and habitats for wildlife. Many of the environmental effects are confined to the sector itself, but off-farm effects are also important. The impacts are often concentrated locally and regionally, although some are of national and international significance.

. . . which is influenced by many factors, including policies . . .

Agricultural and environmental policies, markets, farm-management practices, structural change, technological developments and socio-cultural preferences are the main driving forces that interact – and sometimes give conflicting signals – in determining agriculture's environmental performance. It is no simple task, however, to identify and measure the respective influence of all these driving forces. The heterogeneity of the natural resource base, farm structures and production systems used by farmers, and the assimilative capacity of ecosystems differ from place to place. Disentangling the influence these various factors have on environmental outcomes raises problems of identification and measurement, including the predominance of dispersed, non-point source pollution in agriculture and often lengthy delays in the manifestation of environmental outcomes, such as pollution of groundwater.

. . . which have evolved over a long period of time.

The sufficiency and regularity of food supplies is largely assured in OECD countries. Generally rising prosperity and awareness have led to greater public demand for food produced in ways that also conserve or enhance the natural or aesthetic environment. The environmental performance of agriculture has evolved within the context of a long history of agricultural policies in OECD countries, most of which deliver support through commodity production-linked measures (*i.e.* market price support, output payments, and input subsidies), largely aimed at supporting farm incomes.

Environmental regulations are having an increasing effect on agriculture.

Agricultural policy reforms and trade liberalisation have reduced the importance of production-linked policy measures, but they remain dominant in most OECD countries. Economy-wide environmental regulations increasingly impact on agriculture. Markets function – albeit often heavily influenced by government intervention – to match the demand and supply of agricultural commodities but, with regard to many environmental goods and services, they either

function badly or are non-existent. Frequently, the nature and quantification of the public's demand for "environmental performance" from agriculture is not at all clear.

The future challenge is whether agriculture can produce enough food without degrading natural resources.

The agri-food sector in OECD countries has witnessed a steady trend in output growth, largely through higher productivity, but with mixed results on environmental performance. In the next half-century agriculture, worldwide, will be required to double its output if it is to meet the expected increased global demand for food and reduce hunger. The challenge is whether agriculture can efficiently produce the food to meet this growing world demand over time without degrading natural resources – productive soils, unpolluted air, clean and sufficient supplies of water, conserved habitats, biodiversity and landscapes – and do so in ways that are socially acceptable.

Many policies impact on the environmental performance of agriculture, . . .

In OECD countries environmental concerns in agriculture have been directly addressed through different combinations of specific agri-environmental policy measures; agricultural policy measures that include environmental conditions; economy-wide environmental regulations and policies; zoning regulations; research and development, education, and extension service provision; and facilitation of co-operative, voluntary and market-based approaches.

. . . but the relationship between policies, agricultural production and environmental outcomes remains inadequately understood.

As all policies have some impact on the environmental performance of agriculture, the challenge has been to analyse the extent to which the policy measures and mixes of policies have facilitated or impeded that environmental performance, and to assess the economic and social costs involved. While much work has been undertaken both in individual countries and in the OECD, in many cases the results are preliminary. Research is at a relatively early stage in understanding and measuring the complex relationship between policies, agricultural production and environmental outcomes, in order to evaluate policies and draw general and widely applicable conclusions.

Agri-environmental performance: getting better or worse? [3]

Agriculture is a major user of natural resources, especially land and water . . .

As a major user of natural resources, agriculture has a significant impact on the environment in OECD countries. Agriculture in the OECD area accounts for around 40% of total land and nearly 45% of water use and, in many countries, dominates and shapes the landscape. Contrary to many other economic activities, agriculture has both harmful and beneficial effects on the environment, by changing the quality or quantity of soil, water, air, biodiversity and landscapes.

. . . and generates both negative and positive environmental impacts . . .

Increasing food demand – together with policies encouraging production – and technological and economic changes have often led to a marked intensification of agriculture (more output per unit of land or labour) and farming on environmentally sensitive land, which in some cases has led to environmental harm. These detrimental effects include mainly water and air pollution, but also the loss of wildlife, habitats and landscape features. Soil degradation and water depletion are also serious concerns in some areas. On the other hand, environmental benefits may in some circumstances include: contribution to water accumulation and flood control, nutrient recycling and fixation, soil formation, carbon sequestration by trees and soil, wildlife and biodiversity protection and the provision of recreational services and aesthetic value.

. . . but measuring environmental performance is not easy.

Measuring agri-environmental performance is not an easy task, but progress has been made on developing common methodologies to measure such performance through the construction of agri-environmental indicators. The indicators cover the environmental pressures from developments in markets, policy and technology that potentially determine the state of the environment (*e.g.* soil and water quality, ecosystem stress). These pressures provoke responses or actions by farmers (*e.g.* nutrient management); policy makers (*e.g.* regulations, conditionality); markets (*e.g.* tradeable permits); and technological change (*e.g.* animal feed-use efficiency, global positioning systems and precision farming).

Agriculture has contributed to soil erosion . . .

Agriculture has contributed to ***soil erosion*** through certain practices such as land-use conversion, tilling or overgrazing. Major concerns are soil erosion caused by both wind and water in the **United States** and in the **Canadian** wheat belt, and water-related erosion problems in **Australia**, **New Zealand** and **Mediterranean countries**.

. . . and is a significant source of water pollution in some regions.

Farming is currently a significant source of ***water pollution,*** which is a particular problem in certain regions of **Europe** and the **United States**, and at a local level in other countries including **Australia**, **Canada** and **New Zealand**. The application of fertilisers in agriculture and animal effluent from livestock account for as much as 40% of nitrogen and 30% of phosphate emissions in surface water in some OECD countries, contributing significantly to the problems of eutrophication, which results in the depletion of oxygen in water. Pesticide run-off from agricultural land also impairs drinking-water quality and harms water-based wildlife.

Excessive groundwater extraction is also a concern in many OECD countries . . .

Irrigation accounts for a major share of water use in most OECD countries and ***excessive groundwater extraction*** levels are a concern in many areas, particularly the drier regions of **Australia**, **Southern Europe, Mexico** and the **United States**. Problems of ***salinisation*** are associated with land-clearing and irrigation in several countries, including **Australia**.

. . . while air pollution tends to be pronounced in areas of intensive agricultural production.

Air pollution problems caused by ammonia (acid rain), methyl bromide (ozone depletion), pesticide drift, crop burning and offensive odours also tend to be pronounced in areas of intensive agricultural production. Gaseous emissions from agriculture – in particular methane and nitrous oxide – are also a notable contributing factor to global warming and climate change. It is estimated that agriculture currently accounts for around 9% of total OECD ***greenhouse gas emissions***, although certain agricultural activities have a potentially significant mitigating effect on the process of global warming, particularly the sequestration of atmospheric carbon in the soil and the production of biomass crops, including those grown for energy use. In the longer term, climate change affects agriculture through the levels and variability of temperature and rainfall, which in turn leads to pressures to adjust farm practices and location, and commodities produced.

Agriculture has been identified as a significant cause of the loss of biodiversity . . .

In many OECD countries agriculture has been identified as a significant cause of the ***loss of biodiversity***, in particular leading to habitat degeneration through land-use changes caused by the intensification of farming practices (including larger field size, reduced crop rotations and increased fertiliser and pesticide application). However, abandonment of farming has led to changes in the habitats in a number of areas using specific farming practices. This is especially the case in **Europe,** where many of the most valued areas for wildlife tend to be semi-natural habitats, and species have co-evolved with traditional agricultural practices over many centuries. By contrast, in countries such as **Australia**, **New Zealand** and **North America**, valued habitats are predominantly associated with natural areas including grasslands, wetlands, native forests and bush. These areas have in some cases been put at risk by agricultural practices. For example, in the **United States** the conversion of grasslands and wetlands to cropland is judged to have contributed to the decline of several rare species of wildlife.

