

Environmental management of big riverine floods: the case of Evros River in Greece

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Abstract: - In the present paper the flooding problem of Evros River is presented in connection with the management actions taken in the homonym Prefecture of North-Eastern Greece. The history of Evros flooding is long (since 1897) with two more recent flooding episodes in 2006 and 2007. Various works of dam and embankment construction and arrangement of the catchment area have been undertaken and are still in progress till today, together with a control system of the water level. The chemical pollution of the river is another important factor caused mainly by the sludge and drainage waters coming from the nearby cultivated land. The economic damage of Evros flooding is estimated to be of the order of several hundreds million Euro, making the environmental management of the phenomenon imperative. Additionally, a delicate diplomacy has to be established with the neighboring countries of Greece, Bulgaria and Turkey, that altogether share Evros river, in order to make management more efficient. Measures already in place to prevent Evros flooding are presented in this paper together with some suggestions to better manage Evros flooding, putting emphasis on the prevention phase.

Key-Words: - Riverine Flooding; Environmental management; Trans-boundary Policy making.

1 Introduction

Evros is the greater river of the Balkans with a total length of about 540 km. Its springs from the Rila Mountains in Bulgaria and constitutes the physical boundary between the latter and Greece for 88 km, while for the next 187 km it is the frontier between Greece and Turkey, thus making its management policy a tri-national one. The catchment area of the river among the three states covers a surface of 53.000 km² having also a lot of tributaries, the most important of which is Ardas River in the Greek territory. The wetland of Evros delta is a region of particular natural beauty (200 km², 150 of which belong to Greece) protected by both national and European legislation, such as the Ramsar International Convention for the wetlands of international importance, especially for the biotopes of aquatic birds, and the EU Directive for the conservation of natural habitats, wild fauna and flora (Natura 2000, GR 1110007).

The climate of Evros Prefecture has generally cold winters and hot summers and it is locally wet. The population of the area is 150,000 people dealing mainly with land cultivation and stock farms. For about 4 months per year its low lands are flooded, mainly because of the excessive waters of Evros

River and its tributaries Ardas from Bulgaria and Tunzas and Erginis from Turkey. The maximum water volume that Evros can flow without flooding is about 1600 m³/s of water recharge coming jointly from Evros and Ardas. During the last years this amount is often exceeded with consequent flooding of the lower Greek and Turkish regions owing to a series of reasons such as the amount of water entering from Bulgaria, the climate change with the occurring of extreme weather phenomena, the catchment area constrictions of both Evros and its effluents, the forest fires in the Bulgarian territory, the problematic collaboration between the three countries regarding the administration of waters, and the lack of new appropriate hydraulic works that could retain the floods.

2 Legislative Framework

The Greek Legislation regarding the floods is composed principally by the Laws 1739/1987, the General Plan of Civil Protection of Greece (code name "Xenocrates, 2003)[1], Directives of the General Secretariat of Civil Protection about the measures to take in case of flooding, the EU Directives 2000/60/EE [2] and 2007/60/EE and various International Conventions and Bilateral

Agreements between Greece and Bulgaria or Greece and Turkey. In Appendix 'A' of "Xenocrates" the planning procedure of several types of flooding threats are identified, together with their common origins and the types of consequences expected in each case.

2.1 Pre-Flooding Planning

Flooding Legislation in Greece is explicitly connected with the first step of a Flooding Emergency, i.e. prevention. Indeed, the Greek landscape is characterized by rough geomorphology that contributes to the intensity of flooding phenomena. A large number of streams exist in Greece, most of them having relatively small catchment areas. Additionally, the country's mountainous terrain makes slopes very steep causing maximum concentration of water amounts in minimum time creating, thus, dangerous torrents. Such incidents have frequently resulted in the past in disasters having claimed or endangered human lives and having caused extensive damage in constructions, agriculture, infrastructure and public or private property. Therefore, a priority in flooding emergencies, according to the Plan, is prevention, comprising the detailed inspection of all existing anti-flooding constructions and their proper maintenance, in order to secure their proper functioning conditions, if needed. This task is attributed to a number of different bodies / agencies that are involved in each specific case.

