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Chapter 4 in *The Fiscal System and the Polluter Pays Principle - : a case study of Ireland*

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Chapter 4: AGRICULTURE AND FORESTRY S. Scott

This chapter begins by surveying the environmental effects of the sector and any evaluations of them. A rundown follows of the existing fiscal treatment of the sector and its environmental impacts. We will see that in the case of agriculture, what can broadly be termed fiscal policy in the last couple of decades has had profound environmental effects, especially through its encouragement of intensive agriculture, though farming and forestry can provide many environmental benefits to society, such as maintenance of bio-diversity. Options for addressing the problems, based on information from Ireland and abroad, will be assessed, leading to suggestions as to which economic instruments should be adopted. The underlying aim is neither to raise revenue, nor, necessarily, to achieve a stated environmental objective; the aim is to raise wellbeing by reducing pollution, so long as the benefits of so doing outweigh the costs, with external effects taken into account. This is an "ideal" approach, because external benefits and harms are not easily valued. Though the ideal is likely only to be approximated, the general direction of the use of economic instruments will be indicated, as well as the immediate steps which can be taken.

4.A Agriculture

4.A.1 Environmental Impact of Agriculture and the Costs of Damage

Climate change, acidification, impacts on air quality, damage to nature and biodiversity and to the quality and quantity of water - these are the harmful effects attributed to agriculture. By contrast, it is sometimes less widely realised that agriculture, in its role as major occupier of land, can be a force for good in the countryside, providing stewardship of the rural landscape and maintaining habitation in rural areas and villages. We will discuss these effects in turn; they are summarised in Table 4.1 below. The table indicates, in general terms for any region, which elements are released or affected by agricultural activity, their importance and, in the final column, the potential for improvement.

Agriculture's effect on climate change arises through the sector's use of energy and burning of straw, which release carbon dioxide, through methane emissions from livestock, which is a prominent effect in Ireland, and through release of nitrous oxide from fertilisers.

Table 4.1: *Effects of Agriculture on the Environment*

Theme	*Element*	*Importance of Agriculture*	*Potential for Change*
Climate change	Carbon dioxide CO_2	**	**
	Methane CH_4	***	**
	Nitrous oxide N_2O	***	***
	Overall	*	*
Acidification and air quality	Ammonia NH_3 and Nitrogen	**	***
	Volatile organic compounds VOCs	*	-
	Overall	*	*
Nature and biodiversity	Soil loss	****	***
	Habitat loss	****	****
	Overconcentration of species, genetic engineering	**	**
	Overall	****	***
Water quality/management	Water shortage	***	***
	Nitrates NO_3	****	****
	Phosphates PO_4		
	Pesticide residues	****	***
	Overall	***	***

Note: More asterisks mean more importance or potential for change.
Source: Adapted from DRI et al.(1994) (Travers Morgan Environment).

Agriculture's effect on air pollution and acid rain arises through the release of ammonia by slurry spreading, of nitrogen from fertilisers, and of volatile organic compounds by a variety of activities. In addition to the effect on climate change from methane emissions from cattle, the main impact of agriculture in Ireland is on the last two themes in the table. Its impact on nature and biodiversity arises from many causes, including soil loss due to overgrazing or spread of contaminated wastes, and habitat loss brought about by use of pesticides, fertilisers, monoculture, removal of hedges and ditches and other land developments. The other major impact of agriculture in Ireland is the deterioration of water quality - impact on water quantity

not being the problem that it is in several mainland European countries - through release of nitrogen and phosphorus from manure and fertiliser application, and through pesticide residues.

Agricultural activity, undertaken on a small scale and non-intensively, does not in general impose serious adverse effects. It is large changes and heavy concentrations which, depending on the characteristics of the surroundings, can cause degradation. Over the 1980s much land was converted from arable uses to pasture for an increasing number of beef cattle, and for a dramatic increase in sheep, which more than doubled.[1] Poultry and pigs also rose in numbers, with heavy concentrations in counties Monaghan, Cork and Cavan. Ireland has the highest concentration in Europe for sows; over 80 per cent are in units of more than 100 sows, compared to Germany where only 16 per cent of sows are in units of over 100. Relative to European standards the numbers and herd size in Ireland are small: it is the extent of localised concentrations, and the sensitivity of the surroundings, which makes them significant. Another important change with environmental implications is the strong swing away from hay-making to silage. The pollution potential from silage effluent (in terms of BOD_5) is some 20 times greater than that for untreated domestic sewage.[2]

Thirty million tonnes of manure must be managed by farmers each year. Though the nutrient value of this is put at some £117 million, disposal as a waste is more frequent than use as a nutrient. Total BOD and phosphorus content of animal wastes (excluding that from grazing animals) is put at 663 000 tonnes and 32 000 tonnes respectively, which is six times the levels from sewage and industrial wastes combined. Some 85 per cent of dairy and beef cattle manure is in the form of slurry from slatted sheds, most of the remainder being in farmyards. The pollution potential can be controlled by careful timing and manner of spreading, but this tends to cause extra work and inconvenience to farmers.

Meanwhile fertiliser is relatively cheap and easy to use and it is not surprising to find that fertiliser use has increased significantly. Annual phosphorus (P) fertiliser use quadrupled between 1950 and the early eighties, since when it has been static at about 60 000 tonnes. Nitrogen (N) fertiliser use shows a similar pattern, having levelled off at about 380 000 tonnes. The other important source of phosphorus is animal feed, which amounts to 9000 tonnes of

[1] Lee (1996), who is the source of most of the environmental information in this sub-section.
[2] Department of Agriculture, Food and Forestry (1996).

phosphorus in concentrate fed to cattle and sheep, and 5850 tonnes in concentrate fed to pigs and poultry. Where there are heavy concentrations of manure there would be high levels of phosphorus.

The upshot of these developments is the increased risk of pollution from manure concentrations requiring disposal, from fertiliser application and from silage effluent. Are these features having an effect on the environment, can we put a value on the effect or, at any rate, can we say whether or not it is serious?

4.A.1.1 Effects on water quality

Despite the relatively good quality of most Irish surface waters, a continuing decline is noted by the Environmental Protection Agency (1996). This is of particular concern because of the salmonid status of Irish rivers. The trends are best understood by looking at Table 4.2 which shows the evolution of the quality status of 2900 km of river length from 1971, in the first two columns. Since 1987-90, 96 per cent of total river length has been monitored, amounting to 12 700 km, and the trend in their quality status is shown in the last two columns.

Table 4.2: *Trends in Quality of Water in Selected Rivers*

	2 900 km of river		**12 700 km of river**	
Quality status	**1971**	**1994**	**1987-90**	**1991-94**
Generally unpolluted	84.3	57.5	77.3	72.2
Slight to moderate pollution at times	9.7	41.4	21.7	27.2
Serious pollution at times	6.0	1.1	0.9	0.6
TOTAL	100	100	100	100

Source: Data used for *Water Quality in Ireland 1991-1994*, Environmental Protection Agency, (1996).

The Table shows the decline of the two extreme categorisations, that is, unpolluted river length and river length which is seriously polluted at times. Meanwhile the length of "slightly and moderately polluted river at times" has increased. The increase since 1971 for these categories is from 9.7 per cent of length to 41.4 per cent in 1994, for the shorter stretch of monitored rivers. Results of the wider coverage in the last two columns show a firm increase in slight to moderate

pollution, to over a quarter of river length. This leaves no room for complacency. Agricultural runoff, industrial waste and sewage are all involved. However, the fact that in many cases known "point" sources are not implicated suggests that agriculture is the major cause: farms are very dispersed, and pollution off the land flows from "non-point" sources. These features in fact make it difficult to monitor and control, and will constrain policy as we will see.

The nutrients which are implicated are phosphorus and nitrogen. Levels of phosphorus in water above 20mg per cubic metre (or 0.02 mg per litre) in slow-moving waters can lead to eutrophication, a situation where excessive supply of phosphorus and nitrogen leads to growth of algae, thus disturbing the oxygen balance, with loss of fish, diminished aesthetic quality, reduced amenity value and a deterioration in the quality of drinking water.[3] Even small quantities of phosphorus can be harmful. The problem is apparent in certain lakes, since in these waters phosphorus levels can build up. In rivers, particularly those that are fast flowing, the nutrients are ultimately flushed out to sea, though, more recently, nutrient excess has been identified as the main cause of deterioration in river water quality.

Average phosphorus levels in soil samples have increased ninefold since 1950 to 9 mg per kg. A balance sheet study undertaken for 1988, detailing the inputs of phosphorus (P) to farms and the amount embodied in outputs of farms, expressed in tonnes, is summarised in Table 4.3 below:

Table 4.3: *Phosphorus Inputs to Farms, Outputs from Farms and Remainder (tonnes P)*

P inputs to farms			**77 296**
of which:	Chemical P fertiliser		62 446
	Concentrates fed to cattle and sheep	9 000	
	Concentrates fed to pigs and poultry	5 850	
P outputs from farms		**27 810**	
of which:	Tillage crops		12 177
	Cattle and sheep production		8 717
	Milk		5 170
	Pig and poultry production		1 746
Remainder			**49 486**
of which:	Soluble P loss to water	3 445	
	Build up of soil P		46 041

[3] McNally 1995

Source: Tunney (1990).

The table shows that inputs are over double the amount accounted for in output from farms. The problem then is that the remainder can find its way to inland waters. The ideal is to have a balance so that soils have adequate fertility for production, and that losses to water are low enough not to cause pollution. One study showed that farmers could get 6 years growth with no phosphorus application, if they had proper manure control (McGarrigle 1996). This represents an unnecessary cost to farmers, and some £25 million is wasted annually in unnecessary application of inorganic phosphate fertilisers (EPA 1996). By contrast it should also be said that 25 per cent of soil samples have been found to be deficient in P, which is an indication of the diversity of conditions and also has implications for policy.

Phosphorus losses from agriculture have been identified as a significant cause of water quality decline in Lough Conn, Lough Derg, the Lee catchment and county Monaghan. Large surpluses to agriculture's requirements of phosphorus were found, at 7 kilograms per hectare per year for the Lough Derg catchment, and at 28 kilograms in county Monaghan. This was attributable to animal wastes and chemical fertilisers. Concern about eutrophication in Inniscarra reservoir during the summer months, the annual build-up of phosphorus and the threat posed to domestic and industrial users of water, led to a detailed study of the river Dripsey catchment by Reynolds (1996). Results suggest that more than half the excess P comes direct from farmyards and overland flow from fields is probably still excessive. Slurry spreading after the first silage cut is recommended rather than in October and November. Even with no application of chemical P fertiliser it will take many years to reduce the P level in soils from their present figure, of over 10 mg per kg, to a recommended 6 mg per kg. These recommendations indicate that policy should encourage specific behavioral changes.

Turning now to nitrogen, a nitrogen balance sheet by Sherwood and Tunney (1991) shows that 72 per cent of N inputs are not recovered in the soil or in animal product, and must therefore be lost to water and the atmosphere. However a study of the vulnerability of soils and groundwater to nitrate leaching showed that only 4 per cent of Irish soils are at high risk. Recent measurement show that effects on surface waters are generally low, and well within the limits set for abstraction and drinking waters. However, contamination affects a considerable number of rivers and streams at times, particularly in the south-east where there is a greater than average

proportion of land under tillage. In addition, the south-east displays a continued upward trend in nitrate levels.

A further warning against complacency arises from the fact that pollutants carried in overland or subsurface flows may not reach groundwater supplies of lakes and streams for years after their generation, according to Shortle and Abler (1996). Contemporary problems can reflect decisions and events that occurred many years in the past. Time lags of 30 to 60 years have been reported in Southern California and, similarly, the benefits of current control actions may not be fully realized for many years. While Irish geology is different, it is important to be on guard.

4.A.1.2 Value of harm to water

What is the harm done by excess nutrients and eutrophication? What is the value of the ensuing damage? As is frequently the case with environmental damage, many aspects are uncertain or controversial. For example, nitrate pollution of drinking water has been linked to methaemo-globinaemia in babies (blue baby syndrome) and stomach cancer. A measure of the value of harm is the cost of treating water for abstraction and drinking, where this is considered necessary.

There is also evidence of the harm of eutrophication, other than to health, though no studies have been undertaken for Ireland. Barde and Pearce (1991) describe a number of evaluation studies. One study estimates the willingness-to-pay of around a thousand river-corridor users for water quality improvements. Results, based on interview surveys by WRC/FHRC (1989), indicated that the average household would be willing to pay an additional £6 per year in water rates for further water quality improvements. These studies, called contingent valuation studies aim to elicit people's valuations contingent on an option being available.

Another study, undertaken in the Netherlands by Baan (1983) is quoted, which aimed to give an overview of potential benefits of improvements in the quality of Dutch surface waters. Benefits were calculated relating to recreation, fishing, commercial fisheries, navigation, reduction in public water supply costs, agricultural productivity gains and better drinking water. Many benefits were not estimated, such as aesthetics, effects on eco-systems, or option value. The once-off total monetary benefits were estimated to be between £76 and £210 million (Dfl 200 and 550 million).

A further study aimed to elicit how much Norwegians would be willing to pay for a halving of nutrient leaching to the North Sea (Magnussen 1992). People stated that they would be willing to pay between £50 and £200 annually in increased sewage taxes, which also indirectly gives a measure of the value of the damage.

While not implying that results from foreign studies are a substitute for a proper evaluation of the harm done by eutrophication caused by agriculture in Ireland, they demonstrate that people can place a high value on the quality of surface waters, and that this is without even taking account of the benefits of tourism angling, image abroad, restoration of habitat and the like. Indeed we note that, without prompting, concern for water quality is ranked as issue number one by Irish respondents to a recent survey of attitudes to the environment (Murphy et al. 1994).

4.A.1.3 Effects on nature and biodiversity

Agriculture is central to the shaping of the rural landscape. Farming activities take place on more than 80 per cent of the land area in Ireland and continuation of habitat is vital to nature and biodiversity. There is little truly natural habitat remaining in Western Europe so that the wildlife resource is concentrated largely on agricultural land. In general, the systems most compatible with wildlife are the more traditional farming systems, which are characterised by low intensity, low nutrient input, low or zero use of pesticides and herbicides, relatively large area of semi-natural vegetation and hedgerows, less drainage and irrigation and more continuity (Baldock 1995) - in effect, the opposite of the trend in agricultural development of the past few decades. Chemical contamination and introduction of exotic species may also be harmful.

Grassland being the dominant type of land use, Ireland is a low user of pesticides, annual sales being about one half the EU average and measured concentrations in the soil are correspondingly low. However DDT and its breakdown products are still present at significant levels in some agricultural soils (especially fruit growing) and in town garden soils. Assessment of the effects on soils and habitats of increased hill grazing by sheep is under way. Grazing sheep have additionally led to erosion of peat soils, which enter rivers and lakes and cause harm to fish. Not being a straightforward case of pollution where clearly defined administrative procedures and

legislation exist, extensive damage has occurred before any serious attempt at control.[4]

In Ireland, hedgerows are a part of the traditional landscape and form semi-natural habitats for farm wildlife. Since 1938 a loss of 16 per cent of hedgerow has been reported, equivalent to two kilometres squared. While this is not a huge loss, it is a loss which should not continue indefinitely. This is not to advance the idea that all change is harmful or that farming cannot evolve. However there are benefits which farmers themselves may be foregoing if they do not conserve semi-natural habitats, such as[5] reduction of pesticide use by exploiting pest predators and parasitoids, enhancement of crop pollinator populations, reduced soil erosion, maintenance of landscape diversity, promotion of game species and the like. As this list indicates, from the farmer's point of view, existence of habitats does not purely entail costs and, for the farmer's family, the preservation of landscape diversity would tend to be a benefit.

Some wildlife species have seen improvements in their numbers in the last decade, such as pine martens, Greenland white-fronted geese and buzzards, to name a few. However there is also a significant number of endangered, vulnerable and extinct species. For example, in relation to plants and ferns in Ireland, 10 species are probably extinct, 6 endangered and 44 are vulnerable (Curtis and McGough 1988). In relation to birds, Table 4.4 gives some examples. Internationally important species include the Irish hare which is under threat from agricultural intensification, the Greenland White-fronted goose from afforestation and peat extraction, the otter from afforestation, water quality changes and recreational pressure, and so on.

Table 4.4: *Some Examples of Birds under Threat and Nature of Threat*

(see page from OPW Wildlife Service: Red Data Book, Vertebrates)

Source: Whilde (1993)

Experience in Ireland echoes some of the problems encountered in the UK where, for example, there has been contraction of 24 out of 28 species of farmland birds between 1970 and 1990, the populations of seven species falling by more than half. Loss of habitats is a prominent cause.

[4] Sheehy-Skeffington et al. 1996, Douglas 1996, Whelan 1996, EPA 1996.
[5] Marshall (1993) cited by Lee op. cit.

Ireland has some features which make it special in world terms and which will probably become more special as they become rarer worldwide and better known. For example, Ireland's waters and estuaries are strategically positioned on the migratory routes of many birds; and the extent and richness of its peatlands are only rivalled in Europe by those of Finland. While indeed extinction, as well as evolution of new species, are natural features of life, extinction of species is now taking place at an unprecedented rate, possibly 1000 times greater than the background or natural rate (Pearce 1993). OECD (1996) puts the rate of extinction of species at a possible 100 per day, probably the fastest rate since the natural catastrophes of 65 million years ago, which rendered the dinosaurs extinct. This is a loss to present generations and, owing to probable irreversibility, to future generations also.

Several studies have been undertaken which aim to place a value on the conservation of species, eco-systems or habitats. There is much overlap between countryside and habitat. Generally speaking there is a high demand for leisure in the countryside and a sizable portion of this demand would be for the continuation of habitats. In Great Britain, for example, it is estimated that people spend one-fifth of their free time in the countryside, and 85 per cent make at least one excursion to the countryside per year, of which nearly 30 per cent visit the countryside regularly. For Germany, an informal estimate puts the value of a countryside visit at the equivalent of a cinema ticket, giving a value of some £4 billion per year (DM 10 billion, (Leser 1995)). Even on such a crude basis, the magnitude of values involved is an indication of the significance of the countryside.

