

**Agriculture, Trade
and the
Environment:**

The Pig Sector

SUMMARY AND CONCLUSIONS

Overview

- Pig production in OECD countries raises a number of policy challenges when viewed in terms of the economic, environmental and social dimensions of sustainable agriculture. Pigmeat accounts for nearly 40% of world meat consumption, and pigs are extremely efficient at converting feed to meat. Given the rapidly expanding global demand for meat and the projected need for a 20% increase in global food production by 2020, the pig sector will continue to play an important role in meeting this demand. At the same time, the environmental consequences of pig production are of increasing public concern, particularly regarding the management of pig manure in relation to water and air pollution. There are also human health issues, especially for those engaged in or living nearby large-scale pig operations.

Within this broader challenge, this study focuses primarily on the linkages between pig production, trade and the environment. In particular, two linkages have been explored: the impact of trade liberalisation on pig production and the environment; and the impact on competitiveness of policies introduced to reduce the negative environmental effects of pig production. Animal welfare requirements also have a significant impact on pig producers, but a review of these policies is beyond the scope of this study. Six main conclusions emerge from this study and are discussed in more detail in the following sections.

- In regions with a high concentration of pig production there is a larger risk of negative environmental effects such as water pollution *e.g.* in regions of Northern Europe, Japan and Korea, although the risk is increasing in North America, Spain and Ireland. There is evidence that some environmental pressures are becoming more “decoupled” from production in some countries.

- There has been a significant increase in the number of pigs per farm in all countries, even where total pig numbers have fallen, and evidence of greater regional concentration of production. This potentially raises the environmental risks associated with pig production. At the same time, technologies and management practices have been developed that reduce the risks, some of which are more easily adopted by large-scale operations or have been imposed by legislation.
- The level of support for pigmeat is low relative to other agricultural commodities but varies greatly between countries. Although high support levels are not a necessary condition for environmental pressure, those countries with the highest levels of pigmeat support are also those with the greatest risk of nitrogen water pollution from pig production. However, linking changes in support with changes in environmental risk is much more difficult to substantiate.
- Further trade liberalisation will strengthen the trends that are expected to occur in the market, with production growing at slower rates, if not falling, in Europe and Asia, but becoming more intensive in all countries unless legislation or consumer concerns put limits to it. Incentives for pig production are affected by changes in relative prices of meats and feeds, with trade flows also influenced by sanitary requirements.
- Environmental policies affecting pig production have focussed on water pollution and odour, and more recently on ammonia and greenhouse gas emissions. Policy measures are predominately regulatory, and are increasing in severity and complexity. Research and advisory services have also formed a crucial part of most government's policy response. Apart from payments to reduce the cost of meeting new regulations, economic instruments have been rarely used.
- Manure management regulations vary between countries but they are not significantly different. Variations in the cost of manure management regulations only partially explain differences in trade competitiveness, and environmental regulations appear to be only a minor consideration for location decisions.

Linkages between pig production and the environment

The main environmental issues associated with pig production concern water and air pollution. Water pollution arises from the inappropriate

disposal of pig manure. Nutrients in manure, principally nitrogen and phosphorous, are a significant component of pollution from agriculture to surface water, groundwater and marine waters, damaging ecosystems through eutrophication and degrading their recreational use. Water bodies can also be affected by organic effluents and pathogens contained in manure. Water pollution is more of a local or regional concern, although cross-border pollution can occur.

It is difficult to quantify the specific contribution of pig production to water pollution but an indirect measure — the OECD's soil nitrogen balance indicator — can reveal the potential risks. The OECD balance is only calculated at the national level so regional variations in nitrogen balances, which can be significant, are derived from other information sources. The actual level of pollution also depends on factors such as the soil type, climate and management practices.

Countries can be grouped into four distinct groups according to the *level* of risk as measured by the overall nitrogen balance and the importance of pig manure as a source of nitrogen. The risk is highest in certain regions of Belgium, the Czech Republic, Denmark, France, Germany, Japan, Korea, the Netherlands, Norway and Switzerland. In Australia, Italy, Mexico, Poland, Sweden and the United States the risk of nitrogen pollution from pig production is low at the national level, although studies indicate that the risk at the regional level, particularly in the United States, can be just as large as in the high-risk countries. In Ireland, other regions of France and the United Kingdom, the overall nutrient balance is high but the contribution of pigs is small. In Austria, Canada and Spain, the reverse is true.

