

Development of a new concept for improvement of forest techniques in Croatia – Areas of possible contributions

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Abstract – Nacrtak

The paper addresses a possible concept for improving forest techniques in Croatia as a response to challenges encountered by the Croatian forestry in its effort to satisfy the increased ecological, social and economic commitments. Achieving a safety culture in forestry, increasing energetic efficiency with a lesser impact on the environment, developing innovations and entrepreneurship and receiving more contributions from research activities are considered the key elements of the new concept. The concept of forest techniques improvement focuses on permanent education of specialised staff and on training and certification of working skills of workers and operators of forest mechanisation in particular. A major part of improvements in the quality and safety of forest work relates to mandatory licensing of forest contractors. The article advocates the creation and implementation of an energy efficiency strategy and lower dependence on traditional fuels and lubricants. The comparison of national and European research needs with the ongoing research activities in Croatia has shown that the current research programme is unable to achieve major improvements in the forestry techniques and technology. The solution lies in involving Croatian scientist in international and multidisciplinary research projects.

Keywords: forestry, forest work safety, safety culture, training, education, fuel consumption

1. Introduction – Uvod

Since the early 1990s the development of European forestry has evolved within the framework of forestry policy defined by broad social interests and goals. The framework was primarily outlined in the resolutions of ministerial conferences on the preservation of European forests (Strasbourg 1990, Helsinki 1993, Lisbon 1998, Vienna 1992). These resolutions promote sustainable forest management as the fundamental principle, while multipurpose uses of forest resources and benefits for ecological, economic and social needs of the society are defined as permanent objectives of such management.

In such conditions forest operations as the most important and best recognized part of forestry activities must satisfy numerous requirements both in terms of the choice of technologies and means of work and of the level of education of specialised staff and forest workers themselves. The majority of transitional countries, including Croatia, are faced

with numerous difficulties in adjusting multiple aspects of forest work to the newly established criteria. This refers first of all to the belated introduction of high technologies and development of entrepreneurial activities in forestry (Rametsteiner and Yadlapalli 2004, Rametsteiner et al. 2004).

To overcome the current problems of forest technology and techniques it is necessary to mobilise many areas and many professions. In general opinion, the steps to be taken relate particularly to:

- ⇒ Increasing the efficiency of the existing technologies and focusing on energetic efficiency, ecological acceptability and ergonomic suitability,
- ⇒ Developing new products and services for the purpose of lessening the dependence of business results on the production of roundwood, and
- ⇒ Establishing a culture of forest safety as the key factor for reducing risks and accidents.

Some important areas of possible improvements of forestry techniques in Croatia will be discussed further on in the article.

2. Creating a culture of forest safety; increasing the efficiency, quality and humanisation of work in transition to high technologies – *Postizanje kulture sigurnosti u šumarstvu; povećanje djelotvornosti, kakvoće i humanizacije rada na prijelazu prema visokim tehnologijama*

Forestry in transitional countries is characterized by a conspicuous delay in the application of cutting edge technologies of forest work mechanisation (central automated landings, work with harvesters, chippers and processors, extraction with forwarders) – where such application is justified and purposeful. Coupled with higher efficiency and humanisation of work, this would reverse the present negative statistics of accidents at work and occupational diseases in transitional countries.

Several hundred forest workers are injured in Croatia every year. Along with construction and traffic, accident frequencies and fatality rates are 2–3 times higher than those recorded in other industrial sectors. Apart from significant social and economic impacts, the consequences of unsafe and inappropriately executed forest operations are also reflected on the environment, as the damage to forest ecological systems far outweighs the damage caused by the necessary technological processes. The risk of accidents and injuries of forest workers are primarily the consequence of unsatisfactory levels of organisation

and working techniques, where, as research shows (Martinić 1998), the main causes lie in poor training of professional staff and direct forest workers.

According to ILO/FAO (1998), in order to reduce risks and stop negative trends in the health and safety of forest workers, it is necessary to establish a »safety culture«. This implies a clear mission and a synergistic effect of joint efforts by the participants in such a concept of safety culture: state institutions, employers, workers, forest owners, educational institutions, insurance agencies, and others. This concept calls for continuing professional education and worker education, training, and certification of working skills.