However the value of visits to the countryside might be a poor guide to the valuation of some rare and possibly little known species. A study specifically aimed at estimating people's valuation of threatened species in Norway, namely brown bears and wolves (by Dahle et al, described by Navrud (1992), involved a contingent valuation survey of about 2000 persons. The mean annual willingness-to-pay per household for preservation as well as for extinction was calculated. As the animals are predators, respondents were given the choice of preservation or extinction. Willingness-to-pay for conservation was eight times that for extinction and the net annual willingness-to-pay per household worked out at £20.60 (210 NOK). While disposable income is a good deal higher in Norwegian households, the scale suggests that there would still be significant demand for bio-diversity in Ireland. This again omits other interests such as tourism and benefits to future generations.

4.A.1.4 Other Effects

Other aspects of agriculture's impact on the environment will merely be itemised. Climate change was already mentioned above, however it is less well-known that grassland is believed to serve as a sink for carbon dioxide and nitrous oxide, and thus to help reduce climate change. However, ruminants which feed off grassland emit 200 grammes of methane gases per head daily. Ploughing and removal of grassland releases large amounts of carbon dioxide through decay of soil organic matter.

We have not considered the important effect of pollution on agriculture, but this will be indirectly covered by other chapters. Except in a few spots, pollution of soil by heavy metals is low, though there is concern at the effect of increased loading of sewage sludge on land, arising from the Council Directive Concerning Urban Waste Water Treatment[6].

4.A.2 Existing Fiscal Treatment and Environmental Effects

The European Community's Common Agricultural Policy (CAP), the introduction of milk quotas in 1984 and the MacSharry reforms of 1992, are major influences on agricultural activity and its effects on the environment. A summary of the relevant aspects of European policy needs to be given here. The CAP it must be said has been highly effective as an economic instrument in terms of support for farm incomes in aggregate, levels of agricultural output, the yields that it promoted and the deceleration of urbanisation. It had manifest drawbacks however in the size of the surpluses generated, and the lopsided distribution[7] of benefits (Fitz Gerald and O'Connor 1991). The main original aims of providing stable affordable supplies of food and a fair standard of living for the agricultural community (EC Treaty article 39) seem to have been lost sight of. As predicted, the mismatch of using output price support, when it was incomes that required support, has become clear. With output prices held high, the cost of inputs appeared relatively low, causing a tendency for farmers to apply excessive amounts of inputs such as fertilisers (Delpeuch 1994). Profit-maximising farmers could raise net revenues by increasing output, but with land being a fixed factor, methods had to become more intensive.

Of course, even without the CAP, external effects arising from agricultural activity, as with any

[6] European Commission (1991).

[7] 80 per cent of the support went to 20 per cent of the farmers who produced 80 per cent of the output.

other activity, would require to be rectified, but the operation of the CAP exacerbated the problems. The damage that ensued was effectively subsidised by the taxpayer who, while evidently willing to support agricultural incomes, has become increasingly dissatisfied with paying for an undesired outcome. In addition to the environmental toll, the cost to the European taxpayer and consumer[8] (at well above Ireland's GNP), the surpluses and the likely admission to the EU of large agricultural producers such as Poland and Hungary, have recently caused much concern and added to pressure for reform.

4.A.2.1 CAP reforms in 1992, environmental implications and other grant schemes

The most far-reaching reforms were those introduced by MacSharry in 1992, and they have environmental implications. The main features for the two items, cereals and animal products, are as follows. Support prices for cereals were to decrease by 29 per cent (from 155 ECUs to 110 ECUs per tonne). Income loss was compensated by subsidies in fixed amounts per hectare, distinguishing between small-scale and large-scale farmers. Large-scale farmers, operating more than 15 hectares, are only eligible to hectare compensations if they set aside at least 10 per cent (previously 15 per cent) of their average acreage which was allocated to crops during 1989 to 1991. Compensation per hectare is computed as the compensation per tonne (a figure between 25 and 45 ECUs) multiplied by 6.08 (which is Ireland's reference yield in tonnes per hectare). Small farms receive compensation without any set-aside obligation. The compensation is paid regardless of actual output and is determined purely on an area basis. Producers whose yields had been above the reference yield would face an effective reduction in total revenue (Boyle 1995).

The reform measures for animal products are not quite so strong, with the intervention price for butter and dairy products reduced by 9 and 7.5 per cent respectively and intervention prices for beef lowered by 15 per cent. Premia for bulls and cows are subject to stocking limits, and stocking densities which do not exceed 1.4 livestock units per hectare receive an additional extensification premium. Farmers are still able to stock more but they do not then receive the premium. This is the first time that stocking limits have been specified. Given that Ireland is more active in livestock farming than in growing cereals, this structure of reforms is perhaps to Ireland's advantage. There are accompanying measures for forestry, conservation and amenity

[8] O'Connor (1995) has estimated Producer Subsidy Equivalents (PSEs) for Ireland which measure the proportion of the revenue of farmers which accrues as price support. The main PSEs are: 60 per cent for beef, 61 per cent for milk, 58 per cent for sheepmeat, 20 per cent for poultrymeat, 8 per cent for eggs and for pigmeat, 57 per cent for wheat, 62 per cent for coarse grains and 67 per cent for sugar.

(the agri-environment programme[9]) and early retirement. Import tariffs at the Community border are maintained but under the General Agreement on Tariffs and Trade, (now the World Trade Organisation) it is intended that they be further reduced.

The agri-environment programme in the McSharry reforms includes aid to farmers who reduce applications of fertilisers and pesticides, adopt organic farming, move to extensive production, rear rare breeds, set aside farmland for 20 years for purposes connected with the environment and manage land for public access and leisure activities. To qualify, member countries have to prepare implementation programmes, which will reflect their priorities. Farmers' participation is voluntary. In Ireland, the Rural Environment Protection Scheme (or REPS, described below) was prepared by the Department of Agriculture in 1992. Co-financing by the EU was put at 75 per cent in Objective 1 regions like Ireland.

Reservations have been expressed that the reforms were dominated by concern for farmers' incomes with lesser concern for the environment, which features rather modestly. Funding within the package dedicated to environmental subsidies is forecast at a mere 2.5 per cent of CAP spending (Dixon 1995). Other reservations arise concerning the adequacy of resources of staff to evaluate the proposals, which is a perennial problem with subsidies. Further worries focus on the relatively high subsidies to afforestation (which, for instance, under the Spanish forestry plan submitted to the Commission, could threaten a rare species of bustard, and which need to be carefully applied in Ireland's case, as we will see below). There is also a feeling that the most harmful farming practices will not be reined in.

These criticisms may stem from an underestimation of the benign incentive effects of the price changes in the McSharry reforms to the CAP. The study by Boyle, which investigates the likely response in Ireland to the cereal reforms, indicates that cereal production could fall by 9 to 14 per cent and consequently use of fertiliser in this sector could fall by 9 to 19 per cent. This is the result of disassociating revenue somewhat from output. It would be interesting to see if the impact on the environment were stronger as a result of the curtailment of these underlying incentives to production, rather than as a result of new subsidies for environmental activities. External events however may alter Boyle's results, in that world agricultural prices have recently risen, giving farmers a renewed production incentive. Then, more recently still, turmoil in the

[9] under Regulation 2078/92

beef market could alter the outcome again.

So much for the all-important background. One must however question what lies in store for the future - will European taxpayers be able or willing to continue to pay similar supports to farmers in the EU, given that farmers' numbers will increase with entrants from Eastern Europe? This question is beyond the scope of this chapter, though it is probable that European taxpayers will prefer to pay for a system which is compatible with a healthy countryside.

The following is a list the main agricultural grant schemes affecting the environment, which are specified in more detail in Appendix 4.1. Given their likely transitory nature, it is important that the best possible use be made of the EU monies.

List of grant schemes to agriculture which have environmental impacts

- Control of Farm Pollution Scheme (currently suspended)
- Livestock Headage Schemes in Disadvantaged Areas (for cattle, equines, sheep and goats in Disadvantaged Areas)
- Livestock Premium Schemes
- Nutrient Management Planning via the Advisory Service
- Rural Environment Protection Scheme (REPS)
- Early Retirement from Farming
- Organic Farming

These grant schemes are recent and no evaluation has been undertaken. However the fact that the main scheme, REPS, is aimed at the smaller farmer means that the big polluters will be less influenced. On the other hand, the regions where takeup is likely to be strong are the more remote areas. These are indeed the areas which have most to offer in terms of biodiversity, and may be the more vulnerable, but again perhaps have less to offer in terms of pollution abated. The grants are not directly differentiated according to the existing levels of pollution. There is need for ongoing assessment of the grant schemes.

EU Nitrates Directive

Though the Nitrates Directive is not an economic instrument, it requires a mention because implementation of the Directive abroad will be of interest, and the issue of nitrogen has some parallels with the phosphorus issue here. Recognising the problems caused by application of chemical fertiliser and manure, the Directive aims to achieve a groundwater standard of not more than 50 mg N per litre and the reduction of nitrate pollution of surfacewaters and marinewaters. Member states are required to identify vulnerable zones. No areas have been designated as vulnerable in Ireland. Member states must adhere to an action programme within these zones, as to timing and manner of fertiliser and manure application. Codes of good practice, including conditions such as the manner of application near watercourses, also have to be drawn up, and an Irish Code of Practice has recently been issued by the Departments of the Environment and of Agriculture (1996). Some farms in the UK which are located in Nitrate Vulnerable Zones are claiming that the restrictions are reducing the value of their land, by up to £200 per acre in some cases, and that nitrogen leaving their farms is in fact deposited from the atmosphere. Some 72 areas have been zoned. Conditions are imposed on them without compensation, and there are apparently 87 appeals to the UK Department of the Environment. How the situation evolves will inform the debate on when and how economic instruments versus regulations should be used.

Fiscal treatment of chemical fertilisers, feed and pesticides

Unlike other EU member states, Ireland has a concessionary zero rate of VAT on chemical fertilisers as shown in the Table 4.5.

Table 4.5: *Rates of VAT Applied to Fertilisers in Member States*

Country	Rate of VAT
Ireland	0
Luxembourg	3
Italy	4
Other EU member states	Standard rate

Source: European Commission DG XXI (1995)

In addition to fertiliser, animal feed is also zero-rated for VAT. These are two inputs to farms which contribute to the nutrient levels on the land. Pesticides, on the other hand, are charged VAT at the standard rate of 21 per cent.

While on the subject of VAT, a current anachronism should be mentioned. A manure additive was introduced on the market recently, which has the environmentally benign effect of helping the spreading of manure on land. However its rate of VAT is 21 per cent, meaning that its use is at a disadvantage vis-a-vis the application of zero-rated fertiliser.

4.A.3 Options Based on Information from Ireland and Abroad

In addition to the efforts made by the European Commission to rationalise the CAP, a Ministerial Meeting at OECD (1991) stated that there was a need to "introduce low-energy, low polluting systems based on new technologies; and prices for agricultural inputs that reflect more fully their environmental costs". A major difficulty, as we shall see, is that agriculture is characterised by highly variable and frequently unpredictable environmental conditions, and by the fact that its pollution tends to be "non-point", that is, diffuse, rather than emerging from an identifiable pipe or smokestack. The communique underlined the need for governments to identify and eliminate those subsidies, taxes or other market interventions that distort the use of environmental resources. "Getting the price right" for raw materials, goods and services was seen as critical, to enable them better to reflect their full environmental and social costs. A recent meeting of the OECD policy committee at ministerial level OECD (1996) stated the need for cost internalisation to be part of environmental policies to enable trade liberalisation to contribute to sustainable development, and welcomed the attention focused on the environmental implications of subsidies and tax disincentives. In similar vein, the first recommendation relating to agriculture in the report prepared for DG XI of the European Commission (DRI 1994) was that all subsidies on fertilisers be removed.

Before making practical suggestions for agriculture, we will briefly examine the scope for removing concessions, and for the imposition of pollution taxes, quotas and deposit-refund schemes, to see what each has to offer to deal with excess use of fertiliser. We will also look at competitive tendering to see what that might offer to the protection of biodiversity.

4.A.3.1 Removing concessions

One option is to remove the concessionary zero rate of VAT on fertilisers and feed. Some 98 per cent of farmers (out of a total of 108 600 farmers who come within Revenue Commissioners' remit) in Ireland are not registered for VAT and so they are not reimbursed their VAT payments

in the usual manner by reclaiming them in VAT returns. Instead they receive a flat-rate rebate when they sell their output to a registered person. The rebate received is 2.8 per cent of the value of their sales and represents the amount of VAT paid in the *average* farmer's output. As the average farm spends £1659 annually on fertiliser (Teagasc 1995), the absence of VAT on fertiliser inputs is worth £348 at the standard rate, or £208 at the reduced rate. If VAT were imposed on fertilisers, the flat-rate rebate would be correspondingly raised so that the agricultural sector as a whole, and average fertiliser users, would be overall financially unaffected, but would face higher fertiliser prices than at present. On the other hand, intensive users of fertiliser would be worse off and low intensity users better off. Average expenditure on feed is £3597, the absence of VAT is worth £755 and £450 at the standard and reduced rates, respectively.

The 2000 farmers who are registered for VAT would also be no worse off, except that they would face the costs of financing the VAT paid on inputs, until they received the rebate due on their VAT returns. These farmers would tend to work the larger farms which in some cases may be doing the more environmental damage. The problem of how to correct the incentives facing VAT-registered farmers will be addressed below. Some non-registered farmers may in fact decide to become registered after the imposition of VAT, if they use more than the average amount of fertiliser per unit of output, in order to get the rebate. These might be dairy farmers, who use nearly double the average farm's input of fertiliser. As organic produce is grown without fertiliser, it would enjoy a relative advantage from the removal of the VAT concession on fertiliser. Organic farmers would receive the rebate on output, without having used and paid VAT on fertiliser as an input, leaving them better off.

In sum, given that expenditure on fertilisers in 1994 was £248 million (CSO, 1996), VAT on fertiliser would amount to something above £50 million at the standard rate, and about £30 million at the reduced rate. All farmers would be compensated in the rebate, but for 98 per cent of them the rebate would be according to a flat rate. As stated this would overcompensate relatively low fertiliser users, and vice versa. In other respects it is a non-specific compensation. It is an economic instrument with two good features: provided that fertiliser prices are stable it would operate like a tax per unit of volume of fertiliser. Secondly compensation is assured. This is in marked contrast with many proposed environmental incentives, where the problems of compensation to alleviate hardship and shortage of funds are serious stumbling blocks to their introduction. It is an ideal route for rectifying the current anachronistic incentive structure. The

same could be applied to animal feed.

4.A.3.2 Pollution taxes

As opposed to merely removing concessions, a further step which is already implemented in a few countries, and being considered in others, is to introduce specific taxes on fertilisers. This is in order to pay for the damage that they do. If this damage is not charged for there is a distortion to relative attractiveness of use of fertiliser versus use of manure and the development of technology for spreading manure is at a disadvantage. The same relative price distortions apply to biomass. "If biomass production is less fertiliser intensive than agricultural production, the effects of underpricing fertilisers through a failure to take account of environmental externalities is probably to raise agricultural production above its socially optimal level. The corollary is that the production of biomass may be reduced below its socially optimal level."[10]

The story is somewhat similar when we consider pesticides. Agricultural chemicals are again just one of several factors of production which the farmer combines in order to yield output. The use of pesticides has been likened to the purchase of insurance against a possible attack of pests. In determining what level of chemicals to apply, the farmer weighs the costs of additional chemical usage against the prospective benefits from its use. There are exceptions of course but, in general, the farmer's private calculations will systematically result in over-application of pesticide, because the farmer does not include as a cost the potential health risks to other persons and the danger to wildlife, according to Swanson and Lloyd (1994). Without government regulation or tax there will be excessive application, in the sense that total costs (including environmental damage) outweigh benefits. Regulation, including bans, is the correct instrument for highly toxic or persistent substances. For example organochlorines were banned in the 1960s by many western countries, though paradoxically still produced for sale (eg DDT) in less developed countries. In tropical countries it was estimated that DDT had saved 10 million lives in a campaign to eradicate malaria: an example of the weighing of costs and benefits of chemical usage.

Chemicals of lesser toxicity can be taxed. In Denmark it was found that regulatory measures, such as stricter pesticide registration standards, mandatory education programmes and pesticide

application book-keeping, have failed to attain the targeted reduction in pesticide use, according to Dubgaard (1996). That said, the essential role of regulations is not in question. Advising farmers and providing them with information on agri-chemicals are also necessary tasks, requiring funding.

We saw above that pesticide usage in Ireland is about half the EU rate. However it appears that for Ireland to comply with the EU Pesticides Directive, the level of monitoring will need to be strengthened. This will require extra funds, for which the Department of Agriculture has apparently been calling for five years. In the UK, the costs of monitoring of foods and the environment (eg water and wildlife) are now borne by the UK pesticide industry through a levy on the annual turnover. At the minimum in Ireland there should be sufficient funds to monitor pesticides. The annual costs of registration and monitoring would be at least £0.5 million and extra equipment could add more. Given that expenditure on crop protection is £36 million (or £50 million if one includes total pesticides) then we are talking of imposing a levy in Ireland of very roughly 2 per cent.

Other considerations of pollution taxes are worth examining. In Denmark there has been some concern about the nitrate "front" gradually percolating towards many aquifers in certain regions. Farming organisations have wanted to solve this problem through voluntary measures and have understandably opposed statutory control or taxation of nitrogen. Complicated legislation was introduced in 1988 on manure storage capacity, but it soon became clear that there was no political willingness to furnish environmental control agencies with the resources needed to enforce this legislation. However, the non-point nature of nutrient runoff makes it difficult to devise a tax which discriminates according to the actual amount of pollution in the waters. The more indirect and crude measure of taxation of the nutrient input is therefore resorted to. Rude and Dubgaard undertook a study (described in Dubgaard 1991) of levying a hefty 150 to 200 per cent tax on the nitrogen in chemical fertiliser to achieve a targeted 30 to 35 per cent reduction in the use of nitrogen, alongside a flat-rate refund per hectare. As such a high level of tax would be required, they prefer it to be levied on marginal quantities only. Such a scheme could be implemented by allocating a tax-free quota of nitrogen per hectare to farmers, and taxing additional nitrogen purchased. A levy on nitrogen in chemical fertiliser is currently being discussed by policy makers in Denmark. Meanwhile a pesticide levy has increased pesticide

[10] Fitz Gerald and Johnston (1996)

prices by about 50 per cent on average - with some differentiation between the various products. It is still too early to tell what the impact of this levy will be in terms of reduced pesticide utilization. In any event some of the strongest effects might occur in the longer term.

