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THE IMPACT OF HEAVY RAINFALL IN THE HYDROLOGICAL REGIME OF SUHA RIVER BASIN IN 2006

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Key words: heavy rainfall, hydrological regime, flooding, damage

Abstract. Recent climate changes mentioned in the Intergovernmental Panel for Climate Change (IPCC, 2013) report highlight the fact that in the past 50 years at the planetary level have occurred major changes in all climate components. In this regard the analysis of rainfall oscillations and of their impact on the hydric regime is particularly important, being witnessed in the surface and groundwater level variations. In the Suha River Basin, the year 2006 has been characterized by large rainfall quantities that have been generated, in particular, in June by persistent retrograde cyclonic activity (223 mm at Slătioara 3 hydrometric station, 269.1 mm at Gemenea 5 station, 271.6 mm at Valea lui Ion station and 351.8 mm at Stulpicani). On the main course of Suha, but especially on its tributaries (Gemenea and Slătioara) have been recorded very high flow rates (5% and 2% insurance) caused by the amounts of rainfall felt in a short time. To estimate the impact of rainfall on the Suha basin hydrological regime we used data collected by the Siret Basin Water Administration-Bacău, being analyzed the rainfall quantities, duration, intensity, tendency and effects.

Introduction

Suha River Basin mostly overlaps the sandstone formations of Stânișoarei Mountains, and only its western part is formed on the crystalline Mesozoic formations belonging to the Rarău Mountains. The main collector is Suha, right tributary of the Moldova River. It gathers important tributaries both on the left and on the right side, reaching a basin surface of 356 km². It is located

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at the intersection of the 25°45'20" east longitude meridian with the 47°26'57" north latitude parallel.

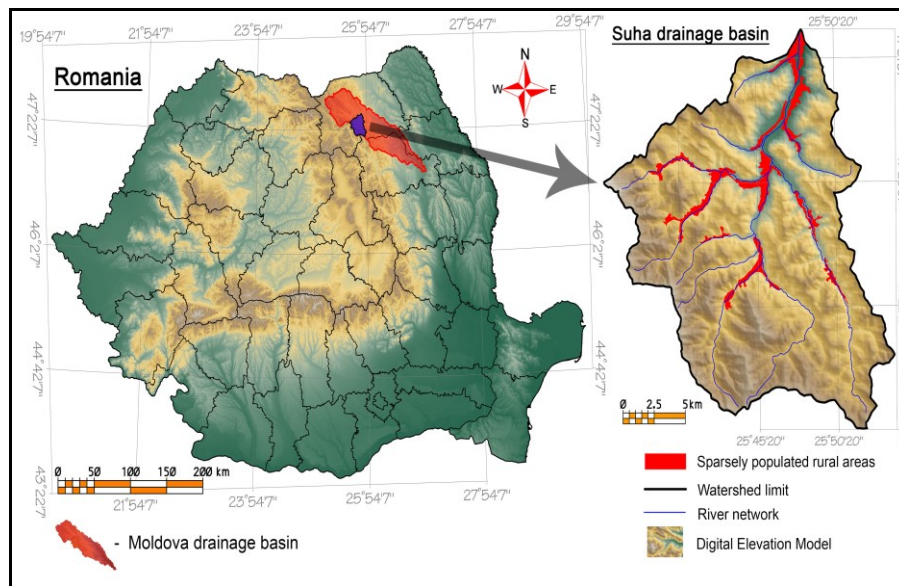


Fig. 1 Geographical position of the Suha River Basin

The problems regarding the discharge regime in the Suha basin are very important for the local population. This hydrological regime is determined by natural geographical factors (climate, geology, landforms, vegetal and soil cover) to which are added the more and more influent human influences.

2. Materials and methods

The analysis of the rainfall impact on the hydrologic regime of Suha Basin can become a basis for the hydrological prognosis which is elaborated based on the rainfall-discharge relation, and will also be an important element in determining flooding areas and identifying specific measures for flood control and defense. Knowing the rainfall quantities implies the knowledge of the minimum and maximum limits in which these might fall, the probability of some specific quantities, as well as their territorial repartition.

In the estimation of the impact of rainfalls on the hydrological regime of Suha basin have been used data obtained by the Siret-Bacău Water Basin

Administration and INHGA-București. The following rainfall elements have been analyzed for the year of 2006: quantity, duration, intensity, tendency and effects.

