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FIRE PREVENTION ROADS IN THE AREA OF THE FOREST ENTERPRISE BUZET

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Abstract

The article deals with a technical segment of preventive measures against forest fires. During 1994, 52 fires were recorded in the area of the forest enterprise Buzet where vegetation in the area of 4,765.86 hectares was burnt. In each fire approximately 91.65 ha of forest was burnt, 559.20 m³ of timber mass was destroyed or damaged and its value is estimated at 46,688.48 kn, while damage due to the loss of generally useful functions of the forest was 501,540.63 kn. Works performed on the protection of forests against fires in the forest are construction of fire-prevention forest roads and fire-prevention straight clearings. The programme of development till 2025 envisages the construction of 300 kilometres of fire-prevention roads per year. Thus the openness of approximately 20 m/ha would be achieved in economic forests and a little bit less in uneconomic forests.

Key words: fire-prevention forest road, fire-prevention straight clearing, economic forest road, multifunctional forest road, forest fire

PROTIPOŽARNE GOZDNE CESTE NA OBMOČJU GOZDNEGA GOSPODARSTVA BUZET

Izvleček

Prispevek obravnava tehnične preventivne protipožarne ukrepe v gozdovih. V letu 1994 je bilo zabeleženih 52 gozdnih požarov v gozdnem gospodarstvu Buzet, ki so uničili 4,765.86 ha gozdov. Vsak požar je v povprečju zajel 91.65 ha gozda, 559.20 m³ lesne mase je bilo uničene ali poškodovane katere vrednost je bila ocenjena na 46,688.48 kn. Škoda zaradi izgube splošnokoristnih funkcij gozda znaša 501,540.63 kn. Protipožarne ceste in preseke so zgrajene za zaščito gozdov pred požari. Program razvoja do leta 2025 predvideva gradnjo 300 km protipožarnih cest letno. Tako bi dosegli odprtost gospodarskih gozdov z gozdnimi cestami okoli 20 m/ha, v negospodarskih gozdovih pa nekoliko manjšo.

Ključne besede: protipožarna gozdna cesta, protipožarna preseka, gospodarska gozdna cesta, mnogonamenska gozdna cesta, gozdni požar

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1 INTRODUCTION

Forest complexes of eumediterranean and submediterranean were raised, grown and cultivated over many years. Their role in the coastal and off-shore areas of Croatian rocky grounds has been manifold. These are mostly protective, tourist, recreational and park forests whose value is fantastically high due to general functions of these forests.

While taking care of forests, each harmful factor has its place and should be approached with a due respect. However, ANDROIĆ already said (1971): "Because... among the most important problems of protecting forests on rocky grounds, in a Mediterranean zone, I put forest fires, without any doubt, in the first place as a constant danger for cultures and forests of this area".

Forest fires are problems that we have to face, that we have to fight against, and not to deny them and understand as a necessity. Frequently, the fight against fire is useless when it spreads, as components of the Mediterranean climate consist of inflammable material.

Measures of fight against fire can be divided into three major groups:

- preventive measures (in order to prevent the fire),
- preparation measures for fire extinguishing (their aim is to prepare extinguishing of fire when it appears),
- measures for fire extinguishing (this group includes all the work on extinguishing fire from the moment it is discovered).

Preventive measures of the fight against forest fires are the most important as only with them the complete protection of forests is achieved without any loss and damage. Preventive measures can be further divided into:

- educational measures,
- legal measures,
- organization of observation and information services,
- organization of patrolling service,
- biological measures (forest-arranging and forest-growing),
- technical measures (building and maintenance of fire-prevention roads and fire- prevention straight clearings).

In this paper the focus of our attention is on a technical segment of preventive measures against fire.

2 THEORETICAL EXAMINATION

It is known that forest roads have more functions that they have to fulfil in forests. The basic aim of forest roads in Croatian economic forests is the transport of timber mass by trucks, i.e. the decrease of the average distance of extraction by tractors to the hard truck roads. All theoretical models of the optimisation of the density of forest roads were based on finding the mutual distance between forest roads at which the total expenses are the minimum. So, the aim is more economic and profitable management of forests where wood is the final forest product.

Roads in such economic forests with our most valuable kinds of trees quickly pay off all investments, and after a period of 33 years they are repaid. The economic calculation is evident here, the profit of cut and sold timber mass will quite soon pay off these roads.

However, the question is how to clear areas with no valuable kinds of native trees, those areas where forests are mostly not economical, where forests are only of general benefit which hasn't been evaluated properly yet.