2.2 The role of Competent Authorities

The "Xenocrates" planning guidelines define the relevant Ministries that are directly or indirectly involved (through their respective agencies) in all phases of flooding emergencies, as presented in Figure 1. Furthermore, the maintenance of all anti-flooding constructions is regulated by the General Directorate of Public Works (Ministry of Environment, Urban Planning and Public Works) and specifically, by the Directorate of Land Reclamation Works. Particularly for the Attica Region (the one that surrounds the city of Athens), the competent maintenance authority is the Directorate of Hydraulic Works of the Attica Region. For the greater area of Thessaloniki, the competent authority is the Special Agency of Thessaloniki Public Works of the Ministry of Environment, Urban Planning and Public Works. These two agencies are in charge of the maintenance for anti-flooding constructions that serve more than half of the population of Greece.

The above-mentioned framework defines also the Regional and Local authorities and their

responsibilities, which are, among others, to inspect all relevant constructions and technical works in their area, focusing primarily to those areas that are more likely to be affected by a flooding; to restore any damage or malfunction that is discovered; to clean the riverbeds and riverbanks of all streams and rivers in order to restore their natural course, in cooperation with Prefectures and Municipalities.

2.3 The Civil Protection authority of the Evros prefecture

As mentioned before, the Civil Protection Law, 'Xenocrates', determines that all relevant authorities elaborate emergency response action plans for all probable emergencies, flooding included. Furthermore, for better implementation of these emergency action plans, Civil Protection Directorates at Regional level, as well as Civil Protection Units at Prefecture level are required to compile Action Memoranda for the case of flooding emergencies, i.e. simple documents that briefly outline the course of actions to be taken in case of flooding, covering all fields of planning requirements (who, what, when, where, why, questions and answers).

In particular the local administrative scheme in the Evros area [3] is as follows. The Civil protection Section of the Prefecture District of Evros belongs to the Expanded Prefecture of Rodopi-Evros. It engages a staff of three officials and aims at the treatment of the civil protection items.

Such items could be the prevention and surveillance of the river waters (as explained below) together with the participation in the design of consequences prevention of the of for all kind of natural, technological and other sorts of catastrophes. They are also in charge of the prompt and reliable warning of the Prefecture interested bodies related with the treatment of dangerous weather phenomena or incoming emergencies from the bordering countries.

This unit normally convokes the Coordinating Prefectural Organ (CPO) of the Prefecture of Evros and publishes civil protection bulletins for the information of the interested bodies. It also coordinates all actions aiming at facing emergencies, of various extension and origin, over the whole territory of the Prefecture. The group designs the itineraries of action and coordinates the joint work of the various groups involved, belonging both to the competent authorities and to the volunteers societies.

3 The Evros flooding management

It has been standard practice that the Evros prefecture is under an alert condition during almost the entire winter season, caused by the flooding of these rivers, which normally induces significant damage to the economical and social life of the area. Since Evros is an international river, the management of all technical and organizational parameters not only to prevent but also to respond to an emergency situation demands the transnational co-operation among three countries, which use the waters of the river. It is a frequent phenomenon that this co-operation is greatly affected by the political agenda of the countries. However, in recent years the collaboration with Bulgaria is very smooth, while the establishment of a good co-operation with Turkey has been inaugurated.

3.1 The causes of flooding

a. The amount of water inflowing from Bulgaria. As a general observation both rain and snowfalls are more intense in Bulgaria than in Greece, owing to the higher mountains in this country. In many occasions and for relieving their reservoirs, the Bulgarian part releases big amounts of water in a short time frame, namely more than 3000 m³/s, while the absolute managing capacity in Greece and Turkey does not exceed the 1600 m³/s [4].

b. The intense meteorological phenomena.

Owing to the climatic change of last years, the phenomenon of intense rainfalls in shorter times is frequently noticed leading to inadequacy of the River Evros catchment area to hold all of this water, thus it outflows and brings it to the sea, causing a flooding phenomena (See Figure 2).

c. The transformation of the river basin (Evros, Ardas etc.)