3. Results and discussions

From a climatic viewpoint, Suha basin is situated in the moderate mid-latitude area of mountainous type. No matter what the position of the baric centers that condition weather states at the continental level is, local influences interfere each time and condition many particular characteristics: atmospheric circulation channeling along river valleys, thermal inversions, föhn and local winds. The general climatic background is influenced by the active surface, expressed through local morphological characteristics, vegetation and human activities.

In the Suha basin, the main local factors which come to attention are the general amphitheatre character of the landscape, with a decrease in altitudes from west (spring area) to east, from the peaks of Rarău, Ostra and Suha mountains towards the Moldova valley; the existence of several depressions and valleys with different orientations and widths which may channel the general atmospheric circulation; the presence of thermal inversions on the background of high altitude differences between the mountain summits and the low areas; the existence of some climatic „shelter” conditions in the depressions; the presence of deforestation on large areas (Ichim, 1979).

In order to analyze the impact of rainfall on discharges from 2006 in Suha Basin, we have used the database of the Siret Basin Water Administration. The observations on rainfall quantities have been conducted at three of the existing hydrometric stations in the basin: Gemenea 5 (on Slătioara river), Gemenea 2 (on Gemenea) and Stulpicani (on Suha) (Fig.2).

The main cause of flood occurrence is rainfall, whose regime characteristics and spatial-temporal repartition is highly variable and discontinuous.

Due to its geographical position, Suha basin is under the influence of the baric centers that act in Europe in the area of interference of tropical and polar air masses. As a consequence, the most significant rainfall quantities have been recorded during the periods with persistent cyclonic activity and the lowest ones when anticyclonic masses have dominated (Sandu et al., 2008).

The variability of mean monthly rainfall quantities evidences significant differences during the year (Fig. 3-5). The flow rates oscillations also vary accordingly to the rainfall quantities (Fig.6)

From the analysis of mean total monthly rainfall quantities from the hydrometric stations in Suha basin it results that from February up to June-July, the monthly rainfall quantities present higher values, while towards the end of the year and in January they constantly decrease.

In June on almost the entire territory of România are measured the highest rainfall quantities during the year, frequently as heavy rains (Sandu I., 2008).

