GEOECOLOGICAL SITUATION IN THE VOLGA-AKHTUBA FLOODPLAIN, ITS BIODIVERSITY AND THE EFFECTS OF VOLGA HYDROELECTRIC POWER PLANT FUNCTIONING

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Abstract: The biodiversity and the geoecological situation of the Volga-Akhtuba floodplain are heavily affected by Volga hydroelectric power plant action in the area. The study conveys the effects of the said water plant on the region's natural environment and, by offering suggestions, is an intent to restore these setbacks. It is hence recommended to develop an activity according to an environmentally friendly program, also a reduction of the water releases volume when in winter, as well as a postponing of the flood peak at the beginning of May together with an increase of 15 % of the flooded land.

Keywords: biodiversity**,** floodplain, hydroelectric power plant, Volga-Akhtuba

The Volga-Akhtuba floodplain is a unique ecosystem which is currently in a very adverse state due to its natural resources exhaustion, landscapes degrading, basins drying up and water species including fishes on the brink of extinction. Water releases are critical for the survival of all the floodplain ecosystems, but floods are needed for the enrichment of soils with fertile alluvium, moisture hay fields and oak woods, providing vast water spaces for fish spawning.

In recent years the Volga-Akhtuba plain has rarely been flooded more than 45-50 % of its total area. The ecology of the floodplain suffers mainly because of the human economic activities. For example construction of various objects in flood zones has been performed for years by now which led to serious damage and losses. Summer gardens and cottage areas are situated on the banks of the river which in flood times are washed away by the waters or destroyed, whence houses and trees are often bent down by floods.

The reason of such situation is the irrational functioning of the Volga hydroelectric Power plant, that cares only for the electric energy production, the problems of the Volga-Akhtuba wetlands being of little or of no concern at all for the administration. The ecological crisis started to develop a decade ago and reached its culmination point in 2006 when the peak flood lasted only 3-4 days and water release was no more than 18.3 thousand m^3/sec, whence the standard is 26.5 thousand m^3/sec. The annual runoff of 208 km^3 was significantly lower than average parameters (standard is 250 km^3); the total flooded area made only 1/3 of the plain. This caused serious damage of the ecosystems that were unable to restore themselves anymore.

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Economic losses because of power plant breaking ecological regulations and waste of natural resources in 2006 made more than 1 billion roubles.

We examined major hydrologic parameters for the recent decade and drew some graphs to demonstrate the average annual flow through Volgograd waterworks and maximum water flows from 2001 to 2010. We also analyzed the volumes of runoff and dynamics of floods in the downstream of Volgograd power plant from 2006 to 2010. It turned out that the volumes of the annual runoff through Volgograd waterworks in the second quarters of 2001, 2002, 2005 and 2007 were higher than the average data.

Table no. 1 Main hydrologic characteristics of Volga hydroelectric power plant water releases

Year	Volumes of runoff in the 2nd quarter, km^3	Days of maximum water level	Maximum water flow, m^3/second	Annual runoff km^3	Average annual flow m^3/second
2001	133.8		28030	281.8	8930
2002	123.0		26040	264.5	8380
2003	103.2	10	25990	252.1	7980
2004	101.1	7	26040	264.2	8347
2005	136.3	15	28180	288.6	9140
2006	76.4	4	18320	208.0	6579
2007	120.2	6	25940	281.8	8933
2008	101.9	9	27180	241.7	7643
2009	92.7	5	27200	241.7	7643
2010	90.7	8	27000	209.9	
Normal rates:	106	16-18	26443	250	7911

Thorough analysis provided various causes for that. To start with, 2001 and 2005 were the years of most abounding in water; in 2007 the high level of floods was a logical reaction to the ecological crisis of 2006. As we can see in the graph, in 2003, 2004, 2006, 2008 and 2009 the parameters are lower than the standard average norm. 2006 was the scarcest of all as the second quarter volumes show only 76.4 km^3 against the 106 km^3 normal amount. This was the year of ecological disaster for the floodplain and almost brought it on the verge of extinction. Despite this obvious danger the volumes of the second quarter runoff in 2009 again did not reach the normal expected level and made only 92.7 km^3. In recent years the sturgeon population has decreased many times. If this situation persists, there are serious doubts about the future of the Volga-Akhtuba floodplain as it will hardly be able to restore itself after such crises.

