EFFECTIVENESS AND EFFICIENCY OF IMPROVEMENTS OF THE FOREST FIRE PROTECTION SYSTEM IN GREEK FORESTS

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ABSTRACT

The objectives of the present paper is to investigate the expediency of introducing new processes in the existing forest fire prevention and suppression system which by providing the new information of preventive and on-process control they will:
a) improve substantially its effectiveness-efficiency and
b) be applicable and equally effective either they are placed within the existing system or into a modified system in respect to the existing one.
In order to investigate the usefulness and effectiveness of the proposed processes the viewpoints of the persons in charge of the fire protection of regional forest services (forest offices and forest directions per prefectures) were collected via an appropriate questionnaire to decide the most expedient category of fire protection measures and the usefulness of information offered by the new proposed processes. The elaboration of replies and the utilization of their information was done separately per forest services of A, B and C degree of fire risk and for the total of forest services as well.
By the analysis of the above it results clearly the usefulness and the expediency of the proposed incorporation of new processes into the prevention and suppression system and the economic efficiency of the proposed investment.

RÉSUMÉ

Ce travail porte sur l'analyse de la convenance à l'introduction de nouveaux processus dans les systèmes actuels de la prévention et de l'extinction des incendies qui, en fournissant de nouvelles informations sur le contrôle préventif et en-cours d'incendie, pourront:
a) améliorer considérablement leurs efficience-efficacité et
b) les rendre applicables et également efficaces soit qu'ils s'insèrent dans le système existant soit qu'ils s'insèrent dans un système différent.
A fin d'analyser l'utilité et l'effiacité des processus proposés, on a fait circuler des questionnaires pour connaître les points de vue des responsables de la protection contre les incendies (bureaux forestiers et direction des forêts par préfecture (pour décider la catégorie la plus indiqueée des mesures de protection contre les incendies et évaluer l'utilité de l'information offerte par les nouveaux processus proposés. L'élaboration des réponses et l'utilisation des informations ont été faites séparemment par service de forêts classé de degré A, B et C quant au risque d'incendie et pour l'ensembe des services de forêts.
L'analyse de toutes ces données démontre clairement l'utilité et la convenance de la proposition d'incorporer les nouveaux processus dans le système de prévention et suppression des incendies et la rentabilité économique de l'investissement proposé.

To fight successfully the forest fires is an issue which during the last two decades has strongly mobilized the international and greek scientific community and has raised the environmental sensitivity of the international and greek public opinion. The mobilization and sensitivity of the public opinion is ought to:
a) the realization that forests and forest lands at worldwide and national level are factors of affecting the climate
b) the realization that forests and forest lands are a substantial component part of people's quality of life
c) the certainty that forests and forest lands at global and, per regions, at national level are reduced to an alarming degree with a major cause of this reduction the pursuit of changing their use. The main means to attain this change is by fires
d) the fact that the destruction of forests constitutes a huge environmental and economic destruction while the degradation of forest ecosystems caused by that is not reversible in most cases
e) the increase of future demand, at global level, for forest products in conjunction to the decrease of forests but also to the gradual limitation of the annually cut down volume from the rich wood production countries. Particularly for our country, despite the attempts of the state, the phenomenon of forest fires still remains an enormous and unsolved problem which causes huge ecological and economic damages, while its human impact is also intense since along with the forests, most of the times, properties and sometimes lives are lost too. Despite the number of cooperating bodies (Forest Service, Fire Brigate, Army, Local Authorities), no satisfactory effectiveness was obtained since between 1981-1990 the burnt area ammounted 5,188,844 stremmata (**figures 1, 2**). The lack of effectiveness is mainly attributed to the retractions and hesitations to make a decision (concerning the ground forces or firefighting by aircrafts, prevention or suppression). A basic cause for this fact is that no transfer, adaptation and use of foreign know -how was made as well as the absence of greek research which should have substantially contributed towards a specialized solution to the problem as it appears under the specific natural and socioeconomic greek environment and mostly to the strict investigation of forest fire causes. It is characteristic that until very recently there was no organized and manned, specialized, and exclusively dealing with the study of fires, Laboratory neither within Universities nor in Re-

