

## FOREST UTILISATION FEATURES IN ALPINE PARTS OF ITALY AND SLOVENIA

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**Abstract:** *Alpine region along Italian – Slovenian border is specific as many common characteristics and tendencies are present in the whole area: similar terrain, depopulation of rural areas, growing share of forest, increasing interest for tourism and forest preservation etc. Professional forestry still has huge interest in managing commercial forest of the area with low cost and competitive quality. In the article analysis of the working conditions in forest utilization in Bolzano Autonomous Province, Trento Autonomous Province, Veneto Region and Friuli-Venezia Giulia Region as well as western part of Slovenia – Tolmin and Bled forest management regions are analyzed. An overview of the forest sector features is provided and the main elements that characterized the sector are examined. There follows assessment of the peculiarities of the forest enterprises that operate in north-eastern Italy, which are compared with Slovenian situation. It is an assessment mainly based on the experiences achieved in the sector and that can be based only in part through data from statistics and surveys. Nevertheless it is possible to consider the state-of-the-art of the forest enterprises and to evaluate the short-medium period perspectives. The article has ambition to be a start of new cross border cooperation between University of Padova and University of Ljubljana.*

### 1. Introduction

Alpine conditions such as predominate in North-Eastern part of Italy and North-Western part of Slovenia are synonym for difficult terrain when discussing forest management and forest operations. The history of skidding techniques in compared countries is long and rich of inventions in both countries.

From Slovenian part – when speaking of cable ways – is necessary to mention first pendulum cableways in 1876 (Košir, 1994), the invention of first Gnezda cable crane in 1932 (Giordano, 1959, Košir, 1988). The use of modern cable cranes in Slovenia today is important for the whole system of forest production on difficult terrain; despite the number of machines has a decreasing trend for years.

On the other hand public interest has been increasing with growing tourism and decreasing farmer population. In Slovenia Triglav national park is in the centre of the area in discussion. Many restrictions to forest utilisation or forest roads and skid trail construction have been present and discussed here since the foundation of Triglav national park area.

The scope of this paper is to compare situation of forest operation and forest utilisation in the North-Eastern Italy and North-Western Slovenia. Main peculiarities are mentioned, as well as the need for more deep studies and cooperation in the future.

## 2. Forest and terrain

### 2.1 North-Eastern Italy

The work in the forest utilization performed in Italy consists in the wood materially procurement from forest performing operations, often characterized by high risk of accidents and carried out under “difficult” working conditions (Cavalli, 2003). To understand the forest work peculiarities, as it is executed in a given situation, it is necessary first of all to define the environmental characteristics, analysing the main components that marks it. Referring these considerations to the study area (Bolzano Autonomous Province, Trento Autonomous Province, Veneto Region, Friuli-Venezia Giulia Region) it is possible to see (Table 1) how the incidence of the forest area on the provincial or regional total area passes from around 50% in Bolzano and Trento Autonomous Provinces to around 1/6 in Veneto Region. Nevertheless, considering the altimetrical position of the forest area, it is possible to notice how, in all the Provinces and Regions analyzed, the forests are mainly located in mountainous areas, with an average percentage equal to 90%. It is an important figure because it confirms that in North-eastern Italy the forest work is mainly performed on sloping terrain that affects the operational methods, the machinery, the road network requirement, the length of the working periods, the availability of manpower.

Also the forests features can characterised the forest work, especially if in relation to the commercial wood assortments that can be derived. Considering the data from Table 2, it is possible to see that, with the only exception of the Veneto Region, the high forest area is prevalent on the coppice one. In Veneto Region the contribute of the hilly and piedmont areas, in which the coppice forests are dominant, even if subjected to large interventions of conversion toward high forest, compensates for the contribute of the mountain areas in which high forest dominates.

A specific consideration should be done considering the spruce and fir area compared not with the total high forest area of the Provinces and Regions analyzed, but rather with the Italian forest area in which the above species are spread. The North-eastern Italy contributes for more than 70% to such forest area and consequently to the spruce and fir wood production.

