Effects of Some Human Activities in the Water Catchment Area of Argeş, Tributary River of the Danube

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Abstract: The highly populated geographical area, even since ancient times, the water catchment area of Argeș River has been the subject of some dramatic changes in time, especially during the last 50-60 years, due to demographical pressure. These changes regarding the natural ecosystems have been, in most cases, contradictory to what can be understood through the concept of sustainable development of the natural capital. The pressures made on the environment, through various human activities, such as the animal husbandry, the intensive over-exporting and, sometimes, the illegal exporting of wood, industrial development, the building of communication systems have led to the development of environmental problems, of some negative effects whose costs had been either underestimated or not considered and which had been much higher reported to the benefits of human intervention. Even some activities that were considered clean, from the perspective of their impact on the natural ecosystems, such as tourism, have proven to have mid and long term negative effects. The analysis of the environmental problems generated by the economic activities in the water catchment areas of some tributary waters of Argeș river leads to the conclusion that the negative effects on the environment can be diminished and that the finding of a sustainable development way of the socio-economic system, represented by the local communities, is the only viable long-term alternative.

Keywords: sustainable development; negative human impact; natural capital; water resources

Introduction

Arges river, with a water catchment of 12,550 km^2 (Gâştescu, 2010), is one of the tributary waters of the Danube in which the density of the population is high and where, implicitly, the natural landscape has been transformed in human landscape for several decades. The average density of the population in this geographical space is 182 inhabitants/km^2 (www.rowater.ro), a double value compared to the

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national one. From the administrative perspective, the Argeş water catchment is spread on wider or smaller areas on the territory of the Argeş, Giurgiu, Teleorman, Dâmboviţa, Călăraşi counties and Bucharest. The water catchment of Argeş (Fig. 1) is approximately spread between the following GPS coordinates: in the north, the N 43º54'50" parallel, in south, the limit is the N 45º36'30" parallel; in the west, the E 24º30'50" meridian, the eastern limit being set by the E 26º44'25" meridian; the average density of the hydrographic network is 0.36 km/km^2 (app. 1.4 km/km^2 in the mountain area of the upper course of Argeş, 0.4 – 0.5 km/km^2 in the plain (www.rowater.ro) Argeş river springs from Făgăraş Mountains, below the Arpaşu Mic Peak (2400 m) and below the Vânătarea lui Buteanu Peak (2506 m), through the fusion of the Buda, respectively Capra rivers; it has a length of 350 km (Gâştescu, 2010). In this mountain sector, the average slope has high values (150 – 80) ‰. (www.rowater.ro). On the middle sector, namely between Curtea-de-Argeş and Găeşti, the Argeş River and its tributary waters drain the Subcarpathian area, where the density of the hydrographic network is 0.3-0.5 km/km^2 and the average slope decreases towards 10 – 15‰. (the sector of the lower course goes from Găeşti and the spilling in the Danube and is featured by a flow profile with a slope between 9 and 6 ‰. (www.rowater.ro)

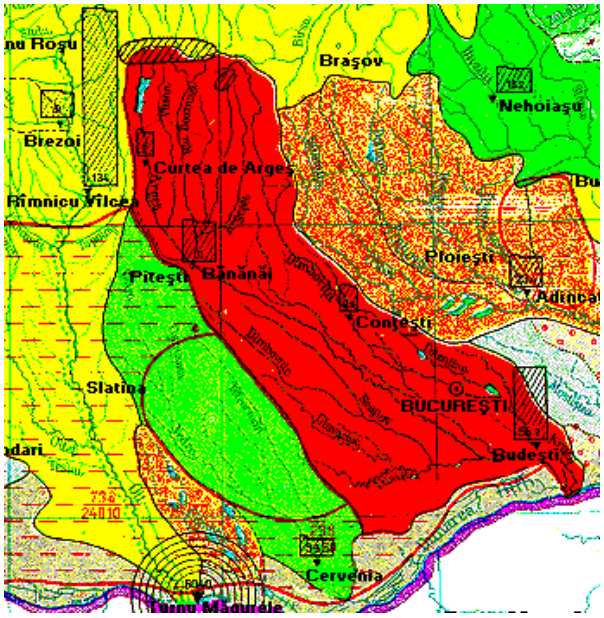

Figure 1. Water catchment area of Argeş River (in red)
Source: From www.elearning.masterprof.ro, excerpt)

The theoretical water resources in the Arges water catchment reach 1,960,000 m^3; the surface waters represent nearly 73.8% of the total theoretical resources in the water catchment (Tab. 1). The water catchment of Argeş is featured by a very large degree of hydro technical work (70%) of the surface, with a total volume of the accumulation lakes of 1,080,000 mil m^3, implicitly with high usable water resources, respectively nearly 1,672 mil m^3; The whole Argeş water catchment has a high usage degree of the water resources, the specific usage index being approximately 600 m^3/capita/year from the surface sources only. (www.rowater.ro)

Argeş is asymmetrically fueled, as the tributary waters coming from the left have a flow capacity intake that is more than 6 times higher compared to the tributary waters on the right; the main affluents on the left, represented by Vâlsan, Doamnei, Dâmboviţa, have their reception basins in the lower mountain area, where the alimentation is mixed, pluvionival and from the underground, and on the right side, Neajlov is the single more significant tributary water, with a continental flow; the main tributary waters of Argeş are presented in Tab. 2, (Gâştescu, 2010).