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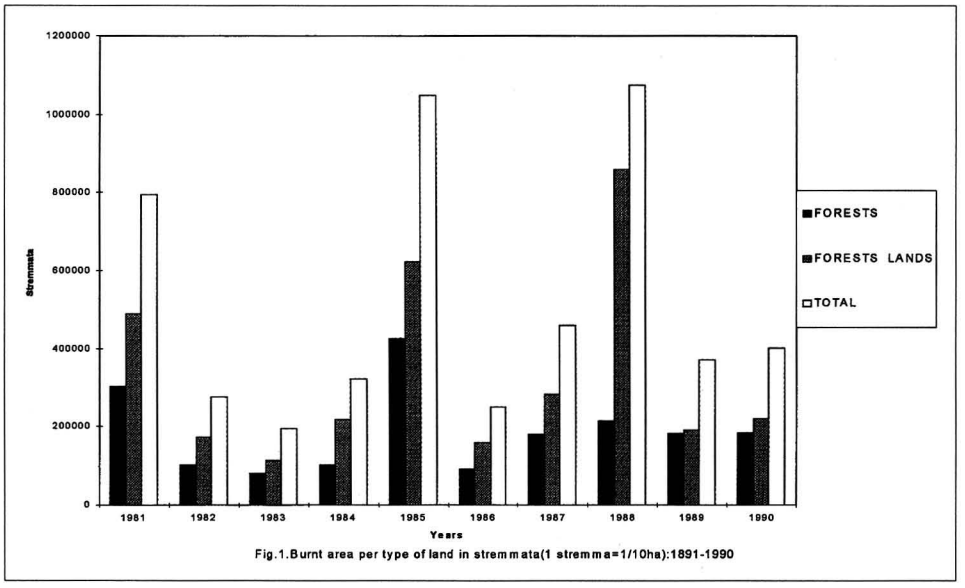


Figure 1 - Burnt area per type of land in stremmata (1 stremma = 1/10 ha): 1891-1990.

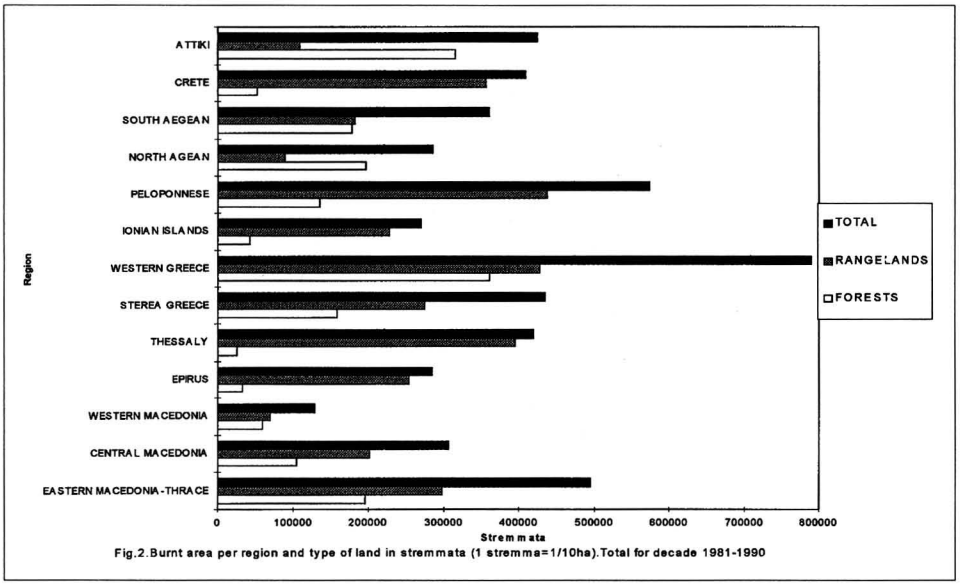


Figure 2 - Burnt area per region and type of land in stremmata (1 stremma = 1/10 ha). Total for decade 1981-1990.

search Institutes of our country. Until such research results are available the following are considered necessary to be undertaken:

a) From the existing know-how to utilize that one the efficiency of which might be independent from the local conditions and consequently that one which could be also used after the outcome of results obtained from the research of the phenomenon as it appears in our country.

b) A part of the research, taking into account the above paragraph, should be focused on the production of direct results for easing off-reducing the intensity of forest fires phenomenon that is its limitation, by choosing to investigate the effectiveness of applying such means and measures which will be also applicable and effective after the production of results by the greek research and consequently they will maximize the effectiveness towards the solution of the problem (**figure 3**). The data of previous paragraphs (a) and (b) enforce us to investigate the improvement of forest fire prevention and suppression system, as this is applied today, by the addition of potential new processes which will improve it significantly and which will also continue to be applied after its eventual modification or the development of a new system, if such a system comes up by the results of the relative to the problem research which also has already started in our country during the last years. Therefore, the objective of the present work is the investigation of adding new processes into the existing prevention and suppression system, which should:

a) improve substantially its effectiveness-efficiency and

b) be applicable and at least equally effective eventhough in the case that the existing system is modified or replaced by another one, directly or in the future.

