ECOLOGICAL AND SOCIO-ECONOMIC CONSEQUENCES OF HAZARDOUS FLOODS IN THE UKRAINIAN CARPATHIANS

Andriy Kovalchuk[1]

[1]*Uzhgorod National University, Dep. of zoology, Uzhgorod, Ukraine,*
e-mail: kov@mail.uzhgorod.ua

Abstract: Historical documents are independent attestations of periodical hazardous phenomena that befell in the Ukrainian Carpathians once or twice per century. These are catastrophic floods. But after the World War II their frequency grows apparently. The article tries to show the marked socio-economic effect of floods mainly on example of the Danube basin and Transcarpathian Province.
Keywords: flood, mitigation, flood prone zone, Tisza, Prut, Transcarpathia, catchments area.

1. Introduction

The river Tisza is the largest tributary of the Danube – about 970 km. Its catchments area is 156.4 square km and partially covered the territory of the Ukraine (Transcarpathia Province) Romania, Hungary, Slovakia, and Serbia. Only 8.1% of the area (201 km length and 11,3 km^2) lies in Transcarpathia but its average annual water flow exceeds 7 cubic km. Present structure of the Tisza in Transcarpathia is still mainly natural, with a lot of meanders, islands, alluvial vegetation on banks. About 40% of the Tisza annual flow-off appeared in spring.

Today the Tisza play an important role as: historical frontier between ethnic Ruthenian culture, Romania and Hungary, water source, place of the very original landscape and unique biological diversity with a lot of endemial and relict species. In the Ukraine the Tisza is in Transcarpathian Province (Zakarpattia).

The river Prut is the second largest left tributary of the Danube. It is river of three countries - the Ukraine, Moldova and Romania. Its length from the issue, which lies not far from the highest Ukrainian mountain Hoverla (2061 m) on the Chornohora ridge of the Carpathians, to its emptying into the Danube in Lower Moldova (exactly at the border between Romania, Moldova and Ukraine), is 967 km. In the Ukrainian territory only upper and partially middle reaches of 272 km long are located. So, in general the catchment area of the Ukrainian part of the river Prut covers about 27.5 thousand squire km. In the Ukraine it is both in Ivano-Frankivsk and Chernivtsi Provinces.

The river Siret (in Ukraine the name Seret is also very useful) flows through Vizhnitsky, Storozhinetskiy and Hlibotsky regions of the Chernivtsi province of the Ukraine. It is one of the largest left tributary of the Danube with the whole length about 726 km (in Ukraine 100 km only), and with emptying place not far from the river Prut. The Siret' catchments area covers 47.6 thousands km^2 in Ukraine and Romania. Only small upper part of it belongs into Ukraine – 2.07 thousands km^2. Its issue is created by junction of two streams – Bursuky and Lustun at the Northeastern slopes of the Pokutsko-Bukovinsky Massif of the Carpathians.

2. General information on the area

Transcarpathia belongs completely into the Tiszha river basin. River net density in the province is very high on average 1.7 km per km^2. The whole amount of rivers in the Ukrainian territory is 9426 with general length 19793 km.

The Middle-Danubian lowland and the Carpathians form peculiar climate regime with high precipitation. Sometimes it exceeds 150 mm per day. Annual precipitation exceeds from 600-700 mm on foothills to 1220-1500 in mountains. Therefore the basin is included into specific Transcarpathian climatic sub-province in Atlantic climatic province. It is characterized by soft winter with frequent and long periods of snow thawing when temperature can exceed 10-14şC. Usual temperatures in January on plain -2.5 - -5.0ş, on foothills - -4.0 - -5.0ş, in mountains -5.0 -

-10.0ş; in July correspondingly on plain +20 - +21ş, on foothills - +17 - +19ş, in mountains -+14.0 - +17.0ş.

At the end of 20-th century the Tisza lost its importance in rafting but the widening of private building up the floodplains of the river raise the problem of negative consequences of water unmanageable influence. Especially dangerous are regular floods, that produced much more economic losses than contamination. Up to date from 1946 about 170 floods took place in the Tisza. Efforts of the local inhabitants to avoid destructive influence of water produce creation of different programmes frequently connected with reconstruction of the river floodplains. In general some of flood protection constructions built up to date (water protected dams – 700 km, banks-protecting structures – about 300 km and 49 permanent pumping plants) are an important elements of preservation the natural diversity in the Tisza river basin, but some measures (channelling, and especially 42 proposed "dry" water accumulative capacities) can badly influenced the natural diversity in the floodplains. Though we propose to use both conservation and renaturalisation of floodplains by alluvial forests as equitable way of lowering the maximum flood wave intensity. Also woodcutting on islands and banks of the river (as everyday practice) should be strictly prohibited before precise scientific investigation.