**Table 1: Total forest area and altimetrical distribution**

	Feature		Bolzano Autonom ous Province	Trento Autonom ous Province	Veneto Region	Friuli- Venezia Giulia Region	<b>North- eastern Italy</b>
A	Forest area	ha	308844	323005	271885	184156	<b>1087890</b>
B	Provincial or regional area	ha	740043	620687	1836400	784600	<b>3981730</b>
	A/B	%	41,7	52,0	14,8	23,5	<b>0,27</b>
	Forest area altimetrical distribution						
C	Mountain	ha	308844	323005	211603	135285	<b>978737</b>
D	Hill	ha	0	0	45752	35348	<b>81100</b>
E	Plain	ha	0	0	14530	13523	<b>28053</b>
	C/A	%	100	100	77,8	73,5	<b>90,0</b>
	D/A	%	0	0	16,8	19,2	<b>7,5</b>
	E/A	%	0	0	5,3	7,3	<b>2,6</b>

**Table 2: Forest area per silvicultural system and forest utilization per silvicultural system and per year**

Feature		Bolzano Autonom ous Province	Trento Autonom ous Province	Veneto Region	Friuli- Venezia Giulia Region	<b>North- eastern Italy</b>	
A	Coppice forest area	ha	17633	68968	125084	62923	<b>274608</b>
	High forest area	ha	291211	254037	146757	121193	<b>813198</b>
	Spruce and fir high forest area	ha	55798	31195	20809	10405	<b>118207</b>
B	Italian spruce and fir forest area	ha					163419
	A/B	%	34,1	19,1	12,7	6,4	<b>72,3</b>
Forest utilization per year							
	Coppice forest	m <sup>3</sup> /y	26488	17980	134705	58836	<b>238009</b>
	High forest	m <sup>3</sup> /y	597947	204410	123902	135293	<b>1061552</b>

Considering the volume of wood extracted per year from high forest and coppice forest, only Veneto Region shows a volume extracted from coppice forest larger than the one extracted from high forest. In the other Provinces and Regions the volume extracted from the high forest is quite larger than the one extracted from coppice forest. Further consideration can be derived considering the distribution of the forest area in relation to the property. It can be seen that in Veneto and Friuli-Venezia Giulia Regions the ratio between private and public property is around 50%, whereas in the two Autonomous Provinces the situation is quite different. In Trento Autonomous Province the public property is prevalent while in Bolzano Autonomous Province the private property is dominant. In the first one the public property (Municipalities, Province domain, valley communities) regards mainly the mountain conifer high forests and the private property is really split and limited to the deciduous forests in the piedmont area. In the latter the 67% of the forest area belong to private farms (“masi”); they are small forests, sometimes split, which are integrated in the farm economy (Provincia Autonoma di Bolzano, 2003). However they heavily contribute to the annual amount of wood extracted from the high forests, especially from the conifer ones.

**Table 3: Forest area per property category**

Feature		Bolzano Autonom ous Province	Trento Autonom ous Province	Veneto Region	Friuli- Venezia Giulia Region	<b>North- eastern Italy</b>	
A	Forest area	ha	308844	323005	271885	184156	<b>1087890</b>
B	State and Regions	ha	5523	7965	18664	23369	<b>55521</b>
C	Municipalities	ha	88493	224104	83577	76603	<b>472777</b>
D	Other Bodies	ha	7187	12149	30936	5642	<b>55914</b>
E	Private	ha	207641	78787	132756	78542	<b>497726</b>
	(B+C+D)/A	%		75,6	50,1	57,4	<b>54,0</b>
			32,8				
	E/A	%	67,2	24,4	49,9	42,6	<b>46,0</b>

## 2.2 North-Western Slovenia

For Slovenian part of comparison we took some facts from the most North-western forest management regions Tolmin and Bled, where Alpine terrain predominates. This are also the regions where most of past and recent development of cable skidding has been present. The altitude of highest mountain peaks reaches 2864 m (Triglav) where timberline lays around 1800 m and commercial forest reach 1500 m above the sea level. Terrain has all characteristics of broken, undulate shapes with several high plateaus and deep alpine valleys with steep slopes. Many of the stands in the region have emphasized protection function, and many of them are excluded from normal forest production. Great part of Slovenian Alps is situated in Triglav National Park where forest production is limited as well as construction of forest roads and skid track. The forests in the whole region have emphasized general-beneficial functions as aesthetic, hydrological, climatic, tourism and others (Krč, 1996).

