

Implementation of Debed river watershed basin ecological assessment in Armenia, by the water landscapes conditions

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Abstract

During the last years seemed economic growth in Armenia means additional pressure to environment, especially without introducing resource economizing new technologies. Debed river as a transboundary river has also regional importance. The area of watershed basin stands out with developed industry and agriculture, causing huge ecological and environmental problems.

As for researches evaluation, Debed river watershed basin is polluted with nutrients, oxygen-consuming materials, heavy metals and chlorinated pesticides, the river ecosystems cannot conquer the level of present anthropogenic pressure sufficiently, causing degradation of ecosystems and disbalance of environment, health and socio-economical problems.

Keywords

Watershed basin, ecological condition, pollution, ecosystem.

Introduction

Environmental pollution is a major global concern. The global impacts of human interventions in the water cycle, including land cover change, urbanization, industrialization and water resources development, are likely to surpass those at least over decades (Meybeck, M. et.al. 2004). Pollution should be recognized as a landscape-level phenomenon. As such, it requires an observational approach consistent with the complex structure and function of the landscape system. Human activity in the landscape has a substantial power to alter the quality of surface waters and ecosystems dependent on that quality.

The watershed is advocated as an appropriate unit for ecological planning. Watersheds, or river drainage basins, can be understood through an ecological chorography. A river is an open system with strong interactions with its watershed basin. A watershed is a geographical feature on the landscape where precipitation collects and then drains to a common water body. Various abiotic and biotic processes, such as tectonic dynamics, weathering, erosion and sedimentation, evaporation, biological activity, adsorption and desorption, flushing etc. as well as human interference, interact within the watershed, the river floodplains, the riparian zone and the water body, determining its aquatic composition and ecological character. Those the assessment of current water quality conditions is a key step in the successful implementation of the watershed approach. Which is a basic information needed to focus resource protection and remediation activities later in the watershed management planning process (Skoulikidis, N.Th. et. al. 2002).

Study area

Debed river watershed basin is located in the North of Armenia. In Armenia area of the basin is 3790 sq. km. The watershed area surface is mountainous, with elevations varying in a range of 390 m to 3200 m above sea level. Climate is comparatively humid, with 500-800 mm of annual precipitation. The population in the area is 393 thousand. River Debed is a trans-boundary river and has also regional importance. Debed river is formed by the confluence of Dzoraget and Pambak rivers and belongs to Kura river basin. In borders of Armenia the length of Debed river is 152 km. The average annual flow rate of the river is 38 cubic m/s, and the average annual water volume is 1086 mln. cubic m. The Pambak river is one of the largest, and the Dzoraget is the largest tributary of the Debed River. Both rivers are mountainous. The water source of all rivers in the basin is from precipitation (snow and rain), and underground waters (springs and drainage). The water regime is uneven, with major flows occurring from spring and autumn flooding. Debed river and its tributaries are widely used for household, irrigation and industrial purposes.

Debed river watershed basin is characterized with rich natural resources, refers to which this area is stand out with developed industry (mining and processing, est.) and agriculture (farming and gardening, as well as cattle breeding), causing huge ecological and environmental problems (Integrated River Basin Planning 2002; Manasyan, M.G. et.al. 2003). The ecological condition in the watershed basin gradually becomes more actual and urgent with restoration of economy after the years of economic crisis, because of industrial and household non-treated wastewaters, non-organized management of solid wastes and agriculture caused pollution. Also due to economic conditions, state and public interest to address environmental problems was rapidly reduced. In addition to agricultural demands, pressures on water resources are compounded by the physical alteration and destruction of habitats by urban and industrial development.

In Debed river watershed basin the sewage treatment plants haven't work more than 15 years. Sewage from the populated areas of the Debed river watershed basin are routinely dumped into the rivers. The litter and slops of traders and service sections located in the suburbs of the cities watershed directly discharge to the rivers too.

Currently, the main treatment method used for municipal household waste is landfilling. The only function that is provided by the enterprises in the best case it is the collection of garbage and transporting to the landfill. Waste collection and transportation activities are quite poor organized, and the landfills do not correspond to sanitary hygienic norms. (Bulghadaryan, N. (2004; Integrated River Basin Planning 2002).

Factories operate without any filters. Industrial wastewater of industrial enterprises operating in the basin is directly discharged into open water basins without treatment, and eventually this wastewater pollutes the river system. Positive trends in mining were accompanied by a number of environmental issues. There are number of mines in Debed river watershed basin, which were formerly subject to open-pit exploitation. The huge danger presents for the environment the tailing part without completely technical control (Ministerial report 2006).

Methodology

Researches have been passed from 2004 to 2008, had as a background the Driving Forces-Pressures-State-Impact-Responses (DPSIR) framework, developed and accepted by EAOC for trans-boundary river basins, by which is possible to understand confluences between the different problems of water management. This framework is well adapted to thematic analysis and can cope with a wide range of environmental issues. Its use also helps to ensure that relevant socio-economic and policy issues are integrated in the analysis (Convention 2006; UN/ECE Task Force on Monitoring & Assessment 2000).

