Topic 10: Economics of Pollution Control

How to deal with the reverse flow of waste products back to environment? This topic will address the following questions:

1. What is the appropriate level of flow of pollution?
2. How should the responsibility for achieving this flow level be allocated?

10.1 What are pollutants?

Pollutants are the residuals of production and consumption – either be recycled or returned to the environment in one form or another. The damage caused by pollution could negatively affect human health, or even leading to death, and other living organisms such as trees, fishes, etc.

Classified by absorptive capacity:

- **Stock pollutants** accumulate over time as emissions enter the environment such as nonbiodegradable bottles, heavy metals (accumulates when the emissions load exceeds the absorptive capacity or the ability of the environment to absorb pollutants).
- **Fund pollutants** are those pollutants for which the environment has some absorptive capacity. Fund pollutants do not accumulate as long as the emissions rate does not exceed the absorptive capacity of the environment.

Classified by zone of influence:

- **Local pollutants** - the damage is experienced near the source of emission
- **Regional pollutants** – the damage is experienced at greater distances from the source of emissions
- **Global pollutant** – the damage affects the entire planet.

Knowing different types of pollutants are useful in designing policy responses to these various types of pollution problems.

10.2 Efficient Allocation of pollution

Stock pollutants –requires dynamic efficient allocation as the damage caused by the production of X today will persists to affect next generation.

- Can create burden for future generations by passing on damages that persist well.

- There is interdependency between the present and the future as the damage imposed in the future depends on current actions. For example, the production of a mineral incurred the extraction costs which is borne only at the time of extraction, while damage persists as long as the stock pollutant remains in the environment.
- At a steady state, emission of the pollutant created by the production of X would be controlled where the size of the pollutant stock would stabilize.
- Technological progress could i) reduce the amount of pollutant generated per unit of X produced ii) create ways to recycle the stock pollutant rather than injecting it into the environment iii) develop ways of making the pollutant less harmful. These would lower the marginal damage cost associated with a given level of production of X.

Fund pollutants –require static efficiency as the level of future damage is independent of current emissions. In other words, current emissions cause current damage and future emissions cause future damage, no link between present and future damage. At efficient allocation of a fund pollution, the marginal control cost will equal to the marginal damage cost or the point at which the marginal cost of controlling the marginal unit of pollution equals to the damage caused by the marginal unit. The marginal control cost commonly increases with the amount controlled, and the marginal damage increase with larger emitted amount.

Graph: Efficient allocation of a fund pollutant

- **Why the optimal pollution is not zero?** – simply because the cost of doing so would be too high. However, the optimal level of pollution may be zero or close to it when the damage caused by even the first unit of pollution is so severe that is higher than the marginal cost of controlling it.

- The optimal level is not the same for all parts of the country
    - Areas with higher population levels/sensitive to pollution – lower levels of pollutions at efficient point
    - Areas with lower population levels/less sensitive to pollution – higher efficient levels of pollutions.

10.3 Market allocation of pollution

Firm production -> residuals or waste as output -> incentives to overexploit air and water resources as waste repositories as they are free-access resources/the cheapest manner.

Pollution damages are externalities.

- When pollutants are injected inter water bodies or atmosphere, they cause damages to all firms and consumers or to society at large
- The costs are not borne by the emitting source.

So, the disposal of wastes into the air or water become inefficiently attractive!!! The case is more sever with stock pollutants, as the burden on future generations caused by the present pollutant would be inefficiently large. Furthermore, firms that attempt to control pollution are placed at a competitive disadvantage – higher costs from addition expense to control pollution.

Government intervention is needed for pollution control!

10.4 Efficient Policy Responses

Ways to achieve efficient outcomes:

- Impose a legal limit on the amount of pollution allowed by each emitter – at the efficient emission level where marginal control cost equal to the marginal damage.
- Internalize the marginal damage caused by each unit of emissions by a tax or a charge on each unit of emissions.

Achieving cost-effective policy choices are difficult in practice:

- Must know the level of emissions at which the two marginal cost curves cross for every emitter. Control authorities typically have very poor information on control costs and little reliable information on marginal damage functions
- How to allocate responsibility for meeting predetermined pollution levels (at efficient level) among the large number of emitters.

10.5 Cost-effective pollution control policies

For **a uniformly mixed fund pollutants** (damage caused by pollutants is relatively insensitive to where the emissions are injected into the atmosphere), the policy can simply focus on controlling the total amount of emissions that minimize the cost of control.

For example, assume there are two emissions sources emitting 15 units each for a total of 30 units. The reduction of a total 15 units that the environment cannot assimilate is needed. How should this 15-unit reduction be allocated between the two sources to minimize the total cost of reduction?

Graph: A Cost-Effective allocation of a uniformly mixed fund pollutant

There are two most common approach **to assign the responsibility for emissions reduction in a cost-minimizing way.**

1. **Emission charges -** a fee, collected by the government, levied on each unit of pollutant emitted into the air or water. Emission charges increase the costs of firms by multiplying the fee with the amount of pollution emitted by firms. A profit-maximizing firm would control pollution rather than emit whenever it is cheaper to do so – or when the firm can control some pollution at a lower cost than paying the emission charge. Control authority imposes the same emissions charge on all sources, compatible with minimizing the costs of achieving the level of control even they may not have sufficient knowledge on control costs.

Graph: A Cost-Effective control of pollution – with an emission charge

The question is how high should the emission charge be set to ensure an efficient level of emission reductions – iterative, trial-and-error process to find the appropriate rate.

2. **Cap-and-trade** – without going through a trial-and-error process, the control authority can choose cap-and-trade policy to achieve the desired level of emissions by allocating allowances to emit equal to the desired emission levels. Each firm/source get allowances to emit and can trade/freely transfer the allowances to other firms/sources.
   Suppose the first source was allocated 7 allowances and the 2nd source was allocated the remaining 8 allowances, with a total of 15 units of desired emission reduction.

Graph: A Cost-Effective control of pollution – with emissions trading

Reference: [TL] – Tietenberg, T. and Lewis, L. Environmental Natural Resource Economics, 2015 (10th edition), Pearson, Chapter 14.