**Table 4: Total forest area and altimetrical distribution**

	Feature		Tolmin	Bled	Total
A	Forest area	ha	138242	67498	<b>205740</b>
B	Provincial or regional area	ha	222924	101566	<b>324490</b>
	A/B	%	0,62	0,66	<b>0,63</b>
	Forest area altimetrical distribution				
C	Mountain	ha	180568	76004	<b>256572,44</b>
D	Hill	ha	0	10657	<b>10657</b>
E	Plain	ha	42356	14905	<b>57260,56</b>
	C/A	%	0,81	0,75	<b>0,79</b>
	D/A	%	0,00	0,10	<b>0,03</b>
	E/A	%	0,19	0,15	<b>0,18</b>

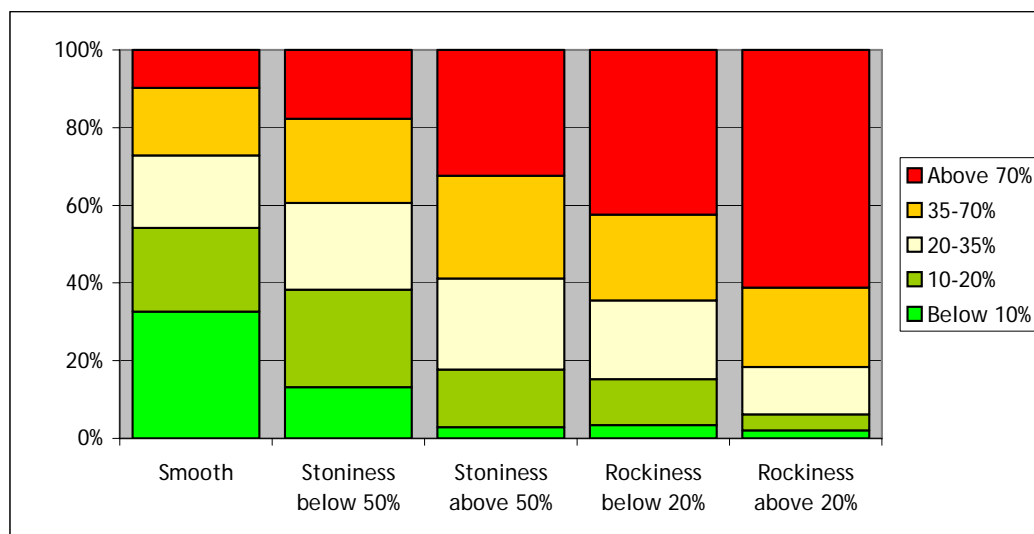
Alpine terrain cannot be always defined as difficult one, as for the high mountains more or less flat plateaus, rich in forest, are typical also. Despite this, the Alpine area is the domain of difficult conditions, where terrain slope is only one obstacle, which is frequently combined with rockiness (Figure 1), cliffs and during the winter with abundance of the rainfall and deep snow cover.

Forest cover is also very diverse. On flat terrain (plateau) the growing stock can reach far than 500 m<sup>3</sup>/ha, while on the steep terrain growing stock per hectare can be very low. Prevailing tree species are beech and spruce, but mixed many times with larch, pine or silver fir. On difficult terrain the timber value is sometimes low, what puts additional strain to the economy of logging. Some forest areas on steep terrain are classified as protection forest and are not managed on usual way.

Slovenia is a land where private forest prevail (Košir, 1993a,b, Medved, 2000, 2003). In average the woodlots are extremely small, but in the mountains this rule is sometimes broken. The forest ownership can be here locally a little larger if speaking about the size of woodlot. State forest is usually better managed with greater growing stock and better structure of tree species.