Part of the transported and suspended material (stones, wood, branches, mud, etc) coming with the water is deposited on the river bed and banks, thus changing its shape by reducing both its free surface and depth [4]. On the other hand, the augmented needs for farmland had led to extended land reclaim in areas which a normal river overflow could happen.

d. Forest fires in the mountainous area of river springs.

Many forests in the Bulgarian territory next to the springs of Evros and its tributaries have been burned down. This has as side effect the causing of severe flooding that is magnified by the unprotected soil that is left after the fire, which is carried away by the rain, causing extensive damage.

3.2 Preventive measures to limit the flooding effect

The construction works to limit the flooding effects of Evros river have started early in the '50s both in Greece and in Bulgaria. The necessary type of infrastructure contains two categories:

a. Vertical to the flow works. These are mainly dams or smaller grades built in the river basin to trap the transported material. These constructions are mainly to be found in the Bulgarian territory, where the river comes down from mountainous regions.

b. Parallel to the flow works. These constructions are mainly erected in the plain part of the river along its banks and necessitate the agreement from both Greek and Turkish competent authorities. Under this category falls also the arrangement of the river basin. This has started in the early '70s among Greeks and Bulgarians and consists of the aligning and deepening of the basin by mutual exchange of land and by the creation of equal height walls on both of its banks. This operation is still going on for the management of the small island occasionally created by the carried away material under the auspices of the European Legislation (Directive 2000/60/EU).

The collaboration with the Turkish competent authorities regarding the Evros water management, has started to move slowly but it is not fully settled. A mutual agreement signed bilaterally in the past (1934) regarding the Evros water management, led to the hiring of an American company in order to study the problem. In 1955 the study has been completed suggesting the construction of retention embankments along Evros Banks by the end of 1959. A "permanent Evros Committee" has been created by officials of the two countries to supervise the works. Though, a political tension among the two countries in 1956 resulted in interruption of the work construction and in the cancelling of most of them.

Actually, two major Greek Universities of the area, the one of Thrace and the other of Thessaloniki, have studied within the framework of an EU funded INTERREG II project the situation and have proposed a variety of preventive measures, like the creation of controlled flooding basins, construction of free flow channels along the river trajectory, better organization of embankments alongside the river and supportive anti-erosion works on the mountains so as to minimize erosion. A significant proposal is the changing of the legal status of the area so that the Civil Protection is commonly managed by a tri-national board that could more effectively administrate both prevention and

emergency management. Indeed, existing embankments and metering system in the Greek territory are as follows:

- a. The main embankments, which have a significant cross section at a distance of 600-1000 m from the main river basin and till 1963 constituted the basic Greek anti-flooding infrastructure to protect the cities of the Evros prefecture near the river.
- b. The secondary or surmountable retention walls were mainly constructed after 1963 to protect the farmland from flooding. As the years passed by the height of these embankments reached the 2.0-3.0 m creating a second barrier towards the river. The same constructions have been erected also on the Turkish territory; in such a way the actual river basin has been restricted to 150-180 m width instead of the initial not protected condition of 1600 to 2000m.
- c. The tertiary level of embankments of lower level (up to 2.0m) which normally protect a specific region and have a length of few hundreds meters.

3.3 Additional Proposed measures

Nowadays, in order to proceed with a global planning of Evros Flooding prevention, the following actions need to be undertaken:

- a. The creation of a common committee composed of experts of all three nationalities to supervise the study and construction of the anti-erosion and anti-flooding infrastructure, especially in the mountainous areas of Bulgaria and Turkey, where the massive water inflow occurs.
- b. The completion of land exchange and river basin alignment in the borders between Greece and Turkey, so as to terminate a procedure initiated long ago.
- c. The checking of existing works (dams, embankments and discharge channels) and the completion of the scheduled ones with the construction of new vertical and parallel embankments in view of retaining future flooding disasters.
- d. The accomplishing of the rational management of the Evros and Ardas rivers waters in the Bulgarian dams.
- e. The creating of correct and documented estimations of the damages to be presented in front of international bodies for further economic assistance.
- f. The formation of a fund of economic resources to be used for indemnities.
- g. The further training of both governmental and voluntary emergency forces through the realization of common trans-boundary exercises.

