FRUSKA GORA HYDRO-ACCUMULATION “SOT”

Dragoslav Pavić, Vladimir Stojanović
Faculty of Science and Mathematics of Novi Sad

Abstract. Due to the presence of large number of stream valleys and their favourable morphological features, this low mountain in the vicinity of Novi Sad is propitious terrain for creation of smaller hydro-accumulations. Lake Sot or Sidska sidina is one of Fruska gora hydro-accumulations which is situated in the west part of the mountain in the valley of Sidska sidina stream. It was formed in 1979 by the construction of a dam (11m high, 185m wide). The lake covers the area of 22 ha, and its total capacity is 880,000 m³. The lake's basin covers the area of 13,6m². The main of this hydro-accumulation has been prevention of strong erosive process. Today it is also used for irrigation, tourism and recreational activities. By forming the hydro-accumulation Sot, a new habitat for numerous plants and animals has been created. Ichthyofauna and ornithofauna are of large importance for the development of tourism in the surrounding area. There are several archeological sites and monuments in the vicinity of the lake as an additional motif in the development of tourism.

Key words: Sidska sidina, Fruska gora, hydro-accumulations

INTRODUCTION

Fruska gora belongs to the category of low mountains, but it represents the most prominent geomorphologic unit in Vojvodina. Due to its geological features, firstly hydro geological characteristics of rocks, and then the relief, the mountain is abundant in ground and surface water. What makes it recognizable from the point of view of hydrology is a large number of permanent springs and stream valleys, down the northern and southern slopes of the mountain, through which numerous permanent waters flow. Also, due to favorable predispositions, there are a number of artificial lakes in Fruska gora, made most frequently by constructing soil or concrete dams in stream valleys. Such hydro accumulations are of manifold character. Primarily, they serve as means of irrigation, then for prevention of floods, torrents and process of erosion. Certainly, there is growing importance of the lakes in development of tourism (bathing, sports and recreation), as well
as sport fishing. The example is the lake Sot on the southern slope of Fruska gora, which was made by partitioning the water flow Sidska Sidina.

1. GEOGRAPHICAL POSITION

Sot hydro accumulation is situated on the furthest western wing of Fruska gora, northeastern from the settlement with the same name, in the valley of the stream Sidska Sidina that runs down the southern slope of the mountain. Its altitude is 150 meters. The closest traffic line is the regional road Sid – Ilok, which passes by the lake. Several tens of kilometers southern from the lake, the international motorway E-70 runs. The regional road Novi Sad-Ilok-Vukovar-Osijek runs north from the lake, which is 9 km far from Sid and 60 km far from Novi Sad.

2. GEOLOGICAL–GEOMORPHOLOGIC FEATURES

Versatile and complex geological structure makes a significant feature of Fruska gora. The mountain comprises rocks of various mineral and petrographic structure, and of different origin and different age. Thus, Fruska gora is a horst with a kernel of old Paleozoic rocks around which rings of younger sediments replace each other (Bogdanovic, 1982).

Paleozoic formations, as the oldest make the kernel of Fruska gora. Those are Paleozoic metamorphic rocks, which belong to the older Paleozoic. Within the structure of this Paleozoic series, there are different shales, among which most prominent are: sericite schists, phyllites, micaceous rocks, quartzite, shale like limestone, marble limestone and other similar rocks. Among Mesozoic formations the prevailing are: conglomerate, sandstone, clay, claylike shales, limestone and flysch facies. Cenozoic is formed of neogene (sands, sand like stones, marl, conglomerate, clay, and etc.) and quaternary (stones, sands, clay, and loess) formations.

The very area of hydro accumulation Sot is the contact zone of the furthest western parts of Fruska gora massive and western parts of Srem loess terrace as a lower geomorphologic unit. This renders information on geological structure, as well as the relief of this area. Namely, the hydro accumulation was built in the valley of Sidska Sidina stream at the locality named Sarkudin, in the close vicinity of the road Sid - Ilok. The Valley Sidska Sidina is a typical loess terrace with its profile in the shape of reverse trapezium (Bogdanovic, 1980).