Particularly, the new processes under investigation, are:

a) the production, for the forest office in charge of surveillance, of information relative to the precise position of firefighting forces during the phase of fire prevention and

b) the production of information, as much as for the standby forest office as well as for the coordinator of the fire suppression during the phase of suppression concerning the precise position of firefighting forces and the precise location of the fire front. The

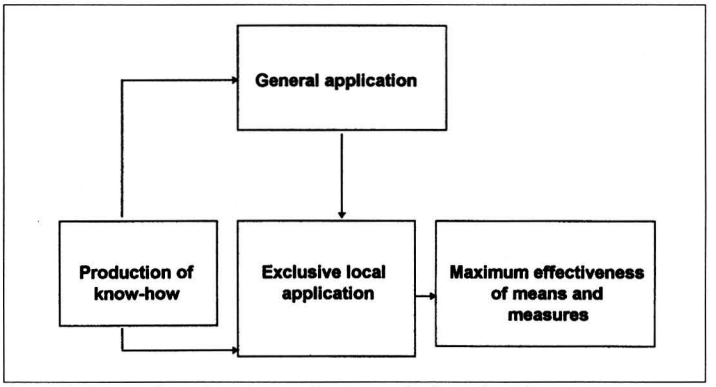


Figure 3 - Impact flow of maximum effectiveness for forest firefighting.

positions of firefighting forces during the prevention stage is possible to be either those indicated usually as strategic for the direct spotting or direct intervention or those which would have come up by research as the best ones for the areas with specific local conditions. The positions in the suppression stage is possible to be either these occupied by the forces during the suppression stage, according to the usual existing plan or to the best intervention plan arised by the research done, or those positions upon which the forces will deploy after the modification of the optimum plan depending on the evolution of the specific fire. It is obvious that we are talking about a continuous production of information which can be used directly and effectively during the stage of prevention and suppression as well.

The importance of research

By the introductory remarks and the aims set out is becoming obvious the importance of the under study research. However, beyond these, the following must be also added:

a) The size of phenomenon in our country in conjunction to the mountainous and semi-mountainous character make the consequences of fires tragic from the viewpoint of soil's productive part by erosion and the loss of huge amounts of water as well.

b) The general impression that the state is unable to deal with the problem of forest fires allows the arsonists to bring into effect their targets. Moreover, it is characteristic the distribution of number of fires per categories of causes during the decade 1981-1990 (**table 1**).

The rate of fires caused by intention (above 30% of number of fires) is constantly big whilst equally constantly big is also the rate of fires by unknown causes (above 27%) within which must be also hidden a cinsiderable number of fires by intention for which the responsible person was not found (Stamou 1989). Consequently, to discourage the arsonists strict measures should be taken by the State which if fails to identify them it will eliminate their pursuits via a substantial-spectacular improvement of the efficiency of the prevention and suppression system. The same need for a substantial improvement is also imposed by the fact(of the constantly big rate of fires by negligence. Therefore, until a) measures are taken to eliminate the known causes (as anticipated by the regulation 2158/92 of E.U), b) the unknown causes are located, and c) new means or new systems of organizing firefighting are recommended for use, it is necessary to improve virtually the efficiency of the existing system.

c) The improvement of the efficiency of the existing system is also necessary for the reason that some of fire consequences may create problems to the nation under some special optical angles: Without being proved it was expressed the suspicion that large wildfires are caused by country's enemies aiming at greek tourism or military installations at specific sensitive areas. True or not some fires (two in Thassos, two in Rhodes, Ierapetra and Evia) have disturbed and defamed the greek tourism, caused massive cancellations to hotel reservations and departures of tourists. Beyond that, the fires at coastal areas destroy the greek landscape and hit the greek tourism in the longrun since one of the major purposes of visiting the country is to enjoy the combination of forest-sea (Eleftheriadis et al. 1989).

