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## Joint Working Party on Agriculture and the Environment

# SUSTAINABLE MANAGEMENT OF WATER QUALITY IN AGRICULTURE: DRAFT ANNOTATED OUTLINE

**7-9 December 2009**
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*This document is submitted for DISCUSSION and GUIDANCE under item 7a) of the draft Agenda of the 29th session of the Joint Working Party on Agriculture and the Environment, which will be held from 7 to 9 December 2009.*

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## NOTE BY THE SECRETARIAT

The attached document builds on the draft outline *Sustainable Management of Water Quality in Agriculture* [COM/TAD/CA/ENV/EPOC(2009)17], discussed at the July 2009 meeting of the Joint Working Party on Agriculture and the Environment (JWP).

The *Draft Summary Record* [COM/TAD/CA/ENV/EPOC/M(2009)44] of the July, 2009 JWP meeting notes that "the JWP welcomed the outline, but views diverged between Delegations as to the *scope* of the report, some considering it should focus only on emerging water quality issues (e.g. pathogens in water), while others wanted to see a broader coverage of nutrients, pesticides and other agricultural pollutants. Concerning the *structure*, a number of Delegations emphasised the need to consider: the use of market based instruments to address pollution in agriculture; the costs of action and inaction to control water pollution; and the need to explore the synergies with JWP work on climate change. The proposal to use a *questionnaire* to collect relevant information for the report also received mixed views, although if a questionnaire is developed it would need to be highly focused and practical. Many Delegations offered to provide relevant *country case studies*, but it was agreed it would be useful if these were prepared using a similar format, to be circulated by the Secretariat. Some Delegations also offered to provide names of experts to prepare reports, while the Committee of Fisheries will provide some funding for a consultant report on managing agricultural pollutant run-offs in inland coastal waters."

This document provides an annotated description of the *Main Report* (the *Executive Summary* will be provided to the June 2010 JWP meeting). At the end of each section, where relevant, an indication is provided ('NOTE TO DELEGATIONS') of how it will be further developed for the next version of the Report, together with suggestions from Delegations (received up to 27 November 2009) and proposals by the OECD Secretariat for country case studies that would further enrich the report.

***Delegations are invited to discuss and provide guidance on the structure and content of the annotated draft outline, in particular, indicating where they are likely to provide country case study material to enrich the report.***

# SUSTAINABLE MANAGEMENT OF WATER QUALITY IN AGRICULTURE: DRAFT ANNOTATED OUTLINE

## Background to the Report, Summary Outline, and List of Consultant Reports

1. This draft annotated outline draws on the discussion at the July, 2009 JWP meeting, written comments provided by some Delegations, and research of the literature by the OECD Secretariat. A key objective of the Report is to bring together recent country experiences where policies and market based approaches have had success in lowering agricultural water pollution. OECD country case study analysis of implemented policies can further illuminate the challenges to achieving successful policy implementation and pollution abatement toward sustainable management of water quality in agriculture.

2. A summary of the ***Draft Outline*** is as follows:

- *Executive Summary*: Highlights (to be provided at the June 2010 JWP).
- *Main Report*: to include the following sections:

I. Agriculture and water quality: Scope and linkages.

II. Recent trends and the outlook for agriculture's impact on water quality.

III. Climate change and variability, agriculture and water quality linkages.

IV. The monetary value of the effects of agriculture on water quality.

V. Enhancing water quality in agriculture: Applying the Polluter Pays Principle.

VI. Using taxes and regulatory instruments for water pollution abatement in agriculture.

VII. The role of payments for water quality improvements in agriculture.

VIII. Use of market based approaches to address agricultural water quality issues.

IX. Enhancing farmer stewardship to improve water quality management.

X. Overall assessment and policy conclusions.

3. C***onsultant reports*** which will contribute to the study are listed below, with a brief outline of their content provided in respective Boxes in the text of this document. The complete consultant reports will be made available to the JWP for discussion at the June 2010 meeting, including reports covering:

i. *Managing agricultural pollution of aquaculture in inland waters and coastal areas* -- Professor Robert James Diaz, School of Marine Science, Virginia Institute of Marine Science, College of William and Mary, Virginia, United States (Box 2).

ii. *The policy challenges from environmental and health risks associated with micro and new agricultural water pollutants* – Dr. Alistair Boxall, Environment Department, University of York, York, United Kingdom (Box 3).

iii. *The application of the polluter pays principle (PPP) to agricultural water pollution* -- James Sinner, Sustainable Business Group Manager, Cawthorn Institute, New Zealand (Box 4).

iv. *Water quality trading in agriculture* -- James S. Shortle, Distinguished Professor of Agricultural and Environmental Economics, Department of Agricultural Economics and Rural Sociology, Director, Environment and Natural Resources Institute, The Pennsylvania State University, United States (Box 5).

