Water Quality and Agriculture: Meeting the Policy Challenge

Key Messages and Executive Summary

OECD

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Water Quality and Agriculture: Meeting the Policy Challenge

Key Messages

Executive Summary

Background Reports

Background reports supporting the 2012 OECD study, *Water Quality and Agriculture: Meeting the Policy Challenge*, are listed below. They are available, along with the main report, at *www.oecd.org/agriculture/water:*

New and Emerging Water Pollutants arising from Agriculture
Alistair B.A. Boxall,
Environment Department, University of York, United Kingdom

Agriculture's Impact on Aquaculture: Hypoxia and Eutrophication in Marine Waters
Robert Díaz,
Institute of Marine Sciences, United States
Nancy N. Rabalais,
Louisana Universites Marine Consortium, United States and
Denise L. Breitburg,
Smithsonian Environmental Research Center, United States

(This paper has also been published in OECD (2010), *Advancing the Aquaculture Agenda: Workshop Proceedings.*)

Agriculture and Water Quality: Monetary Costs and Benefits across OECD Countries
Andrew Moxey,
Pareto Consulting, Edinburgh, Scotland, United Kingdom,
assisted by Eva Panagiotopoulou,
Department of Agricultural Economics and Rural Development, Agricultural University of Athens, Greece

Water Quality Trading in Agriculture
James Shortle,
Environmental and Natural Resources Institute, Penn State University, United States.

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The key challenges for policy makers in addressing water quality issues in agriculture are to reduce farm contaminant lost into water systems while encourage agriculture to generate or conserve a range of benefits associated with water systems (e.g. recreational use). Water pollutants from agriculture include runoff and leaching into water systems from nutrients, pesticides, soil sediments, and other contaminants (e.g. veterinary products).

The impact of agriculture on water quality is either stable or deteriorating, with few cases where significant improvements are reported across OECD from the mid-2000s to 2010. While the current situation varies within and across OECD countries, agriculture is often the main source of water pollution. Achieving further reductions is a challenge for policy makers, especially as a major part of agricultural water pollution is from diffuse sources.

The overall economic, environmental and social costs of water pollution caused by agriculture across OECD countries are likely to exceed billions of dollars annually. No satisfactory estimate of these costs exists, but the scale of damage to water as a result of agriculture needs to be placed in perspective. For most countries drinking water quality is high with limited health risks and agriculture is only one source of pollution.

The outlook over the next ten years for agriculture and water quality suggests that the growth and intensification of agricultural production could further heighten regional pressures on water systems in some countries. Moreover, the task of achieving water quality objectives in agriculture will become more difficult as a result of climate change.

Over many years policies to address agricultural water pollution across OECD countries have cost taxpayers billions of dollars annually. Policy responses have typically used a mix of economic incentives (taxes and subsidies), environmental regulations (prohibition and specific rules backed by penalties) and farm advice and education (information), but this has had mixed results in lowering agricultural pressure on water systems.

Policies have generally fallen short of requirements to meet water quality policy goals in agriculture based on the report's assessment of recent OECD country experiences. This report provides recommendations which countries could consider to move toward the sustainable management of water quality in agriculture, including:

- ***Use a mix of policy instruments to address water pollution.*** A mix of policy instruments to address water quality issues in agriculture is likely to outperform a single policy instrument, like a pollution tax. There is also increasing use of innovative policy tools, such as water quality trading and agreements between water supply utilities and farmers to reduce pollution and water treatment costs. An increasing emphasis of policies is in changing the behaviour of farmers, the agro-food chain and other stakeholders to improve water quality.

- ***Enforce compliance with existing water quality regulations and standards.*** Inefficiencies and failures in enforcing water pollution regulations is an issue in specific cases. Stricter enforcement of regulations can assist in meeting the Polluter-Pays-Principle, and also lower the burden on government budgetary resources compared to some other policy instruments to address water quality issues.

- ***Remove perverse support in agriculture to lower pressure on water systems.*** Policies that raise producer prices or subsidise input use, encourage farmers to increase production and use more inputs than would be the case in the absence of this support. Some 50% (2008-10) of total OECD agricultural producer support provides incentives to produce and/or use variable inputs, although compares to 85% in 1986-88.

