NEW CHALLENGES OF WATER POLLUTION IN EUROPE AND THEIR SOCIO-ECONOMICAL IMPACT

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Abstract

Since 1970, public water policy is part of European framework. The quality of water has always been a concern in the European Union policy. Framework Directive (WFD) of 23 October 2000 (Directive 2000/60) which aims to give coherence to the whole of the legislation with an overall EU policy in the field of water comes just confirm this reality. However, the continuous rise of pollution in the aqueous medium requires permanent vigilance of the engineers in charge of processing as well as responsible legislators of standards of water quality. That is why researchers are constantly working on the most persistent micro-pollutants in the environment. This scientific vigilance is unfortunately with an impact on the economy. Indeed, the cost of investments made in response to the pollution affects the price of water. This study presents the socio-economic impact of water pollution by the news persistent pollutant as nitrate, pharmaceutical and pesticides in Europe. It aims to assess the cost of socio-economic damage linked to the deterioration of water quality. The results show that pollution causes an increase markedly the annual price of water for households, increased grant requirements, a rise of certain diseases and even an impairment of the natural heritage of the people. This is well illustrated by the example of Alsace region in France where from 1988 to 2002, the region because of the pollution has been an increase of about 30 euro per year on water bills per household of 4 people. An amount that would have been between 60 and 100 euro per year per household if the community had not benefited from substantial subsidies. The increase in nitrate content generated more than 10 million euro expenditure in a brewery of the region and the loss of the natural heritage of its population was estimated between 16 and 24 million euro per year; or 180 million to 170 million euro in these 15 years.

Keywords: economic cost; pharmaceutical industry; water pollution

JEL classification: I15; I39; Q53

1. Introduction

An important part of water management that has not received due attention is the socio-economical impact of pollution. The rapid development of industries, agricultures, population etc. in Europe has resulted in heavy losses to surface and ground water quality. Basically water pollution poses a serious challenge due to its impact on a large number of economic activities as several activities depend on the water quality. The problem of water

pollution acquires greater relevance in the context of European economy. While the magnitude of the problem is limited and widely spread, the losses due to its impact are quite substantial. This is mainly due to its direct or indirect impact on water price, human health and natural heritage of the people. Through there are a number of studies on water related to pollution problems, such as surface water, oil, chemical, ground water, thermal and agricultural pollution, only a few studies have dealt with socio-economical impact of water pollution. Pearce David and Warford were shown that the damage costs in term of human health in developing countries are higher than those in developed countries (pearce David and Warford 1993). There researchers have argued that the most important and immediate consequences of environmental degradation in the developing world take the form of damage to human health. However, in most of studies estimates are made on the basis of single reference point. They have not taken into account the changes over the period or compared the affected situations with that of a controlled situation.

The contamination of the water resources by persistent pollutants such as pesticide and pharmaceutical residue is one of them.(Guevart, E. et al. 2006) It is now recognized that some persistent pollutant like pesticide and pharmaceutical compounds reach the environment and can be considered as environmental contaminant. Pesticides used in agricultural activities contaminate soil and then they can be transferred to water resources by precipitations. These types of pollutants are positioned nowadays as new persistent pollutants because they are not always totally removed from the water. Then they can be considered as a new challenge of pollution in Europe even worldwide. There are many researches about the fate of pesticides through to water resources by the way of soil. (Natividad, M. et al. 2012; Hupka, J. et al. 2006). Drugs including antibiotics, antiphlogistics, blood lipid lowering agents, antiepileptics, and β-blockers have been found in the effluents and surface waters of several countries (Besse, J.-P. 2010). They occupy a prominent place among the persistent pollutants and the most part of them are not biodegradable. Consequently, in order to remove, it is required to extract or degrade them totally. This requires knowledge of their origin, manner of transfer and retention by the soil particles. That is why, the researchers are interested in the mechanisms by which these contaminants through the wastewater treatment plants to reach surface water, bind to the ground or are washed down the aquifers that supply drinking water (Doulaye, K. 2002; Boudesocque, S. et al. 2006). Contamination of water, soil and sediment by pesticides and drugs can have toxic effects on organisms in soil, plants, animals and ultimately people (Flogeac, K. 2004). It is possible to determine the relationship among pollutants, water and soil and also between water pollution and water price. Much progress has been made in understanding the fate of pesticides in soil, however there is still much to do especially in relation to drugs. In addition, how to eliminate pesticides and drugs from polluted matrices? Understanding of the specific pollutants, polluted environments and sorption products in the sediments plays a key role in choosing a method for remediation of contaminated area.