## I. Agriculture and water quality: Scope and linkages

4. The report examines OECD countries progress with policies and market approaches to address issues related to water quality in agriculture. This policy experience is drawn on to outline a number of policy options and market initiatives that could further contribute to ameliorating the impact of agriculture on water quality. Despite broadly varying situations across water catchments and between countries, agricultural water pollution is an increasing focus of attention for all OECD countries due to the:

- reduction in pollution from industrial and municipal sources has been more rapid than for agriculture making the sector the largest contributor to pollution of water bodies in many cases;
- need to reduce the monetary costs for drinking water companies and water consumers of removing agricultural pollutants from water and improving water quality for environmental purposes;
- concern with the rising budgetary costs that many OECD countries entail in policy programmes and measures that seek to monitor, manage and mitigate water pollution from agriculture;
- greater public awareness that agriculture can bring benefits by improving water quality in rivers, lakes and marine waters, impacting on recreation, aesthetic values and fishing (leisure and commercial) associated with these water bodies;
- uncertainty over the impacts of water pollutants derived from farming that are in general poorly monitored or where the science is weak (e.g. pathogens, salts, heavy metals); and the,
- potential risks associated with the linkages between climate change, increased climate variability, water quality and agriculture.

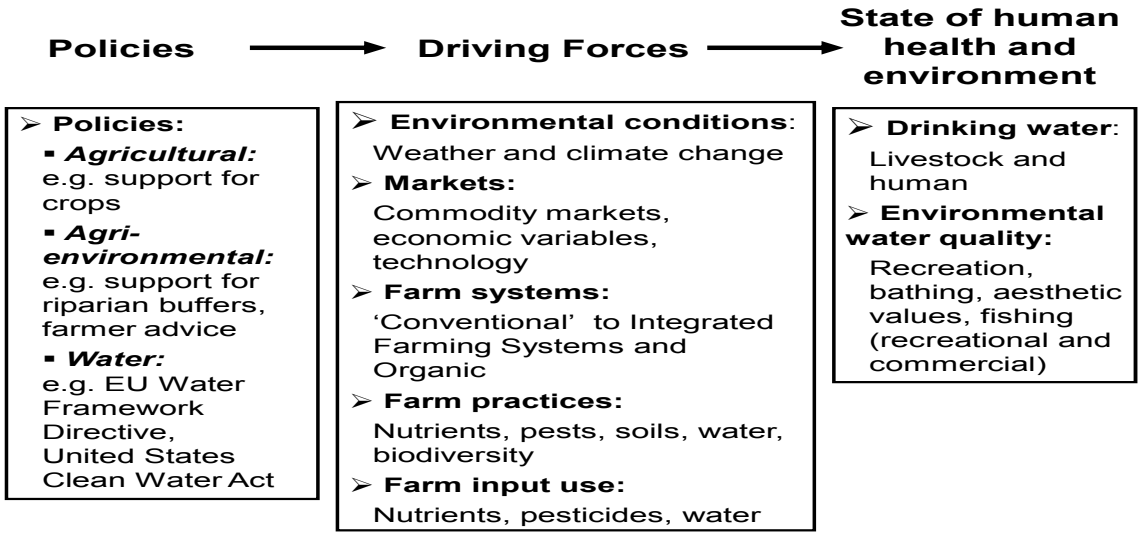
5. Agriculture's impact on the quality of surface water, groundwater and marine waters relates to the contamination of drinking water, and harmful effects on ecosystems and costs for recreational activities (*e.g.* swimming), cultural values (e.g. waterscapes) and commercial fisheries in both fresh and marine waters. Agriculture can also, under certain farming practices and systems, generate benefits for water quality through providing a water purification function.

6. The impact of farming practices on water quality can be significant as a 'non-point' source of pollution (e.g. from spreading fertilisers and manure on fields), especially as industrial and urban sources of 'point pollution' are declining in most cases. But some agricultural 'point pollution' sources are also of concern, such as intensive livestock operations. Nutrients (i.e. nitrogen and phosphorus), pesticides, soil sediments, salts and pathogens are the main agricultural pollutants transmitted to water bodies, through soil run-off and leaching, but also discharges from livestock operations and irrigation systems.

7. Policies, agricultural driving forces (environmental conditions, markets, farm systems, practices and input use) and the state of the environment and human health related to agricultural water quality are linked (Figure 1). ***Sections I to IV examine the driving forces and state of the environment*** linked to agriculture and water quality and: explores (*Section II*) recent trends and outlook for agriculture's impact on water quality; discusses (*Section III*) climate change and variability, agriculture and water linkages; and provides estimates (*Section IV*) of the monetary value of agriculture's impact on water quality.

8. ***Sections V to IX review OECD country policy responses and market approaches*** to improving the state of water bodies impacted by agriculture, with an examination of: (*Section V*) applying the polluter pays principle in agriculture; (*Section VI*) the use of pollution taxes and regulatory instruments for water pollution abatement in agriculture; (*Section VII*) the role of payments for water quality improvement in agriculture; (*Section VIII*) use of market based approaches to address agricultural water quality issues; (*Section IX*) enhancing farmer stewardship to improve water quality management. The final *Section X* provides the overall assessment and policy conclusions of the Report.

**Figure 1. Linkages between policies, markets, environmental conditions, driving forces and the state of the environment and human health**




*Source*: OECD Secretariat, 2009.

## II. Recent trends and the outlook for agriculture's impact on water quality

### *II.i. Recent trends: Agricultural driving forces impacting on water quality*

9. The overall pressure of agriculture on water quality in rivers, lakes, groundwater and coastal waters has eased since the early 1990s due to the ***decline in nutrient surpluses and pesticide use*** for most OECD countries.