d) The annual expenditures for the protection of forest and forest lands are illustrated in **table 2**, in nominal and deflated prices. It is obvious that we have to improve the system's efficiency for the best utilization of the money already invested. Recently, persistent talkings were conducted (Ministry of Macedonia-Thrace 1992) for huge investments in the sector of firefighting by air without investigating the possibility of improving the efficiency of the ground-based forces (Stamou 1992). Besides, if the system of ground forces was more effective, beyond the employment and the income it would have provided for employees it could have also contributed to the implementation of forest works during and outside the cruisal time period of fire protection. Moreover, the discussions about the investments in firefighting by air are not based on some elaborated economic analysis on one hand and it is known that aircrafts can not fly in conditions of strong winds when big fires occur on the other. Yet, in the case the State would proceed to enforce-prefer the air-firefighting, the ground forces would be again needed (Kailidis 1990).

e) Following the above stated, with or without the major role of the ground forces system and given that the ground forces will always exist (Kailidis 1990) (more or less these are the ones which extinguish the fires whenever they occur) it is considered useful to investigate the possibility of improving the efficiency via new processes.

Table 1 ***Numbers and causes of fires (1981-90).***

	Maximum	Minimum
Number of fires per year		
Category of fire causes, % of number	1796	939
a. Accidental incidences	8.5	5.0
b. Negligence	33.9	22.7
c. Intentions	35.3	30.4
c_1. Arsons	23.4	15.5
c_2. Rangeland improvement	16.9	9.0
d. Unknown causes	35.8	26.8
e. Other causes	1.7	0.7

Source: Lab. of Forest Protection.

Methodology

In order to investigate the expediency and effectiveness

Table 2 ***The financing of Forest Protection in Greece.***

Year	Financing of forest protection		Financing of forest protection (constant prices 1980). Thousands drachmas
	Total thousands drachmas	In percent of forestry financing	
1974	47,672	4.0	115,428
1975	52,145	3.2	111,183
1976	194,207	8.6	365,051
1977	150,876	5.5	252,724
1978	276,962	8.6	412,146
1979	244,511	6.9	305.639
1980	224,288	4.9	224,288
1981	613,757	10.4	510.613
1982	932,812	12.8	655,064
1983	2,123,778	19.0	1,250,017
1984	2,306,242	16.4	882.941
1985	2,435,679	14.8	1,014,866
1986	2,149,620	12.8	728.191
1987	2,484,397	13.0	722,860
1988	3,094.518	14.9	793,303
1989	3,850,500	17.1	1,039.635

Source: Ministry of Agriculture, Forest Service.

of the proposed processes through appropriately filled questionnaire the viewpoints of the authorized for fire protection officers of regional forest services (forest offices and prefecture forest authorities) were gathered to find out the most expedient category of fire protection measures and the utility of information provided by the new proposed processes. The processes for which the forest offices were asked to answer are:

a. the improvement of ground forces
b. the improvement of organizing-planning the prevention-suppression system
c. the improvement of infrastructure
d. participation of local self-administration authorities (LSAA)
e. elimination of causes and
f. use of air-firefighting forces

The process of replies and the best use of their information was conducted separately per forest services of A(1), B(2), and C(3) fire risk degree as well as for the total of forest services.

RESULTS

Respond to questionnaires

The number of questionnaires sent and the replies received are shown in **table 3**.

(1) A: 1st fire risk degree.
(2) B: 2nd fire risk degree.
(3) C: 3rd fire risk degree.

The degree of respond of forest offices as much as per fire risk zone as well as for the total, based on the Table below, is considered satisfactory.

Descriptive statistics

By the investigation of the above the first results which came up are the following:

1. For all categories of regional forest services of A, B, and C fire risk degree the dominant viewpoint is that the radical improvement of the efficiency of firefighting should rely on the ground forces and the better organization-planning of the firefighting combat; above 50% of replies support this viewpoint (**figure 4**). Only 10% of the forest services believe that firefighting by air is the measure which would improve radically the efficiency of the combat against fires.