Changes in the nitrogen balance indicator between 1985-87 and 1995-97 reveal a number of different *trends* in the potential risk of water pollution from pig production. The risk has increased in Canada, Korea, Ireland, Spain and the United States; decreased in Austria, Germany, Japan, Mexico and Switzerland; and stayed the same in Australia and Norway. For other countries the nitrogen balance has decreased but the contribution of pig to livestock nitrogen production has increased.

In some countries, the emission of ammonia from livestock housing facilities and from badly managed storage and spreading of manure are also of serious local concern. Livestock accounts for around 80% of total ammonia emissions in the OECD, with the importance of pigs as a source of emissions following a similar pattern to its contribution to livestock nitrogen manure production *i.e.* the issue is particularly serious in regions of high pig concentration in parts of northern Europe and Asia. Pig production can also be a source of greenhouse gas emissions, mainly methane and nitrous oxide, but its importance is small at less than 5% of agricultural related emissions for most

OECD countries. At the local level, odour can be a serious air pollution problem resulting from pig production in all OECD countries.

Other environmental issues relating to pig production include the genetic erosion of pig breeds; the effects of invasive wild pigs on agriculture and the environment; and in some areas, the beneficial impact of the use of free range pigs to maintain certain ecosystems. In terms of genetic diversity, there are globally 650 recorded breeds of pigs, of which 150 have become extinct. A further 164 are at risk of being lost, with OECD countries accounting for around 20% of those at risk.

Analysis of the OECD agri-environmental indicators also suggests that in some countries pig nitrogen manure and methane emissions are becoming more “decoupled” from production in the sense that the output of these environmental risk indicators per unit of pigmeat produced has fallen over time. While some care is required in interpreting these trends, improvements in productivity and the adoption of more environmentally friendly technologies and management techniques would suggest that such changes could be expected to occur.

Developments in the structure, technology and management practices of pig production

To meet growing consumer demand, world pigmeat production increased by almost 75% between 1980 and 2001. Growth has been the most rapid in China, the world’s largest producer. Within the OECD, growth has been particularly significant in Korea, Poland and the United States, and to a lesser extent in the European Union, while production fell in Japan. Trade has grown at a faster rate than production, but less than 4% of pigmeat is traded internationally (8% if intra-EU trade is included).

Along with an expansion of production, there have been significant structural changes in the pig sector. In all OECD countries, production has become more intensive, with an increase in the average number of animals kept both per pig holding and per land area of pig holdings. This is the case even in countries like Japan where overall pig numbers have decreased. In many OECD countries pig production has historically been associated with other agricultural activities that provide livestock feed, for example with grain production in the midwest United States, but has now become more specialised relying on brought in feed. Over time, pig production has become more regionally concentrated, with growth in non-traditional pig producing regions.

A major factor driving these structural changes has been technology. Improvements in production, breeding and management techniques have enabled considerable productivity gains to be made, particularly for larger

operations, thus creating an incentive to increase scale. Technologies and economies of scale have also made it possible to move the industry toward off-farm feed preparation. A major factor encouraging the development and uptake of productivity enhancing technologies has been the intense competition in the meat market and the long-term decline in real prices received by farmers, which in turn is driven by productivity improvements.

These structural changes potentially raise the environmental risks associated with pig production. A greater number of animals per farm leads to a larger volume of manure that must be disposed of. If there is less land available per pig, the quantity of nutrients supplied to the soil will increase, with potential harm to water quality. Greater regional concentration of production further exacerbates this problem. More intensive production along with deficient manure storage management also leads to an increase in air pollution, including odours and ammonia.

