AN ANALYSIS OF INTERRELATION BETWEEN ENVIRONMENT AND SOCIO-ECONOMIC STRUCTURE WITH SPECIAL REFERENCE TO WATER POLLUTION IN THE TURKISH BLACK SEA BASIN: AN INTEGRATED DYNAMIC SIMULATION MODELING APPROACH FOR WATER QUALITY IMPROVEMENT POLICY

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ABSTRACT

The Black Sea is recognized as one of regional seas, mostly damaged by human activities that inadequate and inappropriate planning has a significant role in destroying its biodiversity, habitats, fisheries, aesthetic and recreational value. Since long period, the Black Sea has been used for many purposes ranging from socioeconomic activities, as a transport route, and a place to dump solid/liquid waste. All of these uses have additional economic costs through their impacts on the environment. Largely ignoring these costs have contributed to the present environmental crisis. In the circumstances made clear above, finding solutions to improve the water quality of the Black Sea is one of the critical issues.

In this study, efforts have been made to find out sources of sea water pollutants, their contributions and future trends considering socioeconomic activities in order to contribute in attempting to overcome the pollution problem from the sources as in the basin system and in the Black Sea. At the heart of the study is the integration of the ecosystem as water quality indicators related to macroeconomic structure that modeled into mathematical equations. The framework is itself based on a conceptual model, which sets the links between ecosystem processes, functions, and outputs of goods and services with dynamic simulations of processes in the system, which can be used to explore the consequences of environmental degradation, and produce forecasts of future changes.

In view of the fact that, the entire Black Sea basin is very huge, and the countries have different socio-economic structures and priorities on environmental issues. As a result, the Turkish Black Sea Basin used as a reference study area is one of the important sub-basins, which contributes huge amount of contaminants to the sea.

This study has found out the sources of water pollution, contributions by sectors and the impact of future socio-economic changes on the environment in the Turkish Black Sea Basin, where the main sources of pollutants are domestic wastewater, land use particularly agriculture, industry mainly manufacturing, and livestock activities respectively. As a result, we would emphasize that the current socio-economic policy is not adequate to reduce the pollutants in the future. According the results, it is essential to determine in finding a cost-
effective method to address the water pollution issues in the basin that would be feasible to put in as an appropriate action expressed in the following:

1- The simulations indicate that reduction of pollution from household wastewater is very important since it contributes significant amount of nutrients in the basin. The results also indicate that settlements in the basin need sewerage systems and treatment plants. Big cities should have the first priority for constructing treatment plants since they have already sewerage network, followed by other cities and towns according to number of settlements and state of sewerage network. Second, the capital for treatment should be used to establish sewerage network to the rest of towns to be able to construct treatment plants. Construction of activated sludge (biological treatment) option is one of the cost-effective treatment systems that it is commonly established in Turkey and in the basin. However, in zone2 and zone5, the most populated cities and towns wastewaters are discharged directly to the sea. Therefore, mechanical treatment is appropriate with deep-sea outfall systems.

Government is the main stakeholder in water pollution control in Turkey. In cities, and towns local governments (municipalities) also play significant role. However, without central government support, municipalities’ efforts are not enough to overcome the water pollution issues. Therefore, at first, necessary capital that estimated in this study for constructing sewerage systems and wastewater treatments should be provided by government as subsidy. However, national government cannot recover all costs directly from its budget. Consequently, local government should introduce tax for part of construction, operation, and maintenance cost of treatment from local residents.

2- The most difficult issue to deal with is pollutants (nutrients) from agricultural lands since there are many factors have roles on water pollution such as geographical, hydrological, climate, soil structure, production methods, irrigation techniques etc. Overuse of fertilizer for production is the main reason of pollution. According to the simulation result, the cost of abatement is reasonable to mitigate the pollution. In addition, there are many factors should be taken in consideration to reduce nutrient surplus in a cost-efficient approach. In addition, some specific actions should be undertaken expressed as: (i) Develop guidance on fertilizer application rates to individual crops based on soil analysis and requirements of fertilizers for each crop. (ii) Set specific objectives and standards for agricultural practices. (iii)
Government should revise the agricultural policy like a similar approach adopted in the EU Nitrate Directives.

3- In the basin, intensive cattle and poultry farms are the sources of nutrient emission. In order to reduce pollution from livestock, some specific action should be carried out expressed as: (i) Development of livestock manure management must be area-wide (ii) Use of amount animal manure on agricultural lands should be identified as the demand for application and timing in zones. (iii) In order to reach the EU Nutrient Directives, government should revise its policy on livestock production regarding cost-efficient manure management.

4- The industries particularly food-beverage, textile-leather, paper, and chemical industries are the main polluter in the basin and zones. Thus, a number of actions should be undertaken in order to establish cost-efficient treatments outlined as follows: (i) first, small and medium-scale industries should move to industrial areas provided by local government with the support of central government, then the cost of single treatment plant in that area can be shared by sectors that will not considerable affect on their production activities. Here, local government has a major role to lead and organize the industries. In case of large-scale industries, they should construct their treatment plants that government might subsidize a part of construction, or cost of energy for operation and maintenance.

It is obvious that a uniform policy for pollution reduction targets is neither economically nor environmentally practical for the entire basin, since the basin is very wide and has different natural, environmental, socioeconomic and political systems. Therefore, it is necessary first to determine clearly socioeconomic system and ecosystem interactions in each country to be able to formulate an optimal policy as a comprehensive action to achieve the targets in a certain period.

Finally, It worth mentioning that there is no specific basin-wide study in the Black Sea region as introducing the modeling of ecosystem and environmental structure so as to address the water problems interrelated with socio-economic structure and future changes. These results would be useful in presenting to the researchers, policy makers, and authorities in the Turkish Black Sea Basin and as a reference in the entire Black Sea basin countries to contribute in launching any action plan to reach the water quality objectives in the Black Sea.
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