Apart from increasing the level of forest work safety and lessening the consequences of accidents at work, the implementation of safety culture in terms of improving the forestry techniques also implies:

- ⇒ Higher professionalism and restoration of the image marred by a large number of accidents and frequent employment of unqualified workforce,
- ⇒ Opportunities for further development of organisation of work and improvement in other aspects of forest work, such as economic efficiency, ecological acceptability, energetic efficiency, etc.

To contribute to the increased quality and efficiency of forest work, as well as to improve safety and health, two programmes are currently under way at the Faculty of Forestry of Zagreb University:

- ⇒ Evaluation of forest workers' work techniques,
- ⇒ Investigation of the foundations for the establishment of forest contractor licensing.

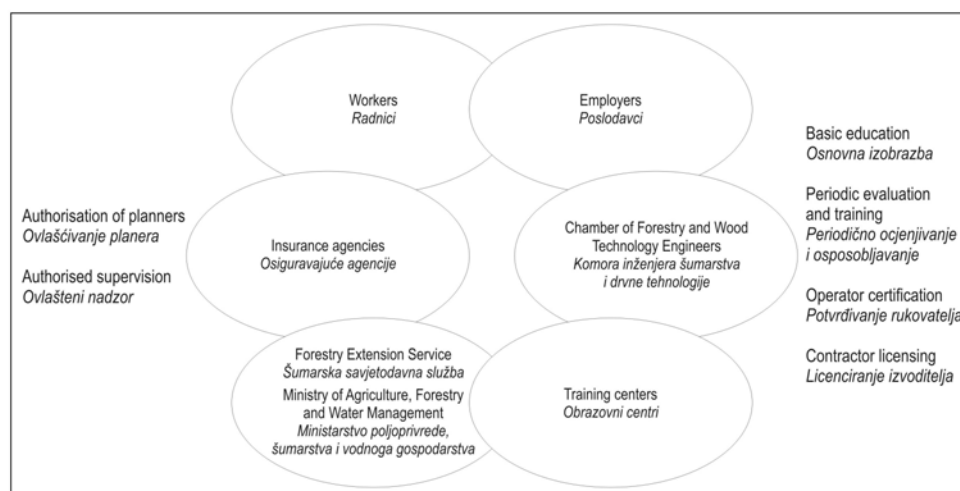


Fig. 1 Key participants and elements in the establishment of safety culture in forestry

Slika 1. Pregled ključnih sudionika i elemenata pri uspostavi kulture sigurnosti u šumarstvu

Evaluation of individual elements of work techniques conducted for the most typical jobs (cutters, tractor drivers, chopper setters) since 2000, has proved to be a very objective method for identifying critical points in work processes and a reliable indicator of points that require correction and improvement through training and practice (Martinić and Matijević 1999, Martinić 2006).

The legal framework for certification and licensing of forest workers was first recognized as a legal commitment in the Forest Act of 2005 (Anon. 2005). In recent years the initial groundwork has been made for a possible institutional framework of the licensing system (Šporčić and Martinić 2005, Šporčić 2003). However the beginning of licensing has been postponed until by-laws are passed regulating in detail the criteria and organisation of licensing.

3. Increasing energetic efficiency and ecological acceptability: lower consumption of energy sources dangerous for the environment and a gradual introduction of biofuels and biolubricants – *Povećanje energetske učinkovitosti i ekološke povoljnosti: manja potrošnja energenata štetnih za okoliš i postupno uvođenje bioloških goriva i maziva*

Energy consumption has always represented a major share in the cost of forest production, and particularly in the cost of mechanised forest operations. Significant ecological consequences and harmful effects of fuel and lubricant consumption on the environment cannot be neglected either, especially in areas of intensive use of mechanisation (Martinić 2000, Auguštin *et al.* 2000, Martinić and Šporčić 2005, Martinić *et al.* 2001). Mechanical and chemical damage to the environment can be, and often is, very serious.

According to research by SkogForsk¹ (News 1/2006), fuel consumption per m³ of felled and transported timber in the period 1985–2005 dropped from 5.4 to 3.7 litres/m³ or approximately by 30%. This was achieved by improving mechanisation, i.e. by replacing heavy machinery with lighter one, improving the engine, and also by improving the extraction system and further transport. Efforts to cut down on energy consumption are continuing, especially in

the field of optimising hydraulic systems and using alternative fuels and lubricants.