10. A growing number of OECD farmers are adopting environmental ***farm management practices*** (EFMPs), as a result of voluntary private led initiatives intended to respond to consumer concerns, including those from food processors and retailers (*e.g.* pesticide management) and government incentives provided through payments and regulations. But only around a third to a half of OECD Member countries are regularly monitoring changes in environmental farm management practices, with the notable exception of organic management where all countries are tracking trends in organic farming.

11. The adoption of improved nutrient management practices (NMPs) is widespread across OECD countries, with an increase in their uptake over the period 1990-2004, for around half of the OECD countries monitoring NMP. The countries with a high and increasing uptake of NMPs have usually experienced a reduction in nutrient surpluses (**Belgium, Czech Republic, Denmark, Finland, Germany, the Netherlands, Norway, Sweden, Switzerland**), but for countries where nutrient surpluses have risen or are well above the OECD average (in terms of kg nutrients per hectare of farmland) (**Canada, Ireland, Japan, Korea and New Zealand**), NMP adoption rates are generally lower, although increasing in **Canada** and **Korea**.

12. Despite the increase in adoption of environmental integrated pest management practices (IPM), the level of uptake across OECD countries is modest, although only about a third of OECD countries track IPM. But countries with a high IPM uptake or growth in organic farming have also experienced a decrease in pesticide use (**Austria, Czech Republic, Denmark, Finland, Germany, Norway, Sweden, Switzerland, United Kingdom and the United States**).

13. The area of farm land under improved soil management practices (SMPs) has remained stable over the past decade, but only a third of OECD countries monitor changes in SMP. Where the rate of SMP adoption has risen (**Canada, United States**), this has led to reduced soil erosion risks and eased the flow of sediments into water bodies, although where SMP uptake rates are low, soil degradation problems remain (**Hungary, Italy, Korea, Slovak Republic and Turkey**).

14. The OECD area under certified organic farming has increased substantially between the early 1990s to 2004, even so it accounted for less than 2% of total farmland by 2002-04. However, the share is higher in most European countries (around 6% or higher in **Austria, Denmark, Finland, Italy, Sweden and Switzerland**) but much lower in mainly non-European OECD countries (under 1% in **Canada, Japan, Korea, Mexico, New Zealand and the United States)**.

### *II.ii. Recent trends: Agriculture's impact on the state of water bodies*

*Surface water*

15. Nearly a half of OECD countries record that nutrient and pesticide concentrations in surface water monitoring sites in agricultural areas exceed national drinking water limits for nutrients and pesticides. But the share of monitoring sites of rivers and lakes that exceed recommended national limits or guidelines for environment and recreational uses is much higher, with agriculture a major cause of this pollution in many cases.

*Groundwater*

16. With respect to groundwater (shallow wells and deep aquifers), agriculture is now the major and growing source of pollution across many OECD countries, especially from nutrients and pesticides, although evidence of groundwater pollution is limited. This is a particular concern for countries where groundwater provides a major share of drinking water supplies for both human and livestock populations, and also as natural recovery rates from pollution can take many decades, in particular, for deep aquifers. There is also some evidence of increasing pollution of groundwater from pesticides despite lower use in many cases, largely explained by the long delays pesticides can take to leach through soils into aquifers.

**Box 1. Difficulties of monitoring agriculture's impact on water quality**

Most OECD countries have monitoring networks to measure the actual state of water pollution of water bodies, while some countries use risk indicators which provide estimates, usually based on models of contamination levels. However, monitoring of agricultural pollution of water bodies is more limited with just over a third of OECD Member countries monitoring nutrient pollution and even fewer countries tracking pesticide pollution. Certain farm pollutants are recorded in more detail and with greater frequency (*e.g.* nutrients, pesticides), whereas an indication of the overall OECD situation for water pollution from pathogens, salts and other agricultural pollutants is unclear. Moreover, pollution levels can vary greatly between countries and regions depending mainly on soil and crop types, agro-ecological conditions, climate, farm management practices, and policy.

The limitations to identifying trends in water pollution originating from agriculture are in attributing the share of agriculture in total contamination and identifying areas vulnerable to agricultural water pollution. In addition, differences in methods of data collection and national drinking and environmental water standards hinder comparative assessments, while monitoring agricultural water pollution is poorly developed, especially for pesticides, in a number of countries, such as **Australia, Italy, Japan, and New Zealand**. The extent of agricultural groundwater pollution is generally less well documented than is the case for surface water, largely due to the costs involved in sampling groundwater, and because most pollutants take a longer time to leach through soils into aquifers.

*Source*: OECD (2008).

*Marine water*

17. Estuarine and coastal agricultural nutrient pollution is also an issue in some regions causing algal blooms (*i.e.* "red tides" or "dead zones"), damaging marine life, including commercial fisheries in coastal waters adjacent to **Australia, Japan, Korea, the United States**, and **Europe**, mainly the Baltic, North Sea, and Mediterranean. This is evident in the widespread problem of eutrophication reported in surface water across OECD countries, and the damage to aquatic organisms from pesticides.

