MONITORING AND VALUATION OF SELECTED INDICATORS OF WATER QUALITY AND NUTRIENTS LOSS BY EXTREME RAINFALL-DRAIN EVENTS IN DEPENDENCE ON CULTURES REPRESENTATION IN SMALL CATCHMENTS

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Introduction

The project aim is water quality monitoring and evaluation and consequently also calculating of nutrients loss from small catchments in the sub mountainous areas of Šumava Mountains and Bohemian-Moravian Highland by extreme rainfall-drain events. The origin of extreme rainfall-drain events in our nature conditions is generated by extreme intensive precipitations or by sudden snow melt in spring. The gained data are evaluated to cultures representation in examined localities. At the same time the data gained by extreme rainfall-drain events were compared with long-time monitoring results by normal water-level stage, because whilst by normal outflow the water quality is changing slowly in connection with vegetation period and adequate human activities, by higher outflows is the water quality strong changing.

Material

Jenínský stream

Jenínský stream catchment spreads out by the borders with Austria not far from Dolní Dvořiště. It belongs to cadastral territories of Jenín and Horní Kaliště. According to regional geomorphologic division of the Czech Republic the area is situated in the Šumavské podhůří unit. According to Quitt Jenínský stream belongs to moderately genial climate region B10. The subsoil is formed by moldanubic pluton. The main rock types are the white mical biotitic gneiss and crystal diorite. From soils it prevails here dystric-cambisol, modal-kryptopodsol, modal-podsol, modal and fluvic-gleysol and gleyic-cambisol. The catchment belongs to the North Sea drainage area. The spring of Jenínský stream (hydrological rank number 1-06-01-138) is located 3 kilometers from village Jenín by the peak Žibřidovský vrch. The catchment area is 4.683 km^2.

Kopaninský stream

Kopaninský stream catchment spreads out in Bohemian-Moravian highland not far from Pelhřimov. It belongs to cadastral territories of Chvojnov, Kletečná u Humpolce, Onšovice u Dehtářů, Velký Rybník u Humpolce anf Žírov. According to regional geomorphologic division of the Czech Republic the area is situated

in the Křemešnická highland unit. According to Quitt the area of Kopaninský stream belongs to moderately genial climate region B10. The subsoil is formed by moldanubic pluton. The main rock types are the white mical biotitic gneiss and crystal diorite. From soils it prevails here modal-cambisol, gleyic-cambisol and gleysol. The catchment belongs to the North Sea drainage area. The spring of Kopaninský stream (hydrological rank number 1-09-02-031) is located in forest complex in the southest part of the catchment. The catchment area is 9.178 km^2.

Methods

As the principle of the water monitoring we consider to be water sampling in selected localities, where the particular elements´ concentrations by extreme hydrological situations were monitored. The sampling intervals are adapted according to the extreme rainfall occurrence. High outflow rate is announced by messaged provided by the GSM modem, which is localized on the sampling profile. Samples' collecting is ensured both on the raising and descending limb of the hydrograph. Water samples are immediately delivered to accredited laboratory for chemical analyses. In the samples there were analyzed all compounds according to the Czech norm for surface waters´ quality. At the same time there were observed the outflow characteristics in sampling profiles through ultrasonic measurer with continuous recording.

Land use monitoring was carried out on the basis of detailed evaluation of actual maps. It was supplemented by terrain observation in selected localities. There were observed mainly arable land and permanent structures (permanent grassland, forests) representation. For graphical works on this project it was used graphical mapping software ArcGIS 9.1.

Results

The area of the catchment labeled as P23 in Kopaninský stream catchment is covered from 75% by farmland, which is used as arable land. These localities serve mainly for traditional plant production as cereals, potatoes and rape growing. Location of these grounds is very questionable because of sloping ground and consequential water erosion. Next problem is unfitting way of traditional agriculture, against the correct agriculture engineering rules. Very low percentage is represented by forest areas (6.33%), which have largely natural species pattern.