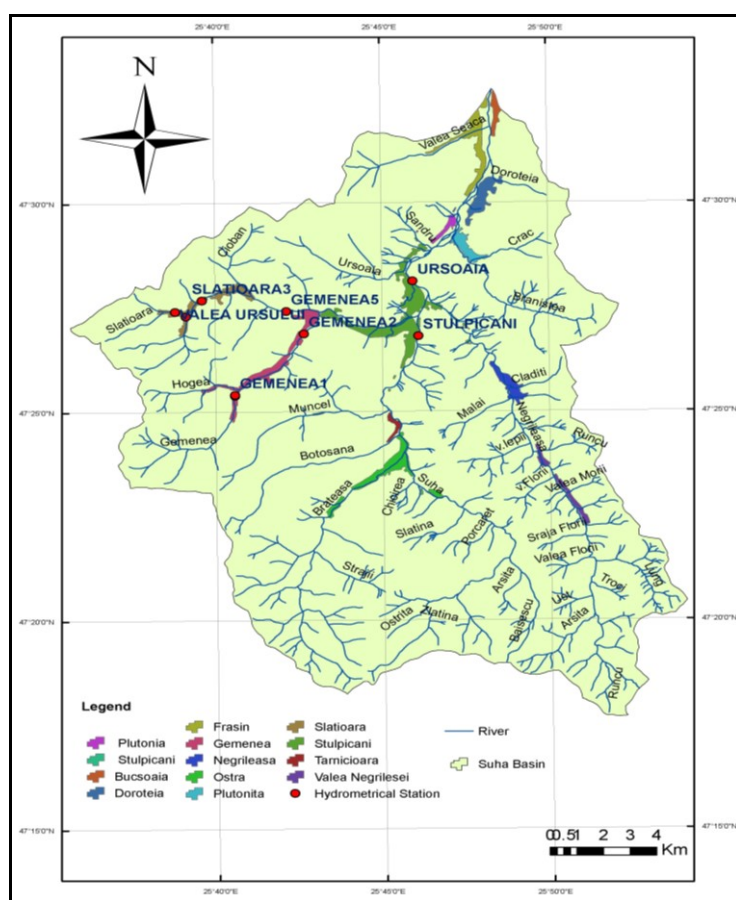


Fig. 2 Geographic position of hydrometrical stations in Suha River Basin

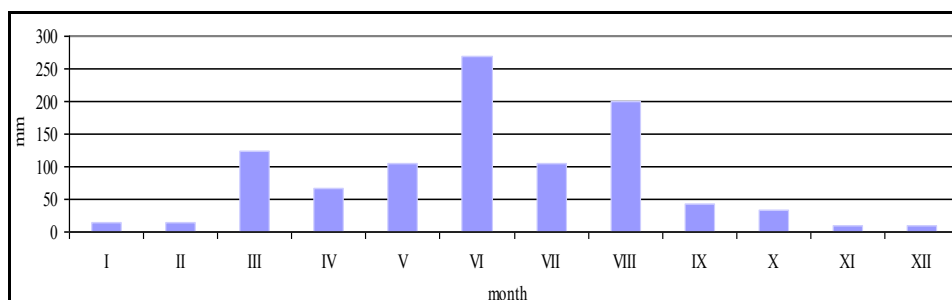


Fig. 3 Total monthly annual rainfall-2006 at Gemenea 5 hydrometric station

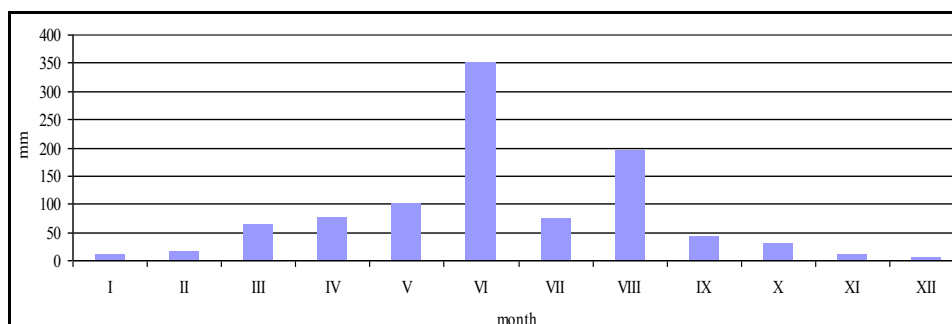


Fig.4 Total monthly annual rainfall-2006, at Stulpicani hydrometric station

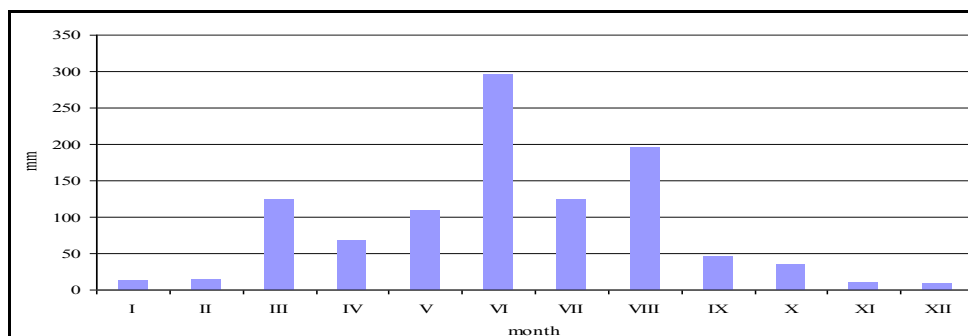


Fig. 5 Total monthly annual rainfall-2006 at Gemenea 2 hydrometric station

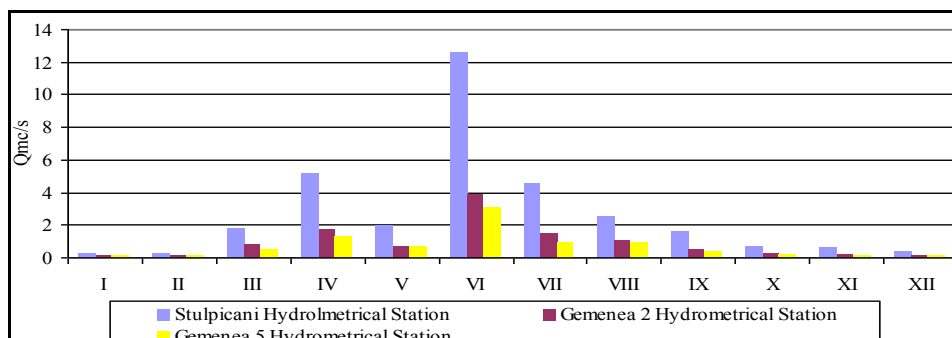


Fig. 6 Monthly average flow rates-2006

During 2006, at the country level have been registered significant rainfall quantities during June, which have caused important floods starting with the second decade and continuing up to the end of the month. Although it presents a high foresting degree, of 78%, Suha basin is characterized by frequent floods determined by local favoring factors.

The cause of these high rainfall quantities has been the one characteristic to the entire basins of Moldova and Siret rivers, namely the retrograde cyclonic movement manifested over the Eastern Carpathians during the entire month of June, amplified by local conditions.

During June 2006, the weather has been extremely hot. Mean daily temperatures have frequently exceeded 18-20°C, and the maximum ones have reached 25-27°C. Beginning with 02.06.2006, important rainfall quantities have started to enter the Suha basin (Fig. 3, Tab 1).

The maximum values recorded in 24 hours have been of almost 60 l/sqm at several hydrometric stations: 52.2 mm / 02.06.2006 at Gemenea 5 (on Slătioara river), 60.1 mm /02.06.2006 at Gemenea 2 (on Slătioara) and 59.0 mm /02.06.2006 at Stulpicani (on Suha).