It is not difficult to answer such a question; certainly, construction of roads in such areas, eumediterranean and submediterranean, is necessary, but the cost of building of such roads should be reduced as much as possible, while at the same time the quality and technical performance should still be high.

Therefore, the roads whose primary task is to contribute in various ways against forest fires are called **fire-prevention forest roads**. The works on building fire-prevention roads are performed with heavy building machines-bulldozers; shovels with hydraulic hammer and smaller bulldozer replace the previous work with explosives.

Excavations that are performed during building fire-prevention roads are mostly built in their body as a sub-base of soil and stone material. The last stage of building fire-prevention roads is rolling by a static roller.

The width of the formation of fire-prevention roads is 4.0 m, longitudinal gradients of a grade line are up to 6 %, and a cross fall is 2 % towards the outer side.

A superstructure is made of broken stone 15 cm thick.

A **fire-prevention straight clearing** should be different from a fire-prevention road. It is done vertically on the fire-prevention road, there is no project documentation for building, there is no superstructure, it is not suitable for the traffic of fire engines full of water during extinguishing fire, and is primarily used as a preventive biological measure for fight against forest fire.

3 FOREST FIRES IN THE EXAMINED AREA IN 1994

During 1994, 52 fires were recorded in the area of the forest enterprise Buzet. In these fires vegetation in the area of 4,765.86 hectares was burnt.

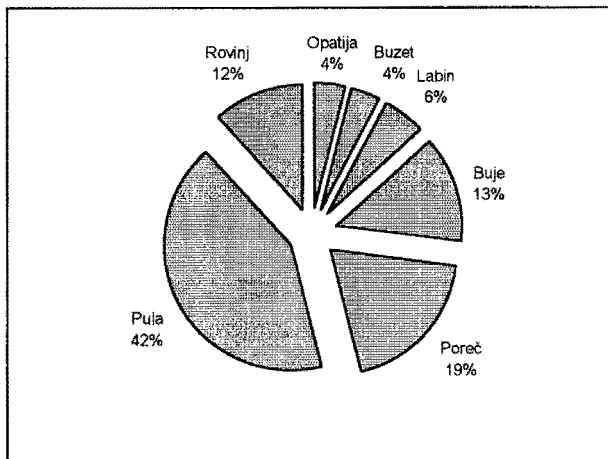
According to the kind of fires, 28 were low fires in which 577.87 ha of forests were burnt, in 13 fires of tree tops 2,435.54 ha of forest area was burnt, and 1,752.45 ha of forest was burnt in 11 combined fires.

Table 1: Number of forest fires according to the kind of fires and the burnt area in the forest enterprise Buzet in 1994

Preglednica 1: Število gozdnih požarov glede na vrsto in obseg požara v gozdnem gospodarstvu Buzet leta 1994

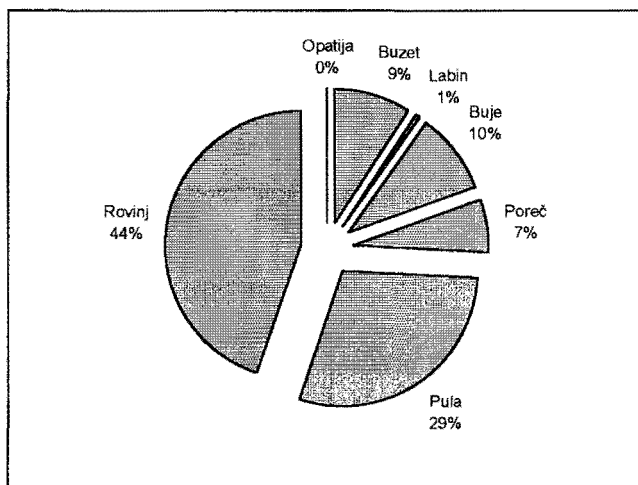
Forest enterprise	Low fire			High fire			Combined fire		
	Total	State forests (ha)	Private forests (ha)	Total	State forests (ha)	Private forests (ha)	Total	State forests (ha)	Private forests (ha)
Buje	5	17.65	155.25	1	79.00	8.00	1	66.00	130.00
Buzet	1		45.00				1	28.70	365.10
Cres-Lošinj									
Labin	3	6.50	22.00						
Opatija	2		0.33						
Pazin									
Poreč	4	10.10	13.00	6	7.00	282.00			
Pula	13	109.04	199.00	1	45.00		8	249.15	798.00
Rovinj				5	988.67	1025.87	1	0.50	115.00
TOTAL	28	143.29	434.58	13	1119.67	1315.87	11	344.35	1408.10

The highest number of fires was in the area of the forest enterprise Pula (42.3 % or 22 fires), but, contrary to all expectations, the total burnt area was the largest in the forest enterprise Rovinj (44.7 % or 2,130.04 ha) though only 11.5 % of fires were linked with this forest enterprise.



