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Assessment of the Socio-economic Impact of the Chemicals Environmental Contamination

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Abstract

Socio-economic impact analysis is one of the key components of the complex management process in which risks from environmental contamination by chemicals are identifying and assessing. Paradigm of risk assessment covers four main phases: hazard identification; examination of the relationship between chemical concentration in environment and its adverse effects; exposure assessment and finally, risk characterization. The socio-economic analysis represents the analytical base, funded on the wide body of the scientific and professional knowledge, for initiating the risk management and mitigating adverse processes in environmental contamination situations. The aim of this analysis is to develop strategy and to propose measures to overcome potential risks of environmental contamination. In the article, the specific emphasis is put on the role of the socio economic analysis in the risk management of environmental contamination by hazardous chemicals. *The process of socio-*economic analysis *of hazardous chemicals includes identification of anthropogenic activities in which these chemicals are present, and based on that, the assessment of the* environmental *changes (pollution) caused by these activities and their adverse impacts on human health,* on *the environment and on economic development* of *impacted communities*. Number of specific methods and indicators for measuring those effects are developed: they are mainly focused on their quantification and sometimes also on monetization, i.e. expressing them in financial terms.

KEY WORDS: environmental contamination, risk management, hazardous *chemicals,* ecological accidents, *socio*-economic impact

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Environmental contamination by chemicals: hazards and risks

Socio-economic impact analysis is one of the key components of the complex management process in which risks from environmental contamination by chemicals are identified and assessed. The aim of this process is to evaluate and to develop set of measures for improvement of the socio-economic situation in smaller and lager communities. This process should include all stakeholders affected by environmental contamination, since only comprehensive approach in risk management would provide sustainable development of the communities. The role of socio-economic analysis in this process is very important – it does represent the analytical base, funded on the body of the scientific and professional knowledge, for initiating the risk management process in assessing the environmental contamination.

Socio-economic analysis is strategically oriented to the development of the society and economy, enabling insight in the current state, identifying the specific issue of interest, and restricting the adverse impact of environmental contamination. The aim of this analysis is to develop strategy and to propose measures for overcoming potential environmental contamination risks.

Ecology, specifically ecotoxicology, is dealing with the adverse effects of chemicals on the environment. In the last few decades there were number of frightful experiences with the global ecological disasters, which unavoidably led to misbalance in eco systems and had as a consequence very negative impact on the human health.

One of the first cases which brought environmental pollution to the public attention was the pollution of Love Canal, on Lake Erie in New York, in the 1970s. From 1942 to 1953, several chemical companies dumped 20,000 metric tons of chemical waste at this site. As a consequence, eighty different chemicals, including dioxins and polychlorinated biphenyls (PCBs), started to leach through the soil, and residents have experienced many unexplainable health problems. Today federal laws stipulate that generators of hazardous waste are responsible for the proper storage and disposal chemicals from the "cradle to the grave." In the following decades environmental accidents continues to happen, among which on the global level the highest level of attention was attracted by the chemical disaster in Bhopal (1984), Chernobyl nuclear disaster (1986), as well as, Mexico gulf oil rig disaster (2010). Even though any of smaller accident should not be neglected having in mind its long lasting consequences to the human health agriculture, economy as a whole, biodiversity and other environmental areas. Moreover, ecological disasters or accidents are not necessary outcome of anthropogenic activities; natural disasters (like volcanic activity, fires, flood etc.) could be also the cause. Floods in Serbia during the 2014 were an example of natural disaster negative influence to living organisms, health of humans and all other relevant factors.

Those, as well as many other, disasters also pointed out the importance of the strategic planning for risk management as a factor in minimizing damage from the accidents and that the socio economic analysis is one of the major components of these plans, in prevention but also in recuperation from their consequences.

The toxic chemicals are of special concerns regarding their effects on environment. They can enter environment, similar like in the case of other accidents, as a consequence of anthropogenic activities or as an unintentional additional effects of various activities.

However, when toxic chemicals ones enter the environment, they pose potential risk which need to be managed in order to minimize the probability of expression their adverse effects. Data on effects of chemicals on animals, plants and other living organisms are obtaining from standardized ecotoxicological studies and results of those studies actually create a base for risk assessment as first step in the process of environmental contamination management.

Socio-economic analysis as a part of the risk assessment and mitigation of chemicals adverse effects on the environment

Paradigm of ecotoxicological risk assessment includes four key steps: first one is hazard identification, second is examination of the adverse effects of the specific concentration of toxic substance on environment; the third one is exposure evaluation and the fourth one is risk characterization. After performing those successive steps in risk assessment and stipulating the risk characterization it could be concluded whether the risks are acceptable for certain targeted living organisms or not. If the results of analysis show that risk is not acceptable it is necessary to take measures for managing the risks of environmental contamination. Socio economic analysis is important and necessary part of this process and it is of great importance to perform it in right time having in minds all relevant factors.

Risk of chemicals contamination could be considered as unacceptable when concentrations of chemicals in certain environmental areas (Predicted Environmental Concentration – PEC) overcome the values for which is confirmed that adverse effect would not appear (Predicted No Effect Concentration - PNEC). Feature of chemicals like persistency reflects their life in the environment, i.e. time necessary to reduce their concentration on the half of the initial concentration. Bioaccumulation and bioconcentration imply potential of chemicals to enter living organisms, for examples concentration in fish could be hundred times higher than in water. Finally, biomagnifications show possibility of chemicals to magnify its presence through the food chain and therefore poses the risk to human health.