- ***Take into account the Polluter-Pays-Principle to reduce agricultural water pollution.*** Encouraging farmers to internalise their environmental costs through implementation of the Polluter-Pays-Principle (PPP) can bring economic and environmental benefits. But application of the PPP in agriculture is not widespread mainly because diffuse source pollution cannot currently be measured at reasonable cost

- ***Set realistic water quality targets and standards for agriculture.*** Targets can help track progress towards water quality goals in agriculture, but need to be realistic, easily measurable and have a clear time frame.

- ***Improve the spatial targeting of policies to areas where water pollution is most acute.*** Spatial targeting within a water system can have a positive impact on water quality, such as differentiation by livestock density or by farms generating the most pollution in a catchment.

- ***Assess the cost effectiveness of different policy options to address water quality in agriculture.*** It is necessary to consider producer abatement costs and programme monitoring and enforcement costs, compared to the benefits generated by a given policy in terms of improving water quality.

- ***Take a holistic approach to agricultural pollution policies.*** Taking a more holistic view of agricultural pollution policy design can help to avoid adverse environmental effects and encourage co-benefits. For example, the development of riparian buffers which can limit pollutant farm runoff can also provide other benefits in terms of wildlife habitats and carbon sequestration by establishing green cover.

- ***Establish information systems to support farmers, water managers and policy makers.*** Policy makers need considerable technical and socio-economic information about the likely impact (science), costs (financial) and farmer reactions (social) to a given policy change to address water quality. Improving information systems is also critical in supporting farm advisory services to raise awareness of water quality management in agriculture, as typically in many OECD countries farmer awareness that they might be a cause of water pollution is low.

EXECUTIVE SUMMARY

Challenges for agriculture and policy makers in addressing water quality issues

A major challenge for agriculture is to produce more food, feed, fuel and fibre, to meet growing global demand. Agricultural production also generates effects external to markets, both positive, conserving a wetland, and negative, such as water pollution. As there are no markets for these externalities, although they can provide a great benefit or impose a high cost on society, there is little incentive for farmers to internalise the costs of these external production effects, other than the farmer's own motivation to do so.

The key challenges for policy makers in addressing water quality issues in agriculture are to reduce farm contaminant lost into water systems (negative externalities) while encourage agriculture to generate or conserve a range of benefits associated with water systems (positive externalities). Clean water is vital in securing economic benefits for agriculture and other sectors, meeting human health needs, maintaining viable ecosystems, and providing societal benefits, such as the recreational, visual amenity, and cultural values society attaches to water systems.

Improving water quality is consistently ranked as a top environmental concern in public opinion surveys across most OECD countries. Over decades, policy actions and major investment in OECD countries have helped to drastically reduce water pollution from urban centres, industry and sewage treatment works, with substantial gains for the economy, human health, environment and social values linked to water. In the light of this success focus has now switched in many countries to addressing agricultural water pollution. This is because agricultural water pollution principally originates from farms spread across the landscape (diffuse source pollution), as opposed to more spatially confined sources, such as urban centres and sewage treatment works (point source pollution). But agriculture is also a point source of water pollution, for example, from intensive livestock farms and the disposal of residual pesticides.

Designing policies to control diffuse source agricultural pollution is more complicated than addressing point sources of pollution, because they are: usually invisible due to low concentrations taking diffuse, indirect and often complex pathways into water systems; commonly extremely difficult and costly to measure; generally cumulative in their impact on water systems due to effects of runoff and leaching from large areas; highly variable in space and time because of influences outside of farmers' control, such as the weather and different soils; and, frequently require co-operation and agreement across sub-national jurisdictions (sub-catchments and catchments) and national borders.

Overall trends and outlook for agriculture and water quality in OECD countries

Water pollutants from agriculture include runoff and leaching into water systems from using and disposing of nutrients (inorganic fertilisers and livestock manure) and pesticides, soil sediments, and other contaminants (e.g. veterinary products). These pollutants can lead to the: harm of aquatic ecosystems; damage to commercial freshwater and marine fisheries as well as farms and other industries; reduction of social values associated with water systems, such as swimming and waterscapes; and impair human health through contaminated drinking and bathing water, although this is less of a concern for most OECD countries.