On the other hand, technological developments (*e.g.* in regard to housing (holding) facilities, manure storage and treatment systems, and alternative energy production units) and management practices (*e.g.* altering feed composition and manure spreading practices) are helping to ease the environmental pressures associated with pig production. Given that some of the technologies are not scale-neutral nor lead to increases in production, operations of a larger-scale have a greater potential to introduce such technologies because the cost can be spread over a larger volume of production. Other changes, such as in feed composition, can provide win-win situations for all farmers, lowering both production costs and the environmental risks. Regional changes in the location of production may also have positive environmental impacts by reducing pressure in current production areas and moving to areas where the environmental impact is not so large. For example, a move to less densely populated areas will reduce the nuisance of odour pollution or a move to areas with a greater carrying capacity due to more favourable geographic or climatic conditions will reduce the risk of water pollution.

Agricultural support policies for OECD pig producers

Like most other commodities, the level of support provided to pig producers varies across OECD countries. In countries where support is provided to pig producers, policy measures that are more output linked (*e.g.* measures such as tariffs and export subsidies) make up a significant proportion. There are clearly two main groups of OECD countries in terms of support levels for pigs. The first have very few trade intervention policies in terms of tariffs and export subsidies *e.g.* Australia, Canada, New Zealand and the United States, and consequently a very low overall level of support. The other group has relatively high tariffs *e.g.* Japan, Korea, the European Union, Norway and Switzerland,

with export subsidies also important for the European Union, and consequently higher overall levels of support. While pig producers do not benefit from budgetary payments to the same extent as other agricultural producers, including beef and sheepmeat producers, the average level of tariff protection on pigmeat is higher than for other meats.

In comparison to other commodities, support levels for pigmeat are generally lower even in countries where pigmeat support is high. Consequently, changes in support levels for other commodities are likely to influence incentives for pigmeat production. In particular, pig producers are affected by changes in support policies for cereals that are used as feed inputs. Reforms that have reduced cereal prices, for example in the European Union and North America, also lower input costs for pigmeat producers in these countries.

This pattern of support for pigmeat, in terms of the level and composition, influences production patterns and contributes to greater pressure on the environment than if they were not in place. The countries where the potential risk of nitrogen water pollution is the highest are also those with the highest level of support to pig producers *i.e.* Europe, Japan and Korea. However, high support levels are not the only factor causing environmental pressure. Negative environmental impacts of pig production are also evident in countries with low levels of support. But where support policies have over the long-term consistently provided higher producer returns, encouraging greater volumes of production, this is likely to have exerted greater pressure on the environment than if producers were responding to market signals, all other things being equal.

Agricultural support policies have also influenced location decisions. For example, in the European Union, access to cheap imported feeds as compared to the price of feed-grains produced under the CAP played a significant role in encouraging the expansion of pig production in the Netherlands. Changes to cereal support policies have encouraged shifts in the location of production in North America.

It is more difficult to connect changes in support for pigmeat with changes in environmental pressure. A number of other variables can contribute including changes in support provided to other commodities, agri-environmental measures, and market induced changes. Changes in environmental pressure need to be analysed on a case-by-case basis. The 1992 CAP reform in the European Union illustrates the complexity of the link between changes in support policies and environmental impacts. By reducing prices for EU-produced feed grains, the reform led to an increase in support provided to pigmeat producers. But a reduction in EU cereal prices also changed the relative prices of feed inputs, leading to a lower protein content in

compound feed. This in turn reduces the nutrient content of animal manure, lowering the overall potential environmental damage.

The impact of further trade liberalisation on pig production and the environment

Developments in the market alone, without further trade liberalisation, are expected to cause changes in pigmeat production, with higher than average growth in Australia, Poland and North America, slower than average growth in the European Union and Korea, and a fall in production in Japan. The competition induced pressure to lower production costs will encourage further intensification of production in all countries. Further trade liberalisation is expected to strengthen these trends in the pattern and scale of production.

The impact of further policy reform on the environment depends on the effects on production arising from changes in relative levels of support, not only between countries but also between commodities. Further reform in the pig sector alone, particularly that driven by trade liberalisation, without increases in other forms of support, would likely result in pig production increasing in countries with lower or virtually no support and decreasing in those with high levels of support. In general, the former group is more land rich than the latter group of countries. Given that many of the environmental issues involved with pig production are associated with pressure on land this would appear to be a positive development, relieving some of the pressure in high support countries if adequate spatial requirements are respected. But as a consequence of increased production, environmental pressures will increase in some areas of the countries that offer less support.