Picture 1: Percentage of the involvement of forest management authorities in the forest enterprise Buzet according to the total number of fires of both property types of forests

Grafikon 1: Delež vključenosti države v gozdnem gospodarstvu Buzet glede na skupno število požarov (državni in zasebni gozdovi skupaj)



Picture 2: Percentage of the involvement of forest management authorities in the forest enterprise Buzet according to the total burnt area

Grafikon 2: Delež vključenosti države v gozdnem gospodarstvu Buzet glede na skupno pogoreno površino

The reason for that is a great number of top fires in the area of forest enterprise Rovinj, while in Pula there was only one high (top) fire (there were mostly low fires). It is known that high forest fires spread fast in favourable climatic conditions, involve larger areas and make more damages than low forest fires.

Table 2: Frequency of forest fires in the examined area according to the days of the week
Preglednica 2: Število gozdnih požarov na proučevanem področju po dnevih v tednu

Days of the week	The number of fires
Monday	4
Tuesday	11
Wednesday	6
Thursday	6
Friday	9
Saturday	10
Sunday	6
Total	52

Most of the fires took place between 12.00 and 16.00 hours.

In forest fires in the area of the forest enterprise Buzet 29,079 m³ of timber mass was destroyed or damaged and its value is estimated to 2,427,801.00 kn. Indirect damage is estimated at 26,080,113.00 kn.

In each fire approximately 91.65 ha of forest was burnt, 559.20 m³ of timber mass was destroyed or damaged and its value is estimated at 46,688.48 kn, while damage due to the loss of generally useful functions of the forest was 501,540.63 kn.

Comparing direct damage of the loss of timber mass with indirect damage connected to impaired generally beneficial functions of a destroyed or damaged forest, we can conclude that the latter damages were 10.74 times bigger.

It should be emphasised that 80 % of the fires were reported in the first 30 minutes of their appearance and the extinguishing began within 30 minutes from the report of fire in 86 % of cases.

Among the total number of fires, forest services reported of 36 % of forest fires.

The share of the forest enterprise Buzet in the total burnt area of Croatia is 59.44 %.

4 WORKS PERFORMED ON THE PROTECTION OF FORESTS AGAINST FIRES IN THE FOREST ENTERPRISE BUZET (1990-1995)

Such works can be divided into:

1. construction of fire-prevention forest roads,
2. construction of fire-prevention straight clearings.

Table 3: Construction of fire-prevention forest roads
 Preglednica 3: Gradnja protipožarnih gozdnih cest

The year of construction	Forest presinct Cres	Forest presinct Labin	Forest presinct Pazin	Forest presinct Poreč
	km			
1991				1.50
1992				1.00
1993	1.70			
1994		3.40	6.70	
1995			1.10	

Table 4: The construction of fire-prevention straight clearings
 Preglednica 4: Gradnja protipožarnih preseka

The year of construction	Forest presinct Buje	Forest presinct Cres
	ha	
1991	0.80	
1992		
1993	4.10	
1994	7.40	2.00
1995		

Data presented in Table 3 show that in a five-year period from 1990 to 1995 15.40 km of fire-prevention roads were built, which is approximately about 3.08 km of such roads per year. Most of them were built by the building unit "Planik", in the forest enterprise Pazin.

Table 4. shows a total area of all fire-prevention straight clearings of 14.30 ha, i.e. 2.86 ha of area of fire-prevention straight clearing per year.

5 THE PROGRAMME OF BUILDING FIRE-PREVENTION ROADS IN THE AREA OF ROCKY GROUND FORESTS IN THE PERIOD 1995- 1999

The condition of openness of rocky ground forests as well as the quantity of fire-prevention forest roads in this part of Croatia where the danger of forest fires is the highest indicate the necessity of intensive building and high investments in this type of forest roads.