18. One example of coastal pollution from agricultural activities is the ***Australian Great Barrier Reef*** (GBR). Water quality entering the GBR has declined affecting about 25% of its area, partly as a result of farm pollutants, although phosphorus run-off from urban sewerage is also a problem. The dry tropical regions in Queensland are the main source of these pollutants, although some farmers are adopting practices to reduce pollution. While evidence of adverse impacts on the GBR from pollutants is not conclusive, research suggests the need for caution for any activities leading to elevated pollution levels.

**Box 2. Managing agricultural pollution of aquaculture in inland waters and coastal areas**

This consultant report will::

1. outline key trends and future projects of agricultural pollution on aquaculture of inland waters and coastal water across mainly OECD countries (e.g. algal blooms in the **Gulf of Mexico, Baltic Sea, Mediterranean,** and of the coasts of **Australia, Japan and Korea**);
2. describe current management and policy practices to address the problem;
3. discuss the key issues in terms of the economic implications of agricultural pollution for aquaculture;
4. examine management options (illustrated by examples of best practices); and,
5. outline the future possible policy actions and challenges.

*Source*: OECD Secretariat based on a consultant report by Professor Robert James Diaz, School of Marine Science, Virginia Institute of Marine Science, College of William and Mary, Virginia, United States.

### *II.iii. Medium term outlook for agriculture and water linkages*

19. Despite the significant impact of the global financial crisis and economic downturn on all sectors of the economy, agriculture is expected to be relatively better off, as a result of the recent period of relatively high incomes and a relatively income inelastic demand for food. The *OECD-FAO Agricultural Outlook* projections (OECD, 2009a) over the next 10 years to 2018 paint a picture of sustained crop prices in nominal and even in real terms (allowing for inflation) that remain well above the levels observed prior to the 2007-08 price peaks*, i.e.* during the 1997-2006 period. Most livestock prices, in contrast, are expected to remain close to the average levels for the next 10 years in real terms (OECD, 2009a).

20. Overall these OECD medium term projections for agricultural production would suggest the following consequences for water quality across mainly OECD countries:

i. Pressures that could lead toward deterioration in water quality as a result of agricultural activities include:

- increasing global demand for food leading to growing production levels and intensities in OECD agricultural exporting countries;
- higher international agricultural commodity prices, including growth in demand for agricultural feedstocks to produce bioenergy, also leading to further expansion in farm production; and the,
- the growing challenge for water quality of pollution from new pollutants from agricultural activities (the consultant's report described in Box 3 would provide an input here).

ii. Changes that might lead to an improvement in water quality resulting from agricultural activities, include:

- improvements in farm management and related technologies, especially biotechnologies and use of global positioning systems (GPS);
- increase in public pressure to reduce the health and environmental costs of water pollution from agriculture; and,
- some decline in overall OECD agricultural support but increasing trend toward decoupled support.

**Box 3. The policy challenges from environmental and health risks associated with micro and new agricultural water pollutants**

The consultant's report will review those micro pollutants − (inorganic (e.g. metals) and organic (pharmaceuticals and veterinary products used in livestock farming), endocrine disrupters and pathogens arising from agricultural activities (and use of recycled effluent in agriculture) − which run-off/leach into water bodies (rivers, lakes, groundwater and marine waters) and for which scientific research, monitoring data in water bodies and policy responses are relatively underdeveloped in comparison to addressing nutrient and most pesticide pollution from agriculture.

The report will address the following questions:

1. What is the scope and definition of new and emerging water pollutants from agricultural activities?
2. What are the known concentrations of these pollutants from agriculture found in water bodies, together with an explanation of the current scientific difficulties of trying to monitor and know of these pollutants?
3. What are the known environmental and human health risks (or know impacts) associated with these pollutants, including any estimates of the monetary costs of the risks (impacts) to drinking water companies and the environment (water bodies).
4. What are the rates of export of these pollutants from agriculture to water bodies and how are they usually transported to water, e.g. leaching, sediment flows, run-off, aerial, etc. (i.e. transport and time lags).
5. What are the likely future trends for these pollutants from agriculture, especially in view on the expected impacts of climate change over the next 10-30 years on the transport, fate, and exposure to these pollutants?
6. How do current management strategies reduce delivery of these pollutants to water bodies (e.g. riparian buffers, constructed wetlands, catch crops, etc)?
7. What are existing policy responses to these pollutants (if any) and what are the future challenges for policy makers in reducing the risks of these pollutants?

*Source*: OECD Secretariat based on a consultant report by Alastair Boxall, Environment Department, University of York, York, United Kingdom.

21. **NOTE TO DELEGATIONS**: Section II will be revised, updated and draw from: the OECD Agri-environmental Indicators work (OECD, 2008); the OECD-FAO Agricultural Outlook (2009a); review of recent literature, especially by drawing on recent country assessments; and the Consultant Reports described in Boxes 2 and 3. Delegations are also invited to provide any material that could enrich this section (e.g. ***Australia*** has offered a study on *Great Barrier Reef Water Quality Report****;*** ***Finland*** has offered a study on *The economics of the State of the Baltic Sea).*

## III. Climate change and variability, agriculture and water quality linkages

22. Much research has been undertake to examine the implications and linkages between climate change, water availability and seasonality, and agriculture. There is also a considerable body of research that examines the environmental and economic consequences of agricultural pollution of water bodies.