Table 3 ***Number of forest offices per fire-risk zone degree and number of received questionnaires.***

	Zone of fire-risk degree			
	A	B	C	Total
Forest offices (number)	40	32	30	102
Received questionnaires	27	25	20	72
Percentage (%)	68	78	67	71

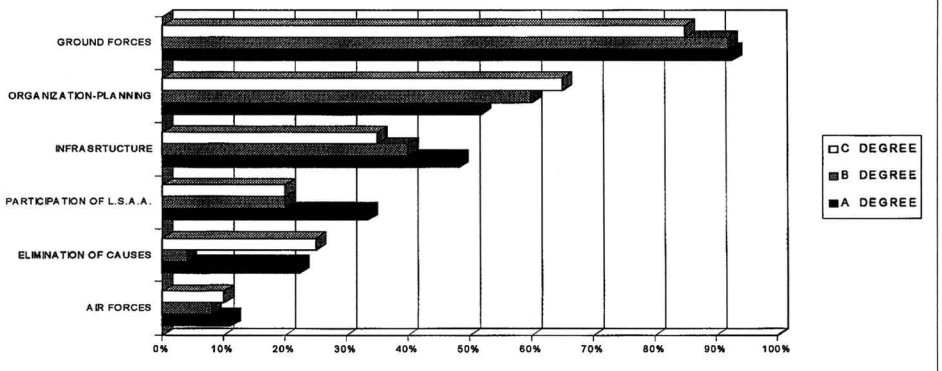


Fig.4.Proposed measures which would radically improved the effectiveness of firefighting combat (per categories of forest offices depending on their fire risk).

Figure 4 - Proposed measures which would radically improved the effectiveness of firefighting combat (per categories of forest offices depending on their fire risk).

2. Planning and organizing the ground forces during prevention stage is very useful and desirable to provide the officer in charge of surveillance with the information shown in **table 4**.
3. As long as the information mentioned in **table 4** is available it would be possible to be utilized for the better spatial allocation and the control of ground forces during the prevention stage as well as for the better coordination and the effective instructions during the suppression stage but also during the surveillance stage after suppression (to avoid possible rekindling). However, to what extent the firefighting would have been effective? From the resutls obtained so far it came out that the burnt average per year area would have decreased to the following rates (**table 5**).
From the above table comes out that a weighted average percentage reduction of the burnt area equals to 35% of total (or 30% of A degree, 38% of B degree, and 36% of C degree of fire-risk of forest offices). During the under study decade the areas which would have been saved up from fires if the officers in charge of surveillance had at their disposal the above information, are estimated to 170,000 stremmata per year.

Statistical inferences

In order to check out the existence of the relation between the replies of forest offices and their fire-risk degree, the forest offices were categorized into two groups. In the first group the forest offices of A fire-risk degree were included and in the second(4) the B and C ones. For these two groups contigency tables were drawn up to include the viewpoints of forest offices with respect to the following 7 questions:
a. Whether it is useful the officer in charge of surveillance office to know from his desk at any time the precise stationing point of each fire engine (or motorcycle) within the under protection area of the forest office.
b. Whether it is of service to have a full synoptical picture of the positions of all fire engines during surveillance.
c. Whether it is useful to exist known permanent central stationing points of fire engines at the area of under forest office's responsibility which will ensure times less or equal to a given limit before interfere to any possible fire ignition point.
d. Whether is necessary the possibility of having an optical control of the entire under surveillance area via a suitable network.
e. Whether the surveillance office is interesting to have a synoptical picture of the entire fire front.
f. Whether is useful during the various stages of fire development to know the precise size of the burnt in so far area.
g. If the above information is all available it would be more effective to interfere for protecting forests from wildfires.

(4) For a start, contigency tables for each question were drawn up separately in conjunction to the fire-risk degree of forest offices. Because the conditions for using coefficient x^2 were valid only for two questions it was decided to shorten out the replies of forest offices (Snedecor and Cohran, 1973) and for making possible the usage of Fisher's exact test the forest offices B and C fire risk degree were categorized into one group.