Among chemicals, of special concerns are persistent organic chemicals (*Organic Persistent Pollutant – POPs*) because they have all three mentioned features toxicity, persistency and bioaccumulation. Management of these chemicals is regulated at the international level by adoption and ratifications of Stockholm convention in 2001. Until 2014, convention has been adopted by 179 countries, where Serbia belongs too.

The content of socio-economic analysis and impact assessment of hazardous chemicals

The process of socio-economic analysis of hazardous chemicals includes identification of anthropogenic activities in which these chemicals are present, and based on that, the assessment of the environmental changes (pollution) caused by these activities and their adverse impacts on human health, the environment and economic development of impacted communities.

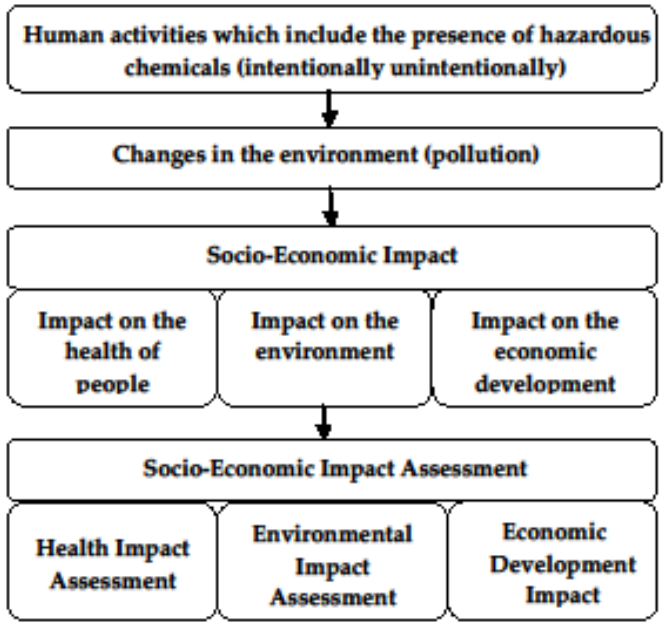

Figure 1: Socio-Economic Impacts of Chemicals and Analyses

In the context of risk management of these chemicals, the social and economic impacts, among other, may include the following:

- *Deterioration of the health of people*: hazardous chemicals inflict a series of adverse effects on the health of people out of which many have been already confirmed by research, laboratory tests and long years of experience in various parts of the world;
- *Loss or increase of means of living*: hazardous chemicals may deteriorate people health and thus reduces their ability productively to work and provide means for their living; also, they may also significantly damage natural resources and so reduce the sources of livelihood for individuals and their communities; at the same time, we should bear in mind, that some activities involving the use of chemicals may represent a significant source of specific benefits for certain social groups;
- *Changes in costs of living*: the above said impacts may sometimes, due to their nature, generate extremely high costs, such as costs of medical treatments, loss of working days due to sick leaves, costs of treatment of the polluted water and air, etc.
- *The level of child labour*: activities related to hazardous chemicals often involve child labour, this is particularly true for underdeveloped and developing countries;
- *Changes in the degree of balanced distribution of social wealth*: many activities (particularly in the domain of agriculture) are the sources of income of poorer classes of society, and any threat to them may also additionally worsen their situation;
- *Opportunities for development of companies (including small and medium-sized enterprises)*: in addition to number of adverse impacts on economy, activities

which result in the presence of POPs may be an opportunity for SME, e.g. the area of recycling and remediation of negative effects of POPs;

- *Changes in demand for public services, such as health care and education and infrastructure*: hazardous chemicals, directly or indirectly, may affect the health care sector (specific capacity for remediating of damages caused by these chemicals need to be provided), the education (the skills and knowledge required to treat chemicals need to be developed), as well as building specific technical capacities to treat them adequately;
- *Impact on vulnerable segments of society*: given the diversity and scope of impact of POPs, we may talk about their impact on vulnerability of individuals and society as a whole, that is, impact in terms of disruption of stability and sustainability of social systems and their subsystems;
- and others.

All these aspects have been the focus of specific research efforts, but the strongest emphasis is put on the assessment of chemicals impact on the health of people, particularly their impact in the work place. There are numerous researching activities which have been focused on the effects which chemicals have on the eco-system and somewhat lower number of researching activities which have dealt with their economic development impact.

Numerous methods and specific indicators for measuring the effects of hazardous chemicals on society can be found in reference books and publications. They are mainly focused on quantifying of those effects by applying specific measurement units and sometimes they are also used for monetizing them, i.e. presenting them in terms of financial units.

Conclusion

In conclusion, it should be said that socio economic analysis is important and necessary part of the chemical risk management in ecotoxicoogy. It is important to predict all necessary preventive measures and perform them on time in order to manage the risk. Showing the whole aspects of socio economic analysis, and pointing out the extent in which it can contribute to the decision making in risk management, we expect that we have sufficiently emphasized necessity for use of this approach in all further accidents, especially in preparing strategic plans for accidents management, where beside economic and financial benefits, reduction of environmental contamination could bring invaluable society benefits.

Generating of the environmental pollution in the modern societies is unavoidable and industrial nations will always produce a certain level of pollutants. Some of the pollutants, even potentially very harmful to the environment are at the same time very beneficial for individuals and communities. The good examples are the pesticides, which besides their potential harmful effects, at the same time, have greatly contributed to the increase of overall food production in the world; the pharmaceuticals, which require potentially dangerous organic chemicals for their manufacture, at the same time considerably have extended human lives; plastics, one of the main environmental pollutants all over the world, are used in all aspects of medical and domestic life, etc. What modern societies need to do is to find an optimal balance between the attempts to minimize the costs and to increase profits in manufacturing numerous consumer and industrial goods and requesting industries and individuals to reduce pollution in their operations.

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