Climate in the Prut basin is mild continental, soft and wet, in the mountain areas more austere with colder summer. Usual temperatures in January on plain -4.8 - -5.0ş, on foothills - -4.8 - -5.5ş, in mountains -6.0 - -10.0ş; in July correspondingly on plain +18.8 - +19.5ş, on foothills - +16.2 - +19.0ş, in mountains -+13.0 - +16.0ş. Annual precipitation increased from 500-600 mm on plain to 700 mm on foothills and 800-1200 mm in the mountains. In the Upper reaches of Prut at the village Verhovyna the highest precipitation per rain was observed – over 300 mm per rain (!). The rainiest period is June-July when 46% of the whole precipitation falls as cloudbursts. The highest daily precipitation during cloudburst is 340 mm with normal duration that does not exceed 78 minutes. Blanket of snow is unstable due to frequent thawing, not powerful. Its duration does not exceed 110 days. There is meteorological center in Chernivtsi city with meteorological station and the other stations in Seliatyn village. Also three stations are situated in Kolomiya, landslide warning station in Yaremcha and mountain snow avalanche station on Pozhezhevska sub-alpine place near Hoverla top. Hydrological observation stations are situated at Krementsi (Tatariv), Jaremcha, Chernivtsi (Ukraine), and near Ungeny and Leovo (Moldova).

In the mountain part the valley of Siret is V-like. Its width is 0.3-2.5 km (near Berehomet town). In the foothills it is trapeziform, symmetrical, 3.5-5.5 km in width. Floodplain is both sides, 0.4-0.5 km in width. Riverbed is anguine, gently furcated; till the village Stara Zhadova it looks like the mountain creek. Its width at this place is mainly 3-10m with typical rifts. Lower the Siret is widening to 20-40 m with a lot of islands and meandering. Incline of the riverbed is 4.4 m per km. River net density in the Siret basin is lower than in the Prut. The main tributaries (right) in Ukrainian territory are Maliy Siret (Small Siret) and Suchava (partially Ukrainian, partially Romanian river), and Hlybochok (left).

Typical water discharge does not exceed 12.7 m^3/s (lower than Maliy Siret River emptying place). The highest discharge – 816 m^3/s was checked in flooding period near the town Storozhnitsa. From 1944 there exist a meteorological station. The Siret water is characterized by high turbidity - it exceed 220 g/m^3. Ice regime is unstable, started from the end of November and finished at the middle of March. Sometimes during floating of ice appeared jams.

This information is partially obtained from Geographical Encyclopedia of Ukraine (1989, 1990, 1993).

3. Floods

What is flood? Flood official definition is given in Act of the Ministry Cabinet of Ukraine (On the order of land use..., 2001): *"Flood – phase of the water regime of the river, which is characterized of short term raise of water level and increasing of flood-off mainly during heavy*

showers and intensive snow melting and could be observed in different seasons". As is considered in Kovalchuk (2001) "*flood is periodical natural phenomena, constituent of functioning of ecosystems"*. But sometimes appeared catastrophic floods with extremely high negative consequences. Appearance of such phenomena needs coincidence of several rare factors. In accordance with Stoyko (2000) from the year 1700 till 1940 no more than 12 catastrophic floods took place on the area of the Ukrainian Carpathians. But as is mentioned in Conclusions of special Commission of National Academy of Sciences from 1799 up to date appeared 26 catastrophic floods.

In the last fifty years only three catastrophic floods befell on the river Tisza – in December 1947, November 1998, and March 2001. The most dangerous (the highest flood wave) was flood in 1947 but it is supposed that economic losses wasn't so high as in 1998, even taken into consideration keeping of special information in secret by soviet propaganda.

Floods at the Prut can appeared in every season but mainly in the summer time. But some of the most dangerous floods from 1927, 1941, 1969, 1970, 1980 and 1998 developed in spring or autumn rarely even in winter. The most dangerous periods for appearance of catastrophic floods is March, when the extra effect of snow melting over precipitation is taking place, and November-December, when abrupt warming can produce thaw. The role of forests and soils in redistribution of moisture in cold periods decline which produce high surface flow.

It should be underlined that coincidence of floods at the Prut basin with other river basins (West Bug, Dniester) is high, except of Transcarpathia (the river Tisza basin) due to completely different meteorological regime of these regions. Normal duration of flooding periods with covering of floodplain by water does not exceed 3-4 days.