Table 4 ***Estimations of forest authorities in relation to the utility of the proposed measures.***

Utility of information supplied to the officers in charge of surveillance as to:		Fire risk degree			
		A	B	C	Total
The stationing points for each of fire fighting crews and vehicles	Very useful	93%	84%	90%	89%
	Useful	7%	12%	10%	10%
	Indifferent	0%	0%	0%	0%
The synoptical picture of positions of all fire fighting crews and vehicles	Very servicealbe	96%	92%	90%	93%
	Serviceable	4%	8%	10%	7%
	Indifferent	0%	0%	0%	0%
The stationing points of fire engines which ensure interference times smaller or equal of a limit	Very useful	93%	84%	80%	86%
	Useful	7%	16%	15%	13%
	Indifferent	0%	0%	5%	1%
The potential of optical control of the entire under surveillance area via a suitable network	Very necessary	81%	80%	75%	79%
	Necessary	19%	20%	25%	21%
	Not necessary	0%	0%	0%	0%
The synoptical picture by the surveillance office, for the entire fire front	Very interesting	70%	68%	70%	69%
	Interesting	30%	28%	25%	28%
	Little interesting	0%	4%	5%	3%
The detailed picture by the surveillance offices, for patrial sections of fire front	Very useful	44%	52%	40%	46%
	Useful	52%	40%	55%	49%
	Indifferent	4%	8%	5%	6%
The knowledge of the precise size of burnt area at various stages	Yes	85%	64%	70%	74%
	No	15%	32%	30%	25%
The synoptical picture of small-fire places which maintain low flames	Very useful	59%	48%	45%	51%
	Useful	33%	40%	55%	42%
	Indifferent	7%	12%	0%	7%

Table 5 ***Estimations of forest authorities in relation to the effectiveness of the proposed measures.***

Percentage of reduction of annual burnt area	Percentage of authorities being asked and reply given			
	Total	A fire risk degree	B fire risk degree	C fire risk degree
0-10	8	11	4	10
11-30	40	44	32	45
31-50	26	22	36	20
51-80	18	15	24	15
81-100	3	–	–	10
Total	**95%**	**92%**	**96%**	**100%**

The contigency tables are given in the annex. The statistical hypothesis we want to check out is the following:

$H_o : P_{ij} = P_i \cdot P_j$

against the alternative

$H_1 : P_{ij} \neq P_i \cdot P_j$

which is also known as independence hypothesis (Andersen 1990) between the rows and columns that is between the two variables "Replies of Forest Offices (RFO)" and "Fire-Risk Degree (FRD)" of a contigency table with R rows {1,2,....i} and C columns {1,2,....j} where P_{ij} the possibility a random sample unit to belong in category i according to the variable RFO and in category j according to the variable FRD.

The above checking out is done either by the help of coefficient x^2 according to the formula:

$$x^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{(Q_{ij} - E_{ij})^2}{E_{ij}}$$

where Q_{ij} the real frequencies and

E_{ij} the expected frequencies

or by the precise checking out of Fisher's exact test (Andersen 1990). The Fisher's exact test was used wherever it could not be used the statistical x^2 because of not satisfying the following two conditions (Zacharopoulou 1989): a) not having expected frequency less than 1 and b) the frequencies with expected value less than 5 are 20% the most of the total frequencies.

The results of statistical controls are shown in **table 6** from which the following arise: The viewpoints of forest offices regarding the above questions are not depending on their fire-risk degree; in other words the difference observed between the replies of A and (B+C) fire-risk degree of the forest offices is not statistically significant; so, we do not reject Ho for any question.

Economic analysis

Concerning the economic effectiveness-efficiency of the system's improvement with the proposed new processes — and for having an indicative number — this might be estimated as follows:

A. Saved-up suppression expenditures

For the years 1989-1991(5) for which there are data, the average suppression expenditures per Ha in constant prices of 1991 amounted to

$$\frac{592{,}805{,}000 \text{ dra}}{101{,}586 \text{ Ha}} = 5{,}837 \text{ dra/Ha}$$

Here, it must be made clear that the above expenditures include payments of forest personnel and vehicle-machinery expenditures as they are written down in the relative forms by the competent forest officers and sent to the central direction of the Min. of Agriculture.

The saved-up annual suppression expenditures due to decrease of burnt area are the following for the decade 1981-1990.

17,000 Ha/year x 5,837 dra/Ha = 99,229,000 dra/year

B. Saved-up expenditures due to decrease of damages(6)

Avoided damages to forest vegetation for the decade 1981-1990 in constant prices of 1991:

a. In the areas of forest offices of A fire-risk degree

Table 6 ***Statistical controls.***

Subject	x^2	Significance	Fisher's Exact Test, Singificance	
			One-Tail	Two-Tail
a			.45876	.70143
b			.37484	.64402
c			.19167	.30193
d	.14035	.70793		
e	.01745	.89489		
f	2.97915	.08434		
g			.51723	1.0000

(5) Supplementary research will follow up for the decade 1981-90.

