

Case study of “Hortobágy” and “Kunfeherto” fires, Hungary: disaster in costs of their elimination’s view

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Abstract. Day by day catastrophes gain bigger emphasis in our lives. The climate change affects not only Hungary and Europe, but every single country on Earth. By this time we can expect the constant raise of the average temperature, and this greatly increases the risk of wildfires. The author is analysing two wildfires happened in Hungary: “Hortobágy” fire and “Kunfeherto” fire. Article focuses on logistic problems in both fires. The topic highlights pointed also to the spread of wildfires connection to the costs required to suppress them. Therefore this article reveals the importance of the defence against the wildfires. „Hortobágy” fire was suppressed by continuously raising resources in 3 steps, each of them was too late to be able to manage the exact situation. “Kunfeherto” fire was suppressed in 1 step with correctly time ordered resources. The size of the fires and the circumstances were more or less the same however the total costs of the extinguishing and the total damages caused by fire were significantly different. Research says that the alarm level for the required resources significantly determines both the damages caused by fire and the time of the intervention suppresses the fire.

Key Words: forest fire, logistic problem, economic analysis, aerial firefighting, Hortobágy, Kunfeherto.

Introduction. The Hungarian legislative background of the topic is the Act on catastrophes CXXVIII of 2011 about the disaster management and about the related laws amendment (Act on catastrophes 2011) and the Act on fire protection XXXI of 1996 about the defending against forest fire, about the technical rescue and about the fire service (Act on fire protection 1996). It was very important to know the relevant special literature, and the article became a big significance to the personal consultation with firemen with many experiences. During the research I studied different sites and plans. These presented the problems of tactics of the forest fires. I analysed two fires with same problems, like the classification of the alarm degree, the qualification of the forest fire, the question with the catering of the extinguishing agent and the difficulties of the aerial firefighting. The article tries to draw a conclusion from the economic side. There are examples in the Hungarian literature but this kind of interpretations are not so general today.

Analysis of the fire in Kunfehértó-Kéleshalom in 2007

Attributes of the fire evolution. In July 2007 was one of the driest summer in Hungary. This encumbered the work of the firemen in the south lowland (<http://www.origo.hu/idojaras/20100712-kanikula-hosegkord-nyari-meleg-eddig-2007-volt-a-legforrobb.html>). On the 25th of July there were more forest fires at the same time, therefore the alarm could not be realized in time. So the fire forces came a bit late to the location. In the morning the fire department Kiskunhalas received an alarm to a forest fire with the alarm stage III in Kistráta. At the same time there was another forest fire in Kunfehértó – Kéleshalom. The leader of the forest fire deemed the second fire more serious, so the big part of the fire forces were moved there. Meanwhile the leader of the forest fire saw „falling fires” because of the strong wind. These „falling fires” were more than 100 m high. After that the wind changed, and blowed the fire towards Kéleshalom. It was clear, that the fire forces are not enough, to fight against the fire. The codicil of the water must be done from big distance. The marching distance between the fire and the water source was 6 km. The capacities of the waterworks in Kéleshalom were thin and quickly emptied. The leader of the forest fire ordered a „fire train” to the location. This train arrived to the railway station of Kunfehértó (Gerner 2007). The firefighters slaked the fire in the next day.

Use of the aerial fire fighting. The use of the aerial firefighting was very useful at the fire in Kunfehértó. The reason for that is the territory was too big and unapproachable.

This kind of firefighting with Bambi Buckets and outside tanks is not so typical in Hungary as against in western Europe (Bayerische Staatsregierung 2013; Bayerischen Staatsministerien 2013). The National Directorate General for Disaster Management of the Ministry of the Interior initiated collaboration with the experts of the Army. Therefore two helicopters type Mi-2 and Mi-8 arrived to assist against the fire. These helicopters worked with inside tank and also with attached outside tank method. The use of the aerial firefighting was studied in Hungary as well. The author mentioned some practical problems, during an intervention, and its difficulties were also shown in Kunfeherto – Keleshalom (Restas 2008). The intervention with airplanes was out of question, because of the few equipment and the lack of the infrastructure. The helicopters interfered in different ways.