In table 1 it can be seen that the highest rainfall quantities have been recorded at the beginning of the month. These quantities have highly contributed to soil saturation and less to significant river level increases. Lower quantities, but with higher intensities have been recorded in the second part of the month, generating important floods (Fig. 7-9).

Tab.1 Daily rainfall, June 2006

Gemenea 5 Hydr. Station		Gemenea 2 Hydr. Station		Stulpicani Hydr. Station	
	Rainfall		Rainfall		Rainfall
Date	mm	Date	mm	Date	mm
02.06.2006	33.6	02.06.2006	56.8	02.06.2006	56.2
03.06.2006	1.7	03.06.2006	1.8	03.06.2006	1.2
03.06.2006	0.6	04.06.2006	8.2	04.06.2006	22.3
04.06.2006	0.7	06.06.2006	3.3	06.06.2006	7.0
04.06.2006	20.5	07.06.2006	4.3	07.06.2006	7.4
06.06.2006	4.3	07.06.2006	8.0	10.06.2006	3.4
07.06.2006	5.0	08.06.2006	1.2	10.06.2006	1.2
07.06.2006	6.5	10.06.2006	4.7	11.06.2006	9.1
08.06.2006	1.0	10.06.2006	3.8	15.06.2006	34.3
10.06.2006	3.2	11.06.2006	11	16.06.2006	5.8
10.06.2006	2.6	14.06.2006	3.1	16.06.2006	1.1
11.06.2006	6.1	15.06.2006	39.4	18.06.2006	7.2
14.06.2006	2.9	16.06.2006	2.5	20.06.2006	6.8
15.06.2006	34.5	16.06.2006	6.1	20.06.2006	2.2
15.06.2006	1.7	18.06.2006	7.3	20.06.2006	1.9
16.06.2006	7.4	20.06.2006	7.4	21.06.2006	1.2
17.06.2006	1.3	20.06.2006	1.6	23.06.2006	16.5
18.06.2006	8.0	23.06.2006	8.8	23.06.2006	22.2
20.06.2006	4.0	23.06.2006	9.5	24.06.2006	3.0
20.06.2006	4.6	24.06.2006	9.5	25.06.2006	22.0
23.06.2006	13.7	25.06.2006	1.4	26.06.2006	12.8
24.06.2006	9.7	26.06.2006	7.5	27.06.2006	8.4
25.06.2006	1.7	27.06.2006	24.4	28.06.2006	40.8
26.06.2006	10.3	28.06.2006	9.4	30.06.2006	48.3
27.06.2006	16.7	29.06.2006	2.6		
28.06.2006	14.8	30.06.2006	18		
29.06.2006	6.0				
30.06.2006	20				