(6) For the valuation of avoided annual damages of forest vegetation the relative table provided by the Min. of Agriculture was used (Organization of fire-break forest protection, Annex C 1993). More specifically: a) for forest offices of A fire-risk degree was used the deflated (in prices of 1991) arithmetic mean term of "classes" value (vegetation types) 7, 6, and 5 of the respective table, b) for forest offices of B fire-risk degree was used the deflated arithmetic mean term of "classes" value 4, 3, and 2 and c) for forest offices of C degree the deflated value of "class" 1 was used.

ANNEX

a) **Fire risk degree**

	Count Exp Val	A 1	B + C 2	RowTotal
Useful	1	25 24.3	39 39.7	64 90.1%
Indifferent	2	2 2.7	5 4.3	7 9.9%
	Column Total	27 38.0%	44 62.0%	71 100.0%

b) **Fire risk degree**

	Count Exp Val	A 1	B + C 2	Row Total
Serviceable	1	26 25.1	41 41.9	67 93.1%
Indifferent	2	1 1.9	4 3.1	5 6.9%
	Column Total	27 37.5%	45 62.5%	72 100.0%

c) **Fire risk degree**

	Count Exp Val	A 1	B + C 2	Row Total
Useful	1	25 23.3	37 38.8	62 86.1%
Indifferent	2	2 3.8	8 6.3	10 13.9%
	Column Total	27 37.5%	45 62.5%	72 100.0%

d) **Fire risk degree**

	Count Exp Val	A 1	B + C 2	Row Total
Necessary	1	22 21.4	35 35.6	57 79.2%
Unecessary	2	5 5.6	10 9.4	15 20.8%
	Column Total	27 37.5%	45 62.5%	72 100.0%

e) **Fire risk degree**

	Count Exp Val	A 1	B + C 2	Row Total
Interesting	1	19 18.8	31 31.3	50 69.4%
Less interesting	2	8 8.3	14 13.8	22 30.6%
	Column Total	27 37.5%	45 62.5%	72 100.0%

f) **Fire risk degree**

	Count Exp Val	A 1	B + C 2	Row Total
Yes	1	23 19.9	30 33.1	53 73.6%
No	2	4 7.1	15 11.9	19 26.4%
	Column Total	27 37.5%	45 62.5%	72 100.0%

g) **Fire risk degree**

	Count Exp Val	A 1	B + C 2	Row Total
Yes	1	26 25.5	42 42.5	68 94.4%
No	2	1 1.5	3 2.5	4 5.6%
	Columm Total	27 37.5%	45 62.5%	72 100.0%

9,749 Ha/year × 4,052,170 dra/Ha = 39,504,605,330 dra/year

c. In the areas of forest offices of B fire-risk degree

5,687 Ha/year × 1,556,520 dra/Ha = 8,851,929,240 dra/year

e. In the areas of forest offices of C fire-risk degree

1,593Ha/year × 415,650 dra/Ha = 662,130,450 dra/year

Consequently, according to the above data, the overall benefit for the decade 1981-1990 as long as the proposed measures were applied would be equal to: (99,229,000 + 39,504,605,330 + 8,851,929,240 + 662,130,450) × 10 = 491 billion dra.

Explanations

a. In the above economic result there have been not co-calculated:

— the cost of the involved in fire fighting non-forest personnel (army, privates, etc.)

— the cost (objective and subjective) of destroyed property (houses, farm-stocking facilities, machinery and vehicles)