The Mi-8 helicopters worked with hanged burden. They used a so called Bambi Bucket for this purpose. These tanks are fabricated in different sizes, from 270 litres to more than 9000 litres. The firemen filled the tanks from a nearby lake (Lake of Szásztelek). After that they deflated it from a high 80-100 metres (Farkas & Laczko 2007). The efficiency of the aerial firefighting is undoubted; still, several authors critique its current effectivity (Restas 2012).

The Mi-2 helicopters worked according to a new Hungarian method. The firemen made a rigid tank in the interior of the helicopter. They filled the tank with water. The capacity of the tank was 700-1000 litres. In average the machine transported 800 litres of water. The dumping was at the high 20-40 metres. The size of that was double big as the Bambi Bucket's (Farkas & Laczko 2007). This method is very new and effective, but some authors (Komjathy et al 2013) tagged that the experts are working for subsequent solutions.

Several forces had been working together to put an end to the spreading fire. The fire in Kunfehértó-Kéleshalom started up at the Kiskunság (this is a location in South Hungary) therefore the arrival for the fire brigades took a long time. The reason for that is the large distances between the towns. It can be 8-10 km. The fire implied high costs. The next topic is about the analysis of the costs.

The fire costs in Kunfehértó. I took account into the fuel costs, the cost of the dining, the cost of the aerial firefighting and the worth of the forest that burned down.

The fuel costs. The management took place in two divisions. The fuel costs of these two divisions were according to following.

1st Division:

Data from the first division:

- 8 water carriers;
- average consumption 20 L/100 km (for 1 carrier);
- marching distance: 6 km (between the fire and the water source);
- 1 fire engine can be uploaded 20 times a day;
- cost of the gas oil in 2007: 260 HUF/litre.

The marching distance for one carrier was together 240 km. It is calculated for 8 carriers 1920 km. The standing engine consumed gas oil as well, so I rounded it up to 2000 km. After the calculation we get that the fire engines consumed 400 litres daily. This is calculate with the gas oil price in 2007, means 104,000 in HUF (340 EUR).

2 nd Division:

In this division there were "only" 3 water carriers. The raw data are similar to those in the first division. It means that one water carrier runs 240 km in one day. Three water carriers run all in all 720 km (3 x 240 km = 720 km). I rounded it up to 800 km. After the arithmetic calculation we get that the carriers consumed 160 liter daily. So it means a cost of 41.600 HUF (136 EUR). The two sum is together 104.000 HUF + 41.600 HUF = 145.600 HUF (476 EUR).

The cost of the dining. The cold dining is more practical at a forest fire, than the warm dining. The reason for this is that the cold foods are cheaper, and they do not go sour at the summer hot days.

For 1 fireman I counted 4 litres of water, 0.5 kg bread and 200 g cold cuts. This costs 550 HUF together (290 HUF + 160 HUF + 100 HUF = 550 HUF). At the fire in Kunfehértó-Kéleshalom 121 man worked, so the total cost of the dining was 66.550 HUF (121 x 550 HUF = 66.500 HUF) (220 EUR).

The cost of the aerial firefighting. Helicopter type Mi-2 was used at the fire. The consume from the helicopter is 300 litres/hour. The estimated price for the kerosene is 400 HUF/litre in 2007. The Helicopter could make a turn just a little bit over 2 mins, despite this I count with the average time of 4 minutes. In Kunfehértó the helicopter landed 316 times, so the operating time was 1264 minutes, almost 21 hours. After the calculations, we get that the helicopter consumed 6300 litres of fuel. This roughly costs 2.520.000 HUF (8260 EUR).

The worth of the burned forest area. The estimated price for 1 hectare forest was roughly 300.000 EUR in 2007. The burned area was almost 2000 hectares. After the multiplication we get a cost from 600 million HUF (2,000 HUF x 300,000 HUF = 600,000,000 HUF) (1,967,213 EUR).