Have been selected 12 sampling points along Debed river and its main tributaries, had as aims to discover the matter of pollution from the watershed basin big residential areas, the clean-self possibilities of rivers and the influence of main tributaries on formation of quality of Debed river waters.

The samplings have been passed monthly, from the spring to autumn on 2005-2006. In order to explore the complex interrelations among the factors and processes in watershed basin, during field and laboratory researches have been studied the physicochemical (temperature, pH, dissolved oxygen, conductivity, turbidity, mineralization, organic compounds, nutrients, main ions, heavy metals and chlorinated pesticides) and hydrobiological (saprotrophic bacteria, phytoplankton, zooplankton and macro invertebrates communities of rivers) parameters of waters of river Debed and its main tributaries.

Discussions

As for all dates evaluations, the waters of rivers of Debed river watershed basin belongs to moderately polluted, polluted and dirty classes of waters. The highest water quality is typically found upstream, while the most degraded is found downstream. From the pollution point of view the worse situation is seems in downstream of river Debed, where developed the metallurgical industry in Debed river watershed basin.

Changes in the water quality are primarily the result of human activities on land that generate water pollutants, or that alter water availability. Point and non-point sources of pollution in drainage basin ensure a steady pollutant load into this water system, highlighting river basin-coastal area linkages.

In Debed river watershed basin as important point-source pollutants have been revealed nutrients, oxygen-consuming materials, heavy metals. Major non-point pollutants are nutrients, chlorinated pesticides and oxygen-consuming materials.

All of these have major impacts on aquatic ecosystems and their biodiversity. Human activities at the basin scale cause increased water-borne pollution from point and diffuse sources, affecting aquatic ecosystems. As a result the ecosystems of rivers of Debed river watershed cannot conquer the level of present anthropogenic pressure sufficiently, seems the degradation of aquatic ecosystem which can also cause the decrease of clean-self possibilities of rivers.

The concept of an ecosystem provides a valuable framework for analyzing and acting on the linkages between people and the environment. Freshwater availability and use, as well as the conservation of aquatic resources, are key to human well-being. The state of the hydrological regime, its water quality and ecosystems are major factors contributing to human well-being. Water quality degradation is harm human and ecosystem health. Degradation of aquatic ecosystems put many ecosystem services at risk, including the sustainability of food supplies and biodiversity.

Condition of water environment directly or indirectly reflects to other components of Debed river watershed environment, because the close linkages and interactions between them (atmosphere, land and biodiversity), as well as on human well-being (see table 1), especially having in count the widely use of waters of Pambak, Dzoraget and Debed rivers (UNEP Global Environmental Outlook 4 2007).

Tab 1. Linkages between state changes in the water environment and environmental and human impacts

State changes	Mediating environmental / ecosystem impacts	Human well-being impacts			
		Human health	Food security	Physical security and safety	Socio-economic
Human water-use related issues – disturbance to the hydrological regime at the basin scale					
↔ Stream flow modification		↓ Downstream water ¹	↑ Irrigated agriculture ¹ ↓ Inland fish stocks ¹	↑ Flood control ¹ ↑ Community displacement ¹	↓ Freshwater fisheries ¹ ↑ Hydropower ¹ ↑ Irrigated agriculture ¹ ↑ Allocation conflicts ¹
		↑ Water-borne diseases ¹	↑ Salinization ¹ ↓ Floodplain cultivation ¹		
	↑ Ecosystem fragmentation, wetland infilling and drainage		↓ Coastal wetland food resources ² ↓ Prawn fishery ¹		
	↓ Sediment transport to coast		↓ Reduces floodplain sediment ¹	↑ Coastal erosion ¹	↓ Reservoir lifecycle ¹
Human water-use related issues – water quality changes at the basin scale					
↑ Microbial contamination		↑ Water-borne diseases ¹			↓ Working days ² ↓ Recreation and tourism ¹
↑ Nutrients	↑ Trophic level	↑ Nitrate contamination of water ¹			↑ Cost of water treatment ¹
	↑ Harmful algal increase	↑ Neurological and gastrointestinal illnesses ¹	↓ Livestock health ¹ ↓ Food available for humans ¹		↓ Recreation and tourism ¹ ↓ Livelihood income ¹
↑ Oxygen – demanding materials	↓ Dissolved oxygen in waterbodies		↓ High oxygen-demanding species ¹		↓ Recreation and tourism ²
Persistent organic pollutants (POPs)		↑ Fish and livestock contamination ¹ ↑ Chronic disease ²			
Heavy metal pollution		↑ Food contamination ¹ ↑ Chronic disease ¹	↑ Flood contamination of agricultural lands ¹		↑ Cost of water treatment ¹
↑ Solid waste	↑ Ecosystem and wildlife damage	↑ Threat to human health (infections and injuries) ¹			↓ Recreation and tourism ²

Arrows show trends of state and impact changes

↑ increase ↓ decrease ↔ no statistically proven change

1 well established 2 established but incomplete 3 speculative

The current quality of waters provides important information on the effectiveness of environmental regulation in Debed river watershed basin. Environmental degradation threatens all aspects of human well being, showing the importance of environment for human well being.

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