The impact of a wider reform programme affecting all commodities is much more complicated. As the level of support for pigs is generally lower than that provided to other commodities, more resources are currently transferred into the production of higher support commodities. Consequently, reductions in support for these commodities could increase the amount of resources going into pig production, even those with relatively high levels of pig support at present. In terms of relative returns from outputs, pigmeat could become a more attractive option for producers. On the input side, there will be some benefit for pig producers in countries with high price support for feed grains, as further liberalisation will lower the cost of feeds. Other pig producers purchasing on markets determined by international trade may find their feed costs increasing. Overall evidence suggests that further trade liberalisation, both a reduction in tariffs and export subsidies, will lead to a reduction in production in the more highly supported countries.

The study also showed that other factors could be as important in determining the future impact of pig production on the environment. Trade flows in pigs and pigmeat are significantly influenced by border sanitary measures and the health situation in the pig and substitute meat sectors (beef, sheep and poultry). Consequently, progress in meeting sanitary requirements, either through improved systems in the exporting countries or changes in the requirements set by importing countries, could have a large effect on patterns of trade and production, particularly for developing countries. Developments in China and the enlargement of the European Union are also likely to have an impact on trade flows and may induce changes in the location of production. Finally, consumer concerns, particularly regarding animal welfare may result in public and private sector responses that change production patterns and processes.

Policy measures addressing environmental issues in the pig sector

Agri-environmental policy measures affecting the pig sector are clearly focussed on reducing the harmful environmental impacts of pig production. The main objectives of such policy measures have been to reduce water pollution and odour. In recent years, measures have been introduced in some countries to deal with other concerns, particularly ammonia emissions. Most of the policy measures have been motivated by local or regional concerns, and are very often designed and implemented at that level. There are relatively few measures that specifically relate to pigs, with pig producers affected by wider policies aimed at the livestock sector or the agricultural sector as a whole. Some policy measures have been introduced in response to international environmental agreements and this trend is likely to continue.

In terms of policy measures, the initial response by most governments to address environmental issues in the pig sector was to impose regulations, develop research programmes and provide on-farm technical assistance and extension services to farmers. Such policy measures remain an integral part of the overall environmental strategy in most countries.

Pig producers face an array of regulations impacting on their production levels and practices. Regulations were first introduced to limit point source pollution, for example by prohibiting or limiting the direct discharge of pig manure into waters. Regulations have been steadily introduced to limit non-point source pollution, for example by regulating the quantity of manure that can be produced, the quantity that can be spread and the way in which it is spread. Overtime there has been a clear trend for the number of regulations to be increasing and to be imposing more stringent conditions on pig farmers. Environmental cross-compliance requirements have typically been imposed on

the receipt of budgetary support payments in the few countries that provide such payments to pig producers.

Economic instruments have not been as widely used. Payments have often been made to assist farmers adopt technologies or change farm structures, and are generally provided for a limited period. Taxes have only been used in a few countries but have increased in their severity. Where used they are levied on the volume of nutrients above a certain level measured at the total farm level. Tradable rights are only used in the Netherlands, and related initially to the volume of manure produced and more recently to the number of pigs kept on-farm. Support has also been provided to encourage alternative uses for pig manure, such as an energy source, in both on-farm and off-farm operations. Payments to stimulate the exit of producers from the sector have been recently introduced in a few countries to more rapidly reduce the environmental pressure of pig production.

A greater number of measures and generally of a more restrictive nature have been applied to producers in northern European countries. This perhaps reflects the relative environmental risks associated with highly concentrated pig production systems. Undoubtedly the various policy measures that have been introduced for environmental reasons since the mid-1980s have reduced the impact of support policies on the environment. An obvious question is the extent to which agri-environmental policies are fixing problems created amongst other reasons by agricultural support policies.

The effect of manure management regulations on competitiveness

Concerns have been raised about the impact of agri-environmental measures on trade competitiveness, and the resulting impact on the pattern of trade and location of production. The important issue for the pig sector is the extent to which variations in environmental regulations between countries could be having an impact on trade patterns by imposing different production costs on producers. In this study, analysis was undertaken of one aspect *i.e.*, the differences in production costs imposed by regulations concerning the storage, disposal and application of manure in five countries.