The total costs. After summing the cost of these items, we get the following values:

- fuel costs: 145,600 HUF;
- dining costs: 66,550 HUF;
- cost of the aerial firefighting: 2,520,000 HUF;
- worth of the burned forest area: cca. 600,000,000 HUF;
- total: 602,732,150 HUF (approximately 2,000,000 EUR).

So the costs were around 603 million HUF in Kunfehértó-Kéleshalom event. The list above shows that the largest part of the costs is the burned areas. The cost of the aerial firefighting is not negligible, even if it is only a fraction of the losses from the forest.

Analysis of the fire in the Hortobágy National Park (2002)

The progress of the fire. The fire was on 27th of June in 2002. The fire generated at the operational area from the Püspökladány Professional Municipal Fire Brigade, northwest from Nádudvar, next to the farm Mihályhalma. The fire affected a total of 4,755 hectares, about 15 km long and 4 km wide in places. The signal about the fire was sent to the Fire Department Debrecen first, who transmitted it to the fire service of Püspökladány. The leader of the fire was the Ladány-24, who classified the fire on a lower level than necessary, although the experiences and the information from the previous years had been classified higher than alarm stage I. The next leader classified the fire immediately to emphasized III before his arriving, so this problem was solved early. The change was correct, because the fire grew up to 600 hectares. The fire spread rapidly due to the strong wind and their frequent change of direction. The affected area was dry grasses, and reeds, which are coupled with the hot and dry temperature, helped the spread of the fire. The increase in high alarm stage V took place late afternoon, when the fire brigade Ladány-24 took over the lead from Karcag 24 (Toth 2002).

It is a basic rule of the forest fire that the not clearly determined fires should determine a bigger level of the alarm, so we can avoid the large scale spread of the fire, because the alarmed staffs are enough to fight against the fire. With the graph we can see how it implemented the definition of alarm levels (Figure 1). The function of the graph increasing strictly, from the lower rating to the higher rating. It made the intervention difficult, because initially very low powers were alarmed to the fire. Ideally the fire is higher classified. So we get a function from the higher level to the lower. In this case the function is strictly decreasing. This function we can relate to the damage-

time function, where the size of the alarm strictly defines the damage (Restas 2008). Nowadays we can make the classification easier by using drones for this purpose (Ollero et al 2006; Restas 2008).

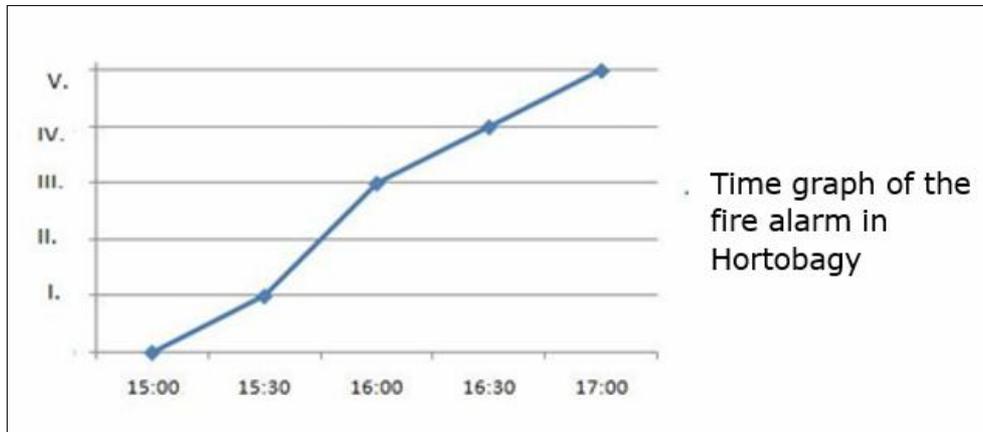


Figure 1. Time graph of the fire alarm in Hortobágy.