However, insufficient research has been undertaken to examine the linkages between climate change, agriculture and water quality.

23. Changes in climate and climate variability that affect the profitability of agriculture will in turn lead to changes in locations of crop and livestock production, and technologies and management practices used to produce individual crops and livestock (Abler *et al.*, 2001). These economic responses to climate change could lead to indirect consequences in changing pollutant run-off and leaching rates as well as soil erosion rates, which may increase or diminish pollution from agriculture assuming no economic or policy response. More recent research suggests that overall climate change could increase environmental and human exposure to agricultural contaminants, but the magnitude of the impacts will be highly dependent on the contaminant type. Risks from pathogens might be highest, although they could be managed for the most part by targeted research and policy responses (Boxall *et al.*, 2009; Delpha *et al.*, 2009; Ficklin *et al.*, 2009; Jennings *et al.*, 2009).

24. **NOTE TO DELEGATIONS:** The Secretariat will undertake a review of relevant literature to complete Section III, drawing on the consultant studies described in Boxes 2 and 3, as well as any country case study material provided by Delegations. **Finland** has offered a study on *Climate change adaptation tools for environmental risk mitigation of acid sulphate soils*. This Section will also contribute to the OECD *Roadmap for Climate Change* [COM/TAD/CA/ENV/EPOC(2009)52].

## IV. The monetary value of the effects of agriculture on water quality

25. The economic cost of agricultural water pollution is high in many countries. Treating water to remove nutrients and pesticides to ensure water supplies meet drinking standards can be significant for water treatment companies, and ultimately paid for by consumers. Eutrophication of fresh and marine waters can also imposes high economic costs on ecosystems and commercial fisheries where it occurs. In the ***United States***, for example, 75% of freshwater bodies exceed safe environmental thresholds for total nitrogen and phosphorus imposing a cost of around USD 2.2 billion annually (Dodds *et al.*, 2009). To date there are no systematic cross country estimates of the economic costs of agricultural pollution, however, some studies are available which give partial insights into the costs that agricultural water pollution imposes on society and the environment.

26. The cost of reducing agricultural nutrient pollution in ***Denmark*** has been considerable and led to a sharp increase in the price of water for household users. The overall cost under the government's second *Action Plan for the Aquatic Environment* (APAE II, 1998-2003) of which farmers have paid 60% of the costs, was estimated at Danish Kroner's (DKK) 525 (USD 65) million or DKK 15 (USD 2) per kg of avoided nitrogen leaching annually, achieved through changing management practices and changes in land use such as forest and wetland development.

27. In the ***Netherlands*** water pollution originating from agriculture is an important environmental concern. While recent trends indicate that the pressure from farming on water quality is diminishing, absolute levels of pollution remain amongst the highest across the OECD. Agriculture is the major source of nutrients, pesticides and the only known source of heavy metals in water. The potential impact of pollution from endocrine disrupters and veterinary medicines on human and wildlife reproductive systems is also a concern. The total external costs of agricultural water pollution is unknown, but in the late 1990s the annual external costs of eutrophication associated with nitrate emissions was estimated at EUR 600 (USD 540) million, and for treating drinking water polluted with nitrates estimated at EUR 23 (USD 21) million.

28. The ***United Kingdom*** has undertaken research on estimating the economic costs and benefits of agriculture on the economy and environment (e.g. EFTEC and IEEP, 2004, Jacobs Report, 2008). UK

agriculture is a major source of water pollution. As urban and industrial water pollution is largely controlled, diffuse pollution, is becoming comparatively more important especially farm run-off of nitrates, phosphorus, pesticides and pathogens, mainly of agricultural origin and concentrated in England. The overall cost of water pollution from agriculture was estimated in 2003/04 at around GBP 500 (EUR 725) million annually contributing over 40% of total water pollution costs. Nearly half of the prosecutions for pollution by the agricultural sector in 2002-03 were related to water pollution incidents, mainly from the dairy sector. Almost 5% of Sites of Special Scientific Interest (e.g. bogs, upland heath) in England in 2005 were in an unfavourable condition because of agricultural water pollution.

29. **NOTE TO DELEGATIONS**: The country examples in Section IV are drawn from OECD (2008), but the Secretariat plans to undertake a literature review to provide further examples of the monetary value of the impact of agriculture on water quality, plus draw on any country case studies offered by Delegations. ***Finland*** has offered a case study on *Impacts of changes in water quality on recreation behaviour and benefits in Finland.*

## V. Enhancing water quality in agriculture: Applying the Polluter Pays Principle

30. Application of the PPP in agriculture, such as by using a pollution tax, may provide the most efficient and effective economic and environmental outcomes. But application of the PPP in agriculture is difficult, mainly because nonpoint emissions from agriculture into water bodies cannot be measured at reasonable cost with current monitoring technologies (this does not apply to point sources of pollution in agriculture), and also due to property right and institutional barriers.

31. **NOTE TO DELEGATIONS:** This section will draw heavily from the Consultant Report described in Box 4, but could also be supplemented by country case material where Delegations feel they could enrich the text on this subject.

