Some Considerations on the Maritime Transport in the Black Sea Area and Health Risk Assessment of Heavy Metals in Marine Fish to the Population

შავი ზღვის რეგიონის საზღვაო ტრანსპორტის ზოგიერთი ასპექტი და მძიმე მეტალების ჯანმრთელობის რისკის შეფასება ზღვის თევზში მოსახლეობისთვის

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Abstract: Transports represent an important aspect of material production, which decisively influences on the other branches of the world economy, including international trade. Thus, the connection between the economic coordinates and the other components of the macroeconomic framework, synthesized from a theoretical point of view must take into account the interactions between: ambient, human resources, superstructure (social, political, legally, cultural, etc), economic relations, material products (technical and technological resources). Maritime transport has a special role in the temporal-spatial relationship between geographical areas, continents and current states of the world. Maritime transport has the role of creating links between all these areas, regions, and states for the performance of complex categories of economic, commercial, social and even political activities. The importance of maritime transport can be traced starting with the following aspects: historic, economic, social political, environment protection, education and scientific research.

Environmental pollution with toxic metals can lead to the possible contamination of the marine fish. The studies of levels of As, Cd, Cr, Hg and Pb is essential to estimate the health risk. The potential health risk may exist for high exposure consumers considering the possible contamination of As and Hg in particular. In this respect we discuss on Health risk of heavy metals in marine fish, Health risk assessment, Estimated of Daily Intake (EDI), Target Hazard Quotient (THQ) for non-carcinogenic risk, Carcinogenic Risk (CR), and on Statistical analysis and map.

Key words: world economy, maritime transport, the environment, technological resources

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აბსტრაქტი: ტრანსპორტი წარმოადგენს მატერიალური წარმოების მნიშვნელოვან ასპექტს, რომელიც გადამწყვეტ გავლენას ახდენს მსოფლიო ეკონომიკის სხვა სექტორებზე, მათ შორის საერთაშორისო ვაჭრობაზე. ამგვარად, ეკონომიკურ პარამეტრებსა და მაკროეკონომიკური ჩარჩოს სხვა კომპონენტებს შორის კავშირის ანალიზი უნდა ითვალისწინებდეს ურთიერთქმედებას გარემოს, ადამიანური რესურსების, სუპერსტრუქტურის (სოციალური, პოლიტიკური, სამართლებრივი, კულტურული და სხვა), ეკონომიკურ ურთიერთობებსა და მატერიალურ პროდუქციას (ტექნიკური და ტექნოლოგიური რესურსები) შორის. საზღვაო ტრანსპორტს განსაკუთრებული მნიშვნელობა ენიჭება გეოგრაფიული არეალების, კონტინენტებისა და თანამედროვე სახელმწიფოებს შორის დროით-სივრცულ ურთიერთობებში. მისი დანიშნულებაა სხვადასხვა რეგიონებს, ტერიტორიებსა და სახელმწიფოებს შორის კავშირების უზრუნველყოფა ეკონომიკური, სავაჭრო, სოციალური და პოლიტიკური აქტივობების განსახორციელებლად. საზღვაო ტრანსპორტის მნიშვნელობა შეიძლება შეფასდეს სხვადასხვა ასპექტით: ისტორიული, ეკონომიკური, სოციალური, პოლიტიკური, გარემოს დაცვის, განათლებისა და სამეცნიერო კვლევების თვალსაზრისით.

ტოქსიკური მეტალებით გარემოს დაბინძურება შესაძლებელია ზღვის თევზის შესაძლო კონტამინაციის მიზეზი გახდეს. აუცილებელია ასპარაგინის (As), კადმიუმის (Cd), ქრომის (Cr), ვერცხლისწყლის (Hg) და ტყვიის (Pb) დონეების შეფასება ჯანმრთელობის რისკის განსაზღვრისთვის. მაღალი მოხმარების მქონე მომხმარებლებისთვის შეიძლება არსებობდეს ჯანმრთელობის შესაძლო რისკი, განსაკუთრებით ასისა და ვერცხლისწყლის კონტამინაციის გათვალისწინებით. ამ კონტექსტში განვიხილავთ მძიმე მეტალების ჯანმრთელობის რისკს ზღვის თევზში, ჯანმრთელობის რისკის შეფასებას, ყოველდღიური მიღების შეფასებას (EDI), სამიზნე საფრთხის კოეფიციენტს (THQ) არაკარცინოგენური რისკისთვის, კარცინოგენულ რისკს (CR) და ასევე სტატისტიკური ანალიზის მაჩვენებლებსაც.

საკვანძო სიტყვები: მსოფლიო ეკონომიკა, საზღვაო ტრანსპორტი, გარემო, ტექნოლოგიური რესურსები

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1.The importance and role of maritime transport in the current world

Currently, the transports are an essential part of material production, which, through their role in the movement of goods, decisively influences the world economy and specifically international trade.