The impact of agriculture on water quality is either stable or deteriorating, with few cases where significant improvements are reported, according to a review of OECD country studies from the mid-2000s to 2010. This marks a change from an earlier period, 1990 to the mid-2000s, when an OECD study concluded there was an overall slight reduction in agricultural pressure on water systems. While the current situation varies both within and across OECD countries, agriculture is often the main source of water pollution. As absolute pollutant levels remain high in many areas, achieving further reductions is a challenge for policy makers, especially as a major part of agricultural water pollution is from diffuse sources. But point source agriculture pollution is increasing in some locations, largely from intensive livestock farms.

There has been an overall increase in the uptake of farm management practices and systems beneficial to water quality, to a large extent encouraged by recent policy changes across many OECD countries. This is mainly because of the effort to decouple farm support from production and the strengthening of agri-environmental programmes with a positive effect on water quality, both in terms of the numbers of farmers and the agriculture land area covered under these programmes.

The disconnect between modest changes in the state of water quality linked to agriculture but higher adoption rates of farm practices and systems beneficial to water quality, can be explained, in part, by time lags and rising commodity prices. A time lag is the period elapsed between adoption of management changes by farmers and the detection of improvement in the quality of a specific water system. This can take from hours to decades depending on the site and type of pollutant. Also recent rises in agricultural commodity prices, projected by OECD/FAO to continue over the next ten years, may have slowed or even reversed the upward trend in adopting management practices beneficial to water quality, as farmers intensify production and/or extend production onto marginal land increasing risks of water pollution. At the same time, however, rising chemical input prices (fertilisers, pesticides) can have a counter-effect, by inducing farmers to use less of these inputs assuming no other changes in farm costs/output prices.

The overall economic, environmental and social costs of water pollution caused by agriculture across OECD countries are likely to exceed billions of dollars annually. No satisfactory estimate of these costs for all OECD countries currently exists. A comprehensive national study in the United Kingdom, however, has shown that in 2007 the annual cost of agricultural damage to water systems (pollution of freshwater, estuaries and drinking water treatment costs) was around EUR 330 million (USD 460 million).

***The scale of damage to water systems as a result of agriculture needs to be placed in perspective*.** For most OECD countries drinking water quality is high with limited health risks, but removing pollutants from drinking water supplies is costly, and in some rural areas unconnected to water networks, health concerns can be important. Also agriculture is not the only source of water contamination, but is becoming a widespread cause of eutrophication of water systems, leading to rising economic, environmental and social costs. There is also concern with emerging contaminant pollution of water from agriculture (e.g. veterinary medicines) and the effects of pollutant mixtures (e.g. pesticides and other chemicals) for human health and the environment.

The outlook over the next ten years for agriculture and water quality suggests that the growth and intensification of agricultural production in North America, Turkey, Korea, Australia and New Zealand, could further heighten regional pressures on water systems. For the EU27 the projected modest growth in agricultural production is likely to lower pressure on water systems, while for Japan this trend might be more pronounced as production could decrease, but localised water pollution "hotspots" could come under further pressure from intensive livestock farming. A number of future developments may help all countries to reduce the pressure of agriculture on water systems, including advances in technology (e.g. higher fertiliser use efficiency); improvements in farm management; and ongoing reforms of agriculture and water policies.

The future consequences of climate change for agriculture and water quality linkages are complex. The anticipated increased incidence and severity of flooding could mobilise sediment loads and associated contaminants and exacerbate impacts on water systems, while more severe droughts may reduce pollutant dilution, thereby increasing toxicity problems. But whatever the impacts on water systems, the task of achieving water quality objectives in agriculture will become more difficult in the coming years as a result of climate change, although this is a poorly understood and researched aspect of climate change science to date.

Recent actions by policy makers to address water quality issues in agriculture

Policy responses to address agricultural water pollution across OECD countries typically use a mix of economic incentives, environmental regulations and information instruments. A large range of measures are deployed at the local, catchment, through to national and transborder scales, across an array of different government agencies. Many measures to control water pollution from agriculture are voluntary. Water supply utilities and the agro-food chain are also engaged in co-operative arrangements with farmers to minimise pollution, such as providing farm advisory services.