It is expected that the current substantial difference in the price of traditional mineral fuels and lubricants and those of biological origin (biodiesel, bio-oils and biolubricants) will decrease significantly in the near future. Efficiency will be additionally increased by better durability and cheaper methods of waste disposal (Makkonen 2000, Skoupy 2000).

In Croatia, the price of diesel fuel rose by 2.5 times between 2000 and 2006 alone. For example, if annual consumption of diesel fuel in the company »Hrvatske šume« d.o.o.² (Table 1) decreased by 20%, annual savings would amount to 1.2 million Euro!

In view of the fact that countries with developed forestry have already adopted strategies of a gradual increase in the share of alternative energy sources, the development and implementation of a strategy for lower fuel consumption and decreased dependence

Table 1 The quantity of consumed fuel in the state company »Hrvatske šume« d.o.o. Zagreb in 2006

Tablica 1. Procijenjene količine utrošenoga goriva u državnoj tvrtki Hrvatske šume d.o.o. Zagreb u 2006.

Type of fuel Vrsta goriva	Quantity Količina	Cost - Trošak		
	L	%	10 ⁶ Kn	10 ⁶ EUR
Diesel fuel <i>Dizelsko gorivo</i>	4 800 000	51,60		
Eurodiesel <i>Eurodizel</i>	2 700 000	29,02		
Diesel, total <i>Dizel, ukupno</i>	7 500 000	80,62	43	5,85
MB super 95 <i>MB super 95</i>	1 000 000	10,75		
MB Eurosuper 95 <i>MB eurosuper 95</i>	650 000	7,00		
MB super 98 <i>MB super 98</i>	150 000	1,61		
Engine gasoline, total <i>Motorni benzini, ukupno</i>	1 800 000	19,36	12	1,63
Other - fuel oil <i>Ostalo - lož-ulje</i>	2 500	0,2		
Overall <i>Sveukupno</i>	9 302 500	100,00	55	7,48

¹ Swedish Institute of Forest Research – Švedski institut za šumarska istraživanja

² Hrvatske šume d.o.o. Zagreb (state owned trade company that manages 1,991,537 ha of state forests – Hrvatske šume d.o.o. Zagreb (trgovačko društvo u državnom vlasništvu koje gospodari s 1 991 537 ha državnih šuma)

on traditional fuels should also be advocated in Croatia³. In order to do this, we should:

- ⇒ Optimize the energetically most demanding work processes (extraction, further transport and forest road construction) with mathematical modelling in both planning and execution,
- ⇒ Stimulate savings by using information technologies to monitor energy fuel consumption per place of consumption,
- ⇒ Provide machinery with engines using high-quality fuel.

As to gradual introduction of biofuels and bio-lubricants, their use would initially be justified in places where there is a risk of threat to areas of special ecological importance, such as parts of the national ecological network or habitats within the NATURA 2000 network. Higher costs of such projects should be co-financed or subsidised by the Environmental Protection and Energy Efficiency Fund.

4. Developing management and financial instruments for modern technologies: advanced systems and state incentives – *Razvoj menadžmenta i financijskih instrumenata za moderne tehnologije: napredni poslovni sustavi i državni poticaji*

Research conducted by the European Forest Institute (EFI) within the INNOFORCE programme has shown a very low level of innovative processes in the forestry of transitional countries (Rametsteiner and Yadlapalli 2004, Rametsteiner *et al.* 2004). Innovations are divided into: organisational innovations (39%); technological innovations (14%); creating new wood and non-wood products (18%) and services (20%).

The basic prerequisite for the above innovations is the development of entrepreneurship in forestry. In view of the specific features of forestry (long-term production cycle, specific jobs and the need for special equipment, etc.), entrepreneurial initiatives in forestry must receive broad support by the society, especially in the part relating to the private forest segment. This includes both advisory assistance and instruments of state financial support.

In order to encourage entrepreneurship in the forestry of Croatia, it is necessary to:

- ⇒ Establish an information and counselling system,
- ⇒ Provide targeted training for specialist services and possible entrepreneurs in the field of business opportunities evaluation and preparation of entrepreneurial projects,
- ⇒ Strengthen competent administrative bodies in counties,
- ⇒ Develop a system of state incentives.