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The owners' income dependency on forest production is also many times very weak. This is a reason why many forest owners are not interested and motivated to manage their forest property. Among the most urgent problems of private forest property is therefore poor equipment of forest owners and their knowledge of safety at work, as well as other aspects of forest woodlot management.



**Figure 1: Terrain roughness and inclination**

**Table 5: Forest area per property category**

Feature		Tolmin	Bled	Total	
A	Forest area	ha	138242	67498	<b>205740</b>
B	State and Regions	ha	35501	27537	<b>63038</b>
C	Municipalities	ha	18186	1112	<b>19298</b>
D	Other Bodies	ha	0	2807	<b>2807</b>
E	Private	ha	84555	36042	<b>120597</b>
	(B+C+D)/A	%	0,39	0,47	<b>0,41</b>
	E/A	%	0,61	0,53	<b>0,59</b>

**Table 6: Ownership structure in NW Slovenia (regional forest management plans for Tolmin and Bled region, Medved, 2003)**

Ownership structure	Tolmin		Bled	
	% of the number	% of the area	% of the number	% of the area
Less than 1 ha	68,0	14,8	42,9	5,0
1 - 5 ha	25,4	37,3	39,3	27,4
5 - 10 ha	4,3	20,2	10,8	22,4
10 - 30 ha	2,1	21,8	5,9	27,4
30 - 100 ha	0,2	5,5	1,0	14,2
More than 100 ha	0,0	0,4	0,1	3,6
Total	100,0	100,0	100,0	100,0

Backbone of the forest production is forest roads network. In Alpine conditions forest roads influence the logging technology and the economy of the whole forest production more strongly than in the flat lands. The average density of forest roads in North-western part of Slovenia is somewhere between 18 m/ha (Tolmin) and 24.m/ha (Bled). In the state forests, which are usually better preserved than the private one,

the forest road density is normally higher and can reach more than 30 m/ha. This is important for the use of modern cable cranes as the machines must always be posted near the roadside.

### **3. Forest operations**

#### **3.1 Forest enterprises and human resources in North-Eastern Italy**

According to the situation analyzed in the introduction and considering the experiences carried out in the sector, also through surveys, it can be said, first of all, that the forest enterprises are mainly independent companies, because enterprises connected to sawmill are reducing by number, as consequence of the structural modifications that are affecting the sawmills. The prevailing legal status of the enterprise is the so called handicraft and the corporation types are less frequent, even the simple ones.

About the enterprises manpower it can be estimated that the ratio owners/workers is around 1/2.5 and the worker number per enterprise moves from 3 to 5 as an average. Very common is the engagement of seasonal workers who represent the 50% of the total workers. 50% of the seasonal workers come from non EU Countries, mainly from Eastern Europe Countries. This fact is quite common in the forest enterprises in Veneto Region and in Friuli-Venezia Giulia Region that are closer to the eastern border, but also in Trento Autonomous Province forest enterprises engage foreign workers, especially Romanians. The Romanian workers are recognized to be well adapted for the forest work and furthermore the communications is easier because the common origin of the Italian and Rumanian languages. Generally the most common employment methods are based on workers who introduced themselves to the enterprises or, especially for the workers coming from non EU Countries, on employed workers who recruit, on request of the employer, other workers among people from the same country. Sometimes the forest entrepreneur goes directly to the foreign country to recruit personally the workers.

About the training it must be considered that normally the forest entrepreneurs worked as employees in a forest enterprise or in a sawmill before starting with a business of their own; the employees on the contrary are trained on the field, acquiring experience through the contact with elder colleagues. This situation is partly linked to the peculiarities of the vocational training in the forest sector, which differ in the Provinces and Regions. In fact in Bolzano and Trento Autonomous Provinces the training courses are periodically organized by the Forest Services. The courses are arranged to satisfy different training levels and are addressed both to the workers and to the forest technicians. In Friuli-Venezia Giulia the training activity has been recently reorganized centred on the “Centro Servizi per le Foreste e le Attività della Montagna” (Services Centre for Forest and Mountain Activities), a facility able to organize both standing and travelling courses. In Veneto Region the training activity is rather lacking and limited to isolated initiatives, often addressed to the forest workers of the Regional bodies rather than to the forest enterprises.