This study is an attempt to estimate the impact of chemical pollution on economy. Besides, the study region provides a unique opportunity to understand the evolution of the problem. He will help us to see the link between water pollution and economy in the society. Our work takes analysis forward by building on these three stands in the literature in order to empirically examine questions that to date have only been addressed conceptually in the institutional ecological economic literature[]. We make news specific contributions to the ecological economic literature in terms of understanding the impact of water pollution in economy life.

2. Data and methodology

In our work, indirect method such as effects on production (EOP), replacement costs (RC), and human capital (HC) approaches were used to estimate the damages and losses crops, agricultural equipment and health. A brief description of the methods and there results is discussed below.

2.1. The effects on production approach (EOP)

The effects on production approach principle states that an activity may affect the output, costs and profitability of producers through its effect on their environment. If there is a market for goods and services, the effects of environmental impact can be represented by the value of the change in output, i.e., the reduced value of fish caught as a result of river pollution. EOP has also been used to trace the impact of environmental changes such as soil erosion, deforestation, wetland and reef destruction, and air and water
pollution on agriculture, forestry, fisheries, power, public services and other sectors (Bateman et al., 2003).

2.2. Replacement costs (RC)

Replacement cost (RC) approach states that if the environment has already been damaged, in order to restore it to its original state one has to spend some money. For example the victims of environmental damage replace their environment by moving away from the affected area. The costs, which the victims incur by moving to a clean environment, are called replacement costs. One of the techniques adopted in the replacement cost method is that of direct observation of actual spending on safeguards against environmental risks (Winpenny, 1991, p. 48; Bateman et al., 2003).

2.3. Human capital (HC)

The human capital approach considers people as the economic capital and their earnings as return to investment. Environmental economics focuses on the impact on human health due to bad environmental conditions, and the effect this has on the individuals and society's productive potential (Bateman et al., 2003). Here the method would estimate the economic costs of illness of a productive human being. Two variants of this can be taken into account while measuring economic costs of illness due to environmental factors: first, the loss of earnings (working days) due to illness, and second, the cost of medical treatment. In our study, we have calculated the loss of productive time and annual expenditure on health care, and then arrived at the total economic loss due to illness. However, it may be noted that we have not taken any help of medical science or epidemiological data to correlate the illness with pollution. However, the laboratory tests of various water samples from the village suggest unequivocally that there are enormous possibilities of water related diseases. The linkages between water pollutants like pesticides and pharmaceuticals are well established (WHO, 2000; Sigal et al., 2003; Farid et al., 2003; Adeel, 2001).

Historical and importance of water treatment

One of the earliest references to the treatment of drinking water is taken from a medical text dating from 2000 years before Jesus Christ. In 1852 in London, a law was passed which stipulates that all water intended for human consumption must be filtered. After 1870 the progress achieved made it possible to prove that water could carry bacteria and promote the transmission of various diseases. From 1904; England proceeded to continuous chlorination of water consumption. The criteria for assessing the quality of water change with the types of pollutant that they evolve with the advances and changes in

habits. In the early twentieth century, for example, the criteria for assessing the quality of water were essentially based on the senses; clear, palatable and free of odor. Since the beginning of the century by cons, we can determine whether water is safe thanks to current technology more and more to the point. We can make drinking any water, whatever its degree of pollution. But the each pollution has a cost. Then, cost of drinking water changes with the degree of pollution. We will show how this is true in Europe and also on what plan population growth and industrialization causes a change in the amount and quality of pollutants discharged into water. Produce drinking water from more or less polluted raw water is the task of engineers in charge of water treatment. The raw water will have to undergo various processing steps defined according to the pollutants present.
The years 1981-1990 have been declared by the United Nations International Water Decennia. WHO and the World Bank had then estimated 300 to 600 billion US dollars with the investment required for premium reduction in the number of patients. According to WHO, 80% of diseases are directly related to water; as one that was not enough, the polluted water is responsible for 50% of infant deaths. In the US, a study has revealed that 35,000 people were victims of salmonellosis, shigellosis and 75000 200000 for hépathite A. infections leading total hospitalization expenses, mortality and yield loss of $ 6.5 million, respectively, 115 million and $ 3.5 million $. []

