Capítulo 06

Agents and Processes of Interference, Risk, Impact, and Environmental Damage in Aquatic Systems

Agentes e Processos de Interferência, Risco, Impacto e Danos Ambientais em Sistemas Aquáticos

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Abstract: With the advances of technology, the extent of interferences has increased, and the existing natural drainage systems are few. Nowadays, developed countries perform a more effective control of their hydrological systems. However, interferences in such systems are carried inadequately all over the world, especially concerning land use (Almeida *et al*., 2019). The economic and social benefits explaining human interference in hydrological cycles are many, also, large scale modifications that immensely affect the functioning of the system as a whole are relatively simple to make. The technologies for building dams, river diversion, land drainage, irrigation systems, and groundwater abstraction are highly developed. Access to new technologies and the prospects for building ever-larger reservoirs, grandiose water-course diversion schemes, and iceberg-towing across the oceans draw the attention of policymakers and planners. Man, with his interference, can modify the efficiency and the capacity of many storages and transfers. In case of actions on the transfer of the surface or the soil, or on storages, probably a chain reaction will provoke changes in all other deposits and transfers. Obviously, as far upstream the interference takes place, fewer components will be affected, albeit the existence of feedback and regeneration mechanisms in the system allows chain reactions through it.

Keywords: agents of risk; environmental damage; aquatic systems.

Resumo: Com os avanços da tecnologia, a extensão das interferências aumentou, e os sistemas de drenagem natural existentes são poucos. Hoje em dia, os países desenvolvidos realizam um controle mais eficaz de seus sistemas hidrológicos. No entanto, as interferências em tais sistemas são realizadas de forma inadequada em todo o mundo, especialmente no que diz respeito ao uso da terra (Almeida *et al*., 2019). Os benefícios econômicos e sociais que explicam a interferência humana nos ciclos hidrológicos são muitos, também, modificações em larga escala que afetam imensamente o funcionamento do sistema como um todo são relativamente simples de fazer. As tecnologias para construção de represas, desvio de rios, drenagem de terras, sistemas de irrigação e captação de águas subterrâneas são altamente desenvolvidas. O acesso a novas tecnologias e as perspectivas de construção de reservatórios cada vez maiores, esquemas grandiosos de desvio de cursos de água e

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reboque de icebergs através dos oceanos chamam a atenção de formuladores de políticas e planejadores. O homem, com sua interferência, pode modificar a eficiência e a capacidade de muitos armazenamentos e transferências. Em caso de ações na transferência da superfície ou do solo, ou em armazenamentos, provavelmente uma reação em cadeia provocará mudanças em todos os outros depósitos e transferências. Obviamente, quanto mais a montante a interferência ocorrer, menos componentes serão afetados, embora a existência de mecanismos de feedback e regeneração no sistema permita reações em cadeia através dele.

Palavras-chave: agentes de risco; danos ambientais; sistemas aquáticos.

INTRODUCTION

Man's interference on intern dynamics of Earth is local and minute. Irrelevant also is his action over geomorphological processes of terrain form modeling. The mechanisms acting upon the formation of the terrain do so in such a scale of time and space that makes remote or even impossible the likelihood of significant anthropic interference.

Geologic structure, time, and geomorphic processes generate the terrain, being upon this one only that man can cause significant modifications. As a diffuse energy circulation, it makes them difficult to control anthropogenically. Changes caused by man, in this case, are local and intensive, rather than extensive. As exceptions, there are sensitive environments, like rivers, coastlines, and semiarid and subarctic regions, that can be disrupted.

In the same way as to what happens with the physical weathering in urban areas, the action of the chemical weathering can be intensified due to local weather changes. However, its major action occurs in structures made by man. In great buildings, slope failures or landslides, the mass movement is accelerated, and erosion rates can increase due to human and cattle trampling.

The mechanisms of fluvial and coastal transport are also subjected to modifications. As a new geomorphic agent, we have the usage of backhoe excavators in the construction industry, earthmoving for various purposes, the opening of roads and slope cutting, which can create new terrain forms and destroy the pre-existing ones. The anthropic terrain alterations that affect previously existing configurations.

The anthropic terrain alterations, as any man-made modifications in the physical environment, can be done deliberately or as a consequence of other activities carried out unknowingly.

Valleys can be formed during great constructions, in a few days or months, by man's hand, or across the centuries, by the natural process of erosion and carriage of materials my nature's agents.

Man builds drainage systems to better control the hydrology of a given area and causes huge gullies due to the type of usage he makes of soils. New areas are created by backfilling wetlands and lakes, or yet by the deposition of sediments carried to estuaries and/or lagoons. This excess of sediments, usually, is due to deforestation done at the hillslopes.

If the soil has its capacity of absorbing rainwater reduced due to anthropic activities, as, for example, paving, the distribution of water through all the other subsequent paths will be affected. Meanwhile, the groundwater abstraction will affect the river flow rates, the lacustrine deposits, and the outflow to the oceans.

METHODOLOGY

It is important to highlight that the research oriented by the dialectic method reveals the historicity of the phenomenon and its relationships, on a broader level, locate the problem in a complex context, at the same time, establish and outline the possible contradictions among the studied phenomena. The qualitative investigation is anchored on the inseparability of the phenomena and their context since the opinions, perceptions, and meanings are more deeply understood from their contextualization.

The validity would refer to the likeness between the concept and its measures, to the degree in which a measurement represents precisely what is expected. The assurance of the validity would depart from the direct comprehension of what must be measured, being, therefore, a matter of research design. The proposed method was separated into three stages, which were further subdivided into steps to the bibliographic survey. In the first stage of the research (Stage 1: Research questions) the main decisions and definitions about the research are observed. Research questions are highlighted and function as impulses to the start of the review. The theme is defined for the bibliographic survey and the period available.