In the area which belongs to the catchment J1 in Jenínský stream catchment, farmland is the main type of land use (86.76%). In contrast to the previous catchment the areas are used entirely for livestock production. Therefore the whole locality is used as pasture. In this case the way of use is only for extensive beef-cattle breading without milk production. More than half of this catchment is drained up by sporadic drainage system, which works perfectly in almost all parts. Only the small part of the catchment is used as the permanent grassland (1.26%) which is represented by ungrazed parts of meadows. Only about 12% are covered by forests – mainly spruce monocultures.

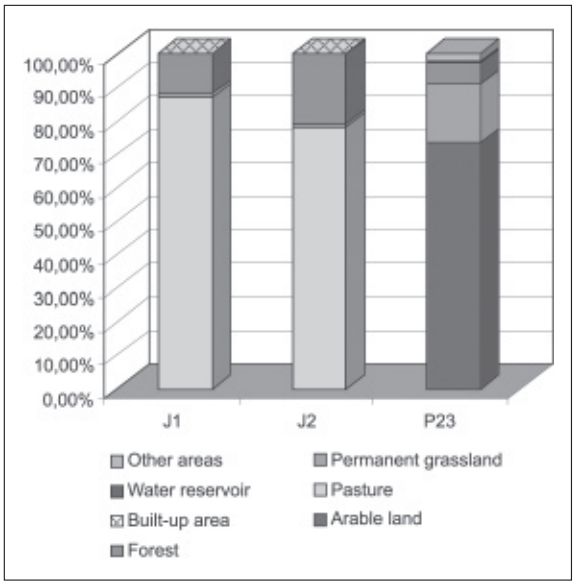

Figure 1. Culture representation in selected localities

The locality of the J2 catchment is very similar to the previous one. There are few details which are different. The main difference is pastures´ character. In this locality pastures cover 86% of the total are, but the grassland is very strongly damaged by the cattle movement. Increased cattle movement is caused by pasture's functional places localization in this locality. Second difference of these two areas is the character of urbanized structures. In this locality J2 there is localized one object which serves for recreation. It's possible to suppose that waste waters from this object run to the natural hydrographic network.

For water quality monitoring we chose 2 rainfall-runoff situations. In the Jenínský stream

catchment (profiles J1, J2) it is rainfall event from 25th September 2007. This event is characterized by average air temperature 11.8 °C and precipitation amount 185 mm. In the Kopaninský stream catchment we chose rainfall-runoff situation from 6th June 2007, which is characterized by average air temperature 14.7 °C and precipitation amount 152 mm.

Suspended solids concentration development

From the hysteretic loops which were constructed for all three catchments it is noticeable that all three loops have the same course. All three hysteretic graphs show the same anticlockwise rotation, with the peak concentrations reached long time after the peak discharge.

The absolute concentrations values reached in the particular catchments are very different. Unambiguously the highest concentrations are reached in P23 profile just because of the dominant representation of arable land, and because of the traditional way of agricultural engineering applied in this locality. The difference between two profiles J1 and J2 in Jenínský stream catchment is caused by drainage objects damage and by the fact that the cattle can move through the stream bed.

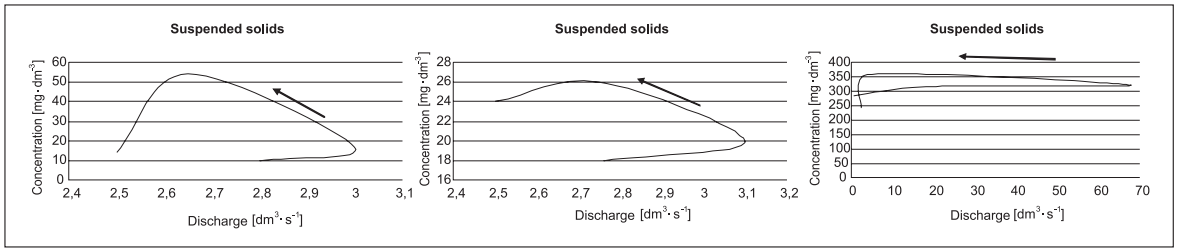

Figure 2. Concentration-discharge hysteresis of suspended solids in localities J1, J2 and P23