2.4. Persistent Organic Pollutants (POPs)

Persistent Organic Pollutants (POPs) include a vast variety of chemicals that threat both the environment and plant, animal and human health. Among the most relevant, agrochemicals, pharmaceuticals, personal care products and other, such as dioxins, polycyclic aromatic hydrocarbons (PAHs), benzofurans, etc. can be included. There are different reasons why these compounds may be (or may become) 'persistent', including their natural lifetime, the possibility that they last long due to a continuous input, their spatial range of occurrence, etc. All these POPs show large differences in their bioavailabilities and bioaccessibilities for which attention should be paid to potential methods for their reduction and/or degradation. (Canle, L. M. 2012)

2.5. Pharmaceuticals

The pharmaceutical industry currently has the highest potential for research and development. Unfortunately, there is still not enough interest on the research about the fate of drugs in the environment after passing through living organisms (humans, animals) and after release into the environment (Bayraç, Z. B. 2011; Errard, P. 2014).Recent studies show that wastewater treatment plants do not remove all drug residues contained in wastewaters, which contributes to the pollution of surface waters. As consequences, , Hermaphroditic fish , who change sex, can be seen, humans can gain resistant against antibiotics and other possible damages that are not known yet can be happened (Durable, C. 2008). A lot of rivers are affected by this pollution (CDURABLE. 2008). In select towns and cities in Iowa (USA), the most frequently detected compounds were metolachlor (92.0%, pesticide), cholesterol (74.7%, plant and animal sterol), caffeine (72.4%, stimulant), b-sitosterol (66.7%, plant sterol), and 1,7-dimethylxanthine (44.7%, caffeine degradate). These compounds represent a wide variety of uses and origins including urban and agricultural sources (Dana W. Kolpin et al. 2004). Drugs being found in the environment may also depend on consumption habits of the population. Moreover, to predict the type of medicine may end up in an environment [where they] can also study the rates of consumption of different samples. According to 2010 data of Turkish Pharmaceutical Industry Employers' Association, Drug consumption per person of 2010 was 133 dollars in the country. In that classification, Turkey ranked 13th far behind the

USA (1st) and France (2nd)(BAYRAÇ Z. B. 2011, BOUVIER, M. et al 2010). Concentration levels in receiving waters vary, depending on the chemical stability, biodegradability, physico-chemical characteristics of the molecules and performance of wastewater treatment plants. Concentrations can vary from nanogram per liter to micrograms per liter in surface water or groundwater (Halling-Sörensen et al. 1998). There is currently no regulation regarding their level of presence in the wastewater and the environment (Guigon, E. M.; 2010). It is important to understand how these drugs arrived to environment, which kind of transformation they have in the environment and what the factors are that govern the environmental toxicity of drugs. Between 2003 and 2010, the most consumed four groups of drugs in Turkey were, antibiotics, cardiovascular, antirheumatismal and nervous system drugs (Neslihan, P. 2012.). (Ben, N. J. et al. 2011)

2.6. Pesticides

Pesticides or plant protection products are defined as substances whose chemical properties protect crops against parasites, insects, mites, rodents or rural destroy weeds or "weeds." Generally, we encounter in daily life insect killers (insecticides), mould and fungi killers (fungicides), weedkillers (herbicides), slug pellets (molluscicides), plant growth regulators, bird and animal repellents, Rats and mouse killers (rodenticides) (Kouzayha, A. 2011; Mutsee, T. 2013) Many pesticides, including herbicides and fungicides are highly toxic to terraneous and aquatic life. They can enter into the environment by several routes such as spraying, soil and storage, as well as wastewater discharge (Şafak, U.; Özkan, Ö. 2015). Environmental contamination occurs when these pesticides migrate from application site into groundwater via rainwater (Guillon, E. 2010; Şafak, U.; Özkan, Ö. 2015).

2.7. Nitrates

The irreversible deterioration in surface water quality by urban and industrial waste, saline intrusion of coastal aquifers, and contamination of groundwater by nitrates are all examples of avoidable stress on water resources. The natural level of nitrate in groundwater is generally below 10.0mg/l. Elevated nitrate levels are specially caused by the agricultural use of nitrogen fertilizers and manure in excess of plant requirements, or by their application at the wrong time of the year. Local pollution from municipal or industrial sources can also be important. On-site sanitation and leaky sewer pipes in urban areas may also contribute to increased nitrate levels. Certain types of aquifer, such as alluvial and shallow aquifers, are more vulnerable to nitrate pollution than others because of differences in such features as hydrogeology and land use. Deep or confined aquifers are generally better protected. Nitrate moves relatively slowly through the ground, so there can be a significant time lag between the polluting activity and the detection of the pollutant in groundwater (typically between 1 and 20 years). The general intensification of agriculture over the last 30 years has only relatively recently been reflected in increasing nitrate concentrations in groundwater. The WHO guideline value for nitrate in water intended for human consumption is 50mg/l NO3. The EU Drinking Water Directive permits the same concentrations. The results from groundwater monitoring programmes in 17 European countries showed high levels of nitrate (greater than 25 mg/l) in groundwater in 50% of the sampling sites in Slovenia. In eight countries this level was exceeded in about 25% of the sites and, in one country (Romania) 35% exceeded 50mg/l. In Denmark, for example, about 2%of all supply wells have been closed since 1986 because nitrate concentrations were above 50mg/l.