Turning to analysis undertaken in Germany, most studies, according to Nutzinger (1994), agree that significant reductions in fertiliser application could only be achieved by large fertiliser taxes. However a gradual introduction would enable adaptation. Farmers' incomes could be compensated on the basis of hectares. More economical use of manure would be encouraged and more re-integration of animal breeding and plant cultivation would occur, the latter at present having no manure to substitute for fertiliser.

A survey by OECD in 1994 shows that five countries impose levies[11] of some sort on fertilisers as shown in Table 4.6. The four European countries charge on the basis of the N, P and K content whereas in the USA the charge (raised at sub-federal level only) is based on tonnage. Charges based on P, which is of interest in Ireland, range from 0.14 ECU per kg P in Sweden, which amounts to 10 per cent of the price, to 0.27 ECU per kg P in Finland, which is 20 per cent of the price. In Finland there was a decrease in the use of phosphorus per hectare which may be due to other policy instruments as well, some revenue from the charge being used for agricultural subsidies. The tax has recently been discontinued. In Norway, phosphorus usage per hectare decreased by around 40 per cent between 1980 and 1988, remaining constant thereafter. In Sweden there has been a small fall in the use of nitrogen.

Table 4.6: Levies imposed abroad on fertilisers and pesticides

Country	Charge base, rate and percentage of price	Incentive		Revenue spending
		Int	Act	
Fertilisers				
Austria	N-, P- and K- content: ECU 0.31, ECU 0.18 and ECU 0.09 per kg	-	-	Subsidies, environmental expenditure

[11] A rise in the price of fertiliser will generally decrease the output of agricultural produce. The profit maximising farmer will increase fertiliser application to the point where: Price of fertilizer/Price of output = marginal productivity (or change in output per unit increase in fertiliser use). An increase in the price of fertiliser in the absence of increased marginal productivity will cause a reduction in fertiliser application, reduced yields and reduced pollution. The relative reduction in output will be small in comparison to the reduction in input and pollution (Simonsen 1995).

Finland	N- and P- content: ECU 0.41 and ECU 0.27 per kg (5-20% of the price)	+	#	Agricultural subsidies, general budget
Norway	N- and P- content: ECU 0.13 (19% of the price) and ECU 0.24 per kg (11% of the price)	+	#	General budget
Sweden	N- and P- content: ECU 0.07 and ECU 0.14 per kg (10% of the price)	+	+	Subsidies, environmental expenditure
USA (certain regions)	ECU 0.07-1.11 per ton (< or = 2.5% of the price)	¨	¨	Environmental expenditure
Pesticides				
Norway	13% on wholesale price	+	¨	General budget
Sweden	ECU 0.9 per kg active ingredient, ECU 3.6 per treated hectare	+	#	Environmental expenditure

Source: OECD (1994), p.75

Notes: Int = intended as an incentive instrument. Act = actual incentive instrument.
+ = yes; - = no; ¨ = no data available; # = unclear.
ECU exchange rate applies to 1 January 1992.

The table also shows charges on pesticides, which are levied in Norway and Sweden. In Denmark an eco-tax was imposed on pesticides in January 1996, increasing pesticide prices by 15.35 per cent, depending on the type of pesticide. The model simulations indicate that the tax-induced reduction in pesticide use will probably be less than 10 per cent. It appears that rather than strengthening bureaucratic control, politicians may be becoming more willing to use economic incentives (Dubgaard op.cit.). In Sweden at the beginning of the 1980s it was decided to reduce usage of pesticides by 50 per cent. The Swedish Board of Agriculture has analysed the responsiveness of pesticide use to its price. They estimate that a 10 per cent price rise results in a decline in use of 2 to 5 per cent. In a study by Gren (1994), also for Sweden, the decline in use after a 10 per cent price rise would be 9.3 per cent for herbicides, 5.2 per cent for insecticides and 3.9 per cent for fungicides. In the Netherlands a levy on pesticides is planned which will aim to raise over £10 million for use in pesticide reduction action programmes.

Monitoring costs for enforcing legislation in general, and who should bear them, are also sources

of debate. In Denmark, for example, a national monitoring programme, measuring nitrogen, phosphorus and organic matter in the aquatic environment was started in 1988. This is based on 255 monitoring stations on streams and rivers, 68 groundwater monitoring points and measurement of concentrations at 37 selected lakes. Some coastal waters are monitored also, as are a number of sources of pollutants. The programme costs Dkr 100 million, or over £11 million, per year. Turning to another country, Norway has a 6 per cent control charge on pesticides, in addition to the 23 per cent tax. In other countries, apparently, the high costs of monitoring have inhibited the monitoring programmes or restricted them to small areas, as in Finland. Ensuring adherence to environmental legislation can be complicated, requiring individual assessment as in Denmark. Some prescriptions are hard to control effectively at realistic cost, such as the upper limit on the amount of nutrients that may be applied per hectare, or the 12 hour time limit after spreading for working manure into the soil. At any rate, with control so difficult and monitoring so expensive, the argument for the removal of concessions which are incentives to over-application is strengthened.

4.A.33 Tradable input quotas, pollution quotas or deposit-refund schemes.

Tradable quotas are worth investigating because they are well-suited to situations where technical or agricultural conditions vary. Pollution taxes, on the other hand, are suited to situations where there is a measurable level of pollution. Will there come a time when measurement of water quality, and hence of pollution, becomes exceedingly cheap and automated? Even if one could overcome the measurement problems there might still be great variation as to an area's vulnerability. Each catchment area could be a special case, such that a uniform tax (not a mere removal of a concession) would be inappropriate, though possibly better than a blanket regulation. Quotas can have advantages over both.

In the option of imposing the standard rate of VAT on fertiliser, mentioned above, we saw that some 2000 farmers in Ireland are registered for VAT and that removal of the concessionary rate would have virtually no effect on them, because they can reclaim the VAT that they paid. Yet it is these large farmers which probably release a large share of the excess nutrients and require an incentive to farm in an environmentally conscious manner. Several ideas are being discussed, such as tradeable pollution quotas, within catchment areas that are vulnerable.

The advantage of the tradable quota regime is that the authorities can be more sure that a limit on

use will be met. Another advantage is that the authorities do not need to have information on the abatement costs. One possibility is for a fertiliser quota to be imposed in vulnerable areas, such as a quota of 90 or 80 per cent of present application. Quotas would be based on the advice of experts such as soil scientists and chemists. Selected localities would be reasonably small such that the quota of fertiliser permits could be allocated on the basis of a uniform rate of application per hectare. Fertiliser permits would then be tradable within the area. Those farmers who decided to use less fertiliser per hectare, by managing manure more carefully or altering their product, would be able to sell their excess permits. They would want to sell if the price offered were higher than their marginal abatement cost. If the output foregone is as minimal as the agronomists imply, then the trade price might be quite low, adding to the scheme's acceptability. However some funds will be required for monitoring and administration.

There are several difficulties with a tradable quota scheme however, including the fact that there are other sources of nutrients such as feed, and adherence to the quota on inputs would need to be verified somehow. One suggestion is that the quota of fertiliser be coloured and that only coloured fertiliser be allowed within the region (like agricultural diesel being coloured to differentiate it from motoring diesel for tax purposes). No examples of such a scheme have come to light and there is a worry that the set-up costs for trading fertiliser permits might be a disadvantage.

On a theoretical level, tradable permits are advised when the cost of damage from an extra unit of pollution is rising steeply relative to the abatement costs. By contrast, taxes are recommended when the marginal damage cost curve is relatively flat. Even if we suspect that cost of damage is rising steeply in some areas, theory may have to give way to practicality for now, though an experiment with tradable quotas in a certain area would be worthwhile.[12]

4.A.3.4 A practical solution

We can now draw the threads together to devise a practical solution. It is noted that nutrient management calculations are and will have to be increasingly undertaken. The calculations might cost a farm in the region of £200 to £300 per year to undertake. They entail the sampling of soil and the recording of inputs to, and outputs from, the farm. REPS participants undertake abbreviated nutrient management plans. Some other regions of the world, Pennsylvania for

example, have mandatory nutrient management plans. Local authorities in Ireland now have legal powers to require farmers to submit nutrient management plans where they consider this to be necessary.[13]

We should further remember that ideally it is not that the P input needs to be discouraged, but rather the P excess, or remainder, when the soil type, inputs and outputs have been taken into account. In this context it may be better to think more in terms of a deposit-refund scheme, where a tax on nutrient inputs is refunded on nutrients in the recorded outputs. Unaccounted nutrients would then actually bear the tax. The items in the recorded calculations, like in Tunney's nutrient balance in Table 4.3 above, bear a marked similarity to the information required in calculating one's VAT rebate. If VAT were charged on fertilisers and feed, but the rebate were related to some adjusted P content of the output, VAT-registered farmers would have an incentive to minimise their inputs and maximise their outputs of P, or "to return the bottles" drawing on the returnable bottles deposit-refund analogy.

Rather than set up a new procedure to deal with the phosphorus problem it would be worth considering how the VAT system might be exploited. Information required to calculate nutrient remainder would also need to cover changes in stocks on farms. This is not required in the VAT returns. Further information required would also include the timing of manure spreading, adherence to good practice in silage storage and the like. It is not just "how much" nutrients are applied that matters, but also "how" they are applied. The proposal, then, is that VAT-registered farmers would be charged VAT on inputs of fertiliser and feed, but the rebate would be made conditional on a satisfactory nutrient balance being demonstrated by the farmer. The rebate might be only a proportion of the VAT originally paid, the proportion being guided by the ratio of nutrient outputs to nutrient inputs. The higher the proportion of outputs to inputs the higher the rebate. The higher the nutrient excess or remainder, the higher the effective tax.

To overcome the mis-match in timing, that VAT is calculated 2-monthly and that the nutrient remainder should probably be calculated annually, cumulation of the intra-annual figures would be needed. To counter the variability problem, that nutrient excess in some regions may be doing a lot of harm and doing none in other regions, local authorities, which are the bodies with direct

[12] As suggested by Johnston (1995)

[13] Local Government (Water Pollution)(Amendment) Act, 1990, as amended by section 66(3) of the

responsibility for Water Quality Management Planning[14], would have the authority to stipulate adjustments to the calculated proportion. For example there might be, say, three types of region: (1) non-vulnerable, (2) potentially vulnerable and (3) vulnerable regions. In non-vulnerable areas, the full rebate could be paid in the usual manner, perhaps.

If the system were not operated via the VAT mechanism, that is if the VAT procedures are not amenable to extensions of this sort, then this deposit-refund suggestion might at least be operated alongside the VAT procedures, so that there is some economy of administration. It would remove the need for setting up a completely new structure for gathering the same information again from the 2000 farmers. Possibly the most practical solution is the appointment of not much more than one or two extra persons to administer it, who would have to be situated inside the Revenue Commissioners Office - since the information cannot be released outside the Office.

Impediments to making the VAT rebate conditional on a satisfactory nutrient balance arise because under present legislation the right of VAT deduction may not be limited. In the meantime, however, a complete overhaul of the common system of VAT in the EU is underway and has been set out in a work programme[15] for 1996-1999. The overhaul will include the need to modernise the existing provisions relating to the *right to deduct*, which in fact is the rebate which we are discussing. In order to incorporate the condition which we are proposing here, approval of all EU member states would be needed. Failing this, as mentioned, the proposed method can operate alongside VAT procedures.

So much for the 2000 or so farmers who are registered for VAT. What of the 98 per cent of farmers who are not registered? These tend to have small farms, though some might be intensive fertiliser users and have a large amount of manure for disposal. If VAT were imposed on fertiliser and feed, as described,they would automatically be compensated on a crude averaging basis, by a higher flat-rate compensation on their output. There may be an initial time-lag, while the flat-rate is adjusted and introduced. Farmers who use relatively less nutrients would gain, above average users would lose, and the incentives to use of manure relative to fertiliser will be improved - all of which are good features. Farmers employing organic methods would gain, and

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Waste Management Act, 1996.

[14] under the Local Government (Water Pollution) Acts of 1977 and 1990.

[15] Phase Three, General principles of VAT, First package of formal proposals, mid-1997, (Commission of the European Communities, 1996).

in theory subsidies awarded to them could be reduced. Fertiliser-intensive farmers may opt to become VAT-registered, in order to receive the full rebate, which is perhaps another good feature.

In sum, using the VAT mechanism with a rebate conditional on good nutrient management is worth considering because:

- it tackles the real problem, namely the nutrient excess.
- only the excess is taxed, benign behaviour will not incur a net tax.
- the documentation on inputs and outputs is already obtained by the system.
- the tax authorities are better placed to take on such a task, as they can withhold the deduction from VAT.
- the number of extra personnel required is relatively small, though this depends on how much "compliance" is incorporated in the conditions.
- it could be applied in a manner which is sensitive to different regional conditions.
- it requires large farmers in vulnerable areas to calculate nutrient balances, which they should be doing anyway.
- the VAT system is ideal because it is somewhat similar to a deposit-refund system.

Many difficulties with such an approach can be foreseen, but these should be looked at in the context of the scale of the problem, and of the objections raised to every other proposal for remedying excess nutrient application.

4.A.3.5 Competitive tendering

Competitive tendering is worth considering when the issue of nature and biodiversity is being discussed. To date, subsidies have been used and there are many areas in the reformed CAP where "cross-compliance" is required. That is, for example, grants are only payable if the farmer complies with stocking density levels and the like. It is important that these methods be adequately monitored and sufficiently sensitive and flexible to deal with specific problems as they arise, such as the over-grazing of hill sides, as an example given earlier. We need to be mindful of the ease with which perverse incentives are introduced, and the difficulty of considering beforehand all the things that might go wrong.

A more targeted approach is for society to view farmers as potential providers of environmental services, which society wants to buy. DRI et al, in their report to DGXI, conclude that governments should ask farmers to tender for biodiversity projects which the government would list. In this way, rather than pay a fixed amount to all farmers who undertake to carry out a

specific activity - maintaining meadows or historic breeds for example - farmers would be able to bid to undertake this activity.

Box 4.1: *Biodiversity activities which governments might put out to tender.*

Example 1: Biodiversity and Habitat Protection
The authorities might invite farmers with land in specified areas, such as Environmentally Sensitive Areas, to submit bids for the minimum subsidy which they would demand in order to provide some type of habitat, or to encourage the expansion of a species. Care would be needed in defining success or failure, be it, for example, density of species or area of groundcover. A limited budget could then be spent in such a way as to obtain the best value for money in an area.

Example 2: Landscape Enhancement
Farmers in an area of natural beauty might be asked to submit bids for the minimum subsidy, based on length or area perhaps, which they would require in order to manage their hedges, ponds, turloughs, et cetera. A pre-determined density of these features could thus be assured at the lowest available cost.

Example 3: Crop Diversity
The authorities might determine that a certain share of crop should be of a specific variety. Bids could be invited from farmers for the minimum subsidy per hectare that they would require in order to grow the variety, enabling the target share to be reached at lowest cost.

Example 4: Sustaining species
The authorises could invite bids from farmers prepared to rear endangered breeds of animal or species of plant. This should allow a guarantee of survival of a set number of each particular breed or plant at the least cost, enabling more conservation to be achieved, given limited budgets.

Source: Derived from DRI et al.

The logic behind this proposal is that some farmers will be especially well disposed to this activity or have good conditions, as well as being knowledgeable and able to carry it out more cheaply and effectively than others. In this manner, society will have achieved its objectives at a lower cost. A list suggested by DRI of the sort of activities which governments might put up to tender is given in Box 4.1. In effect the Countryside Stewardship Scheme in England, and a like scheme in Wales, use a similar approach: they will accept proposals from farmers which bring greatest environmental and public benefits.

The success of such policies is often more dependent on how it is undertaken rather than on what is done. The advantage of competitive tendering is that it could be well-focused but, as with

REPS (the Rural Environment Protection Scheme, see appendix for details), its success would depend largely on correct definition of objectives and monitoring of results. Cross-departmental and, indeed, cross-agency cooperation could be helpful. Non-governmental organisations, which have knowledge of local conditions and can assess results cheaply, could participate to good effect, as with recent efforts to revive the population of corncrakes.

4.A.4 Suggested Use of Economic Instruments

Before summarising the proposals for agriculture, the question must be addressed as to whether one should tax the harm being done or subsidise those avoiding doing harm. A slightly different question arises in the case of past damage. How does one treat farmers who have caused degradation in the past relative to those farmers who genuinely, and at personal cost perhaps, operated in a careful manner, preserving turloughs and thickets and maintaining soil balance and water quality? Should not society pay its debt to them, rather than reward those who did the opposite by awarding them contracts to undo the damage? Moral hazard lies at the core of this issue: encouragement to future damage may be given if polluters are "rewarded". This is a basic criticism of many subsidy schemes. Furthermore, the award of a subsidy implies that the polluter had the right to pollute, which is now being bought. The fact that certain people have been polluting ought not to mean that they then have the right to do so. For practical purposes however, they may have the right. Apart from these reservations concerning moral hazard and uncertain rights, we have to start from the present and aim to get best environmental quality at cheapest cost to society, in the short and longer term.

There is a related issue, which is perhaps a question of definition. It is sometimes difficult to determine where the actual boundary lies between doing good and not doing harm. For example, is habitat conservation a good which should be rewarded, or simply the absence of a bad which, if the bad occurred, would need to be penalised? One is looking at a variable definition and, again, rights lie at the root of the question.

As for the context for framing proposals, there is continuing pressure from the World Trade Organisation to reform the system of price supports under the CAP and the prospect that all EU supports, at over 50 per cent of farmers' incomes, will no longer be affordable within an enlarged EU. Such supports are a clear example of an effective but misdirected subsidy. In sum, there is

double downward pressure on farmers' future incomes. European consumers however would be more willing to support agricultural incomes in return for better environmental quality. While the major CAP reforms may lie in the (not so distant) future, they require realistic consideration and preparation now. Meanwhile there are practical economic instruments for protecting the environment which can be readily adopted as follows.

1. Concessions on fertiliser and animal feed should be removed. VAT should be levied, in the knowledge that farmers are automatically compensated. For 98 per cent of farmers the compensation will materialise as an increase in the flat-rate rebate on their outputs (at present 2.8 per cent), but the important point is that the relative price of fertiliser will have risen. This situation of no net financial effect on average and relative price change is ideal. The remaining 2 per cent of farmers, consisting of some 2000 farmers with high turnover who are registered for VAT, would be individually unaffected financially by this measure, unless the next proposal is adopted.