The most catastrophic flood at the Prut basin took place in June 7-16, 1969. It had been coincident with floods at the West Bug and the Dniester basins. Only in Ivano-Frankivsk region the whole losses in money equivalent exceeded 70 millions of USD, 65 thousands ha of lands were sunked, and 29 thousands of dwelling houses were ruined.

Anti-flood constructions of the riverbanks of the Prut consist of concrete slabs, diking and stony walls. These are drainage canals that also protect lower reaches.

During meanwater in the summer time the Siret with its tributaries frequently looks very shallow. But in time of flooding it becomes very dangerous and water discharges rise exclusively abruptly.

The riverbanks of the Siret are consolidated at large distances due to high frequency of floods and powerful freshet in spring.

4. Consequences of floods

Today the Action Programme for Sustainable Flood Protection in the Danube River Basin has been elaborated. It is supposed that gathered Flood Protected Expert Group of ICPDR could elaborate the uniform and holistic Programme of mitigation of negative consequences of flood events. But it needs very good analysis of possible consequences that lies in political, social, economical, scientific and environmental sphere.

4.1. Ecological aspect

Catastrophic flood could change completely the natural landscapes, ruin the natural habitats, shelters of animals, and spawn places. It produces side and down erosion, landslides and mud slides, flowing of surface waters and changing of underground water level, making of jams and riverbank destruction.

4.2. Political end

It could be subdivided into political profit or failing (risk) and legislative activity. Political risk of any natural catastrophic phenomena is strongly connected with reaction of administration stuff on negative events and minimization of economic losses of electorate, effect on regional economy in general. For instance, officially declared losses of flood in Transcarpathia in 1998

achieved 400 millions of UAH or correspondingly about 200 millions of USD (taking into consideration this time exchange rate). So, it produces huge activity of the Ministry Cabinet, and displacement of a lot of officials that failed even small field of entrusted work.

Other consequence of catastrophic floods in 1998 and 2001 is creation of several commissions with demands of investigation the reasons of floods appearance, both natural and man-caused, and elaboration of large amount of recommendations consecrated the question of mitigation of flood impacts. Every time after catastrophic flood the special State Commission was created. It gathered all available information generalize it and gave recommendations for the government. For instance, expert conclusions of Special Commission in 1998 (Expert conclusion..., 1998) underlined a high role of man-caused factors in appearance of hazardous floods but apprise of the role of forest ecosystems in redistribution of moisture and influence of infringements in forest economy wasn't enough exhaustive (The main reasons..., 1998). Nevertheless some political decisions was made and preventive measures undertaken therefore consequences of next 2001 catastrophic flood were alleviated. Also it was intended that such events belong to very scarce events and could befall not frequently than once per century. But the year 2001 came...

It was international cooperation that was activated after 1998 flood. For instance, an agreement between the Danubian countries was achieved on creation of System of forecasting of accidents and unusual situation (accordingly to the Order No 98 from 1998 and No 149 from 2001 of the Ministry of Ecology and Nuclear Safety two centers were created in Ukraine) but these centers were not highly tailored for floods.

Much more effective was reaction for the year 2001 flood. Simultaneously with the State Commission were created Special Scientific Commission of National Academy of Science of the Ukraine – NASU (Order of State Commission No 4425/98 from March 27, 2001 and order of Presidium of National Academy) and the Province Scientific Commission (Common Order of State Administration and Council of the Province of Transcarpathia No 12 from March 14, 2001). More interesting for us are conclusions of two last commissions.

The NASU Commission was resourced mainly from scientists trained in hydraulics, foresters and several biologists. Only 6 persons were from Transcarpathia. The subgroups were consecrated to social problems, water resources management, forest management etc. The most active discussions appeared at forest group. Once again forest lobby (personally Dr. Mykola Vedmid' – Deputy Head of the Committee of the Forest Economy) tried to influence the conclusion of high role of approaches in forest management on appearance of catastrophic floods. But final decision of forest group completely clarified the situation. Unfortunately when the document was finished off in Kyiv the Chapter belonged to forest role was faked-up and this result was given to the Ministry Cabinet.

It was Province Scientific Commission, which investigated objectively the role of forest management in appearance of catastrophic floods. The conclusions of this commission were used as a base for some decisions both at the regional and state level. For instance, in efforts to promote sustainable use of forest resources the Province Council by the decision No 298 from April 12, 2001 tried to revise the volumes of wood logging especially from major harvest in Transcarpathia.

At all state level the Ministry Cabinet Act No1388 from October 24, 2001 substantiated and asserted the Program of complex anti-flood protection in the river Tisza basin in Transcarpathia for 2002-2006 period and prognosis till 2015. Also State Program forests of Ukraine (Ministry Cabinet Act No 581 from April 29, 2002) took into consideration the necessity of stabilization of the situation in forest economy in the Carpathians.