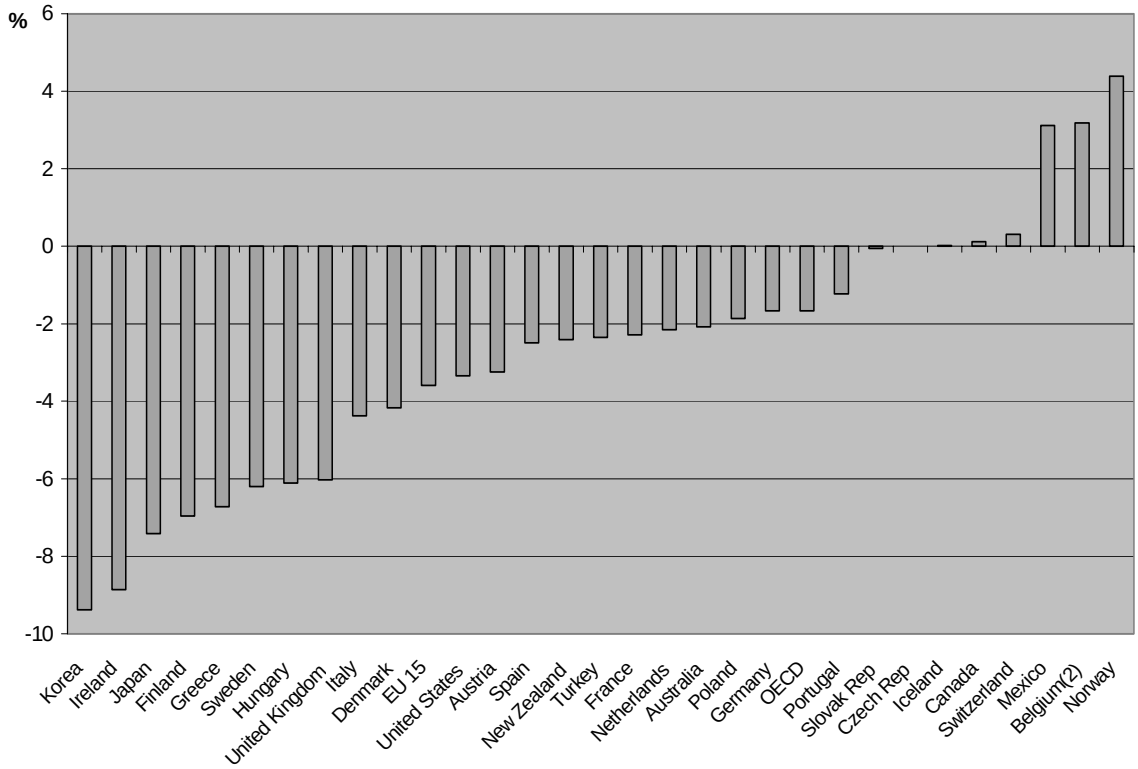
. . . and land abandonment has led to concerns relating to the preservation of landscapes.

Pressures on land use and the adoption of more intensive farming practices, as well as land abandonment in some OECD countries have led to concerns relating to the ***preservation of landscapes*** associated with traditional agricultural practices, particularly in **European countries**, **Japan** and **Korea**, where such landscapes are generally considered to be of cultural significance. In other OECD countries, such as **Australia**, **New Zealand** and **North America**, the preservation of rural landscapes is generally not considered a priority for government financial assistance, although there are concerns relating to the loss of rural land to urban development in certain areas, particularly in regions of the **United States,** and to rural depopulation in **Australia**.

While agricultural production has risen, environmental performance has been mixed across and within OECD countries.

Overall, while agricultural production and productivity have generally increased in all OECD countries, the environmental performance of agriculture has been mixed across and within countries. The area of land used for agriculture and the amount of soil loss have declined, but water use has increased (Figures 1 and 2). Nutrient surpluses discharged into the environment from farming have decreased in many countries, easing pressure on water quality, but pockets of high concentration remain (Figure 3). On average, pesticide use across the OECD has shown a slight increase over the 1990s (Figure 4) but there is, however, insufficient evidence as to the environmental risks of pesticides. Greenhouse gas emissions have increased, on average, although certain countries have shown a considerable reduction in emissions (Figure 5). There is also some evidence of an attenuation of the longer-term decrease in biodiversity and landscape features.

Figure 1. Change in agricultural land area:[1] 1990-92 to 1999-2001

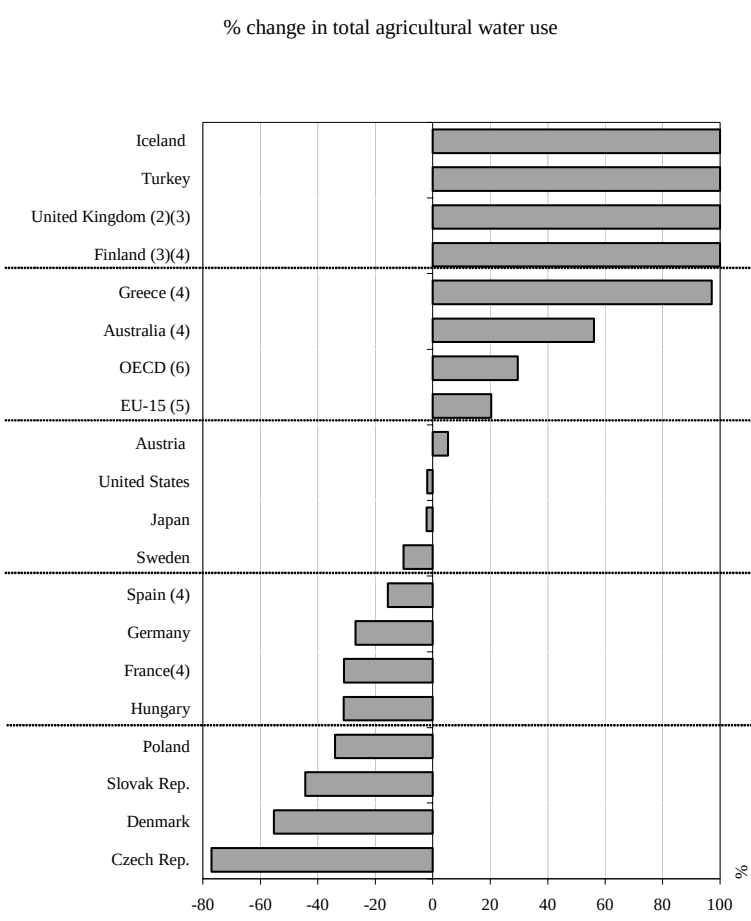


Notes:

1. Agricultural land area: area of arable land plus permanent crops and permanent pasture.
2. Including Luxembourg.

Source: FAO database and national data for Switzerland.

