COST-BENEFIT ANALYSIS OF THE HAIL SUPPRESSION PROJECT IN SERBIA

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I. INTRODUCTION

The main characteristic of this method lies in the evaluation of all the advantages and all the deficiencies of a certain project, which leads to the final judgment about its financial effects. This evaluation is based on a systematic aggregation of all the financial means necessary for project realization, on one hand, and of all the benefits obtainable from the project, on the other.

The main principle used in a cost-benefit analysis application on a hail suppression project is based on a requirement that total benefits deriving from a project must be greater in comparison with total means invested.

II. METHODOLOGY

The principal methods for the evaluation of the hail suppression may be expressed through the following two criteria:

- Present value of net benefit criterion
- Cost- benefit relation coefficient

The present value of net benefit criterion (Kns) equals the difference between total benefits and total costs of the project:

$$Kns = Ks - Ts$$

Ks – Total benefit of the hail suppression project;
Ts – Total costs of the hail suppression project.

The evaluation of the hail suppression project according to this criterion presupposes a positive difference between the indicated values, that is:

$$Kns > 0$$

This difference indicates, in fact, the positive effects of hail suppression.

The cost-benefit relation coefficient, K_o, is represented by the relation between benefits and total costs of the hail suppression project. At the same time, it indicates how much benefit may be obtained from each unit of the means invested in the hail suppression project, and it may be expressed in the following way:

$$\boldsymbol{K_o = \frac{Ks}{Ts}}$$

According to this coefficient, the hail suppression project is financially legitimate if its value is higher than 1 (K_o>1).

III. DATA AND RESULTS

The data used in the analysis enable the objective deduction about the project efficiency. The period of 32 years, from 1972 to 2003, is long enough to show all the particularities in the behavior of all phenomena, while the effects of natural oscillation of the frequency and intensity of hailstorms, which in the short-term analysis may significantly influence the final effects, have been deliberately excluded.

The hail damages were measured by a commission, according to the established methodology, so we may conclude that the percentage of the damage of agricultural cultures was determined objectively. Likewise, during the damage estimation, there were taken in consideration even those damages caused by the loss of crop quality in the areas partially damaged by the hail.

The data about the hail suppression costs were estimated on the basis of apposite reports made by competent state bodies, while the national product value in agriculture was officially published by an authorized state institution.

For the purposes of the indicated analysis, in the Table I are given the initial and derived values, which should allow us to determine the economic effects of hail suppression with a high grade of certainty.

The mentioned values are:

1. B — protected area (ha)(1ha=0.01km^2),
2. Ts — hail suppression costs expressed in fixed prices, with the year 1972 as basis. (10^5 RSD),
3. d — national product in agruculture per ha(1ha=0.01km^2) (10^5 RSD),
4. S(b) — total hail damage in the protected area reduced to a 100% damaged area (ha) (1ha=0.01km^2),
5. S(n) — total hail damage in the non-protected area reduced to a 100% damaged area (ha) (1ha=0.01km^2),
6. K(n) — relation between total damage in the examined non-protected area and the size of the examined non-protected area (%), $Kn = \frac{S(n)}{Ns}100$
7. m — possible damage in protected area $K(n) \cdot B$ (ha) (1ha=0.01km^2),
8. m-S(b) — difference between possible and actual damage in protected area (ha) (1ha=0.01km^2),
9. E — effect of hail supression (%), $E = \frac{m - S(b)}{m}100$
10. Ks — value of the savings gained by hail suppression activities (10^5 RSD), $Ks = (m - S(b))d$
11. Kns — present value of net benefit criterion (10^5 RSD), $Kns = Ks - Ts$
12. K_o — cost-benefit relation coefficient

