# Solutions to Tutorial Questions

**Chapter 13 Economics of water quality improvement**

**13.1 What are the main types and sources of water pollution? Why might the source of the problem matter for policy design?**

*Whilst one can usefully distinguish between stock and flow pollutants (stock pollutants being those that accumulate over time in an ecosystem, and where damages are a function of this stock rather than the emissions in a specific period), the main distinction made in the chapter is between point-source and non-point source water pollution. This distinction is important because a different set of policy options are used to deal with these two types. For point source pollution, the regulator can tax or regulate actual emissions, since they can be measured for each source. For non-point pollution, the regulator has instead to take measures connected with the inputs which lead to non-point pollution (eg fertiliser use) or with estimated emissions, since actual emissions cannot realistically be measured for each producer.*

**13.2 What problems would a regulator face in using a system of pollution taxes to improve water quality in a river, where the main problem is point source discharges from factories and sewage treatment works? What would be the main potential benefits of using such a tax approach, relative to regulation?**

*One problem would be the need to have good estimates of the marginal abatement cost curve for this pollution control problem. Such data can be hard to come by in many instances. Another problem is likely to be the spatial variation in damages which are due to the non-uniform mixing of the pollutant. This would make the regulator consider whether some kind of differentiated tax system should be used, with higher taxes placed on sources with higher damage costs. However, a water pollution tax system offers two big advantages over command-and-control regulation, namely that it should be more cost-effective, and that it gives firms an on-going incentive to invest in cleaner technology.*

**13.3 How could economic instruments be used to reduce pollution from non-point sources in an estuary? In what way does the nature of the pollution source impose additional policy design problems for the government?**

*Since it is very hard to monitor actual emissions from individual pollution sources for non-point source pollution, economic incentives would need to be targeted at the inputs which “produce” pollution, with land-uses that are more polluting, or (less likely), on estimated emissions for each firm or farm. Placing a pollution tax on chemical inputs used in farming (fertilisers, pesticides) would be one example. Having a tradeable permit scheme in more polluting land uses (such as irrigated crop production, relative to grazing on permanent grass) would be another option. The nature of the pollution source dictates the most appropriate set of policy options, as question 13.1 made clear.*

**13.4 How could you use (i) choice experiments and (ii) hedonic pricing to estimate the benefits of an improvement in river water quality in an urban area?**

*Choice experiments could be used to estimate the benefits of improving river water quality to people who live near the river, to those who use the river for recreation (some of whom might travel from a considerable distance, for example to go fishing), or benefits for those who live some distance from the river but who still care about its quality. In this way, choice experiments can measure use and non-use benefits for a broad category of individuals. Hedonic pricing could also be used to measure the benefits of improvements to those living near the river, through an examination of the effect of water quality on house prices. But this would be a narrower set of benefits than we could measure with choice experiments.*

**13.5 What are the problems of undertaking a cost-benefit analysis of a planned improvement in coastal water quality through improvements in sewage treatment?**

*There are many problems to be overcome here, but three which could be important are (i) which is the population of people who might benefit from the coastal water quality improvement? How would we figure out whose benefit to measure? Secondly, there could well be considerable scientific uncertainty on what changes in costal ecosystem quality would result from the investment in better sewage treatment (eg the reduction in health risks to those swimming or engaging in other water sports), and when these would be effective. Third, some of the ecological benefits might relate to aspects of biodiversity which most people are unfamiliar with (eg benthic life). How best to measure these unfamiliar benefits? Having said all of the above, CBA has often been used to look at such project investment questions.*