2. The 2000 farmers who are registered for VAT should be required to supply a satisfactory nutrient management balance in order to receive the VAT refund on their nutrient inputs of fertiliser and feed. Alternatively, given that information on inputs and outputs is to hand in the VAT procedure, the tax could be effectively imposed on nutrients unaccounted for or "lost". The VAT system is in fact a good procedure to link into, because it resembles a deposit-refund system. Ideally the overhaul of the VAT system which is underway would reform the rules on deductibility to facilitate the introduction of conditional rebates. Even if unanimity is required among EU states, this may not be a greater obstacle than the objections raised to every other proposal made to date for remedying the problem of excess nutrient use in agriculture.

An alternative, is to operate a similar scheme, consisting of a fertiliser tax with a rebate conditional on satisfactory nutrient balance, alongside newly-introduced VAT charges in the usual system, which exploits the same data. Less satisfactory suggestions include the imposition of a tax on the phosphorus content of fertiliser. Introduced at the lowest rate applied abroad, specifically at the rate 0.14 ECU per kg P (or £0.112 per kg) used in Sweden, this tax would raise some £6.7 million annually. Alternatively, the tax could be raised in vulnerable areas where only coloured fertiliser would be allowed, or else a fertiliser tradable quota scheme might be used. These last two suggestions are untried, however.

3. A realistic monitoring charge should be levied on inputs which oblige authorities to undertake monitoring. These would include pesticides and possibly fertilisers. Present monitoring for pesticides is apparently under-resourced, and more knowledge of current pesticide levels is needed (Dollard 1994). Monitoring fees are already raised by authorities for industrial waste water discharge.

4. As long as CAP benefits are related to output, it is worth requiring cross-compliance, with set-aside, stocking limits and the like.

5. In addition to removing the perverse incentives to intensification, some landscaping and bio-diversity enhancing projects should be put out to tender. For example farmers could be invited to tender for maintaining barn owls or habitats, or lichens, once a satisfactory means of verifying the existence of the item has been developed. Environmental benefits will then be achieved at minimum cost to society by the farmers most disposed to providing them.

These proposals amount to a two-sided approach to agriculture and the environment. On the one hand the polluter pays, for damage to water mainly. On the other hand the farmer as steward is paid an efficient price, where the farmer acts as guardian of nature and guarantor of bio-diversity.

4.B. FORESTRY

4.B.1 Environmental impact of forestry

After clearance of the indigenous deciduous woodland over many centuries, Ireland was left with less than 1.5 per cent of the country under forest at the turn of this century. Some of the forest has recently been restored, not with deciduous species but with conifers, and forests now cover 8 per cent of the land area (Department of Agriculture, Food and Forestry, 1996). It is in this context, of quite rapid afforestation predominantly by conifers, that we discuss the interaction between forestry and the environment. This contrasts with the situation in many other parts of the world where there is rapid deforestation, or forest decline from mainly airborne pollution.

As with agriculture, forestry has positive and negative external environmental impacts. On the positive side, trees take carbon dioxide from the atmosphere and store it. Therefore planting trees, or increasing their growth rates, can delay the buildup of greenhouse gases in the atmosphere and delay global warming. Lowland forests store more carbon than upland forests and fast growing trees, such as poplar, will take a shorter time to fix (or sequester) a given quantity of carbon than, say, oak trees. The carbon sequestered is eventually, but only gradually, released from the timber and paper, the final products, as a result of decay (Cannell and Cape 1991). The release time might range from hundreds of years for timber incorporated in construction, to less than a decade for pulpwood, pallet and packaging.

Also on the positive side, soil erosion can be reduced by the existence of established forest, once the planting stage is well over. Extremes of water levels can be smoothed. Furthermore forests have amenity value, in providing forest walks and adventure areas, as well as enhancing views and providing windbreaks, and habitats once the forest is established. An estimate of external benefits of forests of £21 million is quoted by the Department of Agriculture, Food and Forestry (op. cit.). Most of these benefits bestowed on society are not rewarded, and in this sense, without state intervention, forest planting will be lower than its ideal level.

On the negative side, forestry can have a detrimental and intrusive effect on scenery, at least if planting has been insensitive to the existing landscape. This could become a disadvantage for tourism, as visitors do not come to Ireland with its forests in mind. Another negative environmental impact is soil and water acidification, occurring particularly at the mature stage when the plantation has been carried out on acid-sensitive soils, with detrimental effects on surface waters and fish. This occurs on sites such as over granite, which are said to be "poorly buffered", that is they cannot absorb the deposition which occurs when clouds and fog droplets impact on the rough surface of a forest causing polluting gases to deposit on the trees and drop to the ground. Trees also filter pollutants in the air which deposit on them, and are washed to the ground by rainfall. So the presence of the forest can increase acid deposition, resulting in increased acidity and heavy metals, particularly aluminium concentrations as a result of the sulphur and nitrogen pollution in sensitive upland freshwaters.
In fact these problems should apply to a minority of water catchments, that is where calcium-poor bedrock is overlain with peat or acid mineral soil, but it is important because the affected catchments are frequently salmonid fisheries. Vulnerable areas would include upland catchments

in Wicklow, west and south county Galway, and parts of counties Mayo, Donegal, Clare, Kerry and Cork which have the largest acid-sensitive areas in the country.[16] In such areas, afforested streams tend to be more acid than unafforested counterparts. Acidified streams in Britain, as in numerous other places, are characterised by impoverished invertebrates and they may be fishless (Alott and Brennan, 1993). In Ireland all aquatic forms of life, water weeds, invertebrates and fish, were severely impaired by acidification as a result of afforestation according to Bowman (1993). If planting occurs up to the edge of the watercourse, this too will increase the risk of acidification, and cause shading of the waters at the mature forest stage, which leads to reduced growth rates of fish. The resulting more even temperature of the water may however be beneficial to fish.

Over 40 per cent of existing plantations in Ireland are on acid-sensitive peatland and there is some uncertainty as to whether the carbon sequestration by the forest compensates for the carbon losses resulting from oxidation of the peat during the development phase (Farrell, 1996).

Mature forests also absorb water, potentially reducing water availability in an area. This occurs because the interception of water passing overhead is more than offset by the high rate of evapotranspiration through the large leaf-surface area. Forested catchments can yield between 10 and 30 per cent less water than unafforested counterparts. Decreased water yield can be of concern generally, and especially in catchments that are used for public water supply.

Other negative effects of afforestation include the increase in sediment exports from the area at the development stage, causing habitat destruction to invertebrates, plant life and salmonid fish. Suspended sediment in water can also have harmful effects (Whelan, 1996). There are of course several courses of action which can restrain the damage, such as careful timing of ploughing and draining, the manner of ground preparation, et cetera. The impact declines as the terrain settles though even after several years, sediment yield can be several-fold higher than pre-drainage levels.

Finally the effects on wildlife and species diversity can be quite marked, though it depends on what was there before afforestation and again on how the forestry is managed and its type.

[16] A map showing the locations of acid-sensitive areas in Ireland is given on page 3 of Bowman (1991).

Afforestation of wetlands, or replacement of broadleaved trees by conifers, would have a negative effect on species diversity, as would fast maturing crops which are then clear-felled, that is, felled in one go. Bio-diversity grows with time in forests, so that longer rotations are more benign than short rotations. Also staggered felling is more benign though more costly than clear-felling. Wildlife populations need habitats with continuity. In addition to destroying habitat, clear felling can cause soil erosion and run-off and leave an unattractive scenery.

In sum, most concern about forestry would centre on acidification of water, on the effect on scenery and on wildlife, possibly in that order. No value has been put on these external costs though work is in train (Clinch and Convery, 1996). Some of these problems can be avoided if precautions are taken and the new guidelines discussed below adhered to (Forest Service 1995/6). The major environmental benefits probably lie in carbon sequestration, and provision of habitat in some instances.

4.B.2 Existing fiscal treatment and environmental effects

An enhanced programme of planting is now underway, for farmers to counter the declines in support for traditional farming, and for the non-farming private sector. Private afforestation, of which farmers account for some two-thirds, is now nearly three quarters of all afforestation. Conditions for forestry in Ireland are ideal with high growth rates at 12 m^3/hectare per year, compared to 4.3 m^3/hectare per year in the rest of Europe (McLoughlin 1996). It is expected that the Irish timber industry will become a net exporter of wood products.

The EU has supported forestry development in Ireland since 1981 through the Western package Scheme and the Operational Programme for Forestry 1989-93. Meanwhile the CAP gives higher returns to agriculture, such that mainly non-agricultural land tended to be used under these forestry schemes. The trend in CAP reform to move away from agricultural output support to direct income support is tilting the balance somewhat towards forestry. The present programme of support introduced in 1994 comes under the Operational Programme 1994-1999 and under the CAP Forestry Accompanying Measure (part of the McSharry CAP reforms). The grant differentials favour the afforestation of diversified species and broadleaves in particular. An additional premium is payable to farmers to help reduce agricultural output. A slightly lower premium is paid to non-farmers. Private afforestation has grown rapidly since 1985. Present subsidisation comes under two schemes: (1) the Afforestation Grant Scheme at a total cost of

£87 million over the five years and (2) the Forest Premium Scheme at a total cost of £125 million, also over the five years (Department of Agriculture, Food and Forestry, 1994). In addition, (3) there are tax incentives applying to forestry development in the areas of income tax et cetera, and subsidies to the timber industry. These are now described in more detail.

(1) The Afforestation Grant Scheme awards an afforestation grant in two stages. At the development stage three quarters is awarded, subject to approval conditions, and four years later as a maintenance grant the remaining quarter is awarded. The total amount per hectare ranges from £1500 for non-diverse species to £3000 per hectare for afforestation which consists of over 75 per cent oak or beech.

(2) The Forest Premium Scheme applies to farmers and others who suffer a loss of income resulting from the afforestation of their land. It is payable only in relation to plantations which qualify for the Afforestation grant above. Premiums are payable annually for 20 years and the levels for farmers range from £130 per hectare for unenclosed land to £300 per hectare for oak or beech on non-disadvantaged enclosed land.

(3) Profits accruing to an individual or a company from the occupation of woodlands managed on a commercial basis and with a view to the realisation of profits are exempt from both income tax and corporation tax. Gains arising on growing trees and on the disposal of felled timber are not chargeable to capital gains tax. Forestry is regarded for VAT purposes as an agricultural activity: there is no VAT chargeable on timber. A person exclusively engaged in forestry is not required to register and account for VAT, though may elect to do so. It is not known what is the cost to the public purse of this tax subsidy. Other subsidies are given to promote the wood-based furniture sector, to aid the construction of forest roads, to courses for forest product marketing, and the like.

The annual real rate of return to forestry under the 1989-93 scheme has been calculated by several authors. On mineral soil, Farrell and Boyle (1990) estimate the rate of return to the forester to be 5.5 to 6.5 per cent, and 4.5 per cent on low-level blanket peats. Clinch and Convery looked at ten per cent of all forest investments grant aided in 1991. Assuming average historical prices, the expected real rate of return was just under 6 per cent in the presence of existing subsidies. However when afforestation subsidies are removed from the calculation, the real rate

of return is decreased to 4.1 per cent. A rate of 5 to 6 per cent would be required for public investment. Under the more generous grants and annual payments introduced in 1994 the rate of return becomes 10.5 per cent, though in reality some of this return will be absorbed by higher land prices. An important question would be: what is the rate of return to public money, in terms of both private and public net benefits, and how does this compare with the cost of raising public funds to provide the subsidy?

Compliance with the guidelines concerning protection of fisheries, landscape and archaeology is a condition for grant aid. The extent to which this affects environmental behaviour is unclear as there are no reports, at least as yet. Afforestation over 70 hectare (reduced from over 200 hectare on 1 October 1996) requires planning permission from the relevant local authority, with submission of a formal Environmental Impact Assessment. If the afforestation is over 40 hectares and includes an aquatic zone the developer must consult the Regional Fisheries Board at least 6 weeks before start of operations - in a Designated Sensitive Area the threshold is 5 hectares. Grant approvals preclude the planting of archaeological sites, and forestry operations must cease on discovery of an archaeological object which must be reported to the Gardai or National Museum. Whether there are adequate resources to monitor and investigate these environmental issues is questionable, as there appears to be no automatic mechanism for their funding, apart from a 5 per cent administration charge on the value of grant payments, which might yield £10 million over the five years. The extra activity will put pressure on existing monitoring resources.

The guidelines for afforestation are published by the Forest Service (1995/6), outlining requirements for protection of fish, archaeology and landscape. A concern is the absence as yet of guidelines regarding wildlife, except that grants are not available for areas which are protected or qualify for protection under EU Directives 79/409 EEC and 92/43 EEC on the Protection of Birds and Natural Habitats. There are currently 75 protected areas under the Birds Directive and none as yet under the Habitats Directive. There is a marked disincentive to the retention of areas of natural and semi-natural vegetation, such as hedgerows and broadleaved groves in properties under development according to Farrell and Kelly-Quinn (1991). These areas are sometimes deducted from the grant-assisted area. This is an example of the distorting effects of grants.

There are as yet no guidelines on procedures for harvesting and transport of timber. However,

the Department's recent *Strategic Plan* (1996) heralds new procedures on notification to local authorities of proposals for over 25 hectares, new conditions on distance from dwellings, buildings and roads, and new guidelines on harvesting, wildlife, and use of chemicals. Also, premiums may be subject to attendance at training courses. With the present heavy planting programme, thought will need to be given to the staggering of felling.

A common theme running through the comment on forestry, as with agriculture, is the need for resources, that is, suitably qualified personnel and equipment, to ensure that the environmental conditions are adhered to. In the case of the requirement, for example, that development of forestry above 70 hectares have an Environmental Impact Study prepared by the developer, the procedure can only operate effectively if the County Councils, which have to assess these studies, have the expertise and the capacity to assess the projects. At the present time, few councils are suitably staffed for this work according to Farrell and Kelly-Quinn. If this is the case then the attachment of environmental conditions might have little meaning in practice. Another reason for concern is the absence of legal protection of Natural Heritage Areas, though amending legislation is currently in preparation by the Department of Arts, Culture and the Gaeltacht.

4.B.3 Suggested use of economic instruments

As with agriculture, forestry receives considerable subsidies from the state, but for development mainly. There is a further need for funds for checking and monitoring the environmental impact. In theory the forestry industry should probably provide these funds.

The underlying aim of the forestry programme is to enhance rural development and provide rural employment, especially in the context of reduced support to agricultural output. An informed outside observer might in fact suggest that these aims could be just as well served by a rural employment subsidy, or reduction in employment taxes, such as PRSI payments and income tax. At present the developer on the afforestation scheme enjoys a higher rate of return than if the grants were absent, but no change in employment costs per se. Hence the developer will want to continue to economise on labour.

However there is an area where subsidisation to forestry is strictly justified in economic terms for environmental reasons, and that is in relation to the external benefits bestowed on society, from carbon sequestration described at the outset. A figure for carbon fixation is quoted by Cannell

and Cape. One hectare of new forest on good sites (in the Pacific Northwest and southern US) will sequester 6 tonnes of carbon per year. One could apply, in reverse, the EU's proposed carbon tax by subsidising trees. In the proposed tax of $10 per barrel of oil, $5 is that part relating to carbon (see the chapter on Energy for more details). This is equivalent to $36.70 or £22.90 per tonne of oil, which contains 0.854 tonnes of carbon, and amounts to a subsidy of about £27 per tonne of carbon sequestered. The reasoning here is that oil users would be taxed £27 per tonne of carbon emitted and, in so far as this represents the marginal damage, the forester should be offered this sum for removing carbon. If a hectare of forest sequesters 6 tonnes per year, then the subsidy per hectare should be in the region of £150 per hectare per year. This would apply only during a certain phase of the trees' lives, though to overcome the aversion to risk some upfront phasing of the subsidy may be necessary. It ought not to be awarded to forest planted on peat soil where the net sequestration value may be zero or negative. If, say, half of the 474 000 hectares of forest in the state qualified, the total subsidy would amount to £38 million per year. The figures used here are for illustration.

This may be an upper limit, because there are other, cheaper, ways of reducing given amounts of carbon emissions[17] and Ireland may choose these rather than forestry, in order to achieve its emissions target. On the other hand, given that forest area will grow and it appears that "the EU is committed to meeting contingent liabilities created pre-1997 in respect of premium payments of up to 20 years duration" (Department of Agriculture, Food and Forestry 1996 op. cit. para. 4.16.3), the funds may be forthcoming anyway. There should however be an obligation to use them optimally. An over-riding consideration is that the future of the CAP is uncertain and its price support aspects will be further phased out. The consequence will be a reduction in land prices, which should help to raise the internal rate of return on forestry and reduce the rationale for such widespread grants.

To the extent that mature forests, and broadleaved forests in particular, provide habitats for wildlife, these should receive a habitats subsidy also. No evaluations of the habitat function of Irish forests been undertaken, to put a figure on the desired subsidy. Such a habitats subsidy plus the £38 million carbon sequestration subsidy combined could amount to something over £40 million per year. Coincidentally, this rough estimate for environmental subsidies is similar to the existing subsidies, which amount to a total of £212 million over the five years 1994 to 1999, and

should replace them. In other words, the existing pattern of subsidies for forests should give way to one that is based on subsidising their benign environmental external effects.

We have just dealt with the external benefits. The external damages, namely acidification, intrusion on scenery and detriment to some wildlife, are not generally amenable to pollution taxes and have to be regulated and monitored. Funds will be required to provide the resources for mapping, testing and analysis along with sufficient qualified personnel, including archaeologists, chemists, fisheries specialists et cetera. The existing administrative charge, which yields perhaps an average £2 million per year, possibly needs to be doubled.

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Appendix 4.1 *Grant schemes to agriculture which have environmental impacts*

Control of Farm Pollution Scheme
The smaller farmer can receive grant aid for certain farm buildings, farmyards, storage facilities for fodder and agricultural wastes and slurry disposal equipment. (The scheme is currently suspended).

Two schemes which have had some adverse environmental effects should be included for completeness, as reforms have recently been introduced to modify their effects:

(i) Livestock Headage Schemes in Disadvantaged Areas (for cattle, equines, sheep and goats in Disadvantaged Areas)
Applicants must undertake to keep the animals for a minimum of two calendar months.
Some main schemes with annual payments are:

Cattle headage payments in handicapped areas range from £40 to £84.