This policy mix has had varying results in lowering agricultural pressure on water systems. Over many years these policies, according to OECD estimates, have cost taxpayers billions of dollars annually. For some countries policies to reduce agricultural water pollution have been successful, with a package of input taxes, payments and farm advice. In other cases despite substantial expenditure on efforts to lower agricultural pollution of a specific water ecosystem, little progress has been made. More recently, some private and public initiatives, for example, water quality trading in agriculture and establishing co-operative agreements to address water pollution are showing signs of success, albeit on a limited scale to date.

Policies have generally fallen short of requirements to meet water quality policy goals in agriculture based on the OECD assessment of recent country experiences. It would appear this is mainly due to: inefficiencies and failures in the development, implementation and enforcement of regulations to control agriculture pollution; increasing budgetary costs of policies that provide support to farmers to control water pollution in specific areas; frustration with the protracted time and institutional complexities to adopt new policy approaches; lack of comprehension of the scale and temporal dimensions of diffuse source agriculture water pollution; and, insufficient attention to establish a more inclusive consultation process and stakeholder involvement.

Policy recommendations in moving toward the sustainable management of water quality in agriculture

To meet the challenge of the sustainable management of water quality in agriculture requires a high level of political commitment and common vision among stakeholders. In this regard, the role of politicians is critical, as they are key players in promoting agriculture and water policy reforms, and can explain the impacts of reforms to society at large. There are often trade-offs between investing in short-term projects with an immediate effect and undertaking actions that can have a larger and longer-term impact, such as investing in research and data collection to improve decision making. Farmers and other stakeholders will also need to develop a common vision, agree shared values, and make collective decisions to manage water quality together, involving integration of all relevant stakeholders. Tradeoffs can then be initiated between different interests, openly and transparently, to move toward sustainable solutions. Based on the analysis of this report a number of recommendations are listed below, which countries could consider in their endeavour to move toward the sustainable management of water quality in agriculture.

Use a mix of policy instruments to address water pollution

A mix of policy instruments (economic incentives, regulations and information) to address water quality issues in agriculture is likely to out-perform a single policy instrument, like a pollution tax, especially where there are multiple impediments to adoption of pollution abatement practices. Each policy instrument has strengths and weaknesses that depend on the specific physical and economic context of the polluted area. The sequencing of policy instruments, starting with suasion and ending with enforcement, is likely to be as important as the policy mix and the targeting of the major polluters. Policies addressing water pollution in agriculture should also be part of an overarching national water policy framework, with all pollutants and polluters considered together, as agriculture is not the only source of water pollution.

There is increasing interest in using innovative policy tools and market approaches, because of growing difficulties in some regions to lower the pressure of agriculture on water systems by relying on the traditional mix of policies. These tools and approaches, albeit not widely used to date, mainly include: economic instruments, especially water quality trading; voluntary regulation supported by payments in some cases, such as between water supply utilities working with farmers to ensure improved water quality to reduce pollution and water treatment costs; information based instruments, like organic standards; and capacity building, such as setting environmental standards by agro-food chain companies, backed by farm advisory services, to encourage best management practices to protect water quality and meet other environmental goals.

A key focus in increasing the uptake of the policies, approaches and practices is in changing the behaviour of farmers, the agro-food chain and other stakeholders to improve water quality by: engaging different actors to address the problems of water quality from farm to water catchment level; enabling change by educating and raising the awareness of farmers and building the capacity of other stakeholders in a water catchment in the realisation of policy goals; encouraging desirable forms of behaviour and discouraging undesirable forms; and, ensuring that minimum standards of water quality are met.

Enforce compliance with existing water quality regulations and standards

Inefficiencies and failures in enforcing water pollution regulations is an issue in specific cases. While regulations are a widely used policy instrument to limit water pollution, there are cases where point sources of agricultural pollution, notably intensive livestock operations, are not covered under water pollution regulations that are applicable to all other causes of point source pollution, such as sewage works. Where non-compliance is widespread, the on-farm inspection of compliance could be improved and sanctions and penalties more effectively imposed, including the withdrawal of agri-environmental payments where applicable. Stricter enforcement of regulations can assist in meeting the Polluter-Pays-Principle, and also lower the burden on government budgetary resources compared to some other policy instruments to address water quality issues.