Impact on health

The rapid industrialization in developing countries, though contributed to economic development, has resulted in heavy losses to economic welfare in terms of effects on agricultural activities, human health and ecosystem at large through air and water pollution. Basically water pollution poses a serious challenge due to its impact on a large number of economic activities. The problem of water pollution acquires greater relevance in the context of European economy. Though at the macro level Pearce David and Warford 1993) have estimated the costs of environmental degradation in terms of human health, soil erosion, deforestation, etc., majority of the indicators are not directly related to industrial pollution. It was shown that the damage costs in developing countries are higher than those in developed countries (Pearce David and Warford,1993). According to their estimates the environmental costs in the developing countries were about 5% of their GDP. A few studies have dealt with the impact of industrial pollution on agriculture, human health and ecosystems in the developed countries (Pearce et al.,1978). Pearce David and Warford (1993) have argued that the most important and immediate consequences of environmental degradation in the developing world take the form of damage to human health.

3. Impact on water price

For fifteen years, the price of water has more than doubled in several European countries, even though the quality of the resource has decreased. In reality, the two are related in part. Water pollution generates substantial costs in two areas: processing operations that allow for drinking water and the cost increases with the degree of pollution, the actions put in place to fight against pollution. In France situation, is logically appears that, for ten years, the pollution tax is the position that has the largest increase in the customer's bill. Suppose that water contains 5 pollutants including 3 persistent pollutants. The treatment of this water will undoubtedly function of all of these pollutants. As against the persistent pollutants will be the most expensive in terms of treatment, they will be those who will most influence the final price of water. The price of drinking water will appear as the norm of the vector resulting from the sum of all the vectors representing each of pollutions. Consumers are extremely willing to pay for water of good quality. Consumption of bottled water is growing in a number of countries. Many people lack confidence in the quality of their tap water and have therefore invested in household filtering device, without knowing that most of these filters do not effectively control contaminants or pathogens. Public pressure and greater awareness have helped to create and carry out a number of pollution control programmes in recent decades in several European countries. Nevertheless, people are increasingly seeking cleaner water for recreation and are prepared to travel to find recreational water of good quality. For example, in terms of beverage, a people consumed only 3 liters of water per day; $1m^3$ of water per year with $5m^3$ per year per person for cooking. When we think that water is polluted, we stop consuming it as a drinking water but, usually because of lack of finance or ignorance, we continued to cook with this water. Yet we know that chemical pollutants, such as, drugs, nitrates and pesticides do not disappear which heat; for some molecules we might even have a change of structure giving birth to a more harmful molecules.

Case of Alsace region in France

Let us focus now on Alsace region in France. People living in and around these industrial estates have suffered damages in terms of losses to crops, cattle and agricultural equipment such as pump sets, contamination of drinking water, diseases and deaths due to water pollution. Polluted water must be treated before use, high pollution, would lead to significant processing; this with consequences on the price of the final product. This is why

the link between pollution and the price of water goes through the cost of water treatment from 1988 to 2002, the region because of the pollution has been an increase of about 30 euro per year on water bills per household of 4 people. An amount that would have been between 60 and 100 euro per year per household if the community had not benefited from substantial subsidies. The increase in nitrate content generated more than 10 million euro expenditure in a brewery of the region and the loss of the natural heritage of its population was estimated between 16 and 24 million euro per year; or 180 million to 170 million euro in these 15 years.

Conclusion

The future of water passes through scientific research, technological development and innovation. The European Union has the largest research program public of the world. This program has invested € 1.3 billion for research Water in the past decade. The projects financed concern almost all aspects of sustainable water management. They benefit to Europe but also in many other parts of the world. Scientific progress is accompanied with an increase in pollution which results expenditure for households, businesses, municipalities and finally governments.

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