The care of work safety appears to be rather variable in relation to the entrepreneurial ability and to the sensibility of the entrepreneur. In many enterprises, however, machinery and implements that satisfy the requirements of the present regulations; in great many of the enterprises the document of self-certification on risk evaluation about workers health is present and many enterprises are provided with the document on risk evaluation and safety protection. It must be appreciated that the last document has been produced in the languages spoken by the employees coming from countries that do not belong to EU at moment.

The methods of forest works management vary in relation to the wood utilized: conifer wood, broadleaves wood, firewood. 60-65% of the conifer wood is bought as standing trees by the forest enterprises that afterwards log and commercialize it; 35-40% of the conifer wood is cut on behalf of the forest owner or of the buyer of the standing trees. Spruce and fir are the prevailing species, representing around 80-85% of the utilized wood; larch and different pine species follow in relation to the area where the forest enterprise mainly operates.

90-95% of broadleaves wood is bought as standing trees by the forest enterprises that afterwards log and market it; only 5-10% of the broadleaves wood is logged on behalf of the forest owner or of the buyer of the standing trees. The firewood is generally bought as standing trees by the forest enterprises, many of which are specialized in such a way to prepare the material for market it, also to the final customer.

Considering the wood assortments of conifer wood, 50% includes industrial wood, 35-40% packing wood and the remaining pulpwood. These are only mean estimations, which figures could be modified in relation to the area where the wood is produced. For broadleaves wood industrial assortments prevail, 80-85%, followed by pulpwood, 10-15%; the remaining consists in packing wood.

The yearly amount of utilized wood and the work productivity vary in relation to the forest typology in which the forest enterprises mostly operates: high forest and coppice forest. In conifer and broadleaves high forests 3.500-4.000 m<sup>3</sup>/year are harvested as average per enterprise with a daily productivity per worker equal to 2.75-3.5 m<sup>3</sup>. In coppice forests 1,000 t/year are harvested as average per enterprise with a daily productivity per worker equal to 1-1.2 t.

Taking into account the operations duration, the forest enterprises which mainly work in high forests operate 8.5-9 months/year, utilizing around 200 working days; the forest enterprises which work in coppice forests operate 8-8.5 months/year, utilizing around 180 working days.

The main work activity is devoted to forest utilization (75-80%), to forest improvement operations (clearing and thinning), (15-20%), to clearing of zones subject to power line and gas pipeline servitude and to utilization of riparian tree vegetation.

Beside the main work activity, the forest enterprises carry out other activities that are different and largely depend on enterprises structure and on entrepreneur's managing capability. A part from the cases where the forest entrepreneur is also a farmer and dedicates to farming the residual time from forest activity, other situations are frequent: the forest enterprise is dedicated to preparation and marketing of firewood, to materials transportation, to winter road maintenance works (snow ploughing and salt spreading), to forest road construction, to small in watershed management works. Some enterprises utilize cable crane based on sledge yarder for building of lifts in sky resorts and in materials transportation in difficult situations (power lines, bridges building).

Further considerations can be derived analysing the data on the forest road network and the forest enterprises (Table 4). The forest road network shows a great variation if the Autonomous Provinces and the two Regions are considered. It can be seen that from an average of 27 m/ha, in Bolzano and Trento Autonomous Provinces, the road network density decreases to an average of 14 m/ha in Veneto and Friuli-Venezia Giulia Regions. These are situations which above all are connected to the differences in topography of the forest areas. In Bolzano and Trento Autonomous Province, which forest areas are totally mountainous, the road network density assumes high values which are necessary for a rational exploitation of the forest resources. In Veneto and Friuli-Venezia Giulia Regions, where forest areas lay partly (around 1/5 of the total forest area) on hilly and less step terrain, the forest road network is less dense; nevertheless it is still lower than the optimum for the forest situation typical of those Regions (Bortoli, 1998).