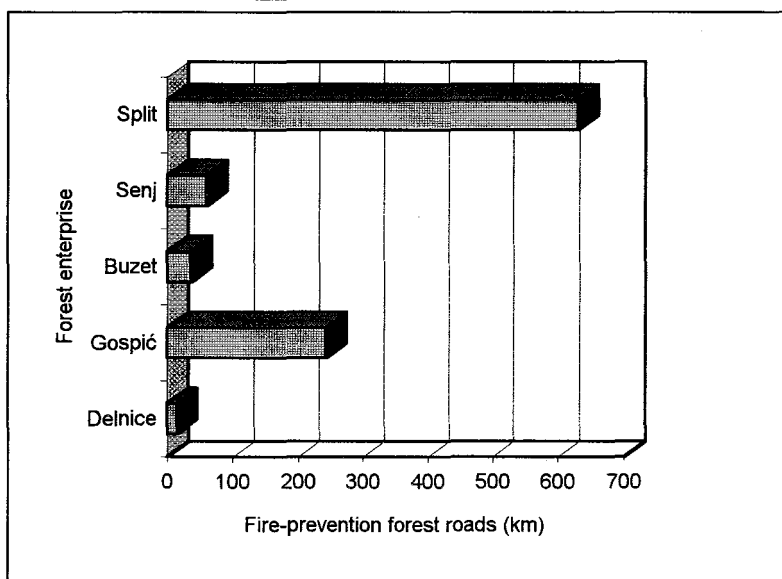
The programme of development till 2025 envisages the building of 500 kilometres of economic forest roads and 300 kilometres of fire-prevention roads per year. According to such a policy of opening of seaside rocky ground forest roads on the end of 2025, the openness of approximately 20 m/ha would be achieved in economic forests and a little bit less in uneconomic forests.

What would be the result of that in this tourist area in all the fields of human activities, needn't be explained.

The cost of the building of fire-prevention roads with the funds provided by the World Bank are estimated at 17,465,321 \$, i.e. at the approximate cost of building of 1 kilometre of 17 783 \$ it is 982 kilometres of fire-prevention roads.

Connected with the financing of fire-prevention roads from the program of the World Bank, the following roads are planned in forest enterprises:

- forest enterprise Delnice: 14 km
- forest enterprise Gospić: 243 km
- forest enterprise Buzet: 36 km
- forest enterprise Senj: 60 km
- forest enterprise Split: 629 km



Picture 3: *The proportion of forest enterprises in the programme of building fire-prevention roads financed by the World Bank*

Grafikon 3: *Razmerje gozdnih gospodarstev v programu gradnje protipožarnih gozdnih cest katere financira Svetovna banka*

6 SOME MOST IMPORTANT FUNCTIONS OF FIRE-PREVENTION ROADS

Though a fire-prevention road belongs to the category of technical preventive measures of the fight against forest fires, it is also used during the arrival of fire-engines to the place of fire, as well as during the procedure of extinguishing.

Functions of a fire-prevention road are as follows:

- regular patrolling by a patrol vehicle,
- in the case of forest fire, a forest fire-prevention road is used, if it is well, maintained, as an impassable zone for defence from fire,
- it frequently represents the limit of a section, and if it is built in the combination with a fire-prevention straight clearings that are vertical on it, it forms the outer limit of the area out of which the fire can't spread,

- if the fire starts during the patrolling of patrol vehicles on the forest road and there are no means of communication in the vehicle, they will reach the closest means of communication by a road,
- it enables fast and urgent arrival of fire engines with water to the place where fire started, and the possible return for additional water and returning to the fire-place in a short period of time,
- offers the possibilities of arrival of an ambulance, the vehicles which carry people and equipment for extinguishing fires to the place of forest fire,
- it represents an ideal place for firemen and other people participating in extinguishing, i.e. fighting the fire, for waiting the fire and its localising,
- the fire-prevention forest road is an ideal place to which fire spreads at localising of fire by a method of burning a pre-fire, and it is also the place from which fire is fought by burning counter-fire,
- it is the place of transport of timber mass from the forest after cutting,
- it is used for easier transport of people, tools and equipment to the place of work at forest-planting, forest-protecting and forest-arranging works, it is used, in the area of a hunting-ground, as a stand during group huntings by driving, and its task is the easier transport of people; equipment and game in hunting-economic works,
- easier access of people to a forest, especially to areas rich with truffles, where people move less directly through the forest, thus less damaging the offspring of this primarily protective forests.

Therefore, a fire-prevention road is a road whose primary aim is preventive protection from starting the fire, and in case of fire, fast intervention of fire-brigade and localisation of forest fire.