Figure 2. Total agricultural water use:[1] 1985-2000



Total agricultural water use
million m^3

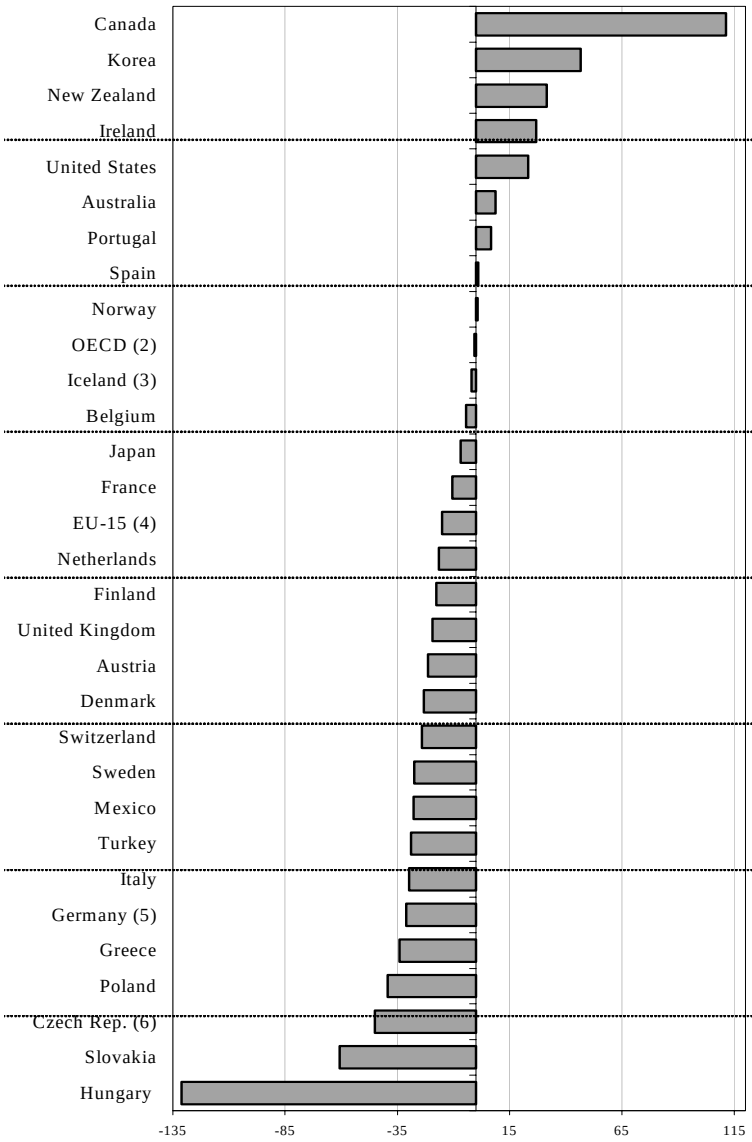
	1985	2000
Iceland	4	70
Turkey	14 300	30 600
United Kingdom	468	1 880
Finland	20	50
Greece	4 600	9 067
Australia	11 500	17 957
OECD	324 304	420 315
EU-15	40 909	49 207
Austria	95	100
United States	195 300	191 555
Japan	58 490	57 240
Sweden	167	150
Spain	30 400	25 640
Germany	223	163
France	4 471	3 088
Hungary	727	502
Poland	1 607	1 061
Slovak Rep.	164	91
Denmark	465	208
Czech Rep.	63	15

Notes:

1. Agricultural water use is defined as water for irrigation and other agricultural uses, such as livestock operations. It includes water abstracted from surface and groundwater, and return flows (withdrawals) from irrigation for Finland, France, Germany, Greece, the Netherlands, Spain and Turkey, but excludes precipitation directly onto agricultural land.
2. England and Wales only.
3. Change is greater than 100% for Iceland (1 650%), Finland (150%), Turkey (114%) and the United Kingdom (302%).
4. Data for irrigation are used where data for agricultural water use are not available.
5. EU-15 excluding: Belgium, Ireland, Italy, Luxembourg, the Netherlands and Portugal.
6. OECD excluding: Belgium, Canada, Ireland, Italy, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway and Switzerland.

Source: *OECD Environmental Data Compendium.*

Figure 3. Soil surface nitrogen balance estimates:[1] 1985-87 to 1995-97



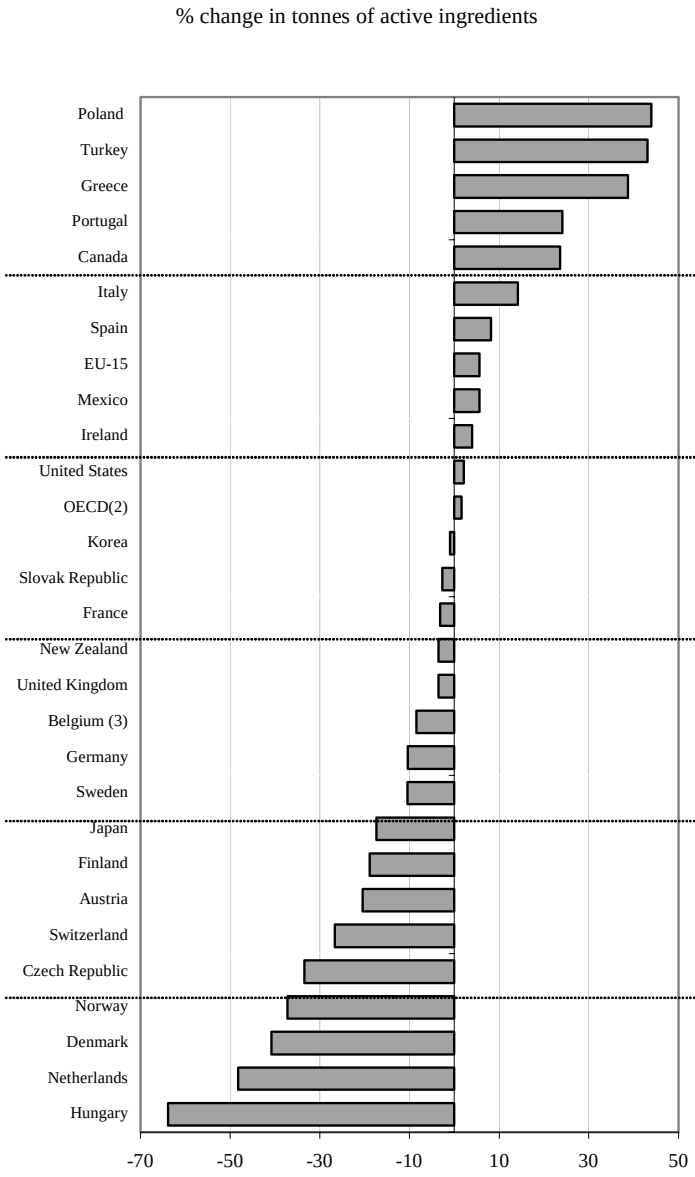
	Nitrogen balance kg/ha of total agricultural land	
	1985-87	1995-97
Canada	6	13
Korea	173	253
New Zealand	5	6
Ireland	62	79
United States	25	31
Australia	7	7
Portugal	62	66
Spain	40	41
Norway	72	73
OECD	23	23
Iceland	7	7
Belgium	189	181
Japan	145	135
France	59	53
EU-15	69	58
Netherlands	314	262
Finland	78	64
United Kingdom	107	86
Austria	35	27
Denmark	154	118
Switzerland	80	61
Sweden	47	34
Mexico	28	20
Turkey	17	12
Italy	44	31
Germany	88	61
Greece	58	38
Poland	48	29
Czech Rep.	99	54
Slovakia	91	36
Hungary	47	-15

Notes:

1. Soil surface nitrogen balance is the difference between the nitrogen available to an agricultural system (inputs, mainly from livestock manure and chemical fertilisers) and the uptake of nitrogen by agriculture (outputs, largely crops and forage). It includes atmospheric deposition of nitrogen, which is mainly independent from agricultural activities.
2. OECD average, excluding Luxembourg.
3. The 1995-97 average refers to 1995.
4. EU-15 average, excluding Luxembourg.
5. Including eastern and western Germany for the whole period 1985-97.
6. Data for the period 1985-92 refer to the Czech part of the former Czechoslovakia.

Source: *OECD Environmental Indicators for Agriculture, Volume 3*, 2001.

Figure 4. Pesticide use in agriculture:[1] 1990-92 to 2000-02



Tonnes of active ingredients

	1990-92	2000-02
Poland	6 507	9 366
Turkey	11 967	17 129
Greece	8 193	11 365
Portugal	12 457	15 461
Canada	33 964	41 980
Italy	69 550	79 408
Spain	36 849	39 883
EU-15	324 544	342 949
Mexico	36 000	38 037
Ireland	2 043	2 124
United States	325 226	332 181
OECD	815 484	829 019
Korea	28 097	27 838
Slovak Republic	3 694	3 596
France	95 281	92 263
New Zealand	3 490	3 368
United Kingdom	34 060	32 873
Belgium	10 246	9 386
Germany	32 629	29 248
Sweden	1 897	1 700
Japan	89 112	73 618
Finland	1 727	1 401
Austria	4 206	3 348
Switzerland	2 120	1 555
Czech Republic	6 699	4 460
Norway	912	573
Denmark	4 948	2 931
Netherlands	17 744	9 199
Hungary	18 554	6 711

Notes:
1. Some caution is required in comparing trends across countries because of differences in data definitions, coverage and time periods: for full notation, see the source below:

Data for 1990-92 average cover:

Canada: 1990
EU-15: with estimates for Greece and Portugal for 1990
Greece: 1989, 1991, 1992 average
Mexico: 1993
Portugal: 1996
Turkey: 1993-95
Slovak Republic: 1991-93.