Croatia needs a well-developed system of incentives and support in forestry equal to that in e.g. tourism, agriculture and artisanship. Financial instruments should include non-returnable funds (one-time or multiple financial supports), loans with subsidised interest, tax benefits, etc.). Similarly, the Environment Protection and Energy Efficiency Funds should be available to forestry sector under prescribed conditions as well as funds collected for non-commercial forest functions as defined in the Forest Act (Anon. 2006a).

Related to the improvement of techniques and technologies, non-returnable funds should be allocated to:

- ⇒ Education and training of private forest owners,
- ⇒ Technological-technical categorisation of working conditions,
- ⇒ Pilot-projects of testing alternative and cost-saving technologies,
- ⇒ Production of an investment strategy into technical infrastructure,
- ⇒ Targeted research.

Subsidised loans should be allocated to the:

- ⇒ Development of a system of education, training and licensing,
- ⇒ Establishment of training centres for the use of forestry machines,
- ⇒ Acquisition of 4E mechanisation.

Tax benefits should be secured primarily for the acquisition of measuring and safety equipment and for the acquisition of mechanisation whose production is not profitable or is impossible to organize in Croatia.

³ Croatia undertook to include 5.75% of alternative fuels in the overall fuel consumption by 2010 – *Hrvatska se obvezala na 5,75 % udjela alternativnih goriva u ukupnoj potrošnji goriva do 2010. godine*

Table 2 Tasks related to the development of forest-based technologies (according to NFPS, 2002)**Tablica 2.** Zadaci vezani uz razvoj tehnologija u šumarstvu (prema NŠPS 2002)

Label Oznaka	Description of Activities Opis aktivnosti	Priority* Prioritet*
A2.2.	Supporting measures for ensuring personnel education in the implementation of 4E technologies <i>Potporna mjerama za osiguravanje potrebne izobrazbe kadrova za provedbu 4E tehnologija</i>	I
A2.3.	Developing financial initiatives for support in implementing environmentally-friendly technologies (e.g. bio-oils, yarders) <i>Razvijanje financijskih inicijativa za potporu u provedbi tehnologija koje nisu štetne za okoliš (npr. bioulja, žičare)</i>	II
A2.4.	Improving work techniques and safety at work through training, evaluation and certification <i>Unapređivanje radne tehnike i sigurnosti pri radu osposobljavanjem, ocjenjivanjem i potvrđivanjem</i>	I
B5.1.	Defining conditions and criteria for licensing forestry contractors <i>Definiranje uvjeta i kriterija za licenciranje ugovaratelja u šumarstvu</i>	I
B5.3.	Establishing and implementing a licensing system for forestry contractors <i>Uspostavljanje i provođenje sustava licenciranja za ugovaratelje u šumarstvu</i>	I

* to be implemented in the period - *obveza provedbe u razdoblju*: I. (2003–2006), II. (2006–2008), III. (2008–...)

5. To what extent is the development of forestry technologies and techniques supported by research? – *Koliko istraživanjima podupiremo razvoj šumarskih tehnologija i tehnika?*

Research is undoubtedly one of the principal triggers for changes and progress in different forestry fields and technologies. The most important contributions are usually the result of targeted research. The question is whether investigations in Croatia, in terms of forestry techniques, address those issues that have been defined as priority. Are there more important issues that are not investigated? What is our position in relation to European research priorities?

If we assume that research priorities in the forestry sector of Croatia should be closely linked with priority activities set down in the National Forestry Policy and Strategy (NFPS), then they refer to two segments (Anon. 2003):

- ⇒ a) Introduction of 4E (ecological, ergonomic, economic, energetic) technology in forestry and
- ⇒ b) Certification and licensing of forest contractors.

Activities related to the achievement of these goals are shown in Table 2.

A special activity within the NFPS (National Forestry Policy and Strategy) is the establishment of a body within the Ministry of Forestry, which would be responsible for coordinating priority research needs and findings. Regrettably, although the NFPS was adopted five years ago, this body has not been established yet.