The analysis shows that costs imposed by manure management regulations are up to 50% lower in New South Wales (Australia), Korea and Iowa (United States) than in Denmark and the Netherlands. However, the additional costs are not of a scale that explains differences in competitiveness. Differences in production costs imposed by regulations should be expected to the extent that these are associated with variations in the environmental cost of pig production and are in conformity with the polluter-pays-principle (PPP). This is particularly true for those environmental effects that are of a local

nature. The environmental costs of pig production are likely to vary between countries just as labour, land and capital costs vary between countries.

Support has been provided in some countries to offset the increased costs imposed by regulations. In particular, support has often been given to reduce the level of capital expenditure required to bring production facilities into conformity with regulations. The 1974 OECD Council Act on the implementation of the PPP specifies the situations where subsidies could be offered to help polluters comply with environmental measures. One of the important specifications is that such support should not create significant distortions in international trade and investment. It is difficult to quantify whether such support in the pig sector has had a significant impact on trade. Nevertheless, the pattern of trade would be distorted to the extent that such support has kept more farmers in pig production than would have been the case had they borne the full cost of the regulations (as a proxy for the cost of pollution).

Another result of the analysis was the relationship between farm size and the costs imposed by manure management regulations. The costs of manure management regulations, as measured in relation to total production costs per pig for slaughter, were greatest for the medium-sized and the very large-scale farm, with a lesser impact on the large-scale farm. Medium-scale farms have less production across which to spread the cost of standard regulations, and very large-scale farms are required to meet additional regulations and have a lower average production cost. In all situations, costs were greatest for the very large-scale farm.

The results indicate that differences in manure regulations are not likely to lead to shifts in the location of production at the international level or across countries. This confirms analysis carried out in the United States indicating that differences in environmental regulations appear to play only a minor role in location decisions inside the country, although this could change with more stringent regulations as evidenced in the Netherlands. These studies also suggested that environmental regulations fall more heavily on small producers, who will opt out of pig production rather than shift production to a different location, or on very large-scale producers who are often the focus of policy measures.

Policy implications

A number of policy implications can be drawn from this study.

- Flows of environmentally damaging materials into water (*e.g.* nutrients) and emissions into the air (*e.g.* ammonia) are a common consequence of pig production. Reducing the flows of these

materials and emissions to an acceptable level of risk in terms of human and environmental health is a priority for policy.

- While support for pigmeat is lower than for other commodities, agricultural support policies are influencing the level and pattern of pigmeat production, with some negative environmental consequences.
- Policy makers need to be aware of the link between commodities when developing and implementing agricultural policy reform. Relative changes in output (*e.g.* beef) and input (*e.g.* cereals) prices that result from reforms will influence incentives for pigmeat production.
- Policy reform, including trade liberalisation, is likely to reduce or slow down growth in pigmeat production in those countries where the environmental risk and cost is currently the highest, and increase it in others.
- While most countries will have to face the pressures associated with increased pig production to meet growing consumer demand, all countries will have to respond to increases in pollution risks associated with the further intensification of production.
- Technologies and management techniques do offer the possibility of reducing the environmental risks, with evidence of some “decoupling” of environmental risk from pigmeat production taking place. Policy makers should examine such developments, and consider ways it can influence their uptake.
- Policy makers should recognise the cost impact of agri-environmental policies, especially regulations, on different sized producers and consider this in relation to the resulting environmental benefit. A one-size-fits-all approach or requirement, particularly when focused on a specific farming practice, may be neither environmentally effective nor economically efficient.
- Sometimes more drastic measures, including policies which lead to the exit of producers from the sector, may be needed in order to achieve the desired environmental outcome.
- Policy instruments that more directly target the localised nature of environmental concerns rather than establish blanket requirements on

all producers need to be developed. In this regard, some of the economic instruments recently developed may provide examples to others.

- Differences in regulations do exist, but these appear to reflect differences in the environmental risk and are not large enough to impact on the trade competitiveness of producers. Payments to offset the cost of regulations should be carefully considered before being provided, particularly if the PPP is to be appropriately implemented.