Sheep or goat headage payments in disadvantaged areas are £10 up to a limit of £2000.

This scheme has in fact had some adverse effects on the environment by causing over-grazing by sheep (discussed above) on commonage on hill areas designated as disadvantaged. In October 1995 new measures provided cash payments to farmers who agreed to reduce sheep numbers on hills, amounting to a payment of £31 per ewe for each ewe removed from the flock and an area-based top-up ranging from £60 to over £100 per hectare up to a maximum of 40 hectares. In addition there are incentives where two or more farmers owning at least 50 per cent of the sheep in a designated area agree to join REPS (see below).

(ii) Livestock Premium Schemes
Some main schemes are:

A suckler cow premium applying to the whole country amounts to £136.70.

A special beef premium of £87.88 per head, payable twice in the life of the animal, up to a maximum total of £15 818.

A ewe premium of £17.37 per ewe is paid, plus £5.37 in Disadvantaged Areas.

This scheme also has had some adverse environmental effects.

Nutrient Management Planning via the Advisory Service
This scheme is a subsidised service to help the environment. Nutrient Management Planning (NMP) has been developed by Teagasc, the State's agriculture and food advisory body, and is being applied at farm level through the Advisory Service, facilitated by the EU LIFE initiative. It is of relevance to the large farmer. Lee notes that recommendations not to apply nutrients at high soil test levels were frequently ignored, especially for high value crops and products such as sugar beet and milk. This may be an indication of wrong incentives facing farmers.

Rural Environment Protection Scheme (REPS)
As mentioned, REPS is the agri-environment component of the CAP reforms. Operated by the Department of Agriculture, Food and Forestry, funding is available from the EU for 75 per cent of the cost to farmers wishing to implement environmental measures. This is the most radical environmental scheme to date, aiming to influence farming practice in its totality rather than just dealing with the "end of pipe" problems. Farmers have to implement plans, drawn up by Teagasc or other approved agencies, for waste storage, management, liming and fertilisation plans for the farm and a grassland management plan which avoids over-grazing and poaching. Farmers in

REPS will be paid annually a premium of 125 ECUs (£100) per hectare for five years up to a maximum of 40 hectares.

Extra payments are available for farmers who undertake additional environmentally friendly farming practices such as preserving Natural Heritage Areas (NHAs), organic farming (discussed below) and rearing animals of local breeds in danger of extinction. The Environmentally Sensitive Areas (ESAs) pilot scheme has been subsumed into the REPS.

The REPS in Ireland has an indicative allocation of £230 million for the period 1994 to 1999. While it might be claimed that the environment features rather modestly in the direct spending of the reformed CAP, Ireland in fact receives a significant amount under this.

Early Retirement from Farming

Farmers between the ages 55 and 66 can avail of an annual pension for 10 years (but not past the age of 70) provided at least five hectares are transferred and the transferee meets certain conditions, or the land is transferred to a non-farm use, including forestry and ecological reserves. Qualifying farmers receive a base payment of 4000 ECUs together with £244 per hectare up to a maximum of 24 hectares. Convery (1994) shows that the terms amount to a doubling of the value of poor quality land on farms of 24 hectares. The pension option will be favoured by farmers on small holdings or on poor land, but its environmental effects will depend in part on the uses to which the land is likely to be put.

Organic Farming

Organic farming is a system of farming which co-exists with, rather than dominates, other systems, sustains soil fertility and protects the environment, wildlife and non-renewable resources. Payments will be available to farmers who are already in or wish to convert to organic farming under the REPS. Payments per hectare subject to a 40 hectare maximum are:

	Holdings < 3 hectares	Holdings > 3 hectares
Land in conversion	£195	£146
Land of organic status	£98	£73

An additional 125 ECU (£100) per hectare per year for 5 years is already payable under REPS. Farmers will be paid £100 on completion of a 20 hour training course (Lampkin and Measures 1994).

Development of the organic farming sector is supported by grant aid to operators for packing and distribution etc and to recognised bodies (eg An Bord Bia) for marketing and promotion. 50 per cent capital grants and 70 per cent marketing/promotion grants are available, co-funded by the EU. A minute proportion, some 0.015 per cent of agricultural output in Ireland is organically grown.

Scott, S. and J. Lawlor, 1997. "ENVIRONMENTAL SERVICES "

Chapter 5 in *The fiscal system and the polluter pays principle: a case study of Ireland*
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Introduction

The three environmental services to be discussed in this chapter are:

1. Water supply
2. Waste water treatment and disposal
3. Solid waste collection and disposal.

These services are provided by local authorities, except in a few cases where parts of the service have been privatised under local authorities' direction. Central government, with support mainly from EU Cohesion Funds, provides almost the whole of the capital cost of water and waste water services, but, in the case of solid waste services, local authorities themselves fund capital investment from their various sources of income. Local authorities have a good deal of autonomy over their operations, subject to the usual budget constraints. Until the late seventies the remaining costs, which are largely operating costs, were paid for out of local Rates, but since the abolition of local Rates on households, the revenue shortfall has been made up out of a Rates Support Grant from central government. As funds are inadequate to cover the rising costs incurred in supplying environmental services, local authorities have had to levy charges for these services, often in the face of local opposition.
As will be seen, charges on business probably cover operating costs at least, while charges on households cover only perhaps one third of the total cost of these services. Thus society is paying for the services mainly via taxation raised by central or local government, or via EU funds.[18] This method of paying for services discourages careful use and recycling. In the case of water supply there is much wastage on the part of the user, which would not be so high if there were more widespread charging for water on a volume basis, according to the evidence described below. People tend to take more care if they are rewarded for doing so in lower bills.

The main economic instrument which will be considered in this chapter is **total cost recovery from charges and extension of volume-based charging where it is economically justified**. Why should one depart from the existing subsidised system of supply, a system which reflects the "public goods" aspects of these services? Avoidance of epidemics and the like would be examples of public goods. The answer is that, while avoiding epidemics is still an objective, use of these underpriced services has grown rapidly and as with most underpricing, it gives wrong incentives; they in turn encourage excessive water demand, excessive emissions and pollution content of waste water, and excessive generation of solid waste. Underpricing puts at a disadvantage efforts to reduce, re-use and recycle, as well as discouraging technological developments in these fields. In the past there was an inadequate social welfare system, and so there was a strong argument for subsidised supply of these services, as there was no means for ensuring that low-income households could pay.

It was noted that parts of the service have been privatised in a few instances. Were privatisation to become more widespread, we would witness an extension of full cost recovery as a matter of course. Indeed it could be argued that absence of full cost recovery from the supply of services to industry and commerce is a form of

1 [18] As mentioned at several points in this document, EU funds ought not to be viewed as costless since there are many worthwhile projects competing for these funds and therefore expenditure on one project is expenditure foregone on some other project

State aid, which the EU Treaty[19] describes as "incompatible with the common market". The Treaty includes here "any aid..favouring certain undertakings.., in so far as it affects trade". The shortfall in cost recovery may indeed be made up by local tax revenue from industry, but explicit payment would be less open to dispute.

We will see that volume-based charging will have good, though unquantified, environmental effects. It will reduce the amounts of water used and waste produced, as well as reduce or delay the need for capital investment in the future. It should also help in establishing correct benchmark prices to help the authorities to make comparisons of resource options. The requirement that costs be recovered means that utilities will have to produce explicit unit cost figures so that, after taking account of local conditions, comparisons of unit costs between regions are possible. Efficiency and careful resource allocation, such as leakage reduction, will be encouraged; it becomes more worthwhile to reduce losses if the "retrieved items" can be sold. The benefits of accountability and efficiency will have to be weighed against the political obstacles and difficulties associated with change, and the requirement that the problems of low-income families and people with special needs be addressed.

Ideally charges should be set to reflect long run marginal costs (LRMC), in order to give the correct resource signals. LRMC is the marginal cost of providing the service, in the long run. It includes not only short run costs but also an element to account for the fact that increased usage of plant brings forward the time when the plant will have to be expanded or replaced. This has implications for the pricing of capital and need not conflict with the practice of cost recovery, which can be ensured in other aspects of the tariff, in a fixed charge for example. The absence of cost recovery at present means that extra funds have to be raised from central government taxation, which can be more distorting than local charges because of, among other things, the effects of grants on local authority behaviour. The demand for items that are "free" tends to be higher than if the item is charged for; and this applies to all agents, including to local authorities. This is not to say that there is no case for central government grants. Grants from central government may be required where a local authority is supplying services to people who live elsewhere and are passing through, eg for trunk roads. Relative local deprivation is another instance. The image of the whole of Ireland may be tarnished, and people outside the region will be affected, if a region has a relatively serious litter problem, or a contagious water-borne disease, and so on. However, a large part of the benefits and disbenefits of the three services discussed here accrue to the people within the region. Furthermore, it is they who impose the costs, so application of the Polluter Pays Principle implies that local people should pay. Though costs may also have been imposed by others, such as the agricultural sector requiring for example extra treatment of drinking water, the aim would be to have these polluters pay also.

This chapter will look at each of the three services, covering industry, commerce and households. There will be an overview of current charging practice and of the current extent of cost recovery. The environmental impact of the present situation and the options for improving the fiscal structure for each service will be considered.

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2 [19] Article 92 of EU Treaty (OJ, 1992)

We discuss the implications of full cost recovery for the present levels of expenditure, and for the future situation, where more costly standards of environmental services will prevail in conformity with EU directives. A final section will give our conclusions and recommendations for all three services. We can envisage that full cost recovery will bring about a reduction in central government funding (and hence taxes) when compared to a continuation of the current charging levels. Later, when higher standards are provided, as required by EU law, there is the prospect of a correspondingly greater reduction in central government funding compared to what it would otherwise need to be.

5.1 Water Supply

Some 1.3 million cubic metres per day are sent out to a population of 2.8 million who are served by public water supply schemes (McCumiskey 1991). Approximately 35 per cent of water is used for commercial or industrial purposes, the remaining 65 per cent being used by households. About 38 per cent of water production is apparently accounted for by leakage from the public distribution system, including leakage within private property, on top of unavoidable leakage of about 15 per cent (O'Connell 1992).

The eighties saw the coming on stream of large power stations and big industrial users, and the expansion of water consumption by dairies. All this was accompanied by rising incomes. Consequently costs of supplying water services have risen, as shown in Table 5.1.

Table 5.1: Costs of Supplying Water 1981-1995 (£m).

Current costs plus capital repayments (1)		**Current costs only**	
1981:	51.7	1988:	59.8
1982:	63.7	1989:	63.7
1983:	75.5	1990:	68.4
1984:	87.6	1991:	71.4
1985:	99.0	1992:	74.4
1986:	101.6	1993:	78.5
1987:	110.9	1994:	81.8
		1995:	88.1

Source: Returns of Local Taxation, various issues.
Notes: These figures are not adjusted for inflation.
(1) Capital repayments were made to the Local Loans Fund. The Fund was subsidised by central government, possibly to the tune of 50 per cent.

Note that inclusion of capital repayments up to 1987 makes the pre-1988 figures not comparable with those for 1988 and after. The pre-1988 figures give an indication of total costs. However on account of a subsidy to the capital costs, these earlier figures also understate total costs.

No direct means of obtaining total costs for water supply exist at present, and a figure for cost recovery cannot be calculated. Neither is a firm figure of total supply to hand, so that unit costs are also elusive. Efforts to put figures on these items yield the information given in Table 5.2 for 1994.

Table 5.2: Estimation of Cost Recovery from Charges and Unit Cost of Water Supply in 1994

	£ million
Current Expenditure (incl. administration)	96
Receipts: Charges (note 1)	72
Current cost recovery percentage	75%
Current Shortfall	24
Shortfall financed by: (note 2)	
Local sources (mainly commercial Rates)	9.6
Central Govt (e.g. Rates Support Grant)	14.4
Capital Expenditure	40
Financed by:	
Govt grant (note 3)	39
Contributions from industry (note 4)	1
Total Cost Recovery percentage	54%
Quantity supplied (note 5)	223 million m^3
Current unit cost	0.43 £/m^3
Capital unit cost	0.18 £/m^3
Total unit cost (note 6)	0.61 £/m^3

Notes:

(1) Of which £40 million and £32 million were paid by households and non-households respectively.

(2) Figures for Local and Central Government sources are supplied only as totals (Appendix Table 2.1), so that the breakdown between local and central sources has been applied pro rata 40% and 60%.

(3) *Local Authority Estimates, 1995*, p.31 and Department of the Environment.

(4) Contributions from industry are estimates, therefore capital expenditure is also approximate.

(5) This is an estimate of the quantity actually delivered to consumers. McCumiskey (1991) p. 48, and Environmental Protection Agency (1996) p. 65 give 1.3 million m^3/day or 474.5 million m^3/year, sent out. O'Connell (1992) p. 53 gives leakage of 53 per cent. The household and non-household shares of consumption are estimated at 65% and 35% respectively.

(6) Unit costs would be higher if financing charges were included.

Sources: Department of the Environment, *Local Authority Returns* and *Local Authority Estimates*.

Total unit cost of water in Table 5.2, excluding finance charges, is £0.61 per cubic metre. The figure is speculative as several components are estimates. Judging from the figures for 1987 and 1988 in Table 5.1, financing charges could add considerably to the figure. Bearing this in mind, the estimate of £0.61 is broadly comparable with the cost of £0.70 per cubic metre in Wales and the South West of England (Fehily Timoney Weston, 1995), which include financing charges.

There is no formal or agreed procedure for setting tariffs for water supply with the result that there is considerable variation in tariffs between local authorities, depending on their circumstances. A consequence as we saw is that there are no national statistics of unit costs or cost recovery, with possible disadvantages for resource allocation and policy decisions.

5.1.1 Industry and Commerce

Industrial and commercial customers with demands above a certain level, which varies between authorities, are charged for water. A proportion, consisting mainly of large users, is charged on a metered basis. Only some 35

per cent of the water distributed is used for commercial or industrial purposes, though these users pay 44 per cent of the revenue from charges. As yet there is no firm breakdown of costs incurred for supply to households and non-households, but it would appear that current cost recovery from industry is above break-even level. However, water charges to non-households (more frequently than with households) include a contribution to waste water treatment, which is often not billed separately from water supply.

5.1.2 Households

There is again considerable variation between local authorities, depending on their circumstances. The costs of providing local water supply, as with other services, have risen and grants from central government have not kept pace. Domestic water charges are now raised by 86 out of 88 local authorities, that is, by all except Dublin and Limerick County Boroughs. These two authorities are relatively well endowed by central government, they have a wide base for business Rates and opposition to charges is strong in some quarters. Elsewhere charges raised annually range from £51 to £145 per household and tend to be a uniform flat fee across households within a local authority area. Some ten authorities impose a charge based on the old valuation of the property which was used under the now-extinct Rates regime. A few authorities charge by type of dwelling, for example according to whether it is terraced, detached et cetera.

The areas where there are higher water charges tend to be areas with no sewerage charges, charges for the two services being effectively combined in about 60 authorities. Local authorities report that it is easier to collect charges for water than for sewerage.

5.1.3 Subsidisation - who ultimately pays?

Nationally, revenue from charges for water supply covers but 75 per cent of *current* costs of supply, as shown in row 3 of Table 5.2. However this coverage is an improvement on the recent past. Taxpayers ultimately pay for these under-priced service. The immediate channels of subsidisation ought to be identified though only broad aggregates can be given.

The government provides a subsidy via the Rates Support Grant, paid to local authorities in lieu of the dismantled household Rates. Industrial and commercial enterprises would also claim to contribute to this subsidy, through the Rates which they have to pay on their property to the local authority (only household Rates were abolished in 1978). The government (and European taxpayer) subsidise practically the entire *capital* cost. A connection charge may however be raised from households, and non-households are increasingly required to pay a "contribution" to the capital costs. To date, contributions have been very small in relation to total capital expenditure, at perhaps 2 per cent of the capital cost.

We estimate that *total* costs of water supply to households are possibly subsidised by some 55 per cent, and to non-households by 30 per cent, disregarding their payment of business Rates. Given that wasteful use is likely due to charging on an unmetered basis, the thrifty are subsidising the profligate. Low-paid and middle-income

households may reckon that they are paying more than their fair share of general taxation, and may consider that they are subsidising the rich, who tend to be big users of water.

Low-income households which are deemed to be unable to pay local authority service charges are granted a waiver. Not being directly reimbursed by central government, the local authority has to finance waivers out of its grants from central government, out of commercial Rates or indeed out of other household and non-household charges. Figures from three local authorities on the proportions of revenue due from domestic charges that have been waived are 13, 20 and 24 per cent, the latter proportion relating to a town with very high unemployment. There is no information on this at central level. Some local authorities say that they are awaiting guidelines from central government on the operation of waivers.

5.1.4 The decision to install household water meters

From the point of view of equity it is desirable that households that consume large amounts of water make a higher payment. It is also preferable if households which reduce consumption pay lower bills. This is facilitated if payment is volume-based, which requires a meter to have been installed. However, owing to the considerable cost of meter installation, metered charging is probably not economic on a wide scale at present. To assess whether metering is desirable on economic grounds, it is necessary to estimate the costs and benefits of installing meters. As with any investment decision, domestic metering and unit quantity pricing are to be recommended from a national economic viewpoint if gains outweigh losses. Somewhat simplified, this condition can be expressed as follows (OECD 1987). After metering:

[Reduction in water use] x [long-run marginal cost of water supply] + external benefits > resource costs of metering and volumetric charging + value of water use foregone.

In other words, if benefits are greater than costs, installation should proceed. Relevant items in the calculation can be expressed as annual equivalents, or as net present values. Owing to difficulties in estimation, the value of external benefits and of water use foregone are frequently omitted from the calculation, but as is now becoming evident the external benefits (or avoided damages of increased abstraction) are considerations to be reckoned with. Potential damages are becoming greater as the most abundant and cheap sources are exploited already. Other benefits include the availability of management information which could help improve performance and forecasting. A by-product of metering is that some repair of leaks can be incorporated at small extra cost. The saved water can reduce costs and be sold for new uses. The resource costs include meter installation and maintenance, and billing costs.