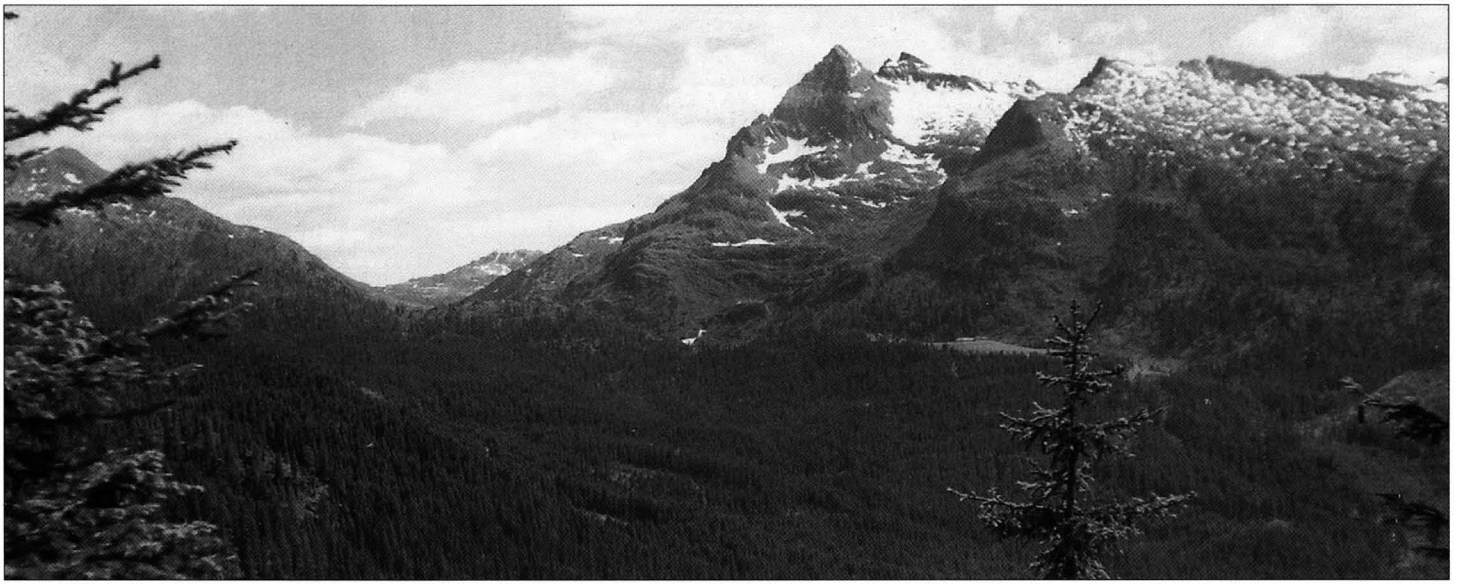
— the cost of human losses and the economic consequences of these losses

— the overall cost of the aircrafts and choppers used for firefighting because the competent forest officers when calculate they include per case only part of this cost a fact which needs special research

— the wages of the permanent forest personnel employed for firefighting

b. During 1989-91 the percentages of the lands burnt in the area under the authority of forest offices of A, B, and C fire-risk degree were respectively 62.63%, 28.84% and 8.53%. Therefore, it was assumed that the same percentages are valid for the period 1981-1990. Consequently, the total of areas burnt (5,188,844 stremmata) were allocated as follows: 3,249,773, 1,496,463 and 442,608 stremmata.

c. According to Table 5 if the proposed measures were applied there could be saved per year the 30%, 38%, and 36% of the burnt areas re-



spectively. In other words:
— areas of forest offices of A fire-risk degree
(3,249,773 × 0.30) : 10 = 97,493 stremmata = 9,749 Ha
— areas of forest offices of B fire-risk degree
(1,496,463 × 0.38) : 10 = 56,866 stremmata = 5,687 Ha
— areas of forest offices of C fire-risk degree
(442,608 × 0.36) : 10 = 15,934 stremmata = 1,593 Ha.

Conclusions

From the above it clearly results the utility and the expedience of the proposed accession of new procedures into the prevention and suppression system.
The prevention of forest fires is attained via a better spatial distribution of forces and their better control during the prevention stage by the output and utilization of information required for the selection and usage of appropriate technology. The better spatial distribution and control lead to the timely and consequently effective attack but also to the effective coordination and guidance of fighting forces by making available the full and detailed picture of the forces positions, the fire front, and the local natural conditions. The total outcome is to face succesfully the wildfires.
Moreover, the proposed improvement is also aiming at the protection and quality of life since the survived forests and forest lands besides being an important factor of people's quality of life they are also terrestrial natural more or less ecosystems-banks of genetic material and genetic diversity.
Finally, the average annual saving expenditure is significant since it amounts about to 1225% of the average value of the overall annual expenditures for the protection of forests (constant prices of 1991).
Consequently, is considered expedient a furthermore research on the existence and usage of new technology which it could ensure the information required by the regional forest services for the best effective organization of their firebreak combat. The search and investigation of applying such new technologies will be the subject in the future of a new research project. ●

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