**Table 7: Forest road network and forest enterprises**

Feature		Bolzano Autonomous Province	Trento Autonomous Province	Veneto Region	Friuli- Venezia Giulia Region	<b>North- eastern Italy</b>
Forest road network	m/ha	25	29	13	15	<b>20,5</b>
Forest enterprises						

Enterprises	n.	40	122	54	133	<b>349</b>
Workers	n.	130	269	234	382	<b>1015</b>

The available data about the forest enterprises come out both from official sources (Friuli-Venezia Giulia Region, 2005) and from estimations (Giovannini, 2003; Schmiedhofer, 2004) and are used to try to define the weight of these productive units on the wood system. It can be estimated that in North-eastern Italy operate not less than 350 forest enterprises, with an utilization of around one thousand workers. It must be clarify that the figures does not include workers from the Public Administrations (Forest Service and Forests and Domain Provincial Agency in Bolzano Autonomous Province, Forest Service in Trento Autonomous Province, Regional Forest Services and Veneto Agricoltura Agency in Veneto Region, Silviculture and Forest Fire Fighting Service in Friuli-Venezia Giulia Region) which contribute performing interventions in the field of silviculture and territory maintenance, including forest utilization.

### 3.2 Forest management principles and executioners of forest production in North-Western Slovenia

By Slovenian Forest Act the forest owners are responsible for managing their forest. Public Forest Service was established with the same act. The successors of previous public forest enterprises have got concessions for forest harvesting within prescribed conditions and under different restrictions in state forests. These enterprises transformed in private share holding companies. A number of private entrepreneurs emerged during the last fifteen years, which are capable to perform any kind of forest operations in state (as subcontractors) and private forest. In private forest the predominant executioners are forest owners with the help of neighbours or hired workforce.

**Table 8: Allowable 10 years cut in NW Slovenia**

Feature	Tolmin		Bled		Total		Total
	Softwood	Hardwood	Softwood	Hardwood	Softwood	Hardwood	
Total cut	1.166.719	2.765.152	1.385.759	375.053	5.692.683	10.218.647	15.911.330
State and Regions	427.868	593.425	585.986	60.635	1.667.914	2.907.960	4.575.874
Municipalities	75.002	170.184	5.714	2.201	253.101	431.200	684.301
Other Bodies			35.764	9.600	45.364	90.728	136.092
Private	663.849	2.001.543	758.295	302.617	3.726.304	6.788.759	10.515.063

The idea which has dominated in forest management in last half of the century is co-natural principle with recognition of multifunctional role of forest. Every part of the forest has general beneficial functions, but some of them can be suppressed by one, which is for particular part of the forest most important. That is valid also for commercial forest, where annual cut is prescribed in ten years forest management plans. For every cutting unit or compartment the silvicultural plan must be written by forest act. Selection cutting and thinning are predominate. Clear cuttings are forbidden by law. Final cuttings as a final stage of group even-aged forest is possible, but such cases have small areas. Average cut per hectare is small. There is always also the question of wind-break and snow- or ice-break wood. In average some 10 – 30% of the annual cut in state forest comes from unplanned cuttings. In some years this share can be much higher on places where local disaster occurs.

Professional forest operations in state forest are in the hands of concessionaires – one in Tolmin and one in Bled region. Concessionaires are successors of previously public owned forest enterprises, which have been transformed into share holding companies. Both companies are working under very different conditions. Along Italian border is a territory of SGG Tolmin forestry enterprise, where broadleaves predominates, over the Alpine ridge GG Bled perform harvesting on high plateaus with spruce forests



and high timber quality. Number of workers is in permanent decrease and is now around 70 in SGG Tolmin and 120 in GG Bled forestry enterprise. Beside these two – the strongest – enterprises, one forestry co-operative is also performing forestry operations in limited extend. Several entrepreneurs are working as competitive individuals or in some kind of relation with stronger enterprises. All together not more than 50 workers are employed on this way.