We are witnessing two trends in the values of the figures which are used in the above calculation for assessing metering. Looking first at the benefits given on the left hand side of the equation, the long-run marginal cost of water supply is rising as water that is most easily accessed is already availed of. Obtaining new water supplies

requires higher capital expenditure or removal of supplies from some existing use such as hydro-electricity, or rivers which have amenity value or ecological significance. The fact that money may not change hands is sometimes interpreted, incorrectly, to mean that such supply options are less costly than other options, including options which influence demand (Herrington 1996). Thus the benefits to be used in the above calculation from avoiding or delaying supply expansion are likely to rise, and therefore so are the benefits of metering. The National Rivers Authority (NRA 1995) reports that in the UK where water resource development costs have risen to £1.5 million per Megalitre per day, domestic metering would be only marginally more expensive than expanding supply. This takes no account of benefits to the environment of the reduced consumption. In fact, therefore, if the financial costs plus the environmental costs amount to £1.5 million to install capacity for a Megalitre per day, then metering is worth considering. This merely indicates the possible order of magnitude involved, and the sort of calculations that should be made.

Furthermore the external benefits are also likely to rise. We need hardly be reminded of the shortages of water in the world, with some 25 per cent or 1.5 billion people being seriously short of safe water, and the same again not having enough for daily needs, according to the UNDP (1990) and OECD (1993). Ireland's abundance of fresh water will make it increasingly attractive to foreign investors seeking locations for their water-using industry. The availability of water in certain regions is a known factor in attracting major companies. However, with strong growth in the demand for water in Ireland, this abundance cannot be taken for granted indefinitely and the value of water saved will rise. There are in fact "water shortages" in some regions such as South Dublin, in addition to conflicts of use, such as between angling on the one hand and water abstraction for use by households or industry on the other. The Eastern Regional Fisheries Board, for example, is concerned that Dublin's claim to being the only European capital endowed with a healthy salmon river may become a thing of the past as the demand for water continues to rise (Evans 1996). In another county, extra supply is being sought from a salmon river in the face of environmental objections, to satisfy demand in a rapidly growing town. Owing to a historic agreement, the town at present is being charged but a fraction of the financial cost of water imported from a neighbouring authority.

It is worth noting that attitudes to various aspects of this issue are likely to alter over time and vary from place to place. For Waprog, the water company for the northern province of Groningen in the Netherlands, for example, the aim of meter installation in 1985 was to achieve a fairer allocation of what people paid for water. The "motive of saving water hardly came into it" (Zweegman 1995). Benefits that were external to the utility were therefore the deciding factor. Installation of meters was carried out, reportedly to the satisfaction of all parties, by people who had been unemployed for a long time. This gave them the opportunity, after a brief training course, to gain work experience. More than 100 000 water meters were installed at a cost of little more than 150 guilders each (£45 in 1986/7, or £58 at 1996 prices).[20]

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3 [20] The chapter on Energy describes a method used in Sweden for encouraging installation of measuring equipment.

The second trend in the calculation to assess the desirability of metered charging arises in the costs on the right hand side of the inequality sign, namely in the improvements in metering technology. The meter itself now costs some £20 to £40. However it has to be installed in a meter box. The box is easily installed at the time of construction of a dwelling, when the overall cost of meter installation would be some £45. Installation at a later stage after the house is built might cost anything between £70 and £290, because there is the added requirement of reinstating the ground or pavement. OFWAT (1995) reports that in the UK in 1995/6 the average charge for internal installation was £120, and £176 for installation in the highway or on the pavement.

Measurement problems in meters (sometimes cited by opponents of metered charges) tend to result in under-recording rather than over-recording, due to jamming or inhibition of the propeller in the meter. According to the National Rivers Authority (1995) in the UK, while 20 per cent of meters in the National Metering Trials that were randomly tested failed to meet the in-service test requirements, incorrect registering "was considered to be so minor that the effect on a customer's bill would be negligible". In the UK the additional costs of metering of water and sewerage are £26 per customer per year. Meter reading technology is also advancing, with experiments underway in the US with hand-held data-loggers which can read the customer's meter from inside a van on the street. The advances in technology of the last few decades should alert us to the likelihood of further improvements, including the possibility of joint metering and charging of several services, such as fuels and water services, as in the Netherlands.

In sum, benefits of metering can be expected to rise and costs to fall, so that we will see increasing economic justification of meter installation in some areas. Early studies, such as those for Rotterdam in 1968 and for the UK in 1976 and 1985 concluded that metering was not viable (though in the latter case selective metering was recommended), but other studies show viability, such as for Perth in Australia in 1982. It depends on the circumstances of the region. If the cheapest leakage reduction options have been taken, it is possible that there is or will be economic justification for metering in some areas in Ireland where there is water shortage. Metering may be worthwhile if the next unit saved through leakage reduction would be relatively costly. NRA give a broad guide to demand management options including leakage reduction and universal metering in England and Wales, summarised in Table 5.3.

Table 5.3: Demand Management Options in Order of Cost Effectiveness, excluding Environmental Costs and Benefits

Option	Costs Pence/m^3	Cost/Benefit Ratio Low cost development*	Cost/Benefit Ratio High cost development*	England and Wales Water savings Ml per day
Efficient washing machines_	0	0.0	0.0	440
Controllers of urinals	9	0.3	0.1	140
Leakage control	13	0.4	0.2	2340
Low flush WC	18-28	0.6-0.9	0.3-0.4	850
Universal domestic metering	89	2.7	1.3	1060
Shower installation	94	2.9	1.4	610
Low volume shower heads	102	3.1	1.6	40
Lower flush WC (6 litres)	172	5.2	2.6	-
Domestic water recycling	321-493	9.8-15.0	4.9-7.5	1280

Notes: Ml is a megalitre, or a million litres. Costs include capital costs.
* Assuming low and high development costs of water supply at £0.75 and £1.5 million per Ml per day, respectively.
Source: NRA (1995)

The first column of Table 5.3 shows the cost of saving a cubic metre of water by each option. The next two columns show the cost/benefit ratio of each option, a ratio of less than unity indicating that an option is financially feasible. As the table shows, universal metering is not the first option which should be considered, as it is unlikely to be viable except in situations where there are shortages and high development (and/or environmental) costs, and where the options of efficient appliances and leakage control have been exploited. Based on these average calculations we can see that the cost per cubic metre saved by metering is 89 pence. In crude terms, if the cost of alternative options, including their environmental costs, is more than this, then metered charging should be considered. Obviously individual cases would have to be considered on their merits.

The Appendix Table gives a brief summary of water charges in 17 European cities. It is noted that the charges vary a good deal as does the rate of VAT applied. About 7 per cent of households in the UK pay on a metered basis. Generally, households can opt for this method of payment and are given ready reckoners for calculating whether it is likely to be worthwhile in their particular circumstances. They pay for the meter installation costs. The Director of OFWAT believes however that where there is tight water supply, the costs of meter installation should be shared across all customers, as metered charging avoids supply expansion. There are also schemes for households which prefer a Do-It-Yourself arrangement for meter installation.

Different options for calculating the basis on which charges should be made were investigated in the UK by Rajah and Smith (1993). They assumed a switch from the existing charging method which would leave total revenue unchanged. The existing charging method for domestic water and sewerage in the UK was based on

rateable valuation of the property, a method that is somewhat regressive, in that the proportion of household income taken in Rates rises as household incomes fall. Not surprisingly it was shown that a flat fee per household was rather more regressive than the rates-based method. Interestingly, they found that a volume-based charge (ie metered), amounting to 91.8 pence per cubic metre, would be nearly identical to the rateable valuation method, in its incidence, the four middle income deciles paying very slightly more, the highest slightly less. In the absence of the rateable valuation method or of metering, they recommend charging on the basis of the numbers in the household. The charge per head worked out at £44.68 and would be marginally more regressive than the existing Rates based system. They also recommended that targeted adjustments to the levels of social security benefits be made to address the distributional effects.

5.1.5 Responsiveness of domestic demand to introduction of metered charging for water

Apart from the benefit of "fairness" invoked for metering in Groningen, it is important to see if metering has an effect on demand. If not, the gains in allocative efficiency may be rather small.

Studies applied to widely differing regions have shown that significant and enduring impacts result from metered charging. OECD (1987) listed twenty-two studies with reported consumption reductions usually in the range of 10 to 30 per cent as a result of metering alone. These studies referred to installations in Sweden, Denmark, Norway, Finland, France, the UK, Canada, the USA and Australia.

In the Netherlands, a considerable drop in individual consumption occurred in the Waprog jurisdiction, actually during the installation period, but was viewed initially as merely temporary. It was expected that the public would soon get used to the new but fairly low charges of 1.25 guilders (then 42 pence) per cubic metre. Now that six years have elapsed there has been virtually no subsequent change in individual consumption, the conclusion can be drawn that there has been a permanent drop in consumption of at least 10 per cent, and that this is probably conservative when viewed in relation to what consumption would have been by now. The ratios of maximum day to average day usage, and maximum hour to average hour usage, have also decreased as a consequence of the meter installation, by 11 and 9 per cent respectively.

The results of a study in the Isle of Wight have been analysed and published as part of the National Metering Trials, and they show that response to metering in the UK is in line with studies from elsewhere. The average reduction in household consumption of eleven small-scale sites (not on the Isle of Wight) was 10.8 per cent due to metering. The Isle of Wight was not in fact intended as a specific test of the impact of metering but rather to assess the problem of switching to metering on a large scale, so that there was no control area, and historic data had to be used instead. Again some 10 per cent reduction in household demand ensued, a further 10 per cent reduction being attributable to the replacement of defective supply pipes. From all trial areas, an average 30 per cent reduction was recorded in peak-month, week, day and hour demand. For a typical water company in the

south east of England this could enable postponement of a new water source for 13 years, based on average demands, and an indefinite postponement based on peaks.[21]

On the issue of acceptability, 71 per cent of customers regarded metering as a reasonable system of charging. The majority of customers had lower bills, but 4 per cent suffered social or financial hardship as a result of the change, according to the National Rivers Authority (1995). These views on metering are consistent with the responses to a survey conducted by the Flood Hazard Research Centre (1993) in the UK, in which respondents were asked how households should pay for water. The results, with percentages of respondents who agree or disagree with each proposed method, are shown in Table 5.4.

Table 5.4: How Households Should Pay for Water: Percentages Agreeing or Disagreeing.

Method of paying	Strongly Disagree %	Disagree %	Neither %	Agree %	Strongly Agree %	Number of Cases
according to the amount of water used	9	9	14	**27**	**41**	994
according to the number of people in the household	15	13	18	**26**	**28**	995
according to household income	24	16	21	21	19	994
according to the size of their house or flat	**28**	24	17	18	13	991
the same amount as any other household	**36**	**30**	16	10	9	995

Note: Percentages of respondents above 25 per cent have been highlighted.
Source: Flood Hazard Research Centre (1993).

The table shows that 41 per cent strongly agree that payment for water should be according to the amount used, another 27 per cent "agree". These replies correspond quite closely to those for Ireland, given in the chapter on the General Background above, where 42 per cent of females and 51 per cent of males said that drinking water should be charged according to the amount used. Understandably, however, UK support for charging "the same amount as any other household" is rather lower than support for this charging method in Ireland where the charge itself is quite small at present.

5.1.6 Responsiveness to changes in the price of water

Other studies have looked not alone at the effect of introducing metered charging while maintaining revenue constant, but at the effects of price changes on demand. International patterns of water consumption suggest that there is a significant price effect on demand. As a start, one should note that water prices in Europe are 50 to 350 per cent higher than in the US and per capita consumption is accordingly 50 to 75 per cent lower (OECD

4 [21] Installation costs in the majority of cases in this study came to £165 for internal meters (that is, meters positioned within the customer's property) and £205 per meter for external meters, at 1992 prices. Operating costs per meter came to £19.08 per year

1993). Econometric studies, quoted by the National Rivers Authority, undertaken in Australia, Canada, Israel and the USA show that domestic use decreases by between 3 and 7 per cent following a 10 per cent increase in the price of water.

Data from the American Water Works Association, derived from a survey of 430 US utilities, were analysed by Nieswiadomy (1992). The study showed that the response to a 10 per cent price rise would be a decrease in water demand ranging from 1 per cent to 6 per cent. Another US study (by Schneider 1991) indicates that short-run response to a 10 per cent price rise is in the 1 to 4 per cent range, but that long-run response is stronger and is in the 3 to 9 per cent range. Table 5.5 presents these results, and also shows responsiveness of demand to changes in income.

Table 5.5: Estimates of Price and Income Elasticities of Demand for Water Supply

	Price Elasticity		Income Elasticity
Type of user	**Short-run**	**Long-run**	**Long-run**
Residential	-0.11	-0.26	0.21
Commercial	-0.23	-0.92	1.97*
Industrial	-0.11	-0.44	n.a.
Government	-0.44	-0.78	0.9
School	-0.38	-0.96	0.89
Total	-0.12	-0.5	n.a.

Notes: Figures show the percentage change in demand resulting from a 1 per cent rise in price or in income.
* Considered unreliable by the author.
Source: Schneider (1991).

The long-run response is generally double the short-run response, showing that behaviour and alterations to water-using equipment do occur. The high long-run response by schools is probably explained by the ease with which schools can switch off water during holidays, or adjust their appliances.

Further studies are summarised by Sanclemente (1995), for Spain. An analysis of nearly 3000 cases in the Metropolitan Area of Barcelona reveals that after the introduction of metered charging, some 24 per cent did not alter their consumption, but that the remaining 76 per cent reduced their consumption by nearly 17 per cent on average. This gives a 10 per cent decline overall. In Terrassa, it is observed that metered customers consume nearly 13 per cent less than customers charged a flat fee. In Mataro, progressive metered charging of customers in the decade to 1993 has reduced consumption per head by nearly 16 per cent "enabling water resources to be released for industrial use without increasing the town's total water consumption". In these three cases the structure of the tariff also played a role. The tariffs consisted of a mains connection fee and two or three consumption blocks charged at progressively higher rates. Other studies were undertaken of the effects of the installation of individual meters in blocks of flats in Paris, Nancy and Rennes, where the decreases observed were larger still.

There are many other worthwhile demand-side measures for constraining the growth in demand for water, which indirectly come within our scope. These measures include the imposition of a tax on appliances which

use relatively more water, such as power showers. However, given that water supply constraints affect only certain regions, such measures could be viewed as crude. On the other hand, subsidies for installation of efficient appliances in some regions could be worthwhile.

5.1.7 The impact of full cost recovery

Table 5.6 summarises the situation. This shows the present shortfall in financing the service, plus the likely increase in costs in the future - £19 million - to give the future shortfall in funding the system in the absence of full cost recovery - £82 million per annum. This is also, by definition, the improvement in public finances by moving to full cost recovery, though increased social welfare payments of perhaps £25 million per annum would be required to help low-income households. We assume no change in water usage levels, though it might be more appropriate to assume some reduction. However, it is likely that reductions by existing users would be compensated for by new firms or increased population, so we have not built any reductions into our figures.

Table 5.6: Impact of Full Cost Recovery on public finances - water supply

	£ million
Present shortfall in cost recovery (from Table 5.2)	63.00
Add:	
Expected increase in annual costs (note1)	19.00
Future shortfall in financing the service, if full cost recovery is not introduced = improvement in public finances if full cost recovery is introduced	82.00
Less:	
Increased social welfare expenditure for low-income households if full cost recovery is introduced (note 2)	25.00
Net improvement in public finances if full cost recovery is introduced	57.00

Notes:
1. KPMG (1996) indicates future increases in operating costs of £47 million per annum, for water supply and waste water services combined. We estimate later in this chapter that the figure relating to waste water is £28 million, leaving a balance of £19 million relating to water supply.
2. On the basis that future domestic supply will cost £100 million per annum (65 per cent of the total), and approximately 25 per cent of households will be unable to pay.

5.2 Waste Water

As with the other services, waste water falls into two main categories - domestic/municipal and industrial. For the purposes of this chapter agricultural waste is ignored, although it is also a very major source of waste water; it is dealt with in the chapter on agriculture. The level of waste water generation and treatment is given in Table 5.7. As can be seen, the majority of waste is generated by the industrial sector, and this sector also does most of the treatment currently carried out.

Municipal service levels vary by whether an agglomeration is inland or coastal. Most inland towns are serviced by secondary wastewater treatment, while no coastal town or city is as yet (of the latter, only Dublin currently has primary treatment). The coastal regions contain most of the large urban areas, which means that currently the bulk of the population (70 to 75 per cent) is not serviced by wastewater treatment plants. This situation is destined to change over the coming years, as the EU Urban Wastewater Directive is implemented. This will involve a major programme of expansion of municipal waste water treatment. Weston-FTA Ltd (1993) calculates that the current contributing population equivalent (PE) to existing sewerage and treatment facilities in the agglomerations affected by the Directive amounts to 2,715,000, while the future design PE for facilities in these agglomerations is 4,099,000. By the time of full implementation they estimate that 70 per cent of the population will be served by treatment plants.

Treatment conditions for industrial waste water are generally set out in the firms' water pollution licence. Because of the lack of treatment in the main urban areas, and the importance of agri-industry (many large food-processing plants are situated in rural areas or small towns), the majority of firms currently carry out their own treatment, as has already been seen. With the planned increase in treatment levels in the urban areas, more firms are likely to become connected to municipal treatment plants in the coming years.

Table 5.7: Estimated Non-agricultural waste water arising and treated nationally ('000 tonnes BOD per annum)

	Total	*Of which -*	
		Industrial	*Municipal*
Waste water generated nationally	114.00	69.00	45.00
Reduction in waste by treatment			
by industry	46.00	46.00	0.00
by local authorities	12.00	3.00	9.00
Waste discharged to the environment	56.00	20.00	36.00

(Source: Various, cited in Scott and Lawlor, 1994)

In terms of hydraulic flows, we estimate that the total quantity of waste water treated in municipal waste water treatment plants or conveyed in the public sewerage system is very roughly 240 million m^3 per annum[22]. The flow treated by industry is very difficult to estimate, since industrial effluent is of a far less uniform standard than municipal waste water.

5.2.1. Environmental impact

5 [22]Weston-FTA (1993) indicate a total flow to the system of 2.7 million PE. The Dry Weather Flow per PE is 82.9 m^3 per annum (domestic sewage strength). 2.7 million x 82.9 = 240 million m^3.