Remove perverse support in agriculture to lower pressure on water systems

Policies that raise producer prices or subsidise chemical input use, encourage farmers to increase production, use more inputs, and farm more fragile lands than would be the case in the absence of this support. Some 50% (2008-10) of total OECD agricultural producer support provides incentives to farmers to produce and/or use variable inputs, although this is a sharp reduction from the 85% share in 1986-88. Production and input support, fail to recognise the biophysical heterogeneity of farmed landscapes, leading to a mismatch between the capacity of the environment to absorb pollution and the intensity of agricultural production. The removal of perverse incentives in agriculture will lower pressure on water systems.

Take into account the Polluter-Pays-Principle to reduce agricultural water pollution

Encouraging farmers to internalise their environmental costs through implementation of the Polluter-Pays-Principle (PPP) can bring economic and environmental benefits. But application of the PPP in agriculture is not widespread across OECD countries mainly because: diffuse source pollution cannot be measured at reasonable cost with current monitoring technologies; there is poor enforcement of water pollution regulations in many situations; and also due to property rights, institutional and other barriers. Even so, where high levels of taxes have been applied to chemical inputs to comply with the PPP, often coupled with a mix of other policy measures, they have usually led to reductions in input use without loss of farm production or income.

Set realistic water quality targets and standards for agriculture

Targets can help track progress towards water quality goals in agriculture, but need to be realistic, easily measurable and have a clear time frame A target needs to take into account the balance between the marginal costs of adopting a farm practice or change to achieve the target and the marginal benefits of a given water quality improvement. Also water quality standards should be consistent with known biophysical responses, taking into account time lags between the introduction of a practice and measurable outcomes, as well as the difficulties of measuring and establishing the origin of agriculture diffuse source pollution.

Improve the spatial targeting of policies to areas where water pollution is most acute

Spatial targeting within a water system can have a positive impact on water quality, such as differentiation by livestock density or by farms generating the most pollution in a catchment. The spatial targeting of policies should be designed so that the specific policy instrument choice is sensitive to local conditions. Land retirement policies, for example, can be a blunt instrument to improve water quality, as they may primarily be focussed on other policy objectives, such as biodiversity conservation. They may help slow soil erosion rates, but do not require changes to management practices on other land under production that continues to contribute to water pollution. Some programmes target land under production which is not always the main source of pollution, while voluntary and farmer initiated participation may not reach the major polluters.

Assess the cost effectiveness of different policy options to address water quality in agriculture

It is necessary to consider producer abatement costs and programme monitoring and enforcement costs, compared to the benefits generated by a given policy in terms of improving water quality. Evidence from some countries shows that expenditure on reducing agricultural pollution has not been cost-effective and that incentive schemes to enhance compliance have been inadequately targeted. The cost of different policy options depends on the: specific farm practices chosen; the scale from farm to national or transborder level; and the selected policy tools. Determining the cost-effectiveness of different policy options to deliver water quality benefits, enables a more informed discussion about what can be achieved environmentally, and also about the agricultural production and environmental trade-offs in achieving those benefits.

Take a holistic approach to agricultural pollution policies

Taking a more holistic view of agricultural pollution policy design can help to avoid adverse environmental effects and encourage co-benefits. Illustrative is where a farmer to meet water quality regulations reduces the nutrient content of manure spread on fields by releasing more nitrogen from stored manure into the air as ammonia. Some policy approaches to abate water pollution can have co-benefits with other environmental goals, such as the development of riparian buffers which can limit pollutant farm runoff but provide other benefits in terms of wildlife habitats and carbon sequestration by establishing green cover.

Establish information systems to support farmers, water managers and policy makers

The linkages between agriculture and water quality are complex. Policy makers need considerable technical and socio-economic information about the likely impact (science), costs (financial) and farmer reactions (social) to a given policy change to address water quality. Estimating the economic costs and benefits from agriculture on water systems can also help in this regard, by defining the scale of different problems for farmers and policy makers and focusing policy responses. Improving knowledge and information systems is also critical in supporting farm advisory services to raise awareness of water quality management in agriculture, as typically in many OECD countries farmer awareness that they might be a cause of water pollution is low.