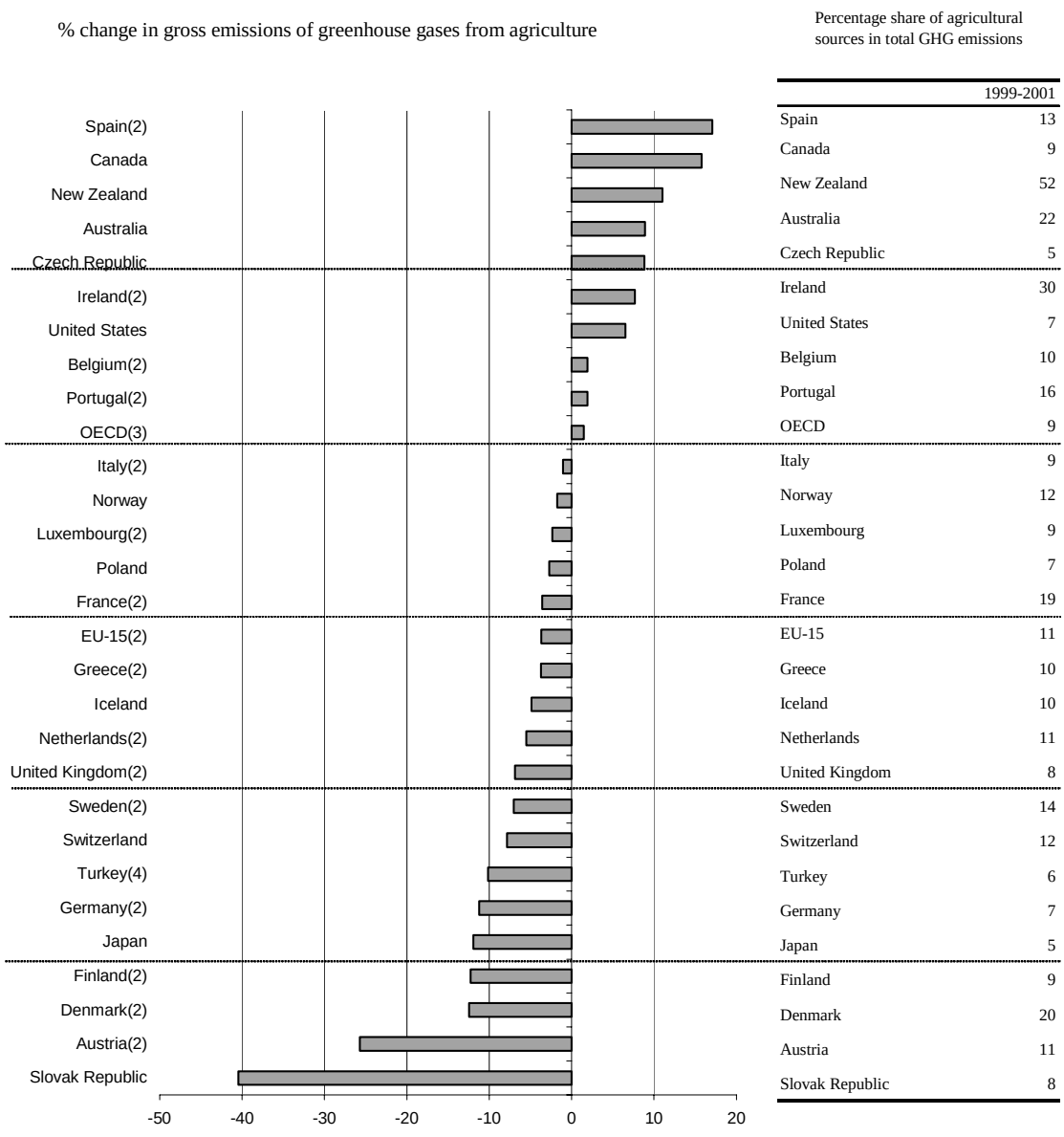
Data for 2000-02 average cover:

Belgium and Mexico: 1998-2000
Canada: 1999-2000
Ireland, Italy, Japan, Korea and Portugal: 1999-2001
Turkey: 2000-01
US: 1997-99
EU-15: 1999-2001, with estimates for Belgium for 2001
OECD: 1997-99.

2. Excluding Australia and Iceland.
3. Including Luxembourg.

Source: *OECD Environmental Data Compendium*.

Figure 5. Gross emissions of greenhouse gases from agriculture:[1] 1990-92 to 1999-2001



Notes:

1. Greenhouse gases include carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), expressed in CO_2 equivalent.
2. Data for carbon dioxide in 2001 are not available; average of 1998-2000 is used for 2001.
3. Excluding Hungary, Korea and Mexico.
4. Turkish Ministry of Environment: data available only from 1990-97.

Source: OECD Secretariat; Turkish Ministry of Environment; UNFCCC (United Nations Framework Convention on Climate Change).

Agricultural support: what are the linkages with the environment? [4]

Commodity production-linked support often exacerbates pressure on the environment.

Agricultural support policies, in particular those providing commodity production-linked support often exacerbate environmental pressures. However, these support policies are not normally implemented in isolation, as they are often accompanied with production constraints (*e.g.* production quotas and set-aside land) and other policy measures specifically designed to mitigate or enhance their environmental impacts (*e.g.* cross compliance and agri-environmental payments).

The more a policy measure stimulates increased production, the greater the pressure on the environment . . .

Ranking agricultural policy measures according to their potential relative impacts on production shows that, all other things being equal, *market price support*, *output payments* (per output unit produced) and *input subsidies* (such as those that apply to fertilisers, pesticides, water and energy) provide the greatest potential incentive to increase commodity production. A key factor determining the impacts of agricultural policies on the environment centres on their effect on raising land and other fixed asset values, which influence farm-level decision-making regarding the choice of farming practices.[5] In general, the more a policy measure provides an incentive to increase production of specific agricultural commodities, the greater is the incentive towards monoculture, intensification (greater yields), or bringing marginal (environmentally sensitive) land into production, and the higher is the pressure on the environment. On the other hand, the more a policy measure can be targeted to a specific environmental goal, the greater is its potential effectiveness in achieving that goal.

. . . but a reduction of production-linked support, together with environmentally targeted support, has eased environmental pressure.

As commodity output and input-linked measures are difficult to target to specific environmental goals, but are likely to provide incentives to farmers to increase the intensity of production and/or expand farm production on environmentally sensitive land, they tend to aggravate many of the environmental pressures in OECD countries. While commodity output and input-linked support measures can contribute to maintaining farm systems providing environmental services such as biodiversity, flood control, carbon sinks and landscape, such support is not targeted at these non-commodity outputs and their effects must be weighed against the environmental damage and other distortions in resource allocation which are also generated. Commodity output and input-linked measures have decreased since the mid-1980s, which, together with the introduction of agri-environmental measures, has reduced some of the pressures on the environment. However, commodity output and input-linked measures still accounted for three-quarters of the total OECD support to farmers in 2003. Therefore, policy measures need to be evaluated in the context of the overall economic and policy environment of the country where they are in place.

Supply controls offset some environmental pressure[6] and . . .

A notable feature of agricultural policy has been the introduction of production limits or quotas in some countries to limit the expansion of agricultural production under high price and payment support schemes in order to bring supply more closely into line with demand on the domestic market. For example, quota regimes govern the production of sugar and milk in the European Union; milk, eggs and some poultry in Canada; tobacco in the United States; and milk in Switzerland and Japan. Compulsory set-aside land is also applied with respect to support for cereals in some countries, for example, the EU. Furthermore, a number of programmes limit the quantity of a given commodity or factor of production eligible for support, as is the case with certain crop programmes in the United States, and headage-based beef and sheep premiums in the EU.