The potential impact of waste water entering open bodies of water is significant, in terms of oxygen depletion, eutrophication (these two factors are mainly responsible for fish kills and reductions in fish populations), health risks from human consumption of the water, loss of amenity, smells, etc.. The actual impact depends on the level of treatment the effluent receives before release, and the assimilative capacity of the receiving waters. In relation to the latter point, one would generally be more concerned about discharges to inland waters than to open marine waters.

5.2.2. Existing fiscal structure

Charging for public waste water collection and treatment services As with the other services, charges under-recover the costs of providing the service, especially in relation to the capital costs. Until recently, charges made no contribution to these costs, with 100 per cent of being paid for by central government (with considerable aid from the EU). More recently, industry has been asked to make capital contributions to the cost of municipal treatment plants to which they discharge. The situation is summarised in Table 5.8.

Table 5.8: Estimation of total cost, unit cost and cost recovery of waste water in 1994

	£ million
Current Expenditure	41
Receipts from charges (note 1)	7
Current cost recovery percentage	17%
Shortfall	34
Financed by (note 2):	
Local sources (mainly commercial rates)	14
Central government (mainly Rates Support Grant)	20
Capital Expenditure	60
Contributions from industry (estimate)	1
Shortfall financed by central government (with EU assistance)	59
Overall cost recovery percentage	8%
Quantity supplied per annum (note 3)	240 million m^3
Current unit cost	£0.17/m^3
Capital unit cost	£0.25/m^3
Total unit cost	£0.42/m^3

(Source: Department of the Environment)

Notes:

1. £6 million of this comes from commercial sources, and the remaining £1 million from households. Many more local authorities levy water supply charges than levy waste water charges; as already mentioned, in many cases the two charges are subsumed into one, and simply called water charges.
2. On a pro rata basis.
3. This is a rough indication of unit cost, based as it is on the hydraulic flow only. Other elements of waste water, such as BOD and suspended solids, are also important cost factors, and can differ from hydraulic flow considerably, especially in the case of industrial effluents.

As regards charging practices, Table 5.9 summarises the results of a survey of Irish local authorities (to which 33 replied). As this survey was carried out in 1994 it is likely that it somewhat understates the current level of

charging. Data for 1996 indicate that 31 out of 88 local authorities currently levy separate domestic waste water charges; in all cases the charge is fixed (i.e. not volume-related).

Table 5.9: Charging for waste water services

Type of charge	*No. of respondents to survey*	*Basis of charge*
Capital contributions from industry	12	Half were volume-related
Industrial effluent operating charge	16	Volume-related
Industrial effluent monitoring charge	28	Mainly related to the frequency of monitoring
Domestic charges	10	Fixed charges
Total number of respondents to survey	33	

(Source: Scott and Lawlor, 1994)
Note: In addition to those already levying industrial effluent charges, a further six respondents were considering adopting charges in the future.

Compliance incentives (i.e. financial penalties for non-compliance) Local authorities have at their disposal several pieces of legislation which allow them to impose fines for non-compliance with regulations or for illegal releases of waste water. The degree to which these are used varies from authority to authority. The income from the fines is not known.

Environmental effects of the existing structure The environmental impact of this fiscal structure - characterised by under-recovery of costs, and non-volume related charges - is that there is likely to be an excessive amount of waste water being generated. One would expect this over-generation mainly to occur at the industrial level (to the degree that firms are connected to the public waste water system), since the capacity to reduce waste water generation at the domestic level is more limited. This assertion is backed up by actual experience where some local authorities have introduced volume-related charges for industrial waste water services: firms responded by reducing their waste water generation quite significantly (Lawlor, 1996). Some reduction might be expected at the domestic level also, if volume-related charging was introduced: there would be an incentive, for instance, to buy domestic appliances that used less water.

5.2.3. Options, from experience in Ireland and Overseas

Charge the full cost of municipal waste water services This would include the full capital and current cost on all users of their treatment plants and sewers. For industry, the charge would be made up of a LRMC charge, which would cover roughly 75 per cent of the capital costs, and the variable element of the operating costs. In addition there would be a fixed charge to recover the balance of the capital and operating costs. A possible design for a capital charging system for industry is given in Scott and Lawlor (1994).

At the domestic level, waste water volumes are of necessity proxied by water supply volumes. Thus volume-related charging would require the metering of water supply to each household. This has already been

discussed in detail in the section on water supply, and we saw that the economic viability of universal domestic metering is unclear.

Introduce charging for discharges to water, even where no treatment is carried out This would be a pure pollution tax, based on the damage cost of the discharges. It would give an incentive to carry out the maximum amount of treatment, up to the point where further treatment is more expensive than paying the tax. It would be levied on discharges by industry *and* the local authorities, and would be administered by some central body, such as the Environmental Protection Agency (EPA). The amount of the tax would vary from place to place, depending on the sensitivity of the particular location. This approach is used in a number of European countries, including The Netherlands and France.

Subsidise or give grants for the capital cost of improved waste water treatment While in Ireland there is an implicit subsidy to users of municipal waste water services, in other countries the authorities often provide grants to industry to introduce improved treatment. However, the funding for these grants usually comes from general charges or levies on industry.

5.2.4. The impact of full cost recovery

What might be the impact for local and central government finances of full cost recovery? Two factors need to be considered:

(i) Operating costs are due to increase significantly as new treatment plants come on stream. We estimate that operating costs will increase by very roughly £28 million per annum as a result of this[23].

(ii) What would be the revenue from a pollution tax on waste water discharged to the environment? This depends on the extent to which the tax is levied (on all waters or just sensitive waters?), the level of the tax, and the level of pollution going into the relevant waters[24]. How much of this would be subject to a tax, and how much the tax would be are also unclear, so it is difficult from the current standpoint to estimate how much revenue this tax might raise.

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6 [23]Department of the Environment (1993) gives illustrative costs of operating new treatment plants of £11.38 per Population Equivalent (PE) per annum for a small treatment plant (capacity 15,000 PE) and of £4.06 per PE per annum for a large treatment plant (capacity 94,000 PE). If we take current municipal secondary treatment capacity from Table 5.7 of 12,000 tonnes of BOD per annum, this converts to 0.5 million PE (on the basis that one PE generates 60 grams of BOD per day). There is a further 700,000 PE of municipal primary treatment capacity in place. The planned future secondary treatment capacity as already mentioned is 4,099,000 PE. We assume that half of this is treated in small plants and half in big plants (including the upgrade from primary to secondary treatment, which we assume costs 2/3's as much as building a secondary treatment plant from scratch) and add 5 per cent for inflation

7 [24] Taking the estimated total waste generated from Table 5.7 of 114,000 tonnes of BOD per annum, this converts to 5.2 million PE. Existing municipal secondary treatment capacity is 0.5 million PE, rising to 4.1 million PE, and current industrial capacity is 2.1 million PE. This seems to suggest that the pollution load arising will be more than catered for by future treatment facilities, but treatment will only reduce the pollution (BOD) content by 80 per cent, future municipal capacity is likely to replace some existing industrial treatment capacity, and future industrial load and treatment capacity are unknown. Hence, it is not clear how much pollution will be released into the environment in the future, except to say that the quantity is not likely to be very large.

Table 5.10 summarises the situation. This shows the present shortfall in financing the service, plus the likely increase in costs in the future - £28 million - to give the future shortfall in funding the system in the absence of full cost recovery - £121 million per annum. This is also, by definition, the improvement in public finances by moving to full cost recovery, though increased social welfare payments of perhaps £20 million per annum would be required to help low-income households[25]. We assume no change in pollution levels, though it might be more appropriate to assume some reduction, especially by industry. However, it is likely that reductions by existing firms would be compensated for by new firms or increased population, so we have not built any reductions into our figures.

Table 5.10: Impact of Full Cost Recovery on public finances - waste water

	£ million
Present shortfall in cost recovery (from Table 5.8)	93.00
Add:	
Expected increase in annual costs	28.00
Future shortfall in financing the service, if full cost recovery is not introduced = improvement in public finances if full cost recovery is introduced	121
Less:	
Increased social welfare expenditure for low-income households if full cost recovery is introduced	20
Net improvement in public finances if full cost recovery is introduced	101.00

Note: Any revenue from a possible pollution tax is ignored.

5.3. Solid Waste

Industry is the major source of solid waste in Ireland, generating over 7 million of the 11 million tonnes or so arising each year (see Table 5.11). Commerce generates over 500,000 tonnes per annum, while households generate over 1.3 million tonnes. A further 240,000 tonnes of hazardous waste arises, and this is subject to various forms of treatment and recovery processes. We do not consider this waste here, as hazardous waste is more properly the subject of regulation than of fiscal instruments.

8 [25]Future design PE is 4.1 million, while the human population covered is estimated to be 70 per cent of the total, i.e. 3.6 million x 70 per cent = 2.5 million. Therefore roughly 60 per cent of the future treatment capacity will relate to the domestic sector. Given future costs of £129 million per annum (from Table 5.8 and above) full cost recovery will require the raising of £77 million per annum from households. If we assume that 25 per cent will be unable to pay, roughly £20 million per annum will have to be provided in increased social welfare payments.

Table 5. 11 Solid waste arising and disposal routes in Ireland, 1995

Source	*Waste arising*	*Disposal methods*						
		Landfilled	*Incineration*	*Disposed to waters*	*Biological/ chemical treatment*	*Recovered/ reused*	*Other*	*Total*
	Tonnes	*Tonnes*	*Tonnes*	*Tonnes*	*Tonnes*	*Tonnes*	*Tonnes*	*Tonnes*
Commercial	523,711	443,339				80,372		523,711
Domestic	1,324,521	1,267,035				57,486		1,324,521
Industrial non-hazardous	7,688,808	5,855,217	8,014	357,681	34,412	1,207,392	226,093	7,688,808
Industrial hazardous	243,754	4,884	45,613		70,590	103,481	19,186	243,754
Municipal sludges	493,323	493,323						493,323
Dredge Spoils	784,600	784,600						784,600
Miscellaneous	202,040	202,040						202,040
Total	11,260,757	9,050,438	53,627	357,681	105,002	1,448,731	245,279	11,260,757

(Source: Environmental Protection Agency, 1996b)

5.3.1. Environmental impact

The environmental impact of this waste is varied, and depends both on the type of waste and its disposal route. Considering industrial waste, the vast majority (almost 6 million tonnes) is landfilled. The major components are mining and quarrying waste (2.3 million tonnes) and construction and demolition waste (0.6 million tonnes). Much of these wastes are quite inert, however the mining waste would include some hazardous substances, and so has a potentially large impact, particularly on water quality. Also, the construction and demolition waste could possibly be put to a better use, if it were recycled into higher grade materials and reused directly for construction (see Box 5.1).

The other substances that end up in landfill, from industry, commerce and households, are the usual range of solid waste materials - plastic, paper, metals, etc., and these will have various impacts on the environment, namely:

(i) land usage, visual impact, etc., through the existence and use of the landfill;
(ii) air pollution and global warming through the generation of methane, from the anaerobic decomposition of organic materials;
(iii) ground and surface water pollution from the leaching of liquids from the landfill into nearby waters; landfill leachate is highly toxic, and once again is generated from the decomposition of organic materials.
(iv) transport impacts from the carriage of waste to the landfill.

Box 5.1 Demolition and construction waste.

This represents a very significant proportion of the waste generated and disposed of annually. While most of this waste is used for land reclamation and site engineering, there appears to be scope for recycling it into higher grade material. A study of this issue in the UK (Department of the Environment, UK, 1994) indicates that in that country approximately 30 per cent of demolition and construction waste is reused on-site, 30 per cent is reused for landfill engineering, and a further 37 per cent is dumped in landfill. Only 4 per cent is recycled to secondary aggregate. The option of increased recycling is being pursued in a number of European countries, in the context of minimising waste going to landfill in general. For example, the French government proposes that by the year 2002, 40-50 per cent of this waste will be recycled, whilst in The Netherlands the target is 90 per cent by the year 2000.

A case in point is the city of Copenhagen (population approximately 1.3 million), where in recent years the percentage of the city's waste going to landfill has fallen from 48 per cent to 11 percent of the total (Fonteyne, 1995). This has been achieved almost totally by a very substantial increase in the recycling of demolition and construction waste, encouraged by a high landfill levy (DKR195 or £20 per tonne) and restrictions on the type of waste allowed into landfill. There are indications that the main use of this recycled waste was for road construction (DRI *et al.*, 1994). However, we do not know the economic cost of the Copenhagen approach; it may be that construction costs have had to be increased to pay for the recycling. The approach suggested in this paper, whereby the full LRMC of landfill disposal is charged, including a levy to cover the external costs, would automatically encourage construction and demolition waste recycling if this is the economically and environmentally better option.

5.3.2. Existing fiscal structure

Charges for public waste collection services[26] We are concerned here with that element of solid waste that ends up in public landfills, i.e. approximately 2.2 million tonnes per annum (Environmental Protection Agency, 1996). As already seen, the majority of industrial waste is dealt with on-site, by industry itself, and so this is not directly affected by the fiscal structure. There is no fixed fiscal structure for the entire country, as each local authority is free to set its own charges. Table 5.12 shows the total and unit costs of providing the service, as well as cost recovery levels.

9 [26]This issue is considered in detail in Barrett and Lawlor (1995), and most of the following discussion is drawn therefrom.

Table 5.12: Estimation of total cost, unit cost and cost recovery of solid waste in 1994

	£ million
Expenditure (note 1)	
Collection	35
Landfill	17
Total (note 2)	52
Receipts from charges (note 3)	12
Cost recovery percentage	23%
Shortfall	40
Financed by (note 4):	
Local sources (mainly commercial rates)	16
Central government (mainly Rates Support Grant)	24
Quantity landfilled per annum (note 5)	2.2 million tonnes
Unit cost of collection (note 6)	£38/tonne
Unit cost of landfilling	£8/tonne
Total unit cost	£46/tonne

(Source: Department of the Environment)

Notes:

1. Unlike the other environmental services, both capital and current costs of the solid waste service tend to be financed at a local level (i.e. there are no capital grants from central government). As a consequence it is difficult to split costs between capital and current.
2. Total expenditure on solid waste services in 1994 was £73 million. This includes roughly £20 million for street cleaning and litter prevention, which are not included above.
3. £5 million of this is from households and £7 million from commercial sources.
4. On a pro rata basis.
5. A certain amount of this waste is collected by individuals and firms other than the local authorities.
6. A recent survey of the major local authorities (Barrett and Lawlor, 1995) indicates costs for collection ranging from £22 - 65 per tonne, with an average of £38 per tonne.

Concerning the level and types of charging that local authorities use, complete data are not available, but Barrett and Lawlor (1995) provide some survey data, presented in Table 5.13. As can be seen from the Table, volume-related charges are quite widely used, especially for commercial users of the service, though the level of charge varies from authority to authority. It can also be seen that quite a sizeable proportion of households - 42 per cent - pay nothing for solid waste services.

In theory, it is preferable that the charge should represent the long run marginal cost (LRMC) of providing the service. We have seen already that charges do not recover the full costs of providing the service, but do they cover the LRMC? A number of local authorities have indicated that they do try to recover their (short run) marginal costs in providing services to the commercial/industrial sector. In general, LRMC will be higher than short run marginal costs, so it is probable that LRMC is not being recovered in most cases.

Two further considerations would lead us to suspect that public solid waste management services are being under-priced. Firstly, future waste management costs will be considerably higher than current levels, and when using LRMC we need to use future costs, rather than current costs levels, since the former is the cost to society

of using up the existing facilities. Secondly, the above discussion relates only to internal costs - external or environmental costs are ignored. In Ireland external costs are estimated to add £4 per tonne to the LRMC and £7 to the average cost of disposing of solid waste to landfill (Barrett and Lawlor, 1995).

Table 5.13: Local authority solid waste collection and disposal charges, survey results

Charge system	*Percentage of respondents (weighted by population size)*		
	Domestic collection/disposal	*Commercial collection*	*Landfill only*
	%	*%*	*%*
Volume-related	13	64	56
Fixed charge	30	14	0
No charge	42	3	9
Privatised service	15	19	1
No landfills in area			34
Total	100	100	100

(Source: Barrett and Lawlor, 1995)

In relation to the increased costs of running the solid waste service, Barrett and Lawlor (1995) present a model of the expected future costs of modern landfill. This model indicates that the cost of replacing all the current landfills with modern facilities will entail a capital expenditure over the coming years of up to £400 million, depending on the number and size of facilities built. As a result annual expenditure on landfill facilities will increase to £45 million, from the present level of £17 million (from Table 5.12). On a per tonnage basis, costs could increase from a current level of £8 per tonne to up to £25 per tonne. Assuming no increase in collection costs, total collection and disposal costs are likely to increase from their present average £46 per tonne to an average of perhaps £63 per tonne (excluding administration) in the coming years. This will obviously have major repercussions for local authority finances and levels of solid waste management charges. We are assuming that the public sector incurs the cost of building all new landfills. It may be that the private sector will build and operate at least some of these facilities. While this may or may not change the cost to the economy of providing solid waste services, it will take the financing burden away from the public sector.

Grants and subsidies Apart from the implicit subsidy in the under-charging for public solid waste services, the central government and local authorities provide grant aid to a number of recycling projects. Most of these are aimed at recycling domestic waste, although some commercial and industrial waste would also be recycled in these projects.

Compliance incentives (i.e. financial penalties for non-compliance) As with the other environmental services, local authorities have at their disposal several pieces of legislation which allow them to impose fines for non-compliance with regulations or for illegal dumping. The degree to which these are used varies from authority to authority.

Environmental effects of the existing structure As with the other environmental services, the under-charging for solid waste services will tend to lead to an excessive amount of solid waste being generated. This will obviously have a detrimental effect on the environment. Artificially low waste disposal costs will also discourage reuse, recycling, and waste reduction, which are the main means by which solid waste can be avoided.

5.3.3. Options, from experience in Ireland and Overseas

Charge the full cost of public waste management services The charging system would be volume-related, and based on the LRMC of waste collection and disposal. In addition, the local authorities would want to recover the balance of costs (including administration) where LRMC is lower than average cost, and this would be achievable by applying an additional fixed charge. Volume-related charging is a practical option for both the domestic and commercial sectors, using systems such as tag-a-bag, or charges by reference to size of bin. In the future, more sophisticated approaches may be appropriate (see Box 5.2).

