How Complementary and how Competitive are Concepts of SEA and DPSIR? A Demonstration on Idricat's WP3

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Abstract: The Idricat project has been about mercury pollution in the Idrijca-Soča rivers catchment. It lasted from June 2002 to December 2003. The primary objective of the project was to demonstrate integral natural and social science based catchment-coastal zone modelling. The main purpose was to show to stakeholders that such a modelling and demonstration enable informed long-term policy related decision-making in both areas: socio-economic development and environmental protection. The working background of the project was the DPSIR framework. By identifying different measures for reducing mercury pollution in the catchment, including coastal sea, under different assumptions of future societal development – BAU, PT, DG – which incorporate different level of risk aversion of the society, the analysis has been made on how complemantary and how competitive are the concepts of SEA and DPSIR in terms of supporting overall strategic development goals. The results show that SEA is more powerful when preventative and optimising approach with integration of socio-economic, space development, and environmental protection goals is applied. This is due to the characteristic of SEA which motivates creation of aditional, more comprehensive alternatives in the evaluation process itself; even more, new alternatives, developed in an open, democratic atmosphere better fulfill interests of different stakeholders. The DPSIR framework, on the other hand, enables more straightforward and quantitative evaluation of the alternatives. The ultimate result of the analysis is that the two concepts are complementary and should be applied in sequence: SEA first, on more strategic planning levels, while DPSIR is more appropriate on a project level.

Key words: strategic environmental assessment, environmental modelling, societal development, space planning.

INTRODUCTION

The Idricat was one of seven sub-projects (catchments) in the framework of the EUROCAT project (http://www.iia-cnr.unical.it/EUROCAT/project.htm). The others were Rhine-Elbe, Humber, Vistula, Po, Axios, and Provadijska. The project encompassed five WPs. Scope and objectives of the WPs were: WP1 to collect data on sources, fluxes, and concentration levels of different compounds for the region; WP2 to develop a DPSIR framework into a practical working tool for a wide spectrum of users, including policy, planning, and regulatory bodies; WP3 to apply a response component of the DPSIR framework under different scenarios of societal future development (foresight by the year 2015 - 2020) as an argumentation for selection of alternative measures aimed at pollution reduction and environmental state improvement; WP4 to de-

velop a tool for appropriate distribution of critical loads in the catchments; and WP5 to facilitate collaboration among natural and social scientists and to ensure policy-relevant findings by active incorporation of representatives of stakeholders. In regard with the WP3 for Idricat specific aims were:

- to investigate present level of understanding, awareness and risk aversion of different stakeholders associated with mercury pollution; an approach and a tool for this investigation is a survey;
- based on results of the survey, to develop different sets of measures as to reduce mercury pollution in the catchment *per se*, and particularly in reference with reduction of health risks; approach should integrate mass balance environmental modelling (transport and accumulation of mercury in the catchment and coastal sea), different scenarios of societal future development: Business As Usual (BAU), Policy Targets (PT), Deep Green (DG), and data on exposure modes and pathways to mercury in the catchment[1,2];
- to apply both DPSIR framework and SEA to evaluate appropriateness of each alternative, i.e. set of measures; tools in DPSIR are cost-benefit analysis (CBA) and multi-criteria analysis (MCA), in strategic environmental assessment (SEA) interaction matrices between strategic development goals and efficiency of the alternatives.

In the paper we focus on the presentation of how DPSIR and SEA performed in the context of the evaluation of the alternatives, further refered to as Idricat's scenarios.