**Box 4. The application of the polluter pays principle (PPP) to agricultural water pollution**

This consultant paper is addressing the following questions, illustrated, where possible, by country examples:

1. To what extent is the PPP implemented in OECD countries?
2. What are main explanations for failure to implement the PPP: for example, market failure, government failure; institutional and property right barriers, measurement of non-point pollution?
3. To what extent may improved policy design with respect to the PPP increase its feasibility?
4. How can we identify what situations are appropriate for use of the PPP?
5. Is the PPP a valid tool for agricultural policy?

*Source*: OECD Secretariat, based on a consultant report to be prepared by James Sinner, Sustainable Business Group Manager, Cawthorn Institute, New Zealand.

## VI. Using taxes and regulatory policy instruments for water pollution abatement in agriculture

### *VI.i. Using regulatory policy instruments to control agricultural water pollution*

32. Regulatory policy instruments are commonly used in OECD countries to address water pollution from agriculture. The regulations concerned are those on the use of potentially polluting inputs such as pesticides, industrial fertilisers and manure (storage, management and field application) and land management measures to prevent the polluting agents from reaching surface water and/or groundwater. Since the 1980s there has been a growing use of regulatory measures to protect surface water and groundwater, in particular the following (OECD, 2009b):

i. *Overall input regulations.* An important aim in all OECD countries is to reduce pollution generated by the use of agricultural input, in part, by using regulations concerning the marketing and sale of chemical inputs, especially pesticides. Regulations have typically been amended over time such that many countries now approve new pesticides for a limited period only (commonly five to ten years). Some requirements relating to inputs have been implemented in response to international pressures – for example, the reduction of run-off of nutrients into the **Baltic Sea** under the Convention to Protect the Baltic Sea (HELCOM Convention).

ii. *Pesticide regulations.* All OECD countries set regulations concerning the storage, and application of pesticides. The aerial spraying of pesticides is now prohibited in some parts of the **European Union and Australia**. It is heavily controlled in many other regions and countries, with licences or permits commonly required. In many OECD countries, the use of pesticides is now restricted within a certain distance of watercourses. In the **European Union**, a process is underway to enhance the adoption of integrated pest management.

iii. *Nutrient regulations.* While regulations prohibiting the direct discharge of livestock waste to surface waters have existed in most OECD countries from the early 1970s, a large number of regulations have since been applied in relation to general farming practices associated with pollution from nutrients. In particular, OECD countries have introduced a variety of requirements relating to manure management in order to limit pollution from livestock farming, including restrictions on the quantity of manure that can be spread; seasonal bans on manure application; manure storage requirements; and limitations on livestock densities and on the expansion of livestock units. Many OECD countries have also tightened regulatory requirements relating to the application of nutrients, either at the national or state/regional level.

iv. *Regulations concerning the scale of production.* In some OECD countries large-scale livestock production units are controlled through a system of permits, either at the national or regional level. For example, the **European Union** *Integrated Pollution Prevention and Control Directive*, which has been applied since 1999 to new facilities (and to existing facilities since 2007), requires member states to impose emission limits in environmental permits which are mandatory for potentially polluting plants of a given scale, especially large scale pig and poultry facilities. In **Japan**, under the *Water Pollution Control Law* and other associated legislation, upper limits are set for discharges of pollution for specified agricultural facilities, including large-scale pig and cattle facilities. In the **United States** concentrated animal feeding operations are the only agricultural sources covered by the Federal Clean Water Act.

v. *Regulations with regard to buffer strips and catch crops*. Buffer strips around water courses and groundwater sources have become a common requirement to limit nitrogen leaching in many OECD countries, including **Australia, Canada, France and New Zealand**. Some governments have also established regulations requiring farmers to maintain a minimum level of green cover during certain times of the year (catch crops). Requirements for catch crops are notably stringent in **Denmark** and some parts of **Sweden**.

### *VI.ii. Applying taxes to control agricultural water pollution*

33. Policy measures imposing a tax or charge relating to pollution or environmental degradation include taxes and charges on farm inputs or outputs that are a potential source of environmental damage. The implementation of taxes and charges is rare in agriculture, compared to other sectors. This may at least partly reflect practical problems of measurement, unlike a factory where pollution can normally be monitored at "point", the pollution from agriculture is much more dispersed, as it tends to originate from many different independent farms and in varying intensities.

34. Nonetheless, some examples of these policy measures do exist, including the ***Netherlands*** which has tackled the measurement problem by introducing a range of levies on off-farm nutrient emissions above a set limit. Since 2006, the system directly regulates the maximum amount of fertilizers (animal manure plus maximum amounts of nitrate and phosphate) that may be used on the farm. Similar taxes on the estimated on-farm generation of nutrients over set levels are also in place in ***Belgium***.

35. In agriculture, environmental taxes are more often applied on the sale of inputs identified as having a potentially adverse impact on the environment. For example, various taxes and charges are currently levied on pesticides in ***Canada (British Columbia), Denmark, Italy, Norway and Sweden***, while fertilizer levies are applied in ***Italy, Sweden*** and some states of the ***United States***. Input-based taxes are generally inexpensive to administer, but may be less effective than a tax on pollution itself, as they do not discriminate on the basis of actual loading on the environment.