. . . production constraints limit the effects of commodity production-linked support . . .

These constraints on production have had an impact on the level and structure of agricultural production, and consequently on limiting the effects of commodity production-linked support on the environment, although they have not been introduced primarily as environmental measures. To the extent that they impose a binding limit on production they could be expected, in particular, to dampen the adverse environmental impacts of commodity production-linked support measures at the intensive and extensive margin. Where quotas have "locked-in" the regional distribution of production they have contributed to the maintenance of farming in less economically competitive areas. To the extent that farming in these areas is also considered as providing significant environmental benefits, quotas have a positive environmental impact. However, it is unlikely that the geographical distribution of quotas – implemented for production reasons – is optimal from an environmental point of view. In practice, a range of other factors tends to shape the environmental effects of such measures, and the overall environmental impacts of supply controls have been mixed.

For example, the environmental impacts of supply management schemes in agriculture often depend crucially on the activities that replace the production activities subject to restrictions. The milk quota system that was introduced in the European Union in the 1980s, for example, led to some farmers shifting to beef and sheep production in order to use their idle production capacity, with total stocking densities actually increasing in some EU member states. Similarly, the environmental effects of crop set-aside measures depend critically on how the land is used, whether idled or used for other commodities, and on the duration of idling a given area of land.

. . . but may give rise to other, unintended pressures on the environment.

Production restrictions may also create other unintended environmental pressures. For example, the imposition of milk quotas in many OECD countries led to production concentration and, together with higher milk prices, many farmers attempted to lower their production costs by reducing the number of cows and increasing milk yields per cow. This was often achieved by the increased use of

concentrated feed and a reduction of the area used for grazing animals, thereby increasing the intensity of dairy production and environmental pressures in specific localities.

The benefits to the environment of set-aside land depend on the quality of the land in question.

Land set-aside schemes generally provide farmers with the incentive to set aside their poorest-quality, least profitable land. The environmental effects of this practice tend to vary depending, among other things, on the quality of the natural resources associated with the land set aside, especially biodiversity and landscape. The environmental effects of rotational set aside can be similarly mixed.

Supply controls combined with high levels of production-linked support can lock-in certain environmental outcomes.

It is also important to note that supply control measures applied in combination with high levels of commodity production-linked support can introduce rigidities in agricultural production structures. This can impede structural adjustment, particularly where non-tradeable production rights are assigned to farmers, and can have the effect of locking-in certain environmental outcomes.

Cross-compliance indirectly targets environmental objectives through agricultural support measures,[7] . . .

Cross-compliance conditions link the receipt of agricultural budgetary payments to a requirement to meet certain environmental objectives. Farmers who choose not to comply with such requirements are not eligible for such payments. Environmental cross compliance thus limits the environmental impacts of production-linked support payments. Cross-compliance conditions are well established in the United States and Switzerland, and are becoming increasingly common in the European Union, following their introduction as a voluntary option for member countries to apply under the Common Agricultural Policy (CAP) as part of the Agenda 2000 package, and as a mandatory element in the 2003 CAP reform.

Cross-compliance conditions are seen in some countries as a means to integrate environmental objectives into agricultural budgetary payments. Although there is still a need to deepen the understanding of the linkages between such policies and their environmental effects, the main potential advantages and disadvantages of cross-compliance can be summarised as follows:

. . . allows a better harmonisation of agricultural and environmental policies, and . . .

- Cross compliance allows a better harmonisation of agricultural and environmental policies, improves compliance with existing legislation and codes of practice, and contributes to the involvement of producers who would not enrol on a voluntary basis. Cross-compliance may heighten farmer awareness of the environmental consequences of their actions, but there is no link between the level of support received and the actions undertaken.

. . . may increase public acceptance of support to farmers, . . .

- Cross compliance may increase public acceptance of support to farmers. However, cross compliance is not a policy option in the context of market price support (MPS), which encourages production intensity and is still the predominant form of agricultural support in many OECD countries. MPS applies across the board to all farmers, while cross compliance requires

support to be separable between farmers as it would not otherwise be feasible to exclude non-compliant farmers from receiving such support.

. . . but there may be a mismatch between areas under cross compliance and environmentally sensitive areas.

- The interest of farmers in applying cross-compliance conditions will vary according to the extent of their dependence on budgetary payments, and mainly affects the behaviour of farmers who depend heavily on such support. But there is no particular correlation between these farmers and those who farm the most environmentally sensitive land. Moreover, those areas not under cross compliance may be some of the most environmentally sensitive. Hence, there is likely to be a mismatch between the areas of land and farming systems over which cross-compliance is able to exert the most environmental leverage and the areas and systems over which leverage is required.

Changes in the level of support reduce the effectiveness of cross compliance, . . .

- Any change in the level of support will change the effectiveness of cross compliance. Cross compliance involves the risk of losing environmental leverage the more that commodity production-linked support is reduced. But support can also become equated with environmental compliance and payments are made for doing things that farmers should be doing anyway. And, if support is counter-cyclical, cross-compliance influence is weakest when economic incentives for environmentally damaging intensive production are strongest.[8]

. . . which does not take into account differences in compliance costs, and may involve high transaction costs.

- Where homogeneous requirements are imposed across farmers, the fact that farmers have different compliance costs is not taken into account. On the other hand, if compliance conditions were to take heterogeneous compliance costs into account, then administrative and monitoring costs would be higher. Although administrative costs may be lower than in the case of voluntary schemes, an administration may need to be set up in order to target cross compliance to the most environmentally sensitive areas; tailor management prescriptions to local circumstances; and monitor and enforce compliance – all of which may involve high transaction costs.

Agri-environmental measures: how have they developed?[9]

There is a wide range of different agri-environmental measures in place . . .

In response to the growing attention focused on the effects of agriculture on the environment, agri-environmental measures have assumed a more prominent role in agricultural policy in OECD countries in the past two decades (Box 1). OECD countries currently address environmental issues in agriculture with a plethora of sometimes overlapping measures, combining elements of direct regulation, economic instruments, education, persuasion and community involvement. The key features of the measures currently in place are that:

- emphasis is put on setting ***targets or thresholds*** especially for pesticide use, water quality, and ammonia and greenhouse gas emissions;

- ***regulations*** are often used to enforce particular farming practices (*e.g.* manure storage), supported by fines and charges for non-compliance;
- the use of ***agri-environmental payments*** varies considerably across countries as they are variously intended to contribute towards the cost of meeting regulations; ***compensate*** for income lost by adopting certain practices; and reward farmers for providing environmental services;
- the use of ***taxes and charges*** is very limited; and
- other market-based approaches, such as ***tradeable permits*** and ***voluntary community-based approaches*** are limited but of growing importance.

Box 1. Main agri-environmental measures in OECD countries

European countries and the **United States**, in particular, have substantially increased the use of ***incentive payments*** in the past decade to improve environmental quality in agriculture. Some notable trends include the growing use of payments to support the adoption of less-intensive farming practices; land retirement payments tailored to specific environmental objectives; and transitional payments to assist farmers in implementing structural changes to benefit the environment. In budgetary terms these policies are becoming increasingly significant – for example, total EU expenditure on agri-environmental payments is projected to increase by 68%, from an average of EUR 2.2 billion per annum in the 1994-99 period, to EUR 3.7 billion per annum over the 2000-06 period.

Some countries, including **Australia, Canada** and **New Zealand**, have made widespread use of ***community-based approaches*** to address environmental issues – *e.g.* through supporting collective action to solve environmental problems, variously known as landcare groups or conservation clubs. These approaches tend to take advantage of farmers' self interest in environmental conservation and make use of local expertise in solving environmental problems.