Table 1. Distribution of water resources in the water catchment area of Argeş River (from www.rowater.ro)

Argeş water catchment	**Theoretical resources** (mil.m^3)	**Usable resources according to the insurance degree of the water catchment** (mil.m^3)
Surface water	1,960,000	1,671,654
Groundwater	696,000	600,000
Total	2,656,000	2,271,000

Table 2. Main tributary waters of Argeş River
(www.rowater.ro; Gâştescu, 2010)

Tributary River	**Lenght (km)**	**Surface of the water catchment (km^2)**	**Observations**
Vâlsan	79	348	
Doamnei River	107	1,836	Highest average flow capacity, 20.31m^3/s
Carcinov	43	184	
Neajlov	186	3,720	Largest water catchment
Dâmbovnic	110	639	
Câlnişţea	112	1748	
Glavacioc	120	682	
Sabar	174	1,346	
Dâmboviţa	286	2,824	Longest tributary water

Materials and Methods

In order to monitor the status in the field, we have made numerous visits in different areas of the Argeş water catchment, between 2004 and 2017 (the itinerant observations method) (more than 100 visits). To calculate the geographical coordinates, we have used a GPSMAP® 76CSx device, with whom we have also calculated the altitude (the elevation). We used topographic, geographic, geologic maps of the visited places; the photos were taken with various devices.

Results and Discussions

As we have already mentioned above, the water catchment of Argeş was the subject of strong human intervention. There is no doubt that the most significant effects have been the ones generated by the building of 38 accumulation lakes on this water catchment, of which the largest and the most known is Vidraru lake, followed by Goleşti lake (www.rowater.ro). As the effects generated by the hydrotechnical work on the Argeş have been approached in other paper, we will not approach it, though insisting on the effects of other human activity categories.

Considering that a large part of the water catchment is located in mountain areas, a big problem is represented by the forest exploitations (deforestation and over-grazing, activities that are specific to the mountain areas, and, thus, to the upper catchment of Arges too. A typical case is represented by the western and central part of Leaota Mountains, where the human intervention is high. Regarding the rare and endangered flora in these mountains, the flora list includes 84 species on the Red List of the vascular plants in Romania (Oltean et al., 1994). They belong to different sozological categories – an endangered species, 7 vulnerable species, 70 rare species. As well, the Orchidacea, one of the most endangered species worldwide, are well represented in the interest area by seventeen species, of which we enumerate: *Dactylorhiza maculata*, *Epipactis helleborine*, *Neottia nidus-avis*, *Platanthera bifolia*, *Pseudorchis albida*. Orchards are very sensitive to the change of the management methods of the field, and the highest danger for them is represented by the sometimes drastic change of the adequate habitats for their survival (Antofie & Pop, 2013).

The biggest problem all over in the mountain area of the Arges water catchment is represented by deforestation and also by over-grazing, which lead to the

replacement of the original vegetation with a secondary one, represented by other species.

Alexiu (2011) shows that in many sectors of the mountain massifs, in the alpine and under alpine floors in Argeş County, deforestation and grazing have artificially determined the lowering of the forests limit far below their natural climatic limit; this is available for many areas in the Leaota Massif, and also for the Iezer-Papuşa, Piatra Craiului and Făgăraş Mountains.

For example, in Leaota, the forest vegetation is still dominant (78% of the total surface of the massif), which significantly contributes to the stability of the slopes (Murătoreanu, 2009). We have though identified, in many sectors, incipient instable places or deeper ones of the slopes, caused by deforestation activities, many of which were probably illegal. Thus, we mention areas in the Leaota Massif (in the water catchment of some tributary waters of Ghimbav; on Andoliei Valley (2004-2017); on the valley of Berbece's Brook (nov. 2014–nov. 2015); in the water catchment of Popii Valley (2015-2017) in the water catchment of the Cheii Valley (2013-2017); in areas on the right bank of Ghimbav (2007-2016); in the water catchment of Bădenilor Valley (2014; 2015). Unfortunately, deforestation does not stop at the Leaota massif only; moreover, we could say that in the area of this massif, the deforestation is not still as wide and intensive as in Făgăraş.