Considering the current understanding, transport and port services are those works that carry out the movement of goods and people over a certain distance, loading, unloading, transshipment of goods from one means of transport to another. The development of transport and the provision of port services, on a national and international level, has led over time to a rapprochement of the countries, to a development at the same rate of trade.

This must be viewed in harmony with the surrounding environment. Thus, the connection between the economic coordinates and the other components of the macroeconomic framework, synthesized from a theoretical point of view mast to take into account the interactions between: ambient, human resources, superstructure (social, political, legally, cultural, etc), economic relations, material products (technical and technological resources).

The development of the environment and the economy must be seen as a component part of an integrated system, which has bidirectional links to the other components, which can influence the development of the system components, being influenced, in turn, by their evolution.

Maritime transport has a special role in the temporal-spatial relationship between geographical areas, continents, and current states of the world. Maritime transport has the role of creating links between all these areas, regions and states for the performance of complex categories of economic, commercial, social and even political activities.

The current maritime transport, in fact, represents a large number of services that have a multidimensional character, which have determined and influenced the development of other economic and social activities, but also of a legal nature.

The importance of maritime transport can be traced starting with the following aspects: historic, economic, social political, environment protection, education and scientific research.

Historically, maritime transport has had generally a major contribution to the development of human society, in particular in the Black Sea region, since antiquity, the era of great geographical discoveries, the modern era and especially the current period.

The economic development of society, the creation of new jobs on board ships, in the port industry and in the shipbuilding, industry was linked to the evolution of maritime transport.

From a social point of view, maritime ships facilitated the movement of people from one country to another, to satisfy economic or social needs, trade, and

knowledge. Currently, new requirements have appeared related to maritime transport, such as those related to tourism, scientific research, etc. Another social aspect is that related to the relationships established between those who use maritime transport, which have ensured over time, the formation of especially close relationships between the owners of maritime vessels and the beneficiaries of the transports, suppliers, intermediaries, and authorities.

The political aspect is reflected in the acts and laws developed by the state authorities. The national authorities have a particularly important role through the measures they adopt in this field, both in the sense of stimulating maritime transport activity, but also of restricting it at certain times. Also in this sense, it must be understood that political decisions have particularly important effects on maritime transport. The influence of the political factor on maritime transport is especially evident in times of crisis that occur in region.

Environmental protection has become such an important feature for maritime transport, through the implications it has, that it can no longer be ignored, also taking into account the fact that international legislation in the field of environmental protection has so many restrictions that they can affect decisions regarding to maritime transport activities. In this sense, these restrictions must be evaluated, taking into account all the costs related to environmental protection and especially to restoration in case of pollution, adding the huge fines. The consequences of maritime transport on the maritime environment do not only refer to pollution, which is of the greatest importance, but also to topographical changes of seacoasts, harbor areas, channels, straits and port basins, etc.

The educational aspect is represented by the training of both officers and sailors, as well as specialists who will work at the headquarters of shipping companies, port operators, maritime agencies, naval authorities.

From the point of view of scientific research, there is practically no fundamental field that does not produce effects on maritime transport, on shipbuilding, as well as on the training and development of human resources in the field. In this way, maritime transport has come to represent a sector of activity that facilitates, from an economic point of view, the production of material goods and the provision of services, having an important contribution to increasing the added value of products and services. On the other hand, taking into account that fish is considered a significant part of a healthy, well-balanced diet due to its exceptional nutritional properties (high-quality proteins, vitamins, essential omega-3 fatty acids). Fish and seafood are unique dietary sources of cardioprotective docosahexaenoic (DHA) and eicosatetraenoic (EPA) fatty acids. Thus, many public health authorities recommend regular fish consumption equivalent to at least 1–2

serving per week in order to prevent diet-related chronic diseases. Unfortunately, anthropogenic environmental impacts (industry, agriculture, mining) significantly increase the naturally occurring amounts of heavy metals in the environment, including the marine ecosystem. Consequently, marine organisms (fish, shellfish, crustaceans) can accumulate these metals to potentially toxic concentrations. Often, fish and other seafood represent one of the main sources of exposure to metals in the general population. Foods that contain toxic metals above the permitted levels are considered to be harmful to human health and are banned for trade by many national and international regulations.