36. **NOTE TO DELEGATIONS:** Section VI draws from OECD (2009b) but will also be updated from any country material offered on the use of regulatory instruments and taxes to control agricultural water pollution, as well as drawing on the OECD *Agri-environmental policy inventory* (http://www2.oecd.org/agr-envdbo/index.asp) and the OECD/EEA database on instruments used for environmental policy and natural resources management (www.oecd.org/env/policies/database). A number of case studies that could be included under this section include the ***EU's Water Framework Directive*** and new initiatives (2009) announced by the ***United States*** to reduce agriculture's (and other sources of pollution) impact on water quality in the Mississippi River Basin/Gulf of Mexico and the Chesapeake Bay.

## VII. The role of payments for water quality improvements in agriculture

37. Agricultural policy reforms in OECD countries have seen a shift toward more decoupled support, including agri-environmental measures. There has been a substantial increase across most OECD countries in the use of agri-environmental payments to achieve environmental objectives in agriculture.

38. Payments to farmers are widely used across OECD countries to control water pollution and encourage the reduction in other polluting emissions (e.g. ammonia), together with payments to promote environmental benefits. The most common form of payments to control water pollution are for agricultural production conditional upon reduced use (or no use) of pesticides and fertilisers (such as extensive production, integrated production, organic farming), green cover and buffer strips.

39. The ***EU Nitrate Directive***, for example, defines areas vulnerable to nitrates in its member states, and sets guidelines to establish the maximum permitted level of nitrates in water. Moreover, the action programmes developed to implement the Directive, establish the necessary measures to ensure that nitrogen of animal origin spread on the land (manure fertilisation) does not exceed 170 kg per hectare. It also makes it mandatory for farmers to ensure that fertiliser use is well balanced to supply the needs of crops.

40. **EU** member states have designed and implemented some agri-environmental measures to further reduce nitrogen losses in water that go beyond the statutory obligations. Reduced use of fertilisers, converting arable land to extensive grassland (pasture), green cover and crop rotation are the main instruments implemented by member states to reduce nitrates in water. In addition, the *EU Water Framework Directive* imposes the objective of achieving good water status by 2015.

41. **NOTE TO DELEGATIONS:** Section VII draws from OECD (2009b) but will also be updated from any country material offered on payments to improve water quality related to agriculture, as well as drawing on the OECD *Agri-environmental policy inventory* (http://www2.oecd.org/agr-envdbo/index.asp). A number of case studies that could be included under this section include the ***EU's Water Framework***

***Directive*** and new initiatives (2009) announced by the ***United States*** to reduce agriculture's (and other sources of pollution) impact on water quality in the Mississippi River Basin/Gulf of Mexico and Chesapeake Bay.

## VIII. Use of market based approaches to address agricultural water quality issues

42. Some countries are refining, developing and introducing market based approaches for water pollution, but little evaluation of their economic efficiency and environmental effectiveness has been undertaken. Moreover, clearer identification and enforcement of property rights is required if water market approaches are to be developed.

43. Well defined and enforceable property rights are the cornerstone of democratic and economic systems in all OECD countries, with most water rights relating to a right to use water or allow discharges into water, both of which provide the foundations of a water trading system. But limits are usually imposed on this right (*e.g.* drawing water or discharging waste into water bodies), and some countries are now engaged in the process of separating water entitlements from land title rights.

44. Tradable permits for regulating environmental externalities can often achieve environmental targets at lower social cost than traditional design and performance standards and environmental taxes. Trading offers a mechanism for achieving a cost-effective allocation of environmental effort across alternative sources without environmental regulators knowing the abatement costs of individual agents. To date, however, few countries have utilised this policy instrument to address water pollution in agriculture.

45. Water quality trading markets are complex because there is plenty of uncertainty about sources and levels of emissions, about effectiveness of different abatement measures and water quality impacts of effluents originating from different sources. When developing a water quality trading market, the policy maker has to first define the tradable commodity for nonpoint polluters (e.g. fertilizer use reduction or establishment of buffer strips and green set-asides).

46. A trading ratio has to be determined that takes into account delivery of pollutants and imperfect substitution between point and nonpoint emissions (on the basis of relative uncertainty related to reduction of emissions from these two sources). Finally the aggregate supply of permits has to be limited (capped) so that water quality targets are met.

47. **NOTE TO DELEGATIONS: S**ection VIII will draw from the OECD report *Guidelines for the design and implementation of cost-effective agri-environmental policy measures* [COM/TAD/CA/ENV/EPOC(2008)20/REV2] and the Consultant Report summarised in Box 5, but could also be supplemented by country case material where countries feel they could enrich the text on this subject. **Australia** has offered a number of case studies on using market based instruments for water quality improvement in relation to the Great Barrier Reef catchments and agriculture. **Finland** has also offered a study on *Developing and testing a competitive bidding system for agricultural water protection and nature conservation*. The **United States** might also form a useful case study with a number of state programmes initiated across the country (see for example, National Research Council, 2008, pp179-183).