Other decisions are taken simultaneously, such as the definition of keywords to work as identifiers. In parallel, the main topics about the theme to be surveyed, as well as the key-words combination are summarized. These, by its turn, can be made by using Boolean Operators, and in many databases, as Portal de Periódicos CAPES, SciElo, Publish or Perish, EBSCO, just to mention a few. In the present case, the databases were Web of Science (or ISI), Plataforma SUSTINERE, SciElo, and Scopus. These collections have easy access, allowing, through their tools, a careful search to be made, encompassing a vast number of journals.

The second stage (Stage 2: Articles selection) starts the surveying and the selection of the articles, using the exclusion criteria. Negative keywords are used to thoroughly classify the articles, delimiting also the timeframe. In the following stage, the first filtering of the papers takes place, identifying the unsuited ones based on their titles.

In the following stage, the abstracts are read in order to eliminate the ones unrelated to the surveyed theme. The following stage encompasses a subjective analysis by the researcher to identify, from the pertinent articles, those with higher academic relevance. A bibliometric analysis indicates the relevance of the author/article to the composition of the bibliographic references.

Stage 3 corresponds to the Classification of the selected articles. The organization of the samples of selected papers is undertaken. The objective is to sort, a

pattern guided by the thematic development of the focal topic. It is evidenced thus the importance of the meticulous analysis of the articles that form the sample.

In qualitative research, the notion of validity takes different forms, because the debate about scales of measurements does not apply to qualitative methods, being necessary an understanding of validity from other perspectives. An attribute that is related to objectivity, to the possibility of experiment repetition, to the fact of the research being opened to verification by other people, and with the capacity of generalization (Golafshani, 2003).

Validity can be generically seen as the correspondence between research and reality (Onwuegbuzie *et al.,* 2007). It refers to the verification of the results as true and reliable. It would be related to the fact of the results precisely reflecting the analyzed situation and being reliable, in the sense of the absence of reasons to doubt them, i. e., the research is valid if the pieces of evidence provide the support needed for its conclusions (Koro-Ljungberg, 2010). The intention is not to generalize but describe, analyze, and seek understanding.

RESULTS AND DISCUSSION

Enormous depressions can be dug for ores exploitation, just as a result of mine openings or yet soil drainage (Aquino *et al.,* 2017).

Any intervention performed on fluvial systems, whether it is to increase or reduce flow, build reservoirs, modify channels, or build bridges or moles, alter the natural equilibrium of the rivers. Erosion and deposition have their balance altered. This kind of interference is rarely noticed only at the point in which is implemented.

Considering the deepening of a riverbed as an example, it may affect the river's behavior for tens or even thousands of kilometers, upstream as well as downstream.

In order to increase the flux of a river, or simply to accelerate the natural transference process, or to be used in irrigation, groundwater must be abstracted at a rate lower than natural recharge, towards avoiding the different modifications on the respective water table.

The abstraction of enormous amounts of water from underground reservoirs has accelerated all over the world in this century. The result was the transference of these waters to other points of the hydrological cycle. Some international research work with the hypothesis that the recent elevation of the seawater, as well as the increase in the volume of the polar ice, may represent the groundwater that has been displaced to new storage systems, via evaporation and precipitation.

If the responsibility were due to climate change, the elevation of the oceans would decrease polar ice, but what seems to be increasing is the bulk volume of the surface waters.

The oceans, even though connected between each other, and with natural barriers limited simply to temperature and salinity differences, do not have the same mass mobility as observed in the atmosphere. Yet, they are effective diluters and

dispersers in nature. They keep the thermal control and balance, given stability to the terrestrial system. Their waters hold huge amounts of solar radiation, but gain and release heat slowly, assuring, this way, the balance.

The stabilizing function of the oceans and its fine balance control are not well understood yet. Notwithstanding, impacts verified on its functions may severely affect or transform the entire terrestrial system.

The second factor is the relative fragility of many coastlines, as the marine environments hit by high-intensity waves. The natural energy and the plasticity of the materials are frequently easy to break, deflect, diminish, or amplify (Almeida, 2007).

Concerning the alterations in coastal aquifers, it can be noticed that, in many parts of the world, an excessive decrease of the hydrostatic levels, favoring the entry of seawater, contaminating this freshwater supply.

The great modifications faced by coastal environments, greater than those verified upon most of the other geomorphic environments, are due mostly to demographic factors and to the very fragility of the coastal environments.

The world's coastal areas are densely populated, considering the planet as a whole, half of the cities with populations greater than 1 million inhabitants is located near the sea. In the Netherlands, 75 % of the coastal terrain has been radically modified by man's action; in the United States and Great Britain, this percentage corresponds to 40 %. The Japanese coast that extends over 100 km between Yokohama and Kisarazu is almost entirely artificial, being made of islands, peninsulas, bays, and plains, caused by anthropic activities.

FINAL CONSIDERATIONS

In intensive agriculture areas, or urbanization construction processes, the load of sediments reaching the rivers undergoes huge increases – these facts simulate the periods of natural erosion. In a general way, what man does is abbreviate the time and intensify the effects of these changes.

The deliberate coastal modifications are usually destined to prevent erosion or to recover lands in the sense of facilitating the economic activity or even to recreation ends in these areas. The affected natural processes are similar to those taking place on rivers. The erosion and disposal of materials on recreation beaches have already caused many problems, as, for example, the destabilization of dunes sparsely covered by vegetation, that collapse under trampling, causing erosion and subsequent dispersion.

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