All OECD countries impose ***regulatory requirements*** to address the negative effects of agricultural activities on the environment, ranging from outright prohibitions, to standards and resource-use requirements. In many cases these requirements have been extended or developed over the past fifteen years. An increasing number of regulatory requirements derive from state, provincial, regional or local measures under the framework of national umbrella legislation, in order to accommodate the local nature of many environmental concerns.

There still appears to be only limited application of ***taxes*** and ***charges*** to directly integrate the environmental costs of agricultural activities into farmers' production decisions – particularly compared to the application of such measures in other sectors. This in part reflects the logistical difficulties of applying such measures in agriculture, but may also reflect differences in how property rights are regarded in agriculture compared to other sectors. Taxes and charges on farm inputs are, however, sometimes used. ***Tradeable rights*** do not appear to play a significant role in agri-environmental policy, although they are applied in the **Netherlands**, and on a state/regional basis in the **United States** and **Australia**.

Many OECD countries have directed greater attention towards improving the knowledge-base relating to environmental issues in agriculture through increased spending on agri-environmental ***research***, often undertaken in co-operation with the private sector. Generally, greater emphasis has also been placed on communicating information to farmers on environmental issues via ***technical assistance*** and ***extension***, in order to induce voluntary changes in farming practices and on improving environmental outcomes, including through the adoption of low input and organic farming systems.

Source: *Agricultural Policies in OECD Countries: Monitoring and Evaluation 2003* (OECD, 2003).

. . . but it is those providing payments for addressing environmental issues that have increased in many OECD countries.

Although having different objectives, many policies directly or indirectly address environmental issues in agriculture. Among these policies, those providing payments for addressing agri-environmental issues have tended to increase in many OECD countries and currently account for about 3-4% of producer support (PSE) on average in the OECD area. However, this figure does not include policy measures attaching environmental conditions to production-linked support policies (such as cross compliance), or support for general environmental services, such as research, education, training and information. In some countries, many transfers to producers are granted with multiple objectives, including the provision of environmental services, while in other countries costs to farmers of implementing environmental regulations are subsidised.

There is some evidence of environmental improvements due to agri-environmental measures.

Some studies point to evidence of environmental improvements generated by these programmes – for example, they have been variously credited in Europe and the United States with reducing soil erosion, limiting pressures from input use, constraining water pollution and overgrazing, and contributing to maintaining biodiversity and valued cultural landscapes. Nevertheless, agri-environmental measures in many OECD countries are at a relatively early stage of development. Therefore it is difficult to assess the extent to which they have provided environmental services or counteracted the negative environmental impacts of agricultural support or practices.

Payment or charge: when should farmers pay for pollution and be paid for services provided?[10]

There appears to be greater scope for full cost internalisation, . . .

There appears to be more scope for full cost internalisation to stimulate incentives to correct environmental damage and encourage innovation in pollution treatment, thus minimising long-term compliance costs. The relative absence of environmental ***taxes*** and ***charges*** and the dominance of ***incentive payments*** in OECD countries, however, suggest that farmers in some countries may have retained broad implicit or "presumptive" rights in the use of natural resources. This has implications for the level and duration of compensation to farmers for any diminution of those rights, and thus for decisions taken by farmers.

. . . but clearer definitions of property rights in agriculture are needed.

In some cases, therefore, there may be a need for the application of more clearly defined boundaries – *"property rights"* – in agriculture. This would indicate where farmers should be held liable at their own cost for environmental damage, and where they could be remunerated for providing environmental services that go beyond usual "good farming practices". Whether farmers:

- are *required to pay* depends on the extent of market failure defined by permitted pollution levels, rights to pollute granted to farmers and other sectors, and the costs of identifying polluters and controlling pollution; and whether they

- *are given* entitlement *to be paid* depends on the extent of market provision defined by the amount of environmental outputs (goods and services) remunerated through agricultural sales relative to the desired amount, and the costs of identifying providers and delivering payments.

Environmental regulations: do they hinder competition?[11]

Environmental regulations are increasingly affecting agriculture . . .

Increasingly, economy-wide environmental policies aimed at specific environmental problems (such as reducing water pollution) are having an effect on agriculture, as one of the main sectors involved in this respect. Governments are also introducing national environmental targets and thresholds, which also affect agriculture, such as those concerning ammonia and greenhouse gas emissions.

. . . but they are insufficient to explain differences in competitiveness, and . . .

Differences in environmental regulations affect relative production costs, producer competitiveness and trade patterns. Differences in production costs due to regulations should be expected to the extent that countries vary in their endowment of natural resources, pressures on those resources, and public preferences. Even if all costs from agricultural production imposed on the environment were paid by farmers, this would not eliminate the differences in those costs between countries - just as the costs of labour, land and capital also differ. Analysis of manure management regulations in the pig and dairy sectors indicates that the impact of variations in the stringency of regulations on farm costs is not sufficient to explain differences in competitiveness between OECD countries. In addition, support has in some cases been provided to partly offset the increased costs imposed by environmental regulations, which is generally not the case with labour and other regulations. Support payments to offset the cost of regulations need to be assessed in relation to the implementation of the *polluter-pays-principle* (PPP).

. . . may raise welfare by improving environmental performance.

Even if environmental regulations in some countries raise farmers' costs and are perceived to reduce competitiveness, they may raise welfare by improving environmental performance. The impact of regulation costs on farmers may also be reduced by improved management, where they encourage productivity gains and (with labelling and certification) the receipt of marketing premiums. The cost of environmental regulations imposed on different farming systems thus needs to be assessed in relation to the resulting environmental benefits. A one-size-fits-all requirement, particularly when focused on a specific farming system, may be neither environmentally effective nor economically efficient.

Trade liberalisation: good or bad for the environment?[12]

Trade liberalisation has been limited, selective and recent (since the Uruguay Round concluded in 1994), varying considerably across countries and commodities. On average, however, OECD domestic commodity prices have fallen on average from around 60% above border prices in the mid-1980s, to just over 30% in 2001-03.

Reductions in trade barriers can have both beneficial and harmful effects on the environment . . .

A reduction in trade barriers affects the environment in a number of ways, both beneficial and harmful. These impacts occur through changes in the scale of economic activities, the structure of production in countries, the mix of inputs and outputs, and production technologies. Some of the impacts are felt domestically, for example groundwater and surface-water pollution from fertiliser and pesticide run-offs, and changes in land-use that affect landscape appearance, flood protection, soil quality and biodiversity. Others occur internationally, with shifts in production across countries, trans-boundary spillovers (such as greenhouse gases), changes in international transport flows, and the potential introduction of non-native species, pests and diseases along with agricultural imports.

. . . but measuring these effects is difficult.

Measuring these various effects is a difficult task, as the wide diversity of agricultural production systems, natural conditions and regulatory approaches means that environmental impacts, both positive and negative, will vary between countries, regions and localities. The available evidence suggests that lower trade barriers will cause production to decrease in countries with historically high levels of fertiliser and pesticide application, thereby relieving environmental stresses in these areas. At the same time, output is likely to increase in countries that can accommodate an increased use of agro-chemicals relatively easily, owing to low levels of fertiliser and pesticide application. Some analytical work shows that environmental pressures at regional level may increase in these countries.

While regional differences are not such a problem for greenhouse gas emissions since here the environmental concern is global, there often exist “hot spots” caused by nutrient pollution of water, the environmental impacts of which may be many times more severe than is shown by national-level indicators. Moreover, although trade liberalisation will increase the volume of products transported between countries, and raise greenhouse gas emissions associated with transportation, such an increase is likely to be very small in comparison to emissions generated by production (at farm level), by domestic trade, or by consumption (transport from the retailer to home). Even though there has been some abandonment of farming with high environmental values, there is little evidence as to whether or not this has been due to trade liberalisation.

Benefiting from the positive environmental impacts of trade liberalisation requires that policies redress negative impacts.