RESULTS AND DISCUSSION

Idricat's scenarios have been identified in the following procedure: first, the main sources of Hg emissions have been determined. Second, a review and collection of Hg concentrations in environmental media has been done. Third, identification of modes of Hg transport and accumulation along the catchment has been performed. Then, a list of possible (alternative) measures on how to prevent/reduce the emissions, reduce Hg concentrations and avoid/reduce/minimise its transport in the catchment with the ultimate reduction of accumulation in the coastal sea has been made. In addition, measures for reducing health risk have been analysed. From the data available and results of further analyses it has been concluded that feasible, i.e. affordable and most effective measures at this stage are those associated with the prevention of the "movement" of Hg from the Idrija mine region (where the main emission sources are) by soil erosion[3]. Additional focus of consideration has been identified in connection with the methylation of Hg; in this context measures aimed at preventing organic pollution of the rivers Soča, Idrijca and Vipava, like construction of Waste Water Treatment Plants (WWTPs) in urban centres and certain industries, have been determined as the most practicable. A list of measures which were considered are summarised in Table 1.

Further specification in terms of Idricat's scenarios is presented in Table 2 and Box 1. A definition and detailed description of the DPSIR is given in the EUROCAT's summary report[1]. Figure 1 gives an insight into the physical environment which is a subject of the second Idricat's scenario (PT). This sce-

Table 1: Summary of the DPSIR for IdriCat with the identification of possible response measures

Drivers	Pressures		State	Impact	Response
	Coast	Catchment			
Development	**Riverine input, methylation**	**Hg input with soil erosion, methylation**	**Elevated Hg concentrations**	**Environmental quality, health**	Close-out of the mine, elimination of the highest Hg pollution – hot spots, land use change, reduction of organic pollution of the Soča river, elimination of lakes at the HEPP
Mining, health interest, safe food (fish)	Mercury (all forms), other pollution	Idrija mine facilities, agricultural land use, land use susceptible to erosion, organic pollution, lakes at hydroelectric power plants – methylation process	Elevated concentrations in soil, air, waters; elevated Me -Hg in the Gulf of Trieste and the Soča river (lakes at HEPP)	Assumed elevated risk and health issues - results of epidemiological studies are not available yet	

nario has been analysed in detail; measures are partly implemented, partly in implementation and partly planned to be implemented by the year 2011. Costs are approximately 27.5 M Euro in total. Apart from the mine closure and related activities, land-use and land cover is to be changed on approximately 40 hectares, if total reduction of about 40 % (wt.) of Hg introduction into the Soča river is to be achieved also by preventing soil ero-

Table 2: Measures to be considered for reducing pollution with, and exposure to, mercury

Idricat's scenarios	Measures	Rationale
Business As Usual	No major changes to existing state: mercury mine in closing, dredging of material at the hydroelectric power plants (HEPP) lakes, development strategy as defined in the Regional Development Plan for Goriška Region and National Development Plan 2001-2006.	Majority of Hg is transported with suspended material, which then accumulates in the HEPP lakes. In lakes, due to a number of factors, Hg methylation occurs. Occasional dredging seems effective in reducing formation of Me-Hg.
Policy Targets	Close-out of the mine, reduction of erosion (forestrisation), immobilisation of Hg in ore tailings and smelting waste – treatment and safe disposing, construction of WWTPs in urban agglomerations, achievement of "good quality" of surface waters (Idrijca, Soča, Vipava).	Requirements of the Water Framework Directive. WWTPs will reduce emissions of organic pollution which will result into reduced Hg methylation. Lower erosion in the catchment will result into lower amount of suspended material in the Soča river and consequently lower amounts of Hg transported to the Gulf of Trieste.
Deep Green	In addition to the above, major reduction of fisheries (reduction of mariculture). Construction of WWTPs in urban agglomerations at the coast – Trieste, Monfalcone, Koper, etc., elimination of lakes at the HEPP on the Soča river.	The aim is to reduce exposure from contaminated maritime fruits. WWTPs will also contribute to reduced methylation in the coastal sea – Gulf of Trieste.