$$Ko = \frac{Ks}{Ts}$$

Year	B	Ts	d	S(b)	S(n)	K(n)	m	(m-S(b))	E	Ks	Kns	Ko
	1	2	3	4	5	6	7	8	9	10	11	12
1972.	1093255	102,2	0,033	22914	85949	4,55	49743	26829	53,94	885,4	783,2	8,7
1973.	1137978	108,4	0,035	27279	57926	4,83	54964	27685	50,37	969,0	860,6	8,9
1974.	1184775	134,6	0,036	18615	52443	4,16	49287	30672	62,23	1104,2	969,6	8,2
1975.	1648612	164,3	0,035	12374	81443	4,70	77485	65111	84,03	2278,9	2114,6	13,9
1976.	1888658	299,2	0,038	13049	30259	3,05	57604	44555	77,35	1693,1	1393,9	5,7
1977.	2236575	377,7	0,040	76962	65093	5,31	123541	46579	37,70	1863,2	1485,5	4,9
1978.	2455712	417,3	0,035	36349	22744	3,65	89633	53284	59,45	1864,9	1447,6	4,5
1979.	2912735	379,6	0,038	21772	9254	1,30	37866	16094	42,50	611,6	232,0	1,6
1980.	3079377	299,1	0,040	25091	10848	2,34	72057	46966	65,18	1878,6	1579,5	6,3
1981.	3133651	270,0	0,040	23724	5792	1,94	60793	37069	60,98	1482,8	1212,8	5,5
1982.	3330067	288,1	0,044	24884	21205	6,16	205132	180248	87,87	7930,9	7642,8	27,5
1983.	3385784	271,3	0,043	14010	5856	2,20	74487	60477	81,19	2600,5	2329,2	9,6
1984.	3753002	257,1	0,042	13802	751	3,68	138110	124308	90,00	5220,9	4963,8	20,3
1985.	3760870	239,8	0,039	6765	-	3,68	138400	131635	95,11	5133,8	4894,0	21,4
1986.	3760870	256,3	0,044	22721	538	3,68	138400	115679	83,58	5089,9	4833,6	19,9
1987.	3760870	200,9	0,041	14856	12	3,68	138400	123544	89,27	5065,3	4864,4	25,2
1988.	3114280	195,4	0,048	28244	2133	3,68	138400	110156	79,59	5287,5	5092,1	27,1
1989.	3148692	181,3	0,045	38246	371	3,68	114605	76359	66,63	3436,2	3254,9	19,0
1990.	3148692	188,9	0,041	5428	-	3,68	114605	109177	95,26	4476,3	4287,4	23,7
1991.	3148692	177,9	0,044	17669	-	3,68	114605	96936	84,58	4265,2	4087,3	24,0
1992.	3930204	233,6	0,038	22172	-	3,68	144631	122459	84,67	4653,4	4419.8	19,9
1993.	3938305	244,6	0,036	40630	-	3,68	144930	104300	71,97	3754,8	3510,2	15,4
1994.	3936455	229,9	0,038	17090	-	3,68	144862	127772	88,20	4855,3	4625,4	21,2
1995.	3936728	265,2	0,039	44088	-	3,68	144872	100784	69,57	3930,6	3665,4	14,8
1996.	3914956	198,1	0,039	11787	-	3,68	144070	132283	91,82	5159,0	4960,9	26,0
1997.	3910060	184,0	0,043	72225	-	3,68	143890	71665	49,81	3081,6	2897,6	16,7
1998.	3909845	200,3	0,042	27952	-	3,68	143882	115930	80,57	4869,1	4668,8	24,3
1999.	3329495	135,1	0,041	106471	-	3,68	122525	16054	13,10	658,2	523,1	4,9
2000.	3321721	192,8	0,043	25475	-	3,68	122239	96764	79,16	4160,9	3968,1	21,6
2001.	3323628	197,3	0,044	21480	-	3,68	122310	100830	82,44	4436,5	4239,2	22,5
2002.	3323725	241,9	0,044	18330	-	3,68	122313	103983	85,01	4575,3	4333,4	18,9
2003.	3323725	309,0	0,045	22422	-	3,68	122313	99891	81,67	4495,1	4186,1	14,5
∑	99181994	7441,2		-	-	-	-	-	-	-	104326,8	-

TABLE I: Data and values of the Cost-benefit analysis of the hail suppression project in Serbia in the period between 1972 and 2003 (RSD)

The present value of net benefit criterion, which equals the value between total benefits and total costs of the project in the examined period of time, has positive values, which indicates its positive effects, even though these values vary between $232{,}0x10^5$ RSD in 1979 and $7.642{,}8x10^5$ RSD in 1982. Its average amount for the period 1972-2003 equals $3.260{,}2x10^5$ RSD, or 19.359.860 USD, calculated according to the average annual currency rate valid in 1972 (1USD=16,48 RSD).

The cost- benefit relation coefficient shows how much benefit is obtainable from each unit of project costs. The values of this coefficient are low in the initial period of project development, especially in 1979 (1.6). In the successive period of hail suppression project development the values of this coefficient increase, and in particular in 1982 (27,5), 1988. (27,1) and 1996.(26,0). In 1999 this coefficient vas relatively low (4,9), as, due to the war, the hail suppression system wasn't functional in the period of the year when the Cb clouds are usually most intensive.

Generally looking, in the period 1972-2003, 744.120.000 RSD (44.187.650 USD) or averagely 23.254.000 RSD (1.380.880 USD) a year were invested in the hail suppression system in Serbia. Due to good functioning of the project, the positive effects of hail suppression in Serbia reached the amount of 10.432.680.000 RSD (619.517.815 USD). That practically means that every RSD (USD) invested in hail suppression project was regained 14 times through its positive effects.

IV. CONCLUSION

The average criterion of present net benefit (326.020.000 RSD, that is 19.359.860 USD) along with single values of the cost-benefit relation coefficient clearly indicate the full economic validity of the investments in the hail suppression system in Serbia during the examined period.

During the period between 1972 and 2003, an amount of 44.187.650 USD was invested in the hail suppression project in Serbia according to the average annual exchange rate between USD and RSD, valid in 1972. In the same period, the amount of positive functioning effects equaled 619.517.815 USD. Considering the fact that in the period 1972-2003 the size of the protected area in Serbia equaled 99.181.994 ha of agricultural area, we can reach the conclusion that an average amount of 0,445 USD per ha was being invested each year in the implementation of the main and regional projects and in the improvement of the functioning of the hail suppression system as a totality. On the other hand, the effects of the hail suppression equal an average annual amount of 6,25 USD per hectare of protected area, which means that each invested dollar had been regained 14 times.

The Cost-benefit analysis allows in a concrete and comprehensive way to determine the effects of hail suppression in Serbia. Further statistical analysis verifies the exactness of the present net benefit criterion as well as of the cost-benefit relation coefficient. This confirms that the conclusions about the high level efficiency of the hail suppression project, along with the validity of the investments in its future implementation and development, may be considered entirely reliable.

V. REFERENCES

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