2. Health risk of heavy metals in marine fish

Generally speaking, accelerating industrialization had dramatic consequences for human society, materialized by multiple changes. These changes has undesirable effects such as amplification of pollutants into the environment. Nowadays, heavy metals are the main ones as micropollutants and are considered of universal interest. Most heavy metals are found in factory and farm wastewater, typically dumped into marine water. These pollutants accumulate as surface sediment. Heavy metals discovered in sediments that are not reactive but are potentially hazardous are considerate as stable contaminants. Thus, pollutants from sediment get into the water, food, and habitats of organisms. Accumulation of these pollutants occurs in the food web due to the relationship between water and sediments. As a result, sediments act like a warehouse of heavy metals in the aquatic environment, mostly in estuarine, coastal, and port areas. A part of such heavy metals is adsorbed on suspended solids and organic tissue in seawater and finally deposited in sediments. As an immediate consequence, heavy metal contents in the sediments can correspond to the surrounding aquatic environment quality, in dissonance with the generally low concentration in the water column. However yes heavy metals such as Ni, Cu and Zn, play a fundamental role for aquatic life, they could be toxic at a certain level, and therefore present risks to aquatic biological diversity. The result is as, heavy metals accumulated in sediments can cause harmful effects on aquatic organisms, leading in time to impacts on the aquatic ecosystem, even threatening human health through the contaminated food chain. In conclusion, sediments are used as an environmental indicator in assessing the impacts of anthropogenic heavy metal pollution.

It is known that seaports are important areas for economic and trade activities, and therefore have become a land–sea coordinated area strongly influenced by human activities. Sea transportation, fishery, ship maintenance, and commercial activities surrounding seaports release pollutants into the adjacent waters and sediments. By

their very role, ports are a semi-enclosed water area with dike constructions, resulting in limited water circulation and slow renewal after being polluted. So, in port areas is favored accumulation of considerable pollutants, e.g, in the sediments which are considered as essential points of anthropogenic pollution.

As far as fishing port management, it is known that this activity plays an essential government role in environmental and economic aspects as it supports the fishery, being the principal food and economic resource, first for coastal localities. Determining the pollution status of fishing ports will help the planning of facilities, construction activities, drafting of management statutes, and control of pollution sources. It turned out that fishing port sediments worldwide have been to a high degree contaminated with heavy metals. Maintenance operations of fishing vessels and wastewater discharges may constitute the primary sources of heavy metals in fishing port sediments.

2.1. Health risk assessment

Increased attention is granted to analyzing the concentration of heavy metals in the muscle tissues of fish, which mainly are consumed as food. In order to assess the potential health shares in connected with heavy metal contamination in water, in most cases the studies determined the Estimated Daily Intake (EDI) and Target Hazard Quotients (THQ) taking into account the levels of heavy metals detected in the fish.

2.1.1. Estimated of Daily Intake (EDI)

It is possible to derived Human health hazards taking into consideration metal consumption via different food. More precisely, EDI calculate based on metal concentrations discovered in any food and associating on the daily consumption of that food. To calculate the value of EDI take into account metal concentration (μg/g), FIR (Food Ingestion Rate) which is the daily consumption of fish (gram day^{-1}) per capita, and Body Weigh BW). The average FIR accepted (FAO) is 55.5 g/day; the BW accepted (USEPA) is 70 kg, meaning average body weight for adults.

2.1.2. Target Hazard Quotient (THQ) for non-carcinogenic risk

The ingestion of contaminants determines the potential health risk which can be identified by assessing THQ. It is calculated as estimated daily intake (EDI)/Oral

reference doses (RfD). The reference dose (mg/person/day) accepted for Pb, Cr, Cu, and Zn is 0.0035, 0.003, 0.3, and 0.3 respectively (USEPA). To calculate THQ must take into account Exposure Duration E_D, e.g 65 years (UESPA) and Exposure Frequency E_F considered as 365 days/year; also, the Estimated Daily Intake (EDI) which is the intake of each metal content per day, while the Average Time (AT) refers to the average exposure time for non-carcinogens (i.e., E_D multiplied by E_F).

2.1.3. Carcinogenic Risk (CR)

In the cases in which exposure to carcinogens exceed a lifetime can increase cancer's probability, called Carcinogenic Risk (CR). In literature, the value of CR is included between 10 and 6 to 10-4. If this value increases to 10-4, it is considered a carcinogenic risk (USPA). To calculate the CR must take into account: Cancer Slope Factor (CSF) described in Integrated Risk Information System (IRIS); the values of CSF in the case of for Pb and Cr are 0.0085 and 0.5 mg/kg/day respectively (UESPA).

2.1.4 Statistical analysis and map

Using the statistical methods, it was done to the concentrations of the metals previously presented. In this respect must be utilize the Pearson correlation coefficient with the aim of obtaining the correlation between these metals; is necessary to determine the location of each study area. To create the maps must use the Geographic Information System tool to present the data (GIS). In order to found where heavy metals are, was used the Inverse Distance Weighted (IDW) interpolation method from ArcMap 10.4's Spatial Analyst Tools.

3. Conclusions

Transports represent an important aspect of material production, which, through their role in the movement of goods, decisively influences the other branches of the world economy, including international trade. Thus, the connection between the economic coordinates and the other components of the macroeconomic framework, synthesized from a theoretical point of view must take into account the interactions between ambient, human resources, superstructure (social, political, legally, cultural, etc), economic relations, material products (technical and technological resources). Maritime transport has a special role in the temporal-spatial relationship between geographical areas, continents and current states of the world. Maritime transport has the role of creating links between all these areas, regions and states

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