In order to review European research priorities in the forestry sector, we will list the main fields of research contained in the document The Strategic Research Agenda (SRA). The Agenda, established within the VISION 2030 project – The Forest-Based Sector Technology Platform (FTP), was drawn up by the most eminent forestry institutions and organisations involving over 1,000 representatives of the forestry sector from 20 European countries (Anon. 2006A, Anon. 2006B). The SRA singled out five strategic goals that represent key research areas in the following decades:

- ⇒ Development of innovative products for changing markets and customer needs,
- ⇒ Development of intelligent and efficient manufacturing processes, including reduced energy consumption,
- ⇒ Enhancing availability and use of forest biomass for products and energy,
- ⇒ Meeting the multifunctional demands on forest resources and their sustainable management,
- ⇒ Placing the forestry sector in a social perspective.

Research priorities within the second strategic goal »Development of intelligent and efficient manufacturing processes, including reduced energy consumption« include:

- ⇒ Advanced technologies for primary wood processing (cutting, processing and transport),
- ⇒ New technologies for optimizing the production of wood products,
- ⇒ Reducing energy consumption and achieving energy efficiency in all production stages,

- ⇒ Continuous rise in the efficiency of production with decreased environmental impacts,
- ⇒ Stimulating the production of biomass-based thermal and electrical energy.

On the other hand, the currently investigated issues of forest techniques in Croatia are contained in a group of projects undertaken by the Faculty of Forestry and the Forestry Institute in Jastrebarsko for the company Hrvatske šume d.o.o. Zagreb, for the period 2006–2010. The research tasks include:

- ⇒ Establishing slash stacking with machinery methods,
- ⇒ Forest biomass and harvesting technologies,
- ⇒ Optimizing a primary forest road network in hilly and mountainous areas using modern work technologies,
- ⇒ Knowledge of and attitudes on biomass as a source of energy,
- ⇒ Planning secondary forest roads (strip roads and skid trails) in hilly-mountainous areas,
- ⇒ Drawing up a feasibility study for investments into thermal power stations,
- ⇒ Licensing and certification aimed at achieving European standards of safety and quality of forest work,
- ⇒ Evaluating business efficiency of organisational forestry units using a non-parameter model,
- ⇒ Environmentally friendly forest techniques,
- ⇒ Environmentally friendly technologies in forest management according to valid international norms,
- ⇒ Classification of forest soils according to field conditions, management methods and criteria for the selection and application of the most suitable techniques and technologies.

The second group of projects is financed by the Ministry of Science, Technology and Sport (MSTS). Among the 38 approved and financed projects for the research period 2006–2009, only 5 are directly linked with forest technologies:

- ⇒ Modern technologies of planning and designing forest road networks,
- ⇒ Ecological, energetic and ergonomic evaluation of forest machines and equipment,
- ⇒ Environmentally-friendly forest harvesting,
- ⇒ Contribution to the study of forest biomass use,
- ⇒ Improving forest-harvesting technologies aimed at providing protection to the environment and workers.

Even a very general comparison of national and European research needs with the ongoing research activities in Croatia shows the following:

- ⇒ The absence of a systematic and comprehensive »research response« to defined priority needs,
- ⇒ Some priority areas are well »covered« with a number of complementary research tasks,
- ⇒ A part of research topics is only segmentarily and/or partially covered by broadly defined research tasks and projects,
- ⇒ Some research priorities are completely exempt from the ongoing research programmes and are not investigated at all; e.g. development of new products, lower energy consumption, optimisation of work processes and others.

Further to the above it can be concluded that the existing research programme in Croatia is not sufficient either in terms of the scope of fields and topics or the number of projects and tasks to guarantee a more significant improvement of forest techniques and technologies.

On the other hand, with regard to the number of scientists-researchers who are potential leaders of research activities in forest techniques in Croatia, the only certainty seems to be the possibility of their cooperation and involvement in international and multidisciplinary projects, which will provide acceptable solutions for home use too. Unfortunately, there has been no regional cooperation among researchers of forest techniques to date.