In the Iezer-Păpuşa Mts. area (the western, southern and eastern slopes), and, especially in the area of Făgăraş Mountains (since 2003) deforestation is made on huge surfaces. At the barrier on the forest road that passes by the former student camp Slatina (Făgăraş, in a single day, on August 7th 2008, during 17-23:00, we had numbered 21 forest trailers which had returned from the mountains filled with trees (both broad-leaved and conifers), with a diameter of at least 0.5 – 0.75m). Things got worse and worse from year to year. În Piatra Craiului are (the slope in Argeş county; complete deforestation of the slopes in front of the Garaofiţa Pietrii Craiului Cabin, in 2002 and 2003 and then on Ivan's Valley. The actual forest vegetation which covers the slopes is secondary, with a different structure.

Going back to Leaota massif, the middle alpine under-floor, which spreads until 1000 meters altitude, is normally featured by beech forests mixed with conifers (spruce and fir) which are included in the *Hieracio transsilvanici–Fagetum* (Vida 1963) Täuber 1987, *Pulmonario rubrae – Fagetum* (Soó 1964) Täuber 1987 (Alexiu, 2011) associations. Where deforestation had been made, the natural forest vegetation was replaced by the associations of the *Epilobietea angustifolii* class

(Neblea, 2007). Neblea (2007) and Murătoreanu (2009) show that in many places the juniper groups have been destroyed by the shepherds, such as in Vaca, Jugureanu, Ţăbra, Geabelea, Tâncava, Cumpărata, Cioara, Albescu or Românescu Mountains, the contact between the spruce forest and the alpine meadow being direct. During our visits we have identified two more examples of juniper deforestation, in Vâja and Secările Mountains and we confirm what the above mentioned authors have shown. Neblea (2007) mentions that the disappearance of the juniper led to its replacement by short bushes of the *Rhododendron myrtifolii – Vaccinietum myrtilli* association, with plateau meadows with Nardus stricta and the alpine coenosis of the *Potentillo chrysocraspedae – Festucetum airoidis* Boşcaiu 1971, *Oreochloo – Juncetum trifidi* Szafer 1927 associations. The author notices that, on Leaota Peak, around the springs and brooks, fontinal coenosis of the *Doronico carpatici – Saxifragetum aizoidis* association Coldea (1986) 1990. Murătoreanu (2009) observes that where juniper was destroyed, it was replaced by associations of *Agrostis rupestris* which extended in many cases until the alpine floor inclusively.

The alpine floor includes the mountain gaps at high altitude, over the climatic limits that allow the existence of trees, but the lower limit of this floor is hard to establish, due to the deforestation (Alexiu, 2011). The vegetation composed of bushes is met in the higher zones, it protects the forests against the action of avalanches and wind, but they protect the soil at a lower extent. It holds 15% of the total surface. Unfortunately, over this intermediate floor, which represents the passing from the forest towards the alpine meadows, a very high pressure is made, nearly everywhere in Romania, due to the shepherds, which cut the juniper, either for fire material, or just to eliminate this vegetation as they try to extend the alpine meadows. It is obvious that there are serious consequences, as this floor has a highly significant role in the protection of the forest against strong winds and especially against avalanches. The disappearance of the juniper from some areas has led to the fact that the avalanches affected the forest, going very low.

We give an example with what happened on the forest road that goes along Rea Valley, 11 km away from the terminus point (the sheepfold in Rea Valley), in August 2006, the detrital material mixed with wood material and ice (!) was still blocking the forest road. This mixture of rocks, soil and cut trees was brought by an avalanche from the right slope of the Rea Valley brook, which would not have such a destructive effect if there had been the juniper floor between the forest and the alpine gap.

Herbal vegetation (pasture, hayfields) is strongly affected by grazing. Murătoreanu (2009) identified more than 60 sheepfolds in Leaota Massif, though the surface of the massif is small, only 336 km^2. This leads to a high vulnerability of these vegetal formations; in Leaota Massif, of the 3,000 ha of pasture in Leaota, more than 2,000 of them host the *Nardus stricta* association (Murătoraenu, 2009). Alexiu (2011) claims that more than 60% of the total pasture surface in Arges county are represented by the mentioned association; sometimes, the *Nardus stricta* species can go up to 80% covering degree of the pasture, contribution to the stabilization of the soil, secondary meeting grass, such as *Festuca airoides, Agrostis rupestris, Avenula versicolor, Festuca rubra* etc. In fact, the *Nardus stricta* invasion is a result of over-grazing. The habitat of Boreal and Alpine meadows is only found as strips in mixture with under-alpine bushes, rocks or other types of meadows and it is fragmented, namely the well preserved areas alternate with degraded areas, where *Nardus stricta* grew (Dorobăţ, 2016).