3. CLIMATE

The municipality of Sid, to which the settlement Sot with its hydro accumulation belongs, is situated in the mild continental climate belt. Climate, in this case temperature and precipitation have been analyzed as one of significant factor for the development of bathing tourism. The aforementioned climate features have been processed on the bases of measure station Sid data (1951-1990) published in annuals of Federal Hydro Meteorological Agency.

3.1. Air temperature
Mean monthly air temperatures for Sid measure station in the observed period show that July is the warmest month with mean monthly temperature of 21.1 °C, and January the coldest month with mean monthly temperature of –0.5 °C. Thus, the amplitude between the two extreme values is 21.6 °C (table 1). Absolute maximum air temperature in Sid is 41.0 °C and it was recorded twice: July 15, 1952 and August 14, 1957. The value of absolute minimum air temperature is –30.5 °C and it was recorded on January 24, 1963.

Table 1. Mean monthly and mean annual air temperature (°C) for measure station Sid in the period 1951-1990

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Media</td>
<td>-0.5</td>
<td>1.6</td>
<td>6.3</td>
<td>11.3</td>
<td>16.3</td>
<td>19.5</td>
<td>21.1</td>
<td>20.7</td>
<td>17.0</td>
<td>11.7</td>
<td>5.9</td>
<td>1.7</td>
<td>11.0</td>
</tr>
</tbody>
</table>

Source: SHMZ, Belgrade

Air temperature highly influences the intensity and quantity of water evaporation, humidity, cloudiness and precipitation. Together with precipitation, it influences the development of vegetation, which further influences nutrition, reproduction and survival of game and indirectly hunting tourism. Air temperature directly influences picnic, excursion, and sports-recreational and bathing-recreational forms of tourism. It also significantly influences thermal regime of the lake and water flows as well as fish population, which is the precondition for development of sport fishing. Air temperature with the thermal regime of water flows determine the duration of bathing season. The aforementioned forms of tourism are represented at the lake Sot and its surroundings; bathing tourism is connected with the warmest period of the year, the months of July and August, whereas other forms of tourism occur during the whole year.
3.2. Precipitation

On the basis of the observed period of several years, it is obvious that on the territory of municipality of Sid the annual residuum is about 670 mm. The month with the largest precipitation is June (90 mm), and with the smallest is January (40 mm). According to table 2 data, it is noticeable that the largest quantity of precipitation occurs during summer, then during spring and autumn, and the smallest quantity during winter.

Table 2. Mean monthly and mean annual precipitation (mm) for measure station Sid in the period 1951-1990

<table>
<thead>
<tr>
<th>Month</th>
<th>J</th>
<th>F</th>
<th>M</th>
<th>A</th>
<th>M</th>
<th>J</th>
<th>A</th>
<th>S</th>
<th>O</th>
<th>N</th>
<th>D</th>
<th>Ann</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40</td>
<td>43</td>
<td>42</td>
<td>52</td>
<td>67</td>
<td>90</td>
<td>73</td>
<td>57</td>
<td>48</td>
<td>45</td>
<td>57</td>
<td>56</td>
</tr>
</tbody>
</table>

(Source: SHMZ, Belgrade)

Graph 2 – Diagram of annual precipitation (mm) in Sid for the period 1951-1990

Diagrama cantității de precipitații (mm) in Sid în perioada 1951-1990

Quantity and distribution of precipitation highly influences the development of flora and fauna, as well as population activities. Together with air temperature it directly or indirectly influences certain forms of tourism. In summer precipitation occurs in the form of short termed showers, which do not influence tourist travels in a negative way. In winter precipitation often occurs in the form of snow which on average lasts for 31.7 days (Group of authors, 1998)
4. HYDROLOGICAL CHARACTERISTICS OF SIDSKA SIDINA BASIN AND MAIN FEATURES OF SOT ACCUMULATION

In the bed of the Sidska Sidina stream, phreatic aquifer has been formed in loess sediments. It has been accumulated in the contact zone of loess plateau and older fine-grained sediments. It is situated rather deep, precisely at the depth of several tens of meters. It is interesting that in the water basin of Sidska Sidina, so-called hanging valley periodically forms due to the existence of clay Paleozoic formations within loess. Depending on morphology of the terrain in the valley of Sidska Sidina, there are several intermittent springs which have been captured and used as water supplies.