In the Figure 2 we can see the location of the fire, the reach of the fire at the alarm stage III and V high priority. In the picture left we can see the location of the fire. In the middle we can see the reach of the fire at alarm stage III and on the right at alarm stage V.

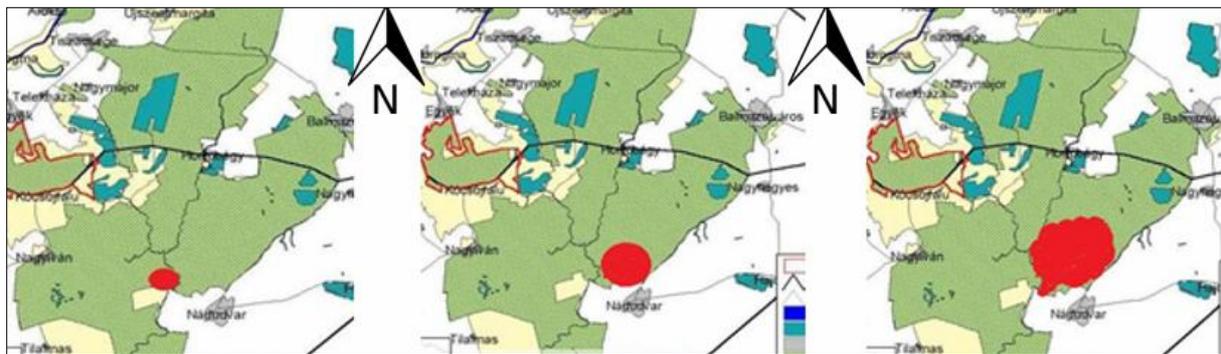


Figure 2. The location of the fire, the reach of the fire at the alarm level III and V high priority.

The agent that was used against the fire was water. The fighting against the fire realized with rays from different sizes. Two helicopters type Mi-8 (http://www.kossuth-csepel.hu/bazis/27_Helikopter%20Mi-8.jpg) helped as well. They used pulled down water curtains. The extinguishing agent had no intensity at the start of the fire fighting, because of the big location and the wind. Another problem was the lack of the forces by the reason of the bad alarm rating. These difficulties lead to the aerial firefighting, which proved to be effective.

These factors below made the efficiency possible:

- the optimal distance from a water source;
- the experience of the pilots, and their adaptation of the land;
- optimal weather conditions;
- direct information-line.

The aerial firefighting proved effective, this helped to make planning and firefighting easier in the future (Kunfehértó 2007)) (Gerner 2007).

The fire costs in Hortobágy. I took account into the fuel costs, the cost of the dining, the cost of the aerial firefighting and the worth of the forest that burned down, like at the other fire.

Fuel costs. Thirteen fire engines and 4 water carriers worked at the fire. The consumption for one fire engine is about 20 litres/100 km. The distance between the hydrants and the fire was 10 km. One water carrier turned 20 times daily, so it made 400 km (20 x 10 km back and forth = 400 km), I calculate with 4 carriers, it is 1600 km (4 x 400 km = 1600 km). Because of the standing engine (passive engine work) consumption I rounded it up to 1700 km. After the calculations, I get, that the fire engines consumed 340 litres of gas oil. It is with the price of the gas oil in 2002 (gas oil in 2002: 193 HUF/litres - <http://www.origo.hu/gazdasag/hirek/20020128ujra.html>) 65.620 HUF (215 EUR).

Costs of the dining. The dining was necessary at the fire in Hortobágy as well. The cold foods were preferred against the hot foods, because of the dog days. We supposed (like in Kunfehértó) that one fireman needs 4 litres of water, 0.5 kg bread and 200 g cold cuts. From these ingredients we can make sandwiches.

The number of the firemen was 44. For 1 fireman is the cost of 448 HUF (250 + 120 + 75 = 445 HUF). It is calculate with 44 firemen 19.580 HUF (44 x 448 HUF = 19.580 HUF) (65 EUR).