If policy makers seek to reap the positive environmental impacts of trade liberalisation, while mitigating the negative ones, in general, the appropriate policies are likely to conform to those prescribed in the case of market failure generally. Where trade improves the environment through positive (or fewer negative) externalities, the benefits of further reform are clear. In the case of additional negative externalities, there will be a need for policy measures that redress these impacts. In general, this is likely to involve correcting the externality at source, for example by taxing or regulating production practices

rather than by erecting trade barriers or halting their reduction. In the case of global public goods (*e.g.* biodiversity or climate change) national policies may need to be complemented by international environmental agreements.

Agri-environmental policies: how effective and efficient are they?[13]

Evaluating the environmental effectiveness and economic efficiency of policies is complex.

Evaluating the environmental effectiveness and economic efficiency of agri-environmental measures is a complex exercise. Compared to the analysis of more conventional agricultural policies (which is undertaken mainly in terms of the effects of price support and input subsidies on production, prices and trade), analysis of agri-environmental policies is difficult in terms of understanding the links between agriculture and the environment and in quantifying the influence of policies. Nevertheless, a growing number of OECD countries have recently set in place evaluation frameworks and procedures, drawing on advances that have been made in environmental monitoring in agriculture, including the development of agri-environmental indicators. These evaluations should advance the understanding of the cost-effectiveness of agri-environmental policies, and thus potentially identify good policy practice.

Policies need to be targeted at clear objectives.

Experience shows that the effectiveness of agri-environmental policies tends to be greater when the environmental objectives are clearly specified and the actions required by farmers are closely targeted to the objectives, which may include tailoring measures to the localised nature of many environmental concerns. Effectiveness also tends to be enhanced when farmer compliance is closely monitored and assessed, and training and advice are provided to ensure that farmers are sufficiently informed about the best ways to implement measures. In practice, however, the transaction costs of implementing agri-environmental policies – given the often localised nature of environmental issues in agriculture – can limit the extent to which many of these conditions can be fulfilled.

A lack of policy coherence in some OECD countries . . .

A lack of ***policy coherence*** can be found in a number of OECD countries where agri-environmental policy measures and agricultural support measures can be seen as pulling in opposite directions. It is notable that countries with relatively low levels of production-linked support are those that tend to rely more on market-related and co-operative approaches. On the other hand, many of the countries that make the most pronounced use of agri-environmental payments also tend to have relatively high levels of market price support and other output-linked payments. The coexistence of such policies can make the attainment of environmental objectives less certain and generate costs that would not otherwise exist. It follows that the reform of agricultural policies would assist the achievement of economic and environmental objectives, and would contribute to improve policy coherence.

. . . means there is a need for improved co-ordination on the part of the authorities involved in agri-environmental policy, and . . .

Another key element of improving policy coherence and efficiency is the need for appropriate ***co-ordination*** within and between government authorities and other institutions involved in agri-environmental policy, in order to ensure a comprehensive response to environmental needs, and to avoid the duplication of effort and waste. Moreover, the increasing interest of farmers in the integrity of eco-system services draws particular attention to the importance of ***information***, ***advice*** and ***training*** for improving the efficiency of any action addressing environmental issues in agriculture.

. . . a role for information, advice and training to assist farmers in identifying environmental concerns.

Most farmers fully understand how to manage the soil, water and biological resources at their disposal in order to maximise commodity output, at least in the short term. But they can often be unaware of the long-term consequences of current farming practices on these resources, or of the alternatives available. Building on farmers' interest in environmental stewardship by making sound advice and information available can help overcome resistance to necessary changes and ultimately minimise the need for more costly agri-environmental policy measures. A further benefit of providing information in this way is that farmers are assisted in identifying emerging trends in consumer concerns relating to the environment, and thus encouraged to develop new market opportunities.

Which mix of policy measures and market approaches is optimal?[14]

Environmental objectives need to be compatible with other policy objectives.

There is a need to ensure the compatibility of environmental objectives with policies that have economic, social, trade and other domestic and international objectives. Defining the rights and responsibilities of farmers *vis-à-vis* the rest of society is crucial in order to determine who pays for fulfilling environmental objectives. The ***attribution of property rights*** that define the desired level of environmental performance to be achieved through the internalisation of both environmental costs and benefits has important implications for the distribution of income and wealth and for equity. Such attribution is also crucial in allowing markets to play a greater role in arriving at the desired environmental outcomes.

Policy reform should enable market signals to determine more efficient uses of scarce resources.

Policy reform (in particular, the reduction or removal of commodity production-linked support) should enable market signals to determine a more efficient use of scarce resources and help improve environmental outcomes where it reduces production and environmental pressures. With policy reform, comparative advantage can be expected to lead to a different geographical distribution of production. It can also stimulate a different but more efficient pattern of specialisation and intensification of agriculture together with changes in the scale of production units and adoption of technologies, with follow-on environmental effects.

In many cases, reform can be expected to reduce incentives for fertiliser and pesticide use, pressures to convert environmentally vulnerable land to farm production, and other stresses such as irrigation water withdrawals. But, as previously noted, there are also concerns in some countries about possible harmful environmental consequences of agricultural trade liberalisation through increased trade of agricultural products.

A major problem is to identify, quantify and value the demand for environmental outputs.

In the absence of well-functioning markets of environmental outputs, a major problem concerns the identification, quantification and valuation of the demand for such outputs. The supply of such outputs, whether jointly produced with agricultural products or not, will be forthcoming if farmers (and others) receive the appropriate signals. The transmission of such signals is often complicated or distorted by the existence of varying forms and levels of agricultural support. In general, market-based approaches (tradeable permits and rights, pricing environmental services) and voluntary co-operative systems are most common in OECD countries with the lowest support.

Policies need to complement, not work against, the market.

The ***market*** is increasingly demanding farm goods that satisfy private environmental performance guidelines, through contracts between retailers and farmers, and public or private certification and labelling schemes (*e.g.* for organic products, or low-input farm systems). The challenge is to explore how far environmental outputs associated with agriculture can be remunerated through markets and quasi markets (*e.g.* trusts, clubs, local payment for local provision), rather than budgetary payments at national level. Experience has shown that policies to support organic production, for example, can impede market signals, and affect trade competitiveness (Box 2). Policies need to complement, not work against, the market.

Box 2. Organic agriculture

Organic agriculture is expanding in all OECD countries to meet increasing consumer demand, although it still only accounts for a relatively small share of agricultural production and food consumption. It is no longer limited to those farmers for whom organic production is part of an holistic life-style, and who sell through specialist outlets, but has extended into the mainstream of the agri-food chain as an economic opportunity to satisfy a niche market at premium prices. Organic farming is generally more environmentally friendly than conventional agriculture but may require more land in some countries to provide the same amount of food and often requires more labour in place of purchased fertilisers, pesticides and animal health care products.

In most OECD countries, organic farming information, standards, certification and labelling are in place or being developed by the organic sector and governments, intended to aid consumer choice. But the proliferation of labels and standards can confuse consumers, and differences between schemes can impede international trade. In most countries, market forces largely drive the development of the organic sector but a number of governments, mostly in Europe, offer financial incentives to farmers to convert to, and continue in, organic production on the basis that some environmental benefits are not captured in the market. Such incentives are higher than would otherwise be the case where existing support to agriculture raises the cost of entry into organic production. There has also been some shift in publicly financed agricultural research towards organic systems, while in a few countries procurement policies feature the purchase of organic food by public institutions.

Source: *Organic Agriculture: Sustainability, Markets and Policies* – Washington, D.C. Workshop (OECD, 2003).

What future direction for agri-environmental policies?[15]

Agri-environmental policy will continue to remain an important issue in many OECD countries.

There seems to be little doubt that agri-environmental policy will continue to remain important in many OECD countries. In the **United States,** the *2002 Farm Security and Rural Investment (FSRI) Act* provides for an 80% increase in funding for agri-environmental purposes over six years, while a feature of the **European Union**'s *2003 CAP Reform* is the strengthening of funding for *Rural Development* measures – including agri-environmental programmes – over the 2006-12 period. In 2002, **Australia** launched a number a new agri-environmental strategies, including a *National Market-Based Instruments Pilot Programme* to investigate the application of market-based instruments in addressing environmental issues, while **Canada's** recently agreed *Agriculture Policy Framework* features a range of new environmental policy initiatives.