Figure 2: Photos of the Idrija mine region[3]

Box 1: ***Definition of the Idricat's scenarios***
First scenario assumes continuation of the present state and future societal development according to Business As Usual. Therefore, no additional measures to physical closing of the mine is envisaged. This scenario has not been further explored in any specific detail, except the review of the calculation of present Hg emissions and measured concentrations in the environment. The second scenario assumes Policy Targets (PT) as the societal future development and is defined as collection of measures aimed at reducing introdution of mercury into Idrijca and Soča rivers; specific measures are closure of the mine, elimination of the so-called "hot spots" (sites where Hg concentrations in soil are highest), reduction of erosion potential by land use and land cover change (primarilly forestrisation), and construction of WWTPs. This scenario has been explored in detail in terms of mass balance modelling and institutional assessment (a questionnaire based survey). Its effectiveness is to be determined in the future based on monitoring. The third Idricat's scenario assumes societal development towards Deep Green (DG) attitude; the scenario considers measures, which are aimed at reducing potentials for methyl-Hg formation and exposure of population to Hg. This scenario has been considered on the level of the mass balance modelling only; it is still under development/verification, so results are not yet available to be presented here.

sion (Hg annual inflow will drop from approximately 2500 kg in the year 2000 to 1500 kg after 2011)[3].

The evaluation and comparison of the DPSIR and SEA has then been performed in the context of answering the following sets of questions:

1. Is there an agreement in the society, i.e. among stakeholders, which are the main societal issues associated with elevated pollution with Hg? Are the goals of the response measures clear and measurable? Are these the same in terms of short-term and long-term environmental protection policy and desired economic development?
2. What are possible and probable “side” effeccts of each of the Idricat’s scenarios? In this context consideration should be given to change in land price, ownership and management; change in urbanisation; change in physical planning; need for prequalification of unemployed miners and fishermen; change in social structure and social status of neewly unemployed people; need for new jobs; vision and alternatives of the development of the Idrija region after closing the mine; etc.! What are the uncertainties in this regard and how to explore them? How much can CBA (cost benefit analysis) and MCA (multi-criteria analysis) assist in coping with these uncertainties and decision making? Who and how is going to compensate unexpected and undesired side effects? Does decision making process of selecting the most appropriate scenario take into account these uncertainties?
3. Which alternatives are affordable, which one is most appropriate, how are they evaluated (are criteria clear and agreed)? Is there any alternative left with least economic costs and side effects but still effective enough? What is eventually wise to do?

A summarized result on these considerations is given in Table 3.

Table 3: Comparative evaluation of the DPSIR and SEA in the context of the Idricat's scenarios

Questions	Performance of the DPSIR and SEA
1	DPSIR conceptually acts as a curative approach when goals are clear and quantifiable. SEA, on the other hand, is more powerful when long-term qualitative and semi-quantitative evaluation on economic development and environmental policy is under consideration. The survey hasn't confirmed assumed high risk aversion to Hg pollution, so no specific societal issues have been revealed[4].
2	Side effects of alternatives have been partly explored in the framework of SEA for National Development Plan 2001-2006 and the Regional Development Plan for Goriška Region. Different development scenarios have been considered beyond measures anticipated in the Idricat's PT scenario. SWOT analysis has also been performed with the involvement of the public and NGOs. This approach has provided results beneficial for more strategic planning level, while a semi-quantified CBA and MCA in the context of the DPSIR provided clear insight into costs of the PT Idricat's scenario and its acceptability among stakeholders (those who responded to the questionnaire)[3,4]. The decision-making process at present does not explicitly take into account the uncertainties.
3	DPSIR does not consider these questions, while SEA is designed to investigate such important issues. Since exploration of this philosophically and ethically complex questions requires a considerable amount of effort, it has not been investigated in depth in the framework of EUROCAT/Idricat. We, therefore, str ongly recommend collaboration on the issues between Slovenia and Italy in the future.

CONCLUSIONS

The work on Idricat's WP3 and comparison of the performance of the DPSIR framework and SEA confirmed the following cognition about SEA: *Reasons for recent actualisation of strategic environmental evaluations could be found in the growing awareness of environmental problems and conflicts caused by former non-integrated economic and space planning. The second reason comes from higher interest of people, i.e. multiple stakeholders, about political and economic decisions: a willingness to participate in the decision-making process and awareness about former exclusion in the stategic valuation* (adapted from.CEAA[5]). DPSIR is more curative approach, while SEA is more oriented towards optimisation.

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