The stream Sidska Sidina represents the most important hydrological occurrence in the basin. This water flow is at the same time the most important stream of the southern foot of Fruska gora, whose spring is north from the settlement Ljuba. The length of the main flow is 40km, whereas the total length of all the flows in the basin is 45.1km. The spring is at 230m altitude and the mouth at 80m altitude. Thus, the total fall of the water flow is 150m and average 3.7m/km. Density of the water net by Neumann in the basin of Sidska Sidina is 571 m/km². Maximum flow through the basin is 13 m³/sec, and minimum is about 4 m³/sec (Bogdanovic, 1982).

Building of hydro accumulation Sot has largely changed hydrological picture of the stream basin Sidska Sidina. Namely, in the upstream part of the area, modern deposits were formed after the micro accumulation had been built, as a result of changes in transport power of the water flow. Shallow aquifier was formed in these newly formed sediments.

The lake was formed in 1979 when the soil dam, 11.6m tall and 185m long, was finished. The dam cut the flow of Sidska Sidina at a very convenient point in the upper part of the basin. The narrowing, with rocks on its left side and loess on the right, was used as the location for the dam. The total area of the lake is about 0.22 km², the total volume of about 880.000 m³ and maximum depth 11.5 m. The peak point of water slowdown reaches the absolute height of 141.84m. The area of the lake basin is 13.6 m² (Bogdanovic, Pavic, 2003).

According to the researches conducted in the period 1981-1990 the transparency of the lake water was between 45 cm and 150cm. It is also significant that the transparency in accumulation Sot is higher in comparison to other examined accumulations in Vojvodina. On the basis of numerous chemical, microbiological and saprobiological analyses the quality of water in the lake Sot mainly coincides with the II class bonity (Djukic et al., 1991).

The main goal in building the accumulation was to stop the strong process of erosion, which was intensive between the settlements of Ljube and Berkasova. As the other artificial lakes in Fruska gora, Sot is a multiuse accumulation. Truthfully, the project of planned use of the lake in the process of irrigation has not been practically conducted in the form it should be. But the special interest for the lake lies in its tourist attractiveness. Pure water, calm and picturesque surroundings, and abundance of fish offer relaxation, recreation and sport fishing at the lake. Due to the purity of water and its temperature
which exceeds 20 °C, the lake is suitable for development of bathing tourism in greater extent than it is the case today (Group of authors, 1999).

CONCLUSION

The main goal of building the hydro accumulation Sot was prevention of intensive process of erosion, which is present in hilly-mountainous areas especially in deforested sectors of Fruska gora. However, the realization of merely this goal would not justify the investments in building this hydro accumulation. Multiuse character of artificial lakes in Fruska gora is their unavoidable feature. Despite that, most of the accumulations are underused. Their multiuse character is seen in possibility of irrigation, development of bathing tourism, sports and recreational tourism, sprat fishing and etc. In the recent years hydro accumulation Sot is becoming more and more attractive for swimmers, picnickers, and fishermen from nearby towns, but still a serious project as the basis for complete and planned multiuse of the accumulation has not been achieved. This is one of the burning problems to be solved in the near future.

BIBLIOGRAPHY

Bogdanović, Ž. (1980), Veštačka jezera Fruške gore, Zbornik radova PMF-a, serija za geografiju, br. 10, PMF, Novi Sad.
Bogdanović, Ž. (1982), Hidrološki problemi Srema, Doktorska disertacija, PMF-Institut za geografiju, Novi Sad.