Ammonium ions´ concentration development

By ammonium ions´ concentration development there were observed two different types of hysteretic loops. In the J1 catchment there was observed the clockwise development and in the other two places (locality J2 and P23) the anticlockwise development. It is caused mainly by higher intensification of agricultural sector. The similar trend is shown also in absolute concentrations´ values. In the P23 profile the concentrations are manifold higher than in other localities. The relatively low amounts of ammonium nitrogen in the Jenínský stream catchment are also caused by great nitrogen storage capacity of permanent grasslands.

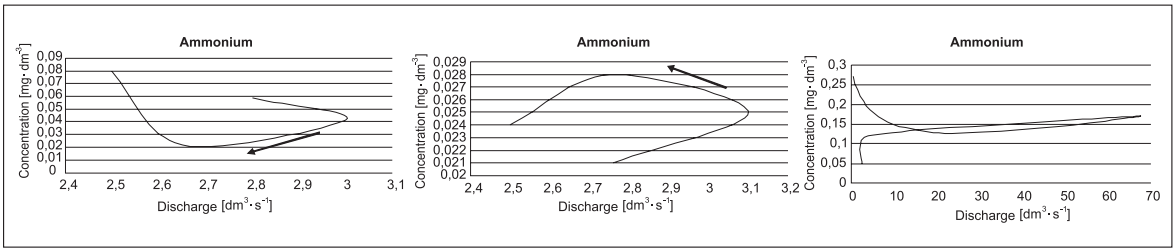

Figure 3. Concentration-discharge hysteresis of ammonium ions in localities J1, J2 and P23

Nitrate ions concentration development

In the J1 locality there was observed clockwise rotation pattern of the hysteretic loop. It means that with the rising runoff dilution of nitrate ions cocnentration is observed and so their concentrations fall down. In the P23 profile in Kopaninský stream catchment the trend looks similar but the rotation of the hysteresis loop is completely different. Its rotation is anticlockwise. In the last locality, labeled J2, no hysteresis effect was observed during the storm period.

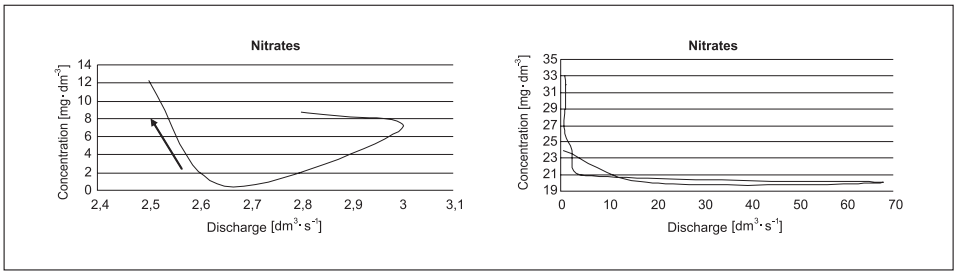

Figure 4. Concentration-discharge hysteresis of nitrate ions in localities J1 and P23

Conclusion

After summarizing of observed discharge-concentration data it is possible to declare that the way of land use in appropriate localities very strongly affects the concentrations and observed discharge characteristics by extreme rainfall events. We can also conclude that the second parameter which affects water quality by these events is the rate of agriculture intensification and its result.

The most affected parameters by extreme rainfall events occurrence are suspended solids and nitrate ions. The second group contains ammonium ions, phosphate and dissolved substances. The least affected water quality parameters from the monitored are nitrites and pH.

Obviously it is shown that intensive agricultural localities embody higher amount of elements´ loss and also higher observed discharge parameters.

Acknowledgement

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