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Sažetak

Razvoj novoga koncepta za unapređivanje šumarske tehnike u Hrvatskoj – područja mogućega doprinosa

U članku se raspravlja o mogućem konceptu unapređivanja šumarske tehnike u Hrvatskoj kao odgovoru na povećane ekološke, socijalne i ekonomske obveze i izazove. Kao ključna sastavnica novoga koncepta i moguća područja značajnoga doprinosa razmatraju se postizanje kulture sigurnosti u šumarstvu, povećanje energetske učinkovitosti uz manji utjecaj na okoliš, razvoj inovacija i poduzetništva te veći doprinos istraživačkoga rada.

Rizik pojave nesreća i ozljeđivanja šumskih radnika u Hrvatskoj u prvom su redu posljedica nezadovoljavajuće razine organizacije i radne tehnike u izvođenju radova, pri čemu se glavni uzroci nalaze u manjkavoj primjeni stručnih znanja i slabostima osposobljavanja izravnih izvođitelja šumskih radova. U tom kontekstu kultura sigurnosti u šumarstvu razumijeva zajedničko djelovanje državnih institucija, poslodavaca, radnika, vlasnika šuma, obrazovnih institucija, osiguravajućih agencija i drugih. U središte unapređivanja šumarske tehnike stavlja se kontinuirano osposobljavanje stručnoga osoblja te izobrazba i potvrđivanje radne vještine radnika, posebno rukovatelja šumskom mehanizacijom. Kao doprinos povećanju kvalitete i ekonomičnosti šumskoga rada, ali i poboljšanju sigurnosti i zdravlja, na Šumarskom fakultetu Sveučilišta u Zagrebu od 2000. godine provodi se ocjenjivanje radne tehnike šumskih radnika. Jednako važan dio poboljšanja kvalitete i sigurnosti pri šumskom radu prepoznaje se u obveznom licenciranju izvođitelja šumskih radova.

Drugi važan doprinos unapređivanju šumarske tehnike smatra se povećanje energetske učinkovitosti i ekološke povoljnosti. Osim značajnih troškova u šumarskoj proizvodnji, uz potrošnju energenata vezan je i nezanemariv utjecaj na okoliš, posebno pri održavanju mehanizacije i u područjima njezine intenzivne primjene. U Hrvatskoj je od 2000. do 2006. godine cijena dizelskoga goriva povećana 2,5 puta. Ako bi se godišnja potrošnja dizelskoga goriva samo u Hrvatskim šumama d. o. o. smanjila za 20 %, dobile bi se godišnje uštede u iznosu od 1,2 milijuna eura! Po uzoru na članice Europske unije i Hrvatskoj se sugerira izrada i provedba strategije energetske učinkovitosti i smanjenje ovisnosti o klasičnim gorivima i mazivima.

Za iskorak u razvoju šumarskih tehnika nužan je razvoj poduzetništva i financijskih instrumenata u šumarstvu, jednak onomu koji sada postoji, primjerice, u turizmu, poljoprivredi i obrtništvu. Pritom bi financijski instrumenti trebali uključivati poticaje, kapitalna bespovratna sredstva, kredite sa subvencioniranom kamatom, carinske olakšice i drugo. Jednako tako šumarskom bi sektoru trebala biti dostupna sredstva Fonda za zaštitu okoliša i energetske učinkovitost te sredstva prikupljena za općekorisne funkcije šuma.

I u Hrvatskoj se očekuje da istraživanja budu jedan od glavnih pokretača promjena i unapređivanja različitih područja šumarske djelatnosti, pa tako i tehnologija i tehnika. Kako su najznačajniji doprinosi redovito rezultati ciljanih istraživanja, postavljaju se pitanja: Istražujemo li u Hrvatskoj, kad su u pitanju šumarske tehnike, ono što

je definirano kao prioritetno? Ima li važnih tema koje ne istražujemo? Gdje smo u odnosu na europske istraživačke prioritete? Na temelju okvirne usporedbe nacionalnih i europskih istraživačkih potreba s tekućim istraživanjima u Hrvatskoj ocjenjuje se kako postojeći istraživački program nije dostatan za značajnije unapređivanje šumarske tehnike i tehnologije, pri čemu se rješenje vidi u uključivanju hrvatskih znanstvenika u međunarodne i u multidisciplinarnе istraživačke projekte.

Ključne riječi: šumarstvo, šumarske tehnike, zdravlje i sigurnost pri šumskom radu, potrošnja goriva, istraživanja

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