**Box 5. Water quality trading in agriculture**

This consultant report seeks to address the following questions:

1. What is water quality trading (WQT) and why explore it as a policy tool to address water pollution from agriculture?
2. What are the basic economics of water quality trading?
3. What are the parameters necessary to ensure the successful implementation of water quality trading in agriculture?
4. For which agricultural pollutants can WQT be applied, e.g. nutrients, pesticides, pathogens, etc
5. What has been the experience of WQT initiatives and pollutant coverage across countries?
6. What appear to be the main policy and market failures (obstacles) to the more widespread adoption of WQT to address agricultural water pollution by OECD countries?
7. What are the future challenges for policy makers to ensure greater use of WQT or should we address agricultural water pollution with different policy instruments?
8. Is WQT too complex a policy instrument to use by governments or can this instrument be designed to overcome these obstacles?

*Source*: OECD Secretariat based on the consultant report to be prepared by James S. Shortle, Distinguished Professor of Agricultural and Environmental Economics, Department of Agricultural Economics and Rural Sociology, Director, Environment and Natural Resources Institute, The Pennsylvania State University, United States.

## IX. Enhancing farmer stewardship to improve water quality management

48. A highly desirable and low cost solution to lowering pollution of water bodies by agriculture is to control pollutants at source on-farm. Many OECD countries have a long experience in using policy instruments to improve farm stewardship that can help reduce farm run-off and leaching of water pollutants, such as research and development programmes, technical assistance and farm advisory services, and in some countries community based measures.

49. There is growing interest in making a greater effort to further develop policy options and market approaches that can alter farmer behaviour and management practices and systems to improve water quality. This is being driven not only by government concerned with the increasing budgetary costs of some agri-environmental measures, but the demand by farmers to reduce the growing regulatory burden of water control measures on agriculture, and by water companies that lower agricultural water pollution would result in capital and operational savings (Barnes *et al.*, 2009; Dowd *et al.*, 2008; Kay *et al.*, 2009).

50. The growing emphasis on farmer stewardship is also associated with the interest to manage water pollution at the catchment scale and to develop greater involvement of farmers and other stakeholders in water pollution decision-making and mitigation strategies, which can also bring co-benefits in terms of achieving other environmental objectives. For example, the development of riparian buffers on-farm can help to limit pollutant run-off but can also provide other co-benefits in terms of wildlife habitats and carbon sequestration by establishing green cover (Aillery *et al.*, 2005; Blackstock *et al.*, 2009; Qiu *et al.*, 2009).

51. **NOTE TO DELEGATIONS**: Section IX will rely on a review of the literature as well as any material offered by Delegations. **Australia** has offered country case study material for this section and also **Finland** have offered a study on communication and training events to help give farmers current up-to-date information on water protection. This section could also draw on elements in the JWP report *Farmer behaviour and management practices in relation to mitigation and adaptation* [COM/TAD/CA/ENV/EPOC/RD(2009)59].

## *X.* Overall assessment and policy conclusions

52. The previous sections will have discussed the policy experiences that OECD countries have encountered in attempting to limit agricultural water pollution. This final section explores: the impediments to achieving water quality goals in agriculture, including institutional and property right issues; which policy instruments, policy mixes and market based approaches are most likely to achieve water quality objectives at least cost given current information constraints; under which situations policy approaches should be employed; and the additional information necessary for decision makers to improve the environmental effectiveness and economic efficiency of policies and market approaches.

53. Policy responses to address water quality issues in agriculture need to be part of a policy package that also encompasses water resource (quantity) issues and a range of policy instruments, institutional reforms and broader community engagement. Water policies and institutions need to focus on the public good (*e.g.* maintaining aquatic ecosystems) and market failure aspects of water quality (*e.g.* pollution), by facilitating stakeholder involvement, developing information (data) and knowledge (science), and enabling public access to this information. Moreover, given the vulnerability of agricultural systems and water quality to climate change and climate variability, policies will need to be increasingly responsive and flexible in adapting to these changes.

54. Water management in agriculture is evolving toward a more holistic and integrated approach rather than just focusing on water quality. Consequently there is increasing integration of land use with water use management decisions to both help conserve water and enhance water quality, but also to promote the potential of agriculture to provide multiple environmental benefits and services. The main focus and developments in OECD policies addressing agricultural water pollution can be summarised as follows:

i. Policy focus has largely addressed nutrient (nitrogen and phosphorus) and pesticide pollution, with less emphasis on other pollutants.

ii. A mix of policy instruments are usually used to address water pollution, but the use of payments and regulatory instruments dominate, followed by farmer education and advice.

iii. Most programmes providing payments intended to help reduce pollution are on a voluntary basis, but in more highly polluted zones programmes tend to be mandatory.

iv. There are often infringements and poor enforcement of regulatory measures to control water pollution related to agriculture.

v. Application of the polluter-pays-principle to water pollution in agriculture has proved elusive, although taxes on pollution have been used in some countries

vi. Use of market based instruments, for example nutrient trading, to address pollution has been very limited but interest is growing across OECD countries.

55. Further effort is required if policy makers and other stakeholders, ranging from farmers at the watershed level through to national levels, are to move toward the sustainable management of water quality in agriculture.

56. **NOTE TO DELEGATIONS**: Section X which summarises the Report and outlines a set of policy conclusions, will also provide the input for the *Executive Summary*.

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