Another problem is represented, in some areas of the Argeş water catchment, by tourism. Though they are not that dangerous as in Bucegi Massif, there are areas where the indirect and the direct effect is strong. We would give the most examples in the Bâlea Valley area, at the limit of Argeş and Sibiu counties, where an uncontrolled tourism develops. A series of buildings emerged in the area between Vidraru and Bâlea, especially at Piscu Negru. In fact, the building of the Transfăgărăşan itself is an example of useless road, whose maintenance is extremely expensive and which is open for only maximum 4 months/year (Bleahu, 2004). This eased the tourists' access to high altitudes with cars, which is totally not recommended and with a massive human negative impact; the road led to the instability of the slopes, landslides, to the emergence in Bâlea Glacial Valley of a series of buildings near to the old mountain cabin; this generated hard to stabilize landslides (Bleahu, 2004). Unfortunately, the easy access of tourists in Piscu Negru-Bâlea area lead to a negative impact through the passing of ATV's on the slopes, by destroying the fragile soil and making loud noises. We have even seen some "tourists" trying to reach the Negoiu saddle by motorcycles, pulling parts of soil and making loud noises. In fact, a feature of Bâlea Valley is the phonic pollution which reaches maximum values during the summer season, the speakers of the pub reaching maximum volume, the noise being even louder than in Şaua Capra. It is useless to say that the garbage is found all along the Transfăgărăşan on both sides. A lower amplitude is held by the tourism in Iezer-Păpuşa Mountains (Voina area), in Leaota Mts. (Cheii or Rudăriţa Valley area). We though mention a core of tourism activities that has strongly developed in the latest years in the Piatra

Craiului area (Dâmbovicioara and Sătic), dealing with the same problem of the garbage. Notable is the fact that trash is frequently thrown by the villagers themselves. This is not only a feature of the mountain villages, as it is noted everywhere. For example, during our visits on Doamnei River, we had noticed that there had been no rural settlement that had not had stacks of garbage deposited on the banks of the river. (Dorobăţ & Udroiu, 2015)

Though, in the touristic areas of Dâmbovicioara, Cheile Cheii and Sătic we have not noticed a phonic pollution comparable to the one in the areas of Piscu-Negru or Bâlea. We cannot say the same about the Poienile Vâlsanului, where touristic buildings appeared, with doubtable aspects and where we once again notice, as always, a phonic pollution generated by speakers, as well as garbage thrown everywhere.

The ballast exploitations represent another human activity with a high negative impact. These are especially present on Argeş and not only. Doamnei River is another example. Moreover, the extraction of large rocks from the gully, even occasionally, as happened on Vâlsan river, by the villagers in the area, is dangerous, jeopardizing species of fishes, such as the *Romanichthys valsanicola* (the most endangered species of fish in Europe) (Vlăduţu, 2005). The ballast extraction leads to the change of the slope, to the increase of the flowing speed and to the increase of vertical erosion. Thus, we can give examples with the case of Grădiştea, with the destruction of the bridge over Argeş, due to ballast exploitation, downstream to the bridge. The exploitation led to the scouring depth, to vertical erosion in the river bet which overpassed the foundation level of the bridge's foot.

Another type of activity that has a negative human impact is represented by the building of micro hydroelectric power stations in the water catchment of the Argeş (Conete & Gava, 2013). This does not only lead to the change of the rivers' flow regime and very large flow variations. The work done led to the modification of the riverbed, to gravel excavation, to the destruction of the bio-derma, to the disappearance of the habitat of some species. Warnings were made before proceeding to work, by numerous specialists, but the political and economic interests have neglected these aspects. The cost/benefit report is negative. Environmental costs (hard to calculate) should be internalized so that the beneficiaries of the profit generated by micro hydro power stations to support the costs, according to the European regulation. (Vădineanu, 2004)

Conclusions

The water catchment of Arges is the subject of high human pressure, being very populated. The deforestation represents an issue of these human influences, being practically present in all the mountain areas. This does not only generate accelerated erosion of the mountain surfaces, but it also leads to landslides and flooding. It is mandatory to stop the cuttings and proceed to some work against the landslides, but the costs are very high.

Over-grazing represents a big problem in the mountain and subalpine sectors. This leads to erosion, to the replacement of the original vegetation with a secondary one; around the sheepfolds, nitrophyle vegetation appears. In a series of mountain areas, the intermediate shrub floor has already disappeared, with the sudden pass from the alpine meadows to the forest. The forest became vulnerable against avalanches and wind. The uncontrolled tourism activities are present in a series of highly attractive areas, especially mountain areas. As a result of not only tourists, but also of the irresponsible behavior of the inhabitants, the accumulation of garbage is omnipresent, especially outside the communities, on the banks of flowing waters.

For a sustainable development of the water catchment area, we appreciate that a very strict monitoring process is needed, focused on these economic activities so that the natural capital would not be degraded, as well as the need of interdicting the ones that destroy the respective areas in an irretrievable manner.

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