Costs of the aerial firefighting. The average consumption of the helicopter type Mi-8 is about 900 litres/hour, and the price of the kerosene was about 300 HUF/litres in 2002. The helicopter took off 75 times. It can turn round in 10 minutes (Restas 2013). After the calculation I get an operating time about 12.5 hours for one helicopter. It is for two Mi-8 helicopters, 25 hours. So the consumption is 22,500 litres kerosene, which is calculated with the kerosene price from 2002 (300 HUF) is a cost from (25 x 900 = 22,500) 6,750,000 HUF (22,130 EUR).

The cost of the burned forest areas. The extension of the burned areas was 4,700 ha (not forest). If we multiply it with 100,000 HUF (the price of 1 ha land in 2002 was about 100,000 HUF) we get a price from 474,500,000 HUF (4,700 x 100,000 = 470,000.000) (1,559,016 EUR).

The total costs. After summing the cost of these items, we get the following values:

- fuel costs: 65,620 HUF;
- dining costs: 19,580 HUF;
- cost of the aerial firefighting: 6,750,000 HUF;
- worth of the burned forest areas: about 470,000,000 HUF;
- total: 476,835,200 HUF (more than 1,500,000 EUR).

Based on the costs above, the cost of the fire in the Hortobágy National Park was more than 482 million HUF. At the two fires the biggest cost was the worth of the burned area. The cost of the aerial firefighting was huge as well, but it is more cheaper than the conventional firefighting. If we use the aerial firefighting we can save areas from the fire. So the costs of the firefighting will be a little bit more, but the worth of the burned areas will be much lower. So we can save money.

Both of the fires apply that point of the costs is the primary criterion of efficiency necessary. The point of that is that manpower, the tools, and the fighting costs must be less than the saved values in the economy. Otherwise, the firefighting is in the point of the economy, uneconomic (Restas 2008, 2012).

Comparison of the two fires. Finally I would like to compare the two fires in tabular form. For this I collected opinions and experiences from the firemen, who participated in the firefighting (Table 1).

Table 1

Comparison of the fire in Kunfehértó-Kéleshalom (2007) and in the Hortobágy National Park (2002)

<i>Emerging issues</i>	<i>Hortobágy (2002)</i>	<i>Kunfehértó (2007)</i>	<i>+/-</i>
The burning material	Mostly grassy area	Mostly wooded area	0
Classification of the fire	Problem of the fire classification, three steps to reach the emphasized V qualification. First I, than II after that V high priority.	The classification of the fire was smooth	+
Agent supply	Transport of the water from distant water source, plus extra water spaces (Lake of Szásztelek)	Using water transport from distant source, and the help of the fire train	0
Aerial forest fighting	Helicopters Mi-8 using water curtain	Helicopter Type Mi-2 and Mi-8, using internal and external tank method	+
Total costs	> 482 million HUF	> 602 million HUF	

"+" and "-" mean the first intervention was in 2002, the second in 2007. I put "+" where the intervention was better in 2007 than in 2002.

The summary chart shows that the exercise of the leader of the forest fire is very difficult. The burned areas are very huge, so every minute of the delay cause huge damages. The leader of the forest fire must make important decisions in short time, so they must have experience. That is why it is very important to analyse previous fires, so the leaders evolve abilities that will help them to take quick and right decisions (Restas 2013).

There were same difficulties and differences in connection with the two fires. There was a problem with the classification at the fire in Hortobágy. The alarm stage V was reached in 3 steps. It means here were not enough forces at the fire. In Kunfehértó was the classification smooth. The firemen worked more efficient, than in Hortobágy (Toth 2002).

Helicopters Mi-8 used water curtain at the fire in Hortobágy. The helicopters type Mi-2 used internal and also external tank method. This was more efficient.

All in all the firefighting was more efficient in Kunfehértó, but the costs are here higher. But in proportion it is lower, than in Hortobágy. The costs were very different in the year 2002 and 5 years later.

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