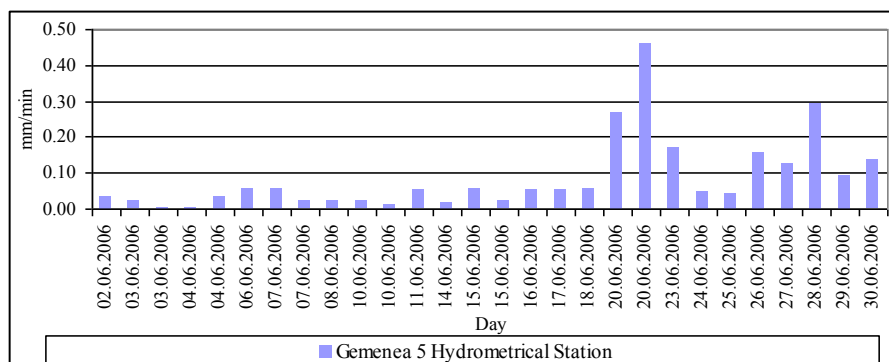


Fig. 7 Rainfall intensity in June, 2006 at Gemenea 5 hydrometric station

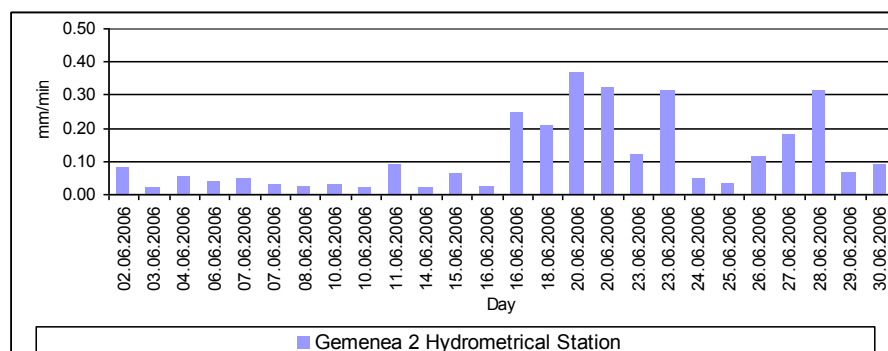


Fig. 8 Rainfall intensity in June, 2006 at Gemenea 2 hydrometric station

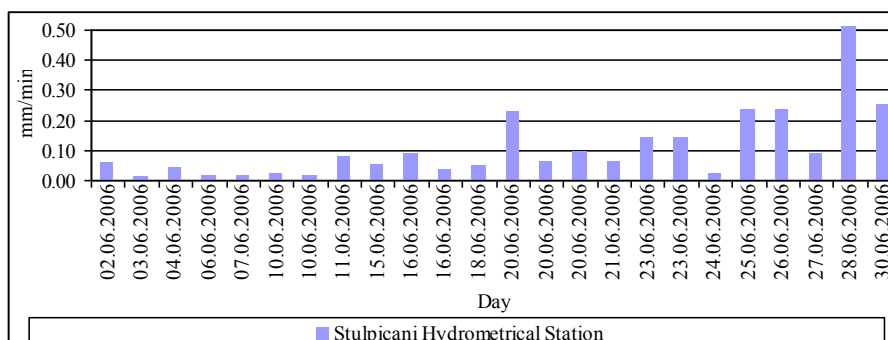


Fig. 9 Rainfall intensity in June, 2006 at Stulpicani hydrometric station

During June 16-28, 2006 rainfall has had very high intensities: 0.460 mm/min at Gemenea 5 station (on Slătioara), 0.370 mm/min at Gemenea 2 (on Gemenea) and 0.742 mm/min at Stulpicani (on Suha).

The floods have affected large surfaces of the basin, while rivers have reached maximum levels of 10 and 5% insurance. The maximum flow rates of the year have been of 84.6 m³/s (20% insurance) on Suha at Stulpicani station, 68.9 m³/s on Gemenea at Gemenea 2 station (being the maximum discharge ever recorded at this station and having a 2% insurance) and 38.8 m³/s on Slătioara at Gemenea 5 (10 % insurance) (Fig. 10).