A concern with volume-related charging for solid waste services is that it gives an incentive to dump illegally. Indeed, this is often used as an argument for not introducing such charges. Discussions with local authorities that have introduced volume-related charges in Ireland indicate that while illegal dumping was an initial problem, the enforcement of anti-littering regulations and the threat of prosecution have been effective in discouraging such activity. In addition, the general public are becoming less tolerant of illegal dumping, and this is also discouraging the practice (Lawlor, 1996).

Charge a landfill levy to cover the external costs This would represent revenue over and above the cost of running the service, and might be collected by a central agency. Given an average external cost to be £7 per tonne (Barrett and Lawlor, 1995), and the present quantity of 2.2 million tonnes landfilled annually, the revenue might amount to £15 million per annum.

The question of what to do with the levy revenue arises. Theoretically it should go into general revenues, to be used for the highest priority purpose. However, there are likely to be increases in exchequer expenditure related to the solid waste area, such as subsidies to recycling (see discussion later), and social welfare compensation for those households that are unable to pay the full charge for waste disposal as envisaged here. So the revenues from the levy can help to finance these.

Another use may be to reduce labour taxes, as is being planned in the UK at present (Smith, 1995). France, which has an up-and-running landfill tax of FF20 (£2.50) per tonne of household and commercial waste, uses the revenues to finance a public body called the Modernisation Fund for Waste Management. This grant aids

research into innovative methods of dealing with solid waste, the construction of modern waste management facilities, and the upgrading and restoration of existing landfill sites. However, as a result of lobbying, many elements of industrial waste are exempted from this tax, as are industrial on-site dumps (Fernandez and Tudenham, 1995). In return for this exemption, industry agreed to set up its own fund (which was subject to legal agreement) to finance the closure of illegal industrial dumps. A major proportion of solid waste in France, be it from household, commercial or industrial sources, goes to illegal landfill sites. Part of the aim of the law that introduced the landfill tax is to close down these sites, and to ensure that the direct disposal of waste to landfill is ended by the year 2,002 (i.e. that waste would go through some other route such as incineration or recycling before going to landfill).

Box 5.2 Weighed refuse collection trials in Denmark (an experiment in pure weight-based charging).

Specially designed vehicles are being used in Denmark which can weigh the refuse left out by households and can charge accordingly. In the trials to date, the vehicles are rear-loaded and the same amount of labour is employed as before (side loaded-vehicles are under development which will only require one man to operate them). The vehicles have two compartments, one for material that can be composted and the other for all remaining refuse which is landfilled or incinerated. The waste is collected from the household in 240 litre bins which are divided into two compartments, 40 per cent for compostible material and 60 per cent for the remainder. The new weight-based charge did not constitute a rise in price. If the household left out the same weight of refuse as before the trial, the average household's payment would be the same.

The result so far has been a 15 to 20 per cent reduction in weight of refuse collected. As the charge did not change, this reduction has been caused by the fact that payment was weight-based, rather than due to a price rise. One might say that households were responding to the opportunity to reduce their bills. Households can take their recyclables, that is bottles, plastics, paper etcetera to recycling centres.

It is hoped that economic analysis of the investment will be undertaken and that price responsiveness will be estimated. The question is: in present value terms, would the savings on the costs of landfill and incineration outweigh the extra capital costs of this equipment? As the vehicles are rather more expensive than traditional vehicles, the economics of the system would be more favourable where there are high landfill and incineration charges, and strict regulations, as is the case in Denmark.

Charge the landfill levy on industry's own landfill sites, to the degree that external costs exist The majority of industrial waste (over 5 million tonnes) is disposed of in industry's own sites. As mentioned, much of the waste is inert, but some would have an environmental impact. Given the quantities involved, this levy might

raise considerable sums of money. The practical problems of calculating the amount of levy payable in each case may of course be large. More research would also be needed to consider the actual external cost applicable to these wastes, and the quantities involved.

Privatisation An alternative approach, which would automatically lead to full charges being applied, is to privatise public waste management services. This is already done to varying degrees, especially in the area of collection of waste. Of course, the landfill levy would still be imposed, by some public agency.

Subsidise recycling to the degree of its external benefit, or preferably introduce an energy tax Charging the full LRMC for disposal to landfill would give an automatic boost to the alternative disposal routes, i.e. recycling, re-use and reduction at source. In addition, these could be subject to a tax or subsidy to reflect their marginal external costs or benefits. The main alternative route currently in use in Ireland is recycling, so it would be important for this at least to have its environmental costs and benefits taken into account. The calculation of this is difficult, and Barrett and Lawlor (1995) take the approach of valuing the energy saved in the recycling of these materials, and treating this as an environmental benefit. They estimate rates per tonne of material recycled (see Table 5.14), but make the point that a general energy tax, equal to the marginal external cost of energy usage, would achieve similar results automatically, without the need for a separate bureaucracy to administer the subsidy[27]. Such an energy tax would also automatically benefit any other waste management route (e.g. re-use, reduction at source) that saved energy, and would improve the efficiency of the economy on an overall basis, not just in the case of waste management.

How much the subsidies would cost if implemented cannot be estimated, as the quantities of industrial recycling is not well known, and perhaps more importantly the reaction to the subsidy is unknown. A benefit of the energy tax in this context is that it raises revenues for the exchequer, which can be used to reduce other taxes.

10 [27]Of course some extra bureaucracy would be needed to administer the energy tax, but the cost would not be as great, since much energy use is already subject to the tax system. Also, an energy tax would apply to a far wider section of the economy and hence the administration costs would be spread more widely

Table 5.14: External benefits of recycling, in terms of energy saved

Material	*Value of energy saving per tonne of material recycled* £
Aluminium	186.00
Glass	2.00
Paper	24.00
Tinplate	16.00
Plastics (average)	148.00

(*Source: Barrett and Lawlor, 1995)*

Product or packaging taxes Product or packaging taxes are taxes on goods or packaging which relate to their waste component, at the end of their useful lives. Such a tax can be used to achieve a number of objectives, but from an economic point of view the objective is to include the cost (internal and external) of the disposal of the product and its packaging, in its price. By making products with a higher "waste content" more expensive, the tax provides an incentive for the consumer to alter consumption patterns, and for the producer to alter production patterns. As a result, one would expect the production and consumption of relatively waste-intensive products to decline, thereby reducing the total amount of waste arising. An example of a packaging tax is a tax on plastic bags, currently provided free in shops and supermarkets in Ireland. These bags tend to have a very high "waste content", mainly in terms of their visual impact when discarded. Such a tax would seek to internalise the cost of this impact, encouraging the public to minimise their use of these bags or to switch to reusable packaging. Another example would be a tax on the phosphate content of detergents, to reflect the impact of the phosphates on receiving waters and waste water treatment plants

Apart from the economic objective of including waste costs in the purchase price, product taxes can be used with the specific purpose of encouraging industry to set up recycling schemes or deposit-refund schemes. For example, Norway taxes non-returnable beverage containers, thereby providing an incentive to operate a deposit-refund scheme. In order for the tax to be successful in achieving these sorts of objectives it must be sufficiently large to make the alternative worthwhile. In using product taxes for this reason, it needs firstly to be established that encouragement of re-use or recycling is an optimal objective. If the costs of re-use or recycling, both internal and external, are greater than the corresponding costs of landfilling, a product tax that creates a strong incentive towards recycling may not be appropriate. Alternatively, the revenue from the product tax could be used directly to set up recycling schemes (or similar schemes). Again, it needs to be established before a recycling scheme is set up that this is the environmentally optimal thing to do.

Another factor to keep in mind is the effect of such a tax on production costs. If the tax is levied only in Ireland, action would need to be taken to ensure that domestically produced goods are not put at a competitive disadvantage. Goods imported into Ireland would have to be taxed on a product basis so as to restore the competitive balance. Domestically produced goods sold abroad would require a tax refund. This would of course mean that the information requirements of the tax would become large. For this reason the imposition of such a tax may make more sense at a transnational level.

Finally, the design and coverage of a product tax depends on the trade-off made between administrative ease and effectiveness. For example, in order to internalise external costs correctly, a large number of tax rates must be used, reflecting the contributions of different products to the waste stream. Clearly though, a higher number of rates will create greater administrative difficulties.

Raw material taxes Raw material taxes come in two forms. First, virgin raw materials can be taxed while secondary (i.e. recycled) raw materials remain untaxed, thus creating an incentive for the use of secondary raw materials. The tax on virgin raw materials can be set so as cover the eventual disposal cost thereof. The logic then in leaving secondary materials untaxed is that their waste component has already been charged for. The second type of tax is where all raw materials are taxed but the rates differ according to the rate of recycling for the material in question. Thus, a raw material that is never recycled would face a higher tax rate than one which is recycled a number of times. In both cases, the incentive to use recycled materials is intended to lead to the diversion of waste from the waste stream. The provisos mentioned for the product tax would also apply here.

Another issue which arises in the context of foreign trade is the possibility that recycled materials could be imported into this country in an effort by firms to avoid a virgin material tax. If this recycled material makes its way into the waste stream following one use, the effect on the Irish waste stream is the same as if virgin materials were used, since no real diversion has occurred from the domestic perspective. It is true that waste is diverted from the country which exports the recycled material but it would seem unfair that Irish consumers and producers would bear the cost of waste diversion for another country. Again, for this reason, imposing the tax at a transnational level may make more sense.

Deposit-refund schemes Deposit-refund schemes operate through an additional charge being placed on an item when it is purchased, and this charge being subsequently refunded when the item or its container are returned. Such schemes have been widely used in the US. and Europe, although typically for a limited range of products such as beverage containers. Other applications have been for car hulks in Greece and Norway and vehicle batteries in the US. (OECD, 1994).

These schemes can be used to internalise the costs of disposal. By setting the charge equal to the marginal social cost of disposal, a consumer who purchases an item and discards as opposed to returning it incurs the cost of disposal. A consumer who returns the item and thus keeps it from the waste stream avoids the disposal cost. Typically, however, the objective of these schemes has not been internalising costs but rather to generate high rates of return of materials, with a view to encouraging re-use and recycling and to reduce waste going to landfills and litter. The deposit rate necessary to achieve this may or may not be equal to the rate that would internalise disposal costs.

Finally, indications from Ireland and abroad are that while deposit-refund schemes may be appropriate at the commercial level or for the on-licence trade (pubs, hotels, restaurants), they are extremely expensive to operate at the domestic level (Barrett and Lawlor, 1995).

5.3.4. The impact of full cost recovery

Table 5.15 estimates the impact of full charging, as recommended here, on central and local government finances. Introducing full cost recovery (with compensating social welfare increases for low-income households) will reduce the revenue raising requirements of both central and local government by over £60 million at future cost levels, while the landfill levy will provide central government with a source of revenue over and above any financial costs. As an alternative, the private sector may become more involved in the provision of the service; this will have a similar effect on public finances as if the local authorities continue to provide the service, but use full cost recovery. We have not taken into account any reductions in waste quantities as a result of higher charges, though some reductions could be expected. However, without information as to elasticities of demand for landfill services, it is difficult to estimate the affect accurately[28].

11 [28]Barrett and Lawlor (1995) review some international research into elasticities of demand, but the findings are incomplete. Those elasticities that have been estimated have tended to be not very large, though they have in general been short term elasticities, and it may be that long term effects could be greater

Table 5.15: Impact of full cost recovery on public finances - solid waste

	£ million
Present shortfall in cost recovery (from Table 5.12)	40.00
Add:	
Expected increase in annual costs	28.00
Future shortfall in financing the service, if full cost recovery is not introduced = improvement in public finances if full cost recovery is introduced	68
Less:	
Increased social welfare expenditure for low-income households if full cost recovery is introduced (see note)	12
	56.00
Add:	
Landfill levy	15.00
Net improvement in public finances if full cost recovery, including a landfill levy, is introduced	71

Note: Expected future costs are £80 million per annum. 1.3 million tonnes out of a total 2.2 million tonnes landfilled per annum come from households, i.e. 60 per cent. Applying this percentage to the costs gives £48 million per annum chargeable to households. If 25 per cent of these cannot afford to pay, social welfare allowances would have to increase by £12 million to account for this.

5.4 Conclusions and recommendations

This chapter has looked at the current fiscal structure as it applies to environmental services provided by local authorities and used by households, commerce and industry. We have seen that in general, these services are being under-priced, leading to over-usage and wastage, and consequent excess environmental damage. Present levels of cost recovery are 54 per cent for water supply, 8 per cent for waste water, and 23 per cent for solid waste. While the EU is at present paying a large share of the capital costs of these services (solid waste excepting), and will continue to do so until the end of this decade, beyond that date capital costs will have to be funded domestically. In view of this, our general recommendations are as follows:

1. Charges be adjusted to achieve full cost recovery and removal of subsidies, on a volume-related basis where possible. Over 95 per cent of Irish households say that they would prefer to pay for future improved environmental services by charges rather than through increases in central government taxes (according to the table in the General Background chapter) and there are sound reasons of efficiency for doing so.
2. This needs to be done *simultaneously* with reductions in central government taxes. If not operated as a package, the proposal might be strongly resisted.
4. Under full cost recovery, alleviation of hardship to low-income households will require an enhanced system of waivers which will put extra responsibilities on local authorities, or increases in social

welfare payments. The latter is to be preferred, but whichever is adopted it should be paid for by central government.

5. The adjustments in charges, income taxes and social welfare should be phased in over perhaps 10 years, and be announced and initiated immediately.

In addition, there are a number of recommendations that relate to the individual services, and they are listed now. For water supply, we would recommend that:

1. In areas where capacity is tight, or may become so, the viability of universal metering should be estimated. The calculated marginal cost of expanding water supplies should include environmental effects such as impacts on amenity waters, water levels in fisheries, environmental impacts on lakes, ponds, wetlands, habitats et cetera, not to mention the opportunity costs of reducing water for hydroelectricity generation and for other potential commercial and industrial uses.
2. In areas where metered charging is not deemed viable, equitable methods of domestic charging include basing the charge on the number of residents in the household, on rateable valuation or on type of dwelling.
3. All new houses being built, or areas where service work is being undertaken, should have water meter boxes installed to give occupiers the option of metered charging. Careful users and consumers of small quantities will tend to opt for metering. Non-metered domestic customers could be charged *their* average costs, ie their total cost averaged only over them. They would find their charges rising as smaller users opt for metering. As prices rise therefore, an increasing number would opt for metering.
4. All customers consuming above a certain calculated level should be charged on a metered basis (possibly above 500 m^3 per year, or 1370 l per day).

For waste water services, we would recommend that a pollution tax be levied on discharges to bodies of water, whether or not treatment has already taken place on the discharges in question. This would apply equally to discharges from industry and municipal facilities, and might be administered by some central body.

For solid waste services, we would recommend that the following:

1. The calculation of costs would be by reference to the next "generation" of landfills, rather than existing landfills, since the new facilities will be very much more costly than those they replace.
2. There would be a landfill levy, equal to the external cost per tonne of disposal to landfill. We estimate that this would raise revenues of perhaps £15 million per annum.
3. There would be subsidies for recycling and re-use of materials, equal to the external benefits of these activities, vis à vis production from virgin materials. As an interim, these could be based on the external benefits of energy saved in the activity in question. The revenues from the landfill levy could help to finance these.
4. In the longer run, an economy-wide energy pollution tax would obviate the necessity to have a subsidy as described in (iv). This however, is an issue that affects much more than just solid waste management, and its implementation may require agreement at an EU or even wider level.
5. The option of increased privatisation could be explored, since this would automatically lead to full cost recovery, and it appears that private firms find it easier to collect waste disposal charges than do local authorities. The landfill levy would of course still be charged on waste disposal.

Implications for public finances of Cost Recovery for Environmental Services Table 5.16 summarises the financial implications of full cost recovery for public finances. It shows the current shortfall on financing the services, and also the future shortfall, if full cost recovery is not implemented - an amount of £271 million per annum at future cost levels. This is by definition the saving to public finances from full cost recovery, though

increased social welfare allowances of roughly £57 million per annum would have to be deducted. A landfill levy might bring in an extra £15 million annually. Note that the figures here do not incorporate any saving to the economy; they simply show the financial effect of moving from a system of paying for services mostly through general taxes, to one of paying for them by user charges. Society is paying for the service either way, although evidence of the incentive effects of use-related charges on quantities of the services demanded suggest that economic and environmental benefits will accrue from using this approach. In practice the incentive effect of charging may be considerable in the long run, given the very large rise in charges that is envisaged.

Table 5.16: Present and future shortfalls in financing environmental services, in the absence of full co recovery (expressed in present day prices)

Service	*Total cost per annum £ million*	*Charges presently levied £ million*	*Annual shortfall /subsidisation £ million*
Present cost levels			
Water supply	136.00	73.00	63.00
Waste water	101.00	8.00	93.00
Solid waste	52.00	12.00	40.00
Total	289.00	93.00	196.00
Future cost levels			
Water supply	155.00	73.00	82.00
Waste water	129.00	8.00	121.00
Solid waste	80.00	12.00	68.00
Total	364.00	93.00	271.00

Note: Data on future cost levels assume that quantites of the services used are unchanged from present level i.e. the incentive effects of charging are ignored.

Appendix 5

The gross bill for water, for a consumption of 200 cubic metres, is as follows:

City	Gross bill*	VAT rate (%)	Av consn m^3/yr
Amsterdam	£121.48 unmetered	6%	117
Athens	£115.75	varies	n.av.
Barcelona	£118.44	6%	103
Birmingham	£144.66	0%	120
	£75.12 unmetered		
Brussels	£221.29	6%	n.av.
Copenhagen	£193.74	25%	n.av.
Dublin	none	n. applic	n.av.
Edinburgh	£69.06 unmetered	0%	n.av.
Frankfurt	£271.96	7%	109
Helsinki	£93.90	0%	n.av.
Lisbon	£79.25	5%	n.av.
Milan	£19.60	9%	n.av.
Normandy	£199.72	5.5%	n.av.
Oslo	£64.18 unmetered	22%	n.av.
Stockholm	£284.88	25%	128

Vienna	£231.00		10%
	n.av.		
Zurich	£208.45	0%	
	n.av.		

Source: Sullivan, D., (1995). *European Water Charges: A Comparison of 17 Cities*. Centre for the Study of Regulated Industries (CRI), Public Finance Foundation, London.
Note: * Bases on metered consumption, unless otherwise stated.
It is estimated that in Ireland the average household consumes 164m^3 per year.

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