Evaluating data from average annual and maximum water flow through Volga water power plant from 2001 to 2010 we see the same picture: the most environmentally favourable was 2001, 2002, 2005, 2007 and 2009 and unfavourable 2003, 2004, 2006 and 2008. The graph of the maximum water flow levels shows that the abounding were 2001, 2005 and 2007 when the maximum flow hit higher than 28 thousand m^3/second against the average norm 26.5 thousand m^3/second and the annual runoff of 280 km3 against the average norm of 250 km^3. One of the reasons of such instability of Volga-Akhtuba floodplain system is the Volga hydroelectric power plant not observing the environmental regulations provided for this area. In the 20th century the area of flooded land reached 70 % of the plain and this was beneficial for the

wetland's biodiversity of the fauna and flora. Woodlands used to take 17 % of the plain, but now ineffective economic activities of the recent decade ruin the forests and reduce woodlands to 8 % of the plain area. Volga-Akhtuba floodplain is a very fragile ecosystem which totally depends on the functioning of Volga hydroelectric power plant and also on the level of its urbanization.

Analyzing the data showing the annual water runoff in 2001-2010 we see that the highest points are in 2001, 2005 and 2007 and reach over 280 km^3 against the norm of 250 km^3. The lowest point was 208 km^3 reached in 2006.

If we now aggregate all graphs and the data and have a close look at it we can notice a certain imbalance which we need to explain. Average annual water flow parameters, volumes of second quarter and annual runoff in 2007 were higher than the usual normal ones, but as for maximum water flow during flood time**,** it is lower than the normal average figures. What can account for that? To understand the reasons we need to have a look at the figures showing the volumes of water release through Volga plant in each month of the year in question. Low flood level was compensated by higher parameters of winter releases when monthly figures in December 2006 reached 19.6 km^3, January 2007 – 19.6 km^3, February 2007 – 22 km^3, March 2007 – 25.5 km^3, December 2008 – 22.9 km^3, January 2009 – 20.4 km^3. The so called "winter water" very negatively tells on the nature of the Volga-Akhtuba plain causing winter ice-driftings, ice erosion of the banks, shearing of vegetation, disturbance of fish spawning and wintering spaces. Before the runoff regulation from December to March the total release flow made 8 m^3, after the regulation they multiplied by two and in certain months or years they would be three times higher than that (here we need to remind that at the level of 12 thousand m^3/second per day the plain is flooded).

The plant administration claims that these high levels of flows in winter months are absolutely necessary because of two reasons: the higher level of electric energy consumption in winter and the danger of the reservoir overflow which should not be lower than the normal headwaters level. This demonstrates that Volga power plant aims only at electric energy production**,** whence environmental problems are out of its concern.

There should be found a "golden mean" in the functioning of the plant. It is necessary to develop an environmentally friendly schedule of the floods so as to support the ecosystem of the Volga-Akhtuba floodplain, its natural resources and elements: to provide restoration of fish and forestry, wetlands and alluvial soils fertility, flooding of inland basins and restoration of their leaching regime.

Conclusions:

To summarize it all we find it necessary to recommend:

- Develop an environmentally friendly schedule for the Volga power plant operation, based on the corrected hydrographs of 1991, 2001.
- Maintain the maximum low volume of winter water releases (from December to March), keeping them at the rates of 5-6 thousand m^3/second.
- Move the flood peak from the end of April to the beginning of May with duration not less than 2 weeks, with flow rates up to 27.5-28 thousand m3/sec. The duration of the flood peak and water releases for fishery development needs to be not less than one month. Water flow during this fishery water release should not be less than 17 thousand m^3/sec.
- Increase the total area of the flooded land to 50-60 % of the floodplain territory. This will provide an opportunity to restore hydraulic connections between the inner lakes and currents.

Agree on the recommended schedule with all the organizations and businesses that use the nature of the Volga-Akhtuba floodplain in their economic activities.

Rezumat:

SITUAȚIA GEOLOGICĂ ÎN LUNCA INUNDABILĂ VOLGA-AKHTUBA, BIODIVERSITATEA EI ŞI EFECTELE FUNCȚIONĂRII CENTRALEI ELECTRICE

Biodiversitatea şi situația geologică a luncii inundabile Volga-Akhtuba sunt puternic afectate de acțiunea centralei electrice Volga din regiune. Studiul arată efectele centralei menționate asupra mediului natural al zonei şi, oferind sugestii, este o încercare de a restaura aceste neajunsuri. Astfel, se recomandă un program prietenos cu mediul, o reducere a volumului de eliberare de apă în timpul iernii, precum şi amânarea maximului de inundație la începutul lunii mai, însoțită de o creştere a zonei inundabile de până la 15 %.

Istros – Museum of Braila