Industrial water pollution in Uruguay and indirect spillover: sectors' subsystems through input–output analysis and geographic information systems

Extended Abstract ESEE (600-1200 words)

Effluents emissions to water resources are one of the main ecological damages in Uruguay. Water resources anthropogenic pollution became a significant environmental problem since the 50's decade. But it was during the 80's that the problem became critical as a consequence of industrial growth, mainly in the beaches of Montevideo. In late 80's Montevideo's local government asked for international financial aid for implementing a huge sewerage infrastructure plan for alleviate emissions to the Río de la Plata. Its implementation started in 1996, after the Sewerage Director Plan was approved. The Plan is being implemented in four stages. Two has been already finished, and the third one is expected to start in 2013. First, the existing sewerage was improved and extended to the most relevant residential areas looking mainly for diminishing households' water disposals impact on Montevideo's beaches. Also, industrial decay consequence of the national crisis between 1999 and 2002 helped to alleviate industrial pressure to watersheds. A second stage extended the network to the north-west of the city, looking to bring better quality of life to population in the peripheral residence zones as well as to provide connection to agro-based industries. They are mainly food and leather industries located near creeks that serve the Río de la Plata. Pollution control in this area is a very important task because it affects local biodiversity and Montevideo's beaches water quality, but also the most fragile population in socioeconomic terms is located around them. This implies also health troubles for the less favored population.

Focusing the attention only in directly water polluting sectors we may miss some very important interactions in the pollution generation if non-polluting sectors indirect pollution is not considered for policy analysis and recommendations. Input-Output (IO) analysis allows isolating the effects of each sector, and studying their linkages with the rest of economic sectors and the environment. Industrial water pollution is defined as those emissions declared by the firms that have a permit for developing activities that involve emissions to water resources (ADI permits). But industrial sectors can pollute for attending their own final demand, or for producing inputs that the rest of the economy needs. Geographic information systems (GIS) allow identifying the hotspots where it takes place the main point-source impacts and the efforts to recovery the good state of water bodies and in general ecosystems. With this micro and meso link, one may trace back and forth the impacts through the supply chains from the points of consumption to identifying the local areas of pollution.

The objective of the present paper is then to decompose the water pollution responsibility of polluting and non-polluting sectors' subsystems and make this spatially explicit link between production and consumption. The specific methodologies with which we can decompose the industrial water pollution responsibility are based on the IO subsystem analysis (furthermore making use of an updated IO table of 2008), as in some applications previously applied by (Alcántara, 1995; Alcántara and Padilla, 2009; Fritz et al., 1998; Navarro and Alcantara, 2009; Sánchez-Chóliz and Duarte, 2003), using a multiplicative decomposition as proposed by (Sonis and Hewings, 1993). Similar applications for water pollution and IO that we also review is for example (Sánchez-Chóliz and Duarte, 2005). On the methods with GIS, the different joins, spatial tools and localization of sources of pollution, populated places, rivers and basins, utilities and treatment plants, enables an integrated and interdisciplinary physical and ecological economic analysis of the studied areas in Uruguay. Literature that we review for the modelling

approaches based on the integration of ecological and socio-economic assessment methods, scale-specific and GIS-based data and knowledge modelling and visualization techniques for water pollution and risks are for example (Bhuiyan et al., 2013; Volk et al., 2008).

Results shows that polluting sectors' subsystem is responsible of about 88% total industrial water pollution (but also with differences by sectors on whether they satisfy domestic final demand or exports), but the remaining 12% is spillover pollution indirectly produced by the non-polluting sectors' subsystem, mainly explained by direct input requirements to the polluting sectors. It is worth to note that despite services sectors were not important because of their technology, they are the most significant when their weight in final demand is considered (61% of total non-polluting sectors industrial water emissions). The concentration of water treatment plants in the southern area of Uruguay, particularly near Montevideo contrasts with their absence in northern areas (particularly the west), where some important point-source pollution also takes place.

All this opens a box of complementary demand policies for pollution mitigation applied to indirect spillover polluters, among others, through input substitution (clearly identified through IO analysis), and labeling and process certification, apart from the existing regulations and ADI permits.

References

Alcántara, V., 1995. Economía y contaminación atmosférica: hacia un nuevo enfoque desde el análisis input-output. Universitat de Barcelona.

Alcántara, V., Padilla, E., 2009. Input-output subsystems and pollution: An application to the service sector and CO2 emissions in Spain. Ecological Economics 68, 905-914.

Bhuiyan, A.B., Mokhtar, M.B., Toriman, M.E., Gasim, M.B., Ta, G.C., Elfithri, R., Razman, M.R., 2013. The Environmental Risk And Water Pollution: A Review From The River Basins Around The World. American-Eurasian Journal of Sustainable Agriculture 7, 126-136.

Fritz, O.M., Sonis, M., Hewings, G.J.D., 1998. A Miyazawa analysis of interactions between polluting and non-polluting sectors. Structural Change and Economic Dynamics 9, 289-305.

Navarro, F., Alcantara, A.R., 2009. Sobre los subsistemas input-output en el análisis de emisiones contaminantes. Una aplicación a las emisiones de CH4 en Cataluña. Economía Agraria y Recursos Naturales 10, 25 – 39.

Sánchez-Chóliz, J., Duarte, R., 2003. Analysing pollution by way of vertically integrated coefficients, with an application to the water sector in Aragon. Cambridge Journal of Economics 27, 433-448.

Sánchez-Chóliz, J., Duarte, R., 2005. Water pollution in the Spanish economy: analysis of sensitivity to production and environmental constraints. Ecological Economics 53, 325-338.

Sonis, M., Hewings, G.J.D., 1993. Hierarchies of regional sub-structures and their multipliers within input-output systems: Miyazawa revisited. Hitotsubashi Journal of Economics 34, 33-44.

Volk, M., Hirschfeld, J., Dehnhardt, A., Schmidt, G., Bohn, C., Liersch, S., Gassman, P.W., 2008. Integrated ecological-economic modelling of water pollution abatement management options in the Upper Ems River Basin. Ecological Economics 66, 66-76.