Agri-environmental policy measures currently implemented in OECD countries have in general been introduced in response to domestic, regional or local environmental issues. But international pressures also look likely to exert a growing influence over agri-environmental policy in the future. These pressures include commitments relating to a range of international environmental agreements to address trans-boundary environmental issues, such the *1997 Kyoto Protocol,* which specifies greenhouse gas emission targets for 2008-12, and the *Convention on Biological Diversity*, which requires signatory countries to develop national strategies for the conservation and sustainable use of biological diversity.

Farmers need appropriate policy and market signals so that environmental costs and benefits can be taken into account.

The effects of agricultural policy reform on the environment in a given country will vary depending on a wide range of factors, such as the overall policy framework (including environmental regulations); the international competitiveness of its agricultural sector; technological change and the nature of factor and product markets; and production alternatives such as those illustrated by the growing interest in developing agricultural biomass markets (Box 3). Reform itself cannot be expected to stimulate all the environmental amenities demanded by society, or to sufficiently reduce environmental harm. Where agricultural producers do not have appropriate incentives to take all the environmental costs and benefits to society of farm activities into account in their decisions, further action is needed.

There is unlikely to be a general "one-size-fits-all" formula for dealing with environmental concerns.

There is unlikely to be a general "one-size-fits-all" formula for dealing with environmental concerns and achieving an optimal mix of policy and market approaches across OECD countries. The first step is to remove policy measures that raise pressure on the environment. There will still be an on-going role for policies addressing environmental issues in agriculture, including an appropriate ***regulatory framework***, ***information-based strategies*** and ***economic instruments***. In justifying policy intervention it will be imperative to establish, firstly, that markets alone cannot deliver the

environmental outcomes required; secondly, that intervention would promote rather hinder their achievement, while enhancing economic welfare as a whole; and, thirdly, that the policy mix is the most cost-effective of the available intervention options.

Box 3. Agricultural biomass: potential for bio-energy and bio-materials

The 21st century could see a switch from the fossil-fuel to the biological-based economy. The projected prices of fossil fuels over the next 30 to 50 years may continue to ensure the dominance of the fossil-fuel economy. However, the price of bioplastics is already competitive with petroleum-based plastics at the top end of the market, and some biofuels, such as ethanol, are easier to exploit for their market potential than fuel cells.

Across OECD and many developing countries there is growing interest, from both governments and the private sector, in expanding markets for bioproducts from agricultural biomass. Such interest is associated with concerns for: reducing greenhouse gas emissions; encouraging greater energy supply diversification and security; enhancing environmental benefits, for example biodiversity conservation; and fostering a range of socio-economic opportunities, such as diversifying and maintaining rural incomes and employment.

A policy strategy for biomass that focuses on demand rather than supply means a switch in current emphasis from using agricultural policies, to other policy tools and market approaches. Instead of simply closing the gap between production cost and market price, such policies would be targeted at: lowering set-up costs, encouraging innovation, reducing technology costs, and providing large-scale test facilities. Codes of best practice could ensure that carbon savings are delivered and wider environmental benefits are maximised.

Source: Biomass and Agriculture: Sustainability, Markets and Policies – Vienna Workshop (OECD, 2004).

What are the main policy conclusions from the OECD work on agriculture and the environment?

The cost of protecting the environment would be lower in the absence of production-linked support measures.

The main ***policy conclusion*** from the work thus far in the JWP is that improving the environmental performance of agriculture in many countries involves costs that would be lower in the absence of commodity production-linked support measures. In other words, it is not sufficient to show that policies have been effective in achieving a desired environmental outcome; it is also necessary to evaluate the economic costs and benefits of such achievement, and demonstrate which combination of policies and market actions would achieve the same or better environmental outcome at lower cost. The choice of policies or market actions should ultimately depend on their combined contribution to the environmental, social and economic dimensions of sustainable development.

There is a need to deepen the analysis of policy linkages with environmental performance.

In this respect, there is a need to deepen the understanding, measurement and analysis of the cause-effect linkages between policies and environmental performance; to examine the experiences in OECD countries in order to analyse the mix of policies and market approaches that would be most cost-effective; and to identify the policy implications from possible future pressures on natural resources, especially land and water. These are the areas on which OECD work on agriculture and the environment is now focused.

The challenge is to identify and understand the complex linkages between all factors shaping agri-environmental outcomes, and . . .

Such work involves a number of challenges in identifying and analysing the complex linkages between the multitude of factors (*e.g.* market developments, policies and other exogenous factors such as natural conditions and climatic events) shaping agri-environmental outcomes. Agriculture is also characterised by the heterogeneity of the natural resource base and production systems used by farmers, with often site-specific environmental outcomes. Disentangling the specific influence of policies on environmental outcomes raises problems of identification and measurement, including the predominance of dispersed, non-point source pollution in agriculture and often lengthy delays in the appearance and disappearance of environmental outcomes.

. . . to improve the measurement of environmental indicators.

This work requires improving the measurement of environmental indicators in order to relate environmental performance to the characteristics of different policy measures. These issues need to be taken into consideration in the design and implementation of policies and are not insurmountable, but need further development and refinement of the conceptual and analytical framework, and improvements in the information and data currently available.

NOTES

1. Summarised results of the work in the JWP can be found in *Agriculture and the Environment: Issues and Policies* (1998) and *Improving the Environmental Performance of Agriculture: Policy Options and Market Approaches* (2001).

2. OECD reports [22] and [24].

3. OECD reports [11] and [19].

4. OECD report [46].

5. OECD report [44].

6. OECD reports [41], [42] and [48].

7. OECD report [42].

8. For example, when market prices are high, converting wetlands or ploughing-up highly erodible land is economically more attractive for farmers, while there is less leverage from cross compliance, as support is very low or nil in such circumstances.

9. OECD reports [25] and [47].

10. OECD report [24].

11. OECD reports [40], [41] and [45].

12. OECD reports [40], [41] and [45].

13. OECD reports [25], [46] and [47].

14. OECD reports [9] and [24].

15. OECD reports [25] and [47].

JOINT WORKING PARTY PUBLICATIONS

The following publications present the results of the work in the JWP on agriculture and the environment, which can also be accessed through the website: www.oecd.org/topic/.

Sustainable Agriculture and Resource Issues

[1] *Sustainable Agriculture – Concepts, Issues and Policies in OECD Countries*, 1995.

[2] *Sustainable Management of Water in Agriculture: Issues and Policies – The Athens Workshop*, 1998.

[3] *A Policy Decision-making Framework for Devising Implementation Strategies for Good Agricultural and Environmental Policy Practice*, 2000.

[4] *Information Note on the Use and Potential of Biomass Energy in OECD Countries*, 2000.

[5] *Agricultural Practices to Reduce Greenhouse Gas Emissions: Overview and Results of Survey Instrument*, 2001.

[6] *Analytical Report on Sustainable Development (chapter on "Sustainable Agriculture")*, 2001.

[7] *Adopting Technologies for Sustainable Farming Systems* – Wageningen Workshop, 2001.

[8] *Biomass and Agriculture: Sustainability, Markets and Policies* – Vienna Workshop, 2004.

Indicators

[9] *Environmental Indicators for Agriculture Volume 1: Concepts and Framework*, 1997.

[10] *Environmental Indicators for Agriculture Volume 2: Issues and Design* – York Workshop, 1999.

[11] *Environmental Indicators for Agriculture Volume 3: Methods and Results*, 2001.

[12] *OECD National Soil Surface Nitrogen Balances: Preliminary Estimates 1985-1997*, 2001.

[13] *Agriculture and Biodiversity: Developing Indicators for Policy Analysis* – Zurich Workshop, 2003.

[14] *Agricultural Impacts on Landscapes: Developing Indicators for Policy Analysis* – Oslo Workshop, 2003.

[15] *Soil Organic Carbon and Agriculture: Developing Indicators for Policy Analysis* – Ottawa Workshop, 2003.

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