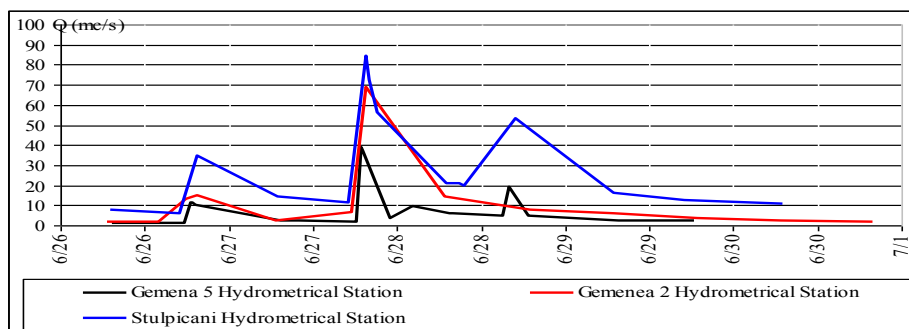


Fig. 10 Floods in Suha basin, 2006

On the background of a warm, tropical weather, a cold air front has rapidly entered from the north. The largest floods from this area are due to torrential rainfall. The negative impact is increased by the floodplain aggradation, the lack of longitudinal levees and the construction of households in the floodable area (Diaconu, 1965; Romanescu, 2003).

The devastating floods induced by the circulation of weather fronts (the retrograde circulation from the north-western part of the Black Sea) produce material and sometimes human losses. In some cases they are also the reason for large landslides. The floods occurring on certain rivers with high discharge rates (torrential) may block circulation by flooding, destroying or blocking bridges and by depositing sediments on the roads. The material losses that are produced every year sum up millions of euro, in the conditions in which the drained area is relatively reduced.



Fig. 10 Suha River (ABA Siret, 2006)

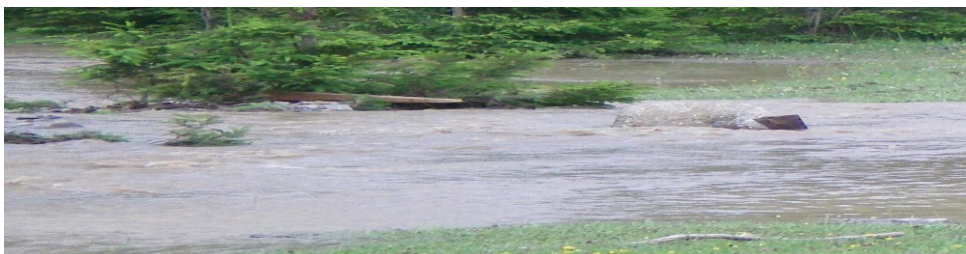


Fig. 11 Slatioara River (ABA Siret, 2006)



Fig. 12 Gemenea River (ABA Siret, 2006)



Fig. 13 Gemenea River (ABA Siret, 2006)

According to the report of Siret- Bacau, during June 4-28, 2006 damages and losses have been signaled in all localities from Suha basin. In the town of Frasin have been destroyed three households, one socio-cultural building, 7 bridges, 0.8 km of national road blocked by sediments, 0.96 km of bank protecting works and two flooded fountains. In Ostra township have been affected 0.15 km of county road, while in Stulpicani township (Negruleasa and Gemenea villages) have been affected 10 houses, 1 concrete bridge whose retaining walls have been destroyed, 1 bridge, 0.05 km of the 32 commune road, 1.6 km of the longitudinal levee on Negruleasa brook.

Conclusions

Suha Basin is a middle-sized one and has a hydrological behavior which depends on the rainfall quantity and intensity. The year of 2006 has been characterized by high rainfall quantities which have generated significant increases in river discharge rates. The absolute maximum value recorded in 24 hours has been of over 50 mm. beginning with the second decade of June have been recorded high rainfall intensities: 0.460 mm/min at Gemenea 5 station (on Slătioara), 0.370 mm/min at Gemenea 2 (on Gemenea) and 0.742 mm/min at Stulpicani (on Suha). These intensities have generated the floods that have affected large areas of the basin, and the rivers have reached maximum levels with 10 and 5% insurance rates.

The creation of hydrological prognosis based on the detailed analysis of the rainfall role in the discharge process is extremely important.

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