The most important Ministry Cabinet Act No 87 was promulgated in January 31, 2001. Its name was "On the order of using lands in zones of it possible coastal flooding". The act regulates activity in the flood-prone zones of the rivers with the purpose of minimization of flood caused losses. Also it includes the main definitions and references connected with floods and freshets.

On international level an important step for improving the general ecological situation in the Tisza river basin was undertaken when the framework Convention for the Protection and Sustainable Development of the Carpathians. But it only gives us possibilities that should be effectively realized.

4.3. Social factor

It is intended that inhabitance in the Carpathians region of Ukraine get used to live with floods. The population forgot the drastic consequences of catastrophic floods and still plow up the flood plains build up dwelling houses in risk zone and hack at alluvial forests. It is connected with total failing of state control system on such activity, corruption and bribing of stuff of state administration. Small salary of these officials (highly under life standards) influenced significantly the situation. Sometimes also population is even interested to suffer losses for state compensation.

Also 18 persons died as a result of catastrophic flood in 1998, 1426 dwelling houses were ruined completely and 1347 partially, 187 villages loose telephone communication. So, social tension appeared as a result.

Putting the question: "what to do?" – produce special social activity that becomes apparent in a lot of conferences both national and international, international projects consecrated catastrophic floods (TACIS, DANCEE), scientific investigations, recommendations and proposals of measures of anti-flood defense etc. The other step was elaboration of programs as Environmental program for the Tisza River Basin. Unfortunately, the program was implemented partially only in Hungarian and Romanian part of the basin.

Also actual is deficiency of high-qualified administration stuff on local level that also produces economic losses due to bad management.

4.4. Economical factor

One should remind than November 1998 flood produce losses about 200 millions of USD. Except of ruined dwelling and other buildings 20 large bridges and 254 km of motor roads were destroyed. As well more than 100 th. ha of arable lands were covered by water and temporary not useful for rural economy (Stoyko, 2000).

In 2001 flood losses were not so large – about 50 millions of USD but it cover only direct losses. When calculate compensations and financing of anti-flood measures (dams, dikes, banks consolidation etc.) this sum should be in rough precision duplicated. But all these

Sometimes anti-flood "measures" were absolutely stupid, for instance in 2001 the author of the article founded in Khust region near the river Tisza about 1.5 ha of maple grove hacked by the State Forest Entertainment under the far-fetched reason of interference against flood wave.

The other example is the Decree of Governor of Transcarpathia No 163 from April 17 (On the clearing of islands from forest vegetation in between dykes distances), 2001. It ordered to liquidate several islands on the river Tisza. Some of them are 60 ha large! Tentative calculation shows that in such case one need to dig about 1.200.000 m^3 of the ground and to move it into disposal area. Absurdity of such order is obvious.

Large amount of means produce their no-purpose using. Also speculations on financial compensations were widely distributed. Illegal including of some persons into lists for compensation and other squandering produced hundreds of criminal cases and investigations.

5. Conclusion

So, catastrophic floods could influence strongly both human life and the environment. Only well synchronized, uniform and well managed measures on sub-basin and basin levels could mitigate the bad influence of catastrophic floods. Strong international cooperation is necessary to achieve success in struggle against catastrophic floods.

5. References

Expert Conclusion on the reasons that bring to wide scale consequences of catastrophic flood in Transcarpathia (November 1998). From 9 Ministries and Committees, Kyiv, Ukraine.

Geographical Encyclopedia of Ukraine (1989, 1990, 1993). V. 1, 2, 3. Ukrainian Encyclopedia in name of Mykola Bazhan, Kyiv, Ukraine.

Kovalchuk, A., Nikolaichuk, V., Krochko, Y., Boyko, M. (2001). The reasons of catastrophic floods in Transcarpathia and possibilities of avoiding them in future. Visnyk of Uzhgorod University. Biol. Ser. v.7, p.5-20, Uzhgorod, Ukraine.

On the order of land use in flood prone zones (2001). Cabinet Ministry of Ukraine Act No 87 from January 31, 2001. Orientyr (News Paper), no 11, Kyiv, Ukraine.

Stoyko, S. (2000). Reasons of catastrophic floods in Transcarpathia and system of ecological prophilactic measures of their prevention. Ukrainian Botanical Journal, v. 57, no. 1, p.11-21, Kyiv, Ukraine.

The main reasons of flood situation in Transcarpathia in November 1998 (1998). Collected expert conclusions. State Committee (SC) of Ukraine for Hydrometeorology, SC of Forestry et al., Kyiv, Ukraine.