The basic thought that is leading us to build a fire-prevention road in the field should be the fulfillment of the primary role of a fire-prevention road. As a raw base of rocky ground forests which are constantly endangered by fire, is uneconomic for exploitation, so the period in which it has to pay off is extremely long, construction of fire-prevention roads is carried out at the minimum building and maintenance costs with a high level of technical and technological performance of the superstructure and substructure.

Apart from the primary function of a fire-prevention road, immediately after its building, and particularly a decade after, it has many secondary, but not less important functions.

Therefore, roads in the forest enterprise Buzet are multifunctional, their role is manifold, and forests in this area are everything else but economic forests and they are constantly connected with tourism, with the total life of man, so they are used in this sense of completeness and continuity.

7 FIRE-PREVENTION FOREST ROADS AND ECONOMIC FOREST ROADS

If we view fire-prevention roads in the area of the forest enterprise "Buzet" inflexibly and rigidly, and if we include here only those forest roads that were opened with the aim of being primarily fire-prevention roads, then the openness of forest complexes is very bad.

However, if we are flexible and we regard forestry as a complex unity made of disciplines that have their characteristics and particularities, but are mutually intrelinked, then other forest roads that originally had other primary functions, but one of their tasks is fire-prevention, are also included in fire-prevention roads.

We can say that we distinguish two kinds of roads that are used for preventive protection from forest fires and for intervention of firemen and other factors present in localising a forest fire:

- **fire-prevention forest roads** - while designing a project they are defined as fire- prevention forest roads, and secondary have other functions. Their priority task is preventive protection from forest fires,
- **economic forest roads** - protection forest from fires is their secondary task, and the basic idea at designing was transport of timber mass.

Apart from priority functions they have to satisfy, these two types of forest roads differ in the way of building a superstructure and substructure as well as according to technical conditions required for their building.

8 CONCLUSIONS ON THE FIRE-PREVENTION FOREST ROADS IN THE STUDY SITE

Regarding what has so far been written, and based on field research, the following can be said about fire-prevention roads in Istria:

- during the last five years a comparatively small number of fire-prevention forest roads was opened in the area of the forest enterprise Buzet (15.40 km in five years or approximately 3.08 km per year),
- a route of fire-prevention roads mostly sticks to the route of already existing tractor haulage ways probably for lower initial building costs, and less problems of finding the best version of a certain road regarding the primary task it has to fulfil,
- precise, correct documentation of already built roads does not exist or is difficult to get,
- though comparatively a small number of fire-prevention roads was built in the last five years in this area, they are quite well built from the aspect of access of intervention vehicles,
- roads in the area of the forest enterprise Buzet can be divided into fire-prevention roads and forest roads only regarding the primary main task they have to fulfil and according to the way of building a substructure and a superstructure,
- both roads have the same tasks, but their share in the total sum of all the functions of a road is different according to intensity and importance,
- due to the high cost of building forest roads on one side and uneconomic raw base of the forests of this climate on the other side, roads that would have more useful tasks should be built, so-called **multifunctional roads**,
- a period of depreciation of a certain multiuseful road is inversely proportionate to the number of tasks that this road fulfils,
- while designing roads, we needn't always use old tractor haulage ways for the smaller expenses of performance; in the longterm such a road needn't be and usually isn't as profitable and functional as a road by which a certain area is opened taking into account all the tasks that a road has to fulfil,
- forest roads should be built in stages,
- the opening of forest areas should be done according to a plan, according to priority categories that include all relevant factors for the existence of a certain road,

- the distance between roads should be from 442 m to 920 m, i.e. the quantity of 16.2 m to 22.6 m of roads per hectare,
- an inventory of forest roads should be done and they should be drawn into the maps and new roads should be accompanied with a complete documentation,
- all the roads should be regularly maintained, both regarding a superstructure and shoulders, where bushes should be removed and tree crowns should be prevented from joining above the road.

POVZETEK

Znano je, da gozdne ceste predstavljajo največja vlaganja finančnih sredstev v gozdarstvu. Povrnitev vloženih sredstev v gozdne ceste je možno v relativno sprejemljivem časovnem obdobju, če so gozdne ceste na gozdnih področjih visoko vrednih vrst gozdnega drevja.

Postavlja se vprašanje kako izvesti odpiranje gozdnih kompleksov eumediteranskega in submediteranskega dela hrvaškega primorja, kjer ni gospodarskih gozdov z vrednimi sortimenti, ampak je njihova osnovna naloga zagotavljanje splošnokoristnih funkcij, katerih gozdarstvo v največji meri še ne more plačati.