5 Conclusions

It should be noted that in Greece the majority of the victims and most of the resulting damage owing to flooding, is attributed to sudden flooding emergencies, not to mounting ones. Furthermore, such sudden flooding incidents constitute the second most frequent natural disaster in Greece, next only to forest fires. Finally, such sudden flooding are usually very localized and spontaneous phenomena, therefore it is the local authorities of the lowest and most decentralized levels (municipalities – prefectures), who are the major players in emergency response most of the times.

As far as river flooding is concerned, some necessary countermeasures to its prevention is the accelerated construction of infrastructure work to limit river spreading, the further use of automated level metering stations and, last but not least, the enhancement in the collaboration among neighboring countries.

On top of this, in the case of Trans-boundary Rivers the long operating experience has demonstrated that the collaboration among neighboring countries in view of common profitable use of the rivers' water turns out to be in the interest of all parties, allowing also for better water management and flooding prevention [5].

The transition from the old Civil Protection organizational scheme to the new one is a quite recent development. In many cases some flooding preventive or protection measures may take many years to be decided, planned, constructed and delivered (taking also into account the slow pace and the bureaucratic nature of public works sector). For that reason the limits of responsibility of each one of the agencies involved is not easy to be defined clearly during this transition period. A lot of misunderstanding has occurred in a series of recent flooding cases in autumn 2011 in Greece, resulting in politicians of various levels of local authorities to argue and quarrel in public about who is to blame for the disaster. A common agreement point has been the accusation of the Ministry of Finance and Economics that missed to provide with the funds needed; this prevented the competent authorities to proceed with the realization of the protection infrastructure on time. The whole Civil Protection scheme could have worked better!!

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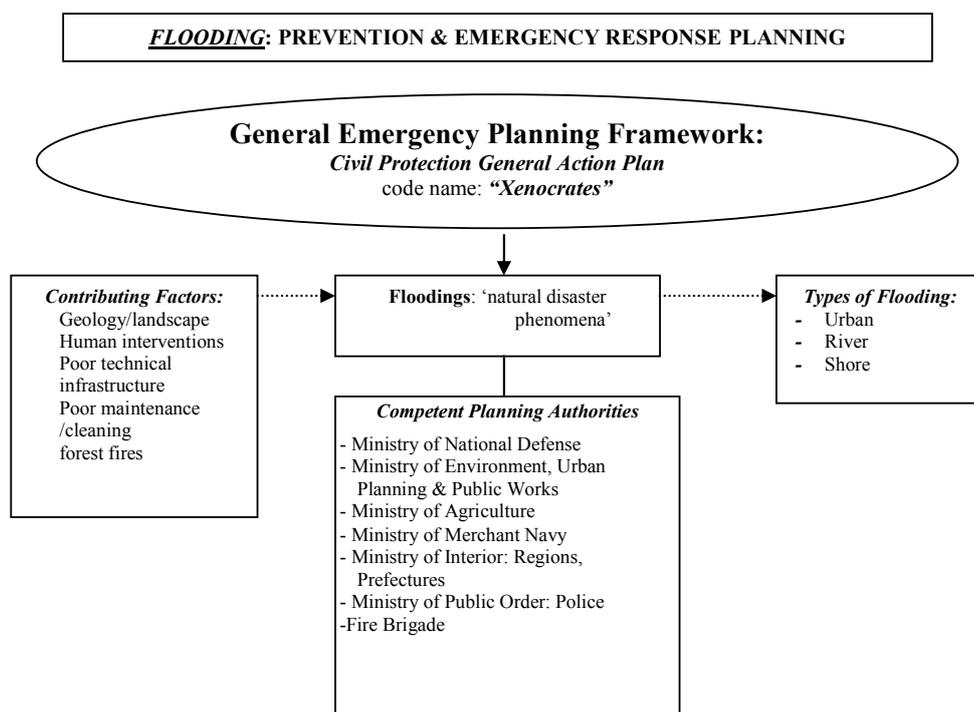


Fig. 1 The Greek Emergency Response Plan "Xenocrates"



Fig 2 Flooding episode in Evros River