Sharing a Polluted River: The Responsibility Rule

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Extended Abstract

A usual environmental problem is the presence of pollutants in the water of rivers. This is a major problem faced by authorities since polluted water can be very harmful for people, plants and animals, causing serious diseases and affecting ecosystems. Around the world, about 200 rivers (see Ambec and Sprumont [1] and Barret [2]) flow through different countries, regions or municipalities. Cleaning transboundary rivers requires cooperation of the different authorities involved and coordination of the efforts in order to be effective. However, the distributions of the costs of cleaning such rivers among the different regions involved may be a problematic issue, particularly when the (level of) responsibility of each of them in the pollution discharged is not well-defined.

Ni and Wang [3] model a river as a segment which is divided into \( n \) subsegments from upstream to downstream such that each region or country is located in one of them. The countries generate some kind of pollution in the river. There is a central agency that sets a standard of the minimal quality of the water and, then, implicitly determines the costs that has to be incurred between all the countries to clean the river among them. They characterize two rules for allocating the total cost among different countries considering two different definitions of “responsibility”. The first one is based on the principle called “local responsibility”, which says that each agent is only responsible for the pollution present in his own area. The second one is based on the principle called “downstream responsibility”, where each region has responsibility not only of the pollution in his own segment but also of the pollution in its downstream areas. As a consequence, the cost of cleaning each segment is distributed equally among these regions. However, the "local responsibility" principle does not take into account the fact that the pollution can be swept along the river by the current and a country may not be totally responsible for the pollution present in his territory.

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and the "downstream responsibility" principle does not take into account that countries discharge different levels of pollution.

In this paper, we assume that the pollution is transmitted from upstream to downstream to some rate. If this rate was known for the social planner, then she could estimate from the cost vector the amount of pollution discharged for each of the countries to his own segment, and she could distribute the cost according with the actual responsibility of the agents. Unfortunately, in most real situations it is not possible to know this precise information over the rate. However, from the cost vector we can estimate at least minimum and maximum limits of responsibility for each country. This information should be used in order to distribute the costs fairly in such a way that the cost assigned to each agent should be between these limits.

We propose a new rule, namely the responsibility rule, which takes into account the information derived from the limits of responsibility in order to distribute the cost among the countries. Further, we provide a characterization result of this rule with four properties: No Upstream Responsibility (which states that a country \( j \) situated downstream from other country \( i \) has no responsibility from the pollution present in this region \( i \) and, therefore, it does not have to pay the costs of cleaning it), Consistent Responsibility (that ensures that the responsibility of country \( i \) relative to the responsibility of country \( j \) located in a downstream segment, in the generation of the pollution there, is consistent along all the downstream areas of both countries), Symmetry of the non-imputable pollution (that says that given two consecutive agents, the part of the cost of cleaning the pollution in the downstream country that is not imputable to any of both is equally shared between them) and Partial Independence of Position (that states that the part of the cost that one country should pay for the cleaning process of its own territory does not depend on the position it occupies in the river). Besides, we prove that the properties are independent.

References