Glavna nevarnost za obstoj priobalnih gozdov hrvaškega krasi so gozdni požari. Najpopolnejša zaščita pred ognjeno stihijo so preventivni ukrepi. Med njimi je treba poudariti tehnične preventivne ukrepe, ki predstavljajo izgradnjo in vzdrževanje protipožarnih cest ter protipožarnih presek. Protipožarne ceste se od gospodarskih gozdnih cest ločijo po osnovnem namenu, tehnični in tehnološki izvedbi ter stroških izgradnje po dolžinski enoti.

Protipožarne gozdne ceste so gozdne ceste, katerih osnovna naloga je preventivna protipožarna zaščita in po potrebi pomemben prispevek pri gašenju požarov in vseh delih v zvezi s protipožarno aktivnostjo. Protipožarne gozdne ceste so zgrajene s kar najmanjšimi stroški, vendar morajo biti dovolj kvalitetne, da lahko opravljajo svoje naloge.

Protipožarne gozdne preseke moramo razlikovati od protipožarnih gozdnih cest. Praviloma so pravokotne na protipožarne gozdne ceste, za njih ni potrebna projektna dokumentacija, nimajo zgornjega ustroja in služijo kot preventivni ukrep v boju proti gozdnim požarom, cena izgradnje pa je bistveno nižja kot za protipožarno gozdno cesto.

Gospodarske gozdne ceste niso prvenstveno namenjene, projektirane in zgrajene kot protipožarne ceste, ampak služijo transportu lesne mase in drugim nalogam. Tako so zgrajene po vseh tehničnih pogojih za gospodarske ceste, prenesejo višjo prometno obremenitev, vendar so tudi dražje. V specifičnih priobalnih razmerah, kjer je nevarnosti požara, opravljajo tudi protipožarno nalogo.

Mnogonamenske gozdne ceste istočasno opravljajo več nalog ne glede na to, kateri namen je dominiral pri njihovem projektiranju. Čas povrnitve vloženih sredstev v take ceste je obratno proporcionalen številu in intenziteti različnih rab gozdnih cest. Zaradi visokih stroškov izgradnje gozdnih cest in ekonomsko slabih gozdov v primorju, morajo take ceste biti opredelitev gozdarskih strokovnjakov v eumediteranskem in submediteranskem kraškem predelu Hrvaške.

REFERENCES

- BILANDŽIJA, J., 1988. Organizacija preventivnih mjera zaštite šuma od požara, Šumarski institut Jastrebarsko Radovi 75, s. 205-213.
- JELIČIĆ, V., 1983. Šumske ceste i putevi, skripta, SIZ odgoja i usmjerenog obrazovanja šumarstva i drvne industrije SRH, Zagreb.
- PENTEK, T., 1995. Protupožarne ceste u Upravi šuma Buzet i njihova uloga pri sprječavanju požara, Diplomski rad, Šumarski fakultet Sveučilišta u Zagrebu, 73 s.
- PIČMAN, D., 1993. Utjecaj konfiguracije terena i hidrografskih prilika na ekonomsku opravdanost izgradnje optimalne mreže šumskih prometnica, Disertacija, Šumarski fakultet Sveučilišta u Zagrebu, s. 1-112.
- SABADI, R., 1992. Ekonomika šumarstva, skripta, Školska knjiga, Zagreb.

- ŠIKIĆ, D./BABIĆ, B./TOPOLNIK, D./KNEŽEVIĆ, I./BOŽIČEVIĆ, D./ŠVABE, Z./PIRIA, I./Sever, S., 1989. Tehnički uvjeti za gospodarske ceste, Znanstveni savjet za promet JAZU, Zagreb.
- ŠOŠTARIĆ, V., 1989. Požari šuma, Šumarski list, 3-5, Zagreb, s. 168-172.
- VAJDA, Z., 1974. Nauka o zaštiti šuma, udžbenik, Zagreb.
1994. Prijedlog plana izgradnje šumskih protupožarnih prometnica na području krša od 1995. do 1999. godine, Javno poduzeće Hrvatske Šume, Zagreb, s. 1-5.
1995. Pravilnik o tehničkim mjerama zaštite šuma od požara, Narodne novine, 24/71, Zagreb.
1995. Godišnje izvješće UŠ Buzet o šumskim požarima, Zagreb, s. 1-3.