Unprofessional part of forest work is in the hands of forest owners, who can work in their forest or in the forest of their neighbours without limitation and tax payment. Forest owners are poorly equipped with proper mechanisation and safety equipment (Medved, 2000). They are also not skilled workers and that is the reason of great risk and frequent injuries at work in private forests. It is also hard to estimate the number of forest owners who are interested for forest work and are really working in the forest.

### **3.3 Working systems and machinery in North-Eastern Italy**

The system that consists in felling and delimiting and cross cutting at stump (cut-to-length system) and logs terrestrial yarding (80%) and cable yarding (20%) is prevalent. Felling, delimiting and crosscutting are performed using chainsaw, while yarding is carried out through different ways in relation to the slope of the field and the road network density. Ground yarding is mainly performed with tractor and winch; tractors are mostly 4WD (80-85%) and crawler (15-20%) agricultural tractors, the winches being mounted (60%) and fixed (40%).

Aerial yarding is carried out by means of cable cranes based on sledge winch yarders and mobile tower yarders. The ratio between the two cable cranes moves between 50:50 and 60:40 in relation to the forest area. It is likely that in the next future the ratio will not change because the two cable cranes do not have competitive uses compared to the different operative features and especially in relation to the different length of the cable lines that can be set up.

In the last years work systems have been introduced that consider felling and partial delimiting and crosscutting at the stump, yarding and final delimiting and crosscutting at landing, or felling, yarding of the full tree and delimiting and crosscutting at landing. These systems are based on the processor, mounted or self-propelled, able to delimit and crosscut the stem, ground or cable yarded in relation to the size of the tree and to the slope of the logging area. At moment in Provinces and Regions of North-eastern Italy a number of 12 processors is estimated<sup>1</sup>: 5 processors are mounted on tractor, 6 are self-propelled, based on crawled and wheeled excavators, one is coupled with a tower yarder mounted on a truck to compose a “*gebirgsharvester*”. The rapidity of introduction of these machines and the opinions from the entrepreneurs allows that the system of processing trees at landing will grow in the future.

Considering the use of harvester for fully mechanized tree harvesting at moment six machines are operating<sup>1</sup>, four of them wheeled, one crawled and one hybrid. All six harvester work in heavy intensity cuts, on small and medium diameter trees; the wheeled harvester are able to move on slope up to 40%, the crawled one, equipped with the self levelling cab, can move on slope up to 60% and the hybrid one can work on sloping land up to 100% and more. Two of the four wheeled harvesters are linked to two forwarders for the wood transportation. Also in the case of the forwarder the interest of entrepreneurs is growing: in the study area seven forwarders are operating<sup>1</sup> and, with the exception of the two coupled with the harvesters, the other five are used for yarding and transportation of logs in semi-mechanized systems, in which they replace tractor with forest trailer.

### **3.4 Harvesting technologies in North-Western Slovenia**

In Slovenia cutting is performed mainly by chainsaw. Cut-to-length mechanised cutting has been in fast progress after 2000 and combination of cable crane and processor with tree method has also been introduced. Promotion of CTL technologies involves great efforts of researchers on the university and institute. Forestry companies and entrepreneurs are permanently investigating opportunities to invest into

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<sup>1</sup> Estimate is based on Italian Author's information and on information kindly provided by Companies Euromach s.r.l., Greifenberg s.n.c., IMAI s.r.l. and Sicma di Tremea s.r.l.

modern machines. GG Bled enterprise is equipped with harvesters and forwarders and is performing CTL technology for several years. The problem of cutting the trees will be solved on easy and moderate terrain while on difficult terrain where cable skidding prevails the chainsaw will probably stay in use for a longer time.

Among the skidding forms tractors predominate. In Slovenia three types of tractors are in professional use in forestry. Major types are wheeled agricultural tractors, four wheel drive, equipped with two drum hydraulically driven and remote controlled winches. Second type are forestry skidders like Timberjack 240 C, Iwafuji T 41 or WOODY 110; and the third type is represented by tracked tractors equipped for forest work similarly as agricultural wheeled tractors. Cable skidding is important way of skidding in mountainous parts of Slovenia, where can locally reach one third of the wood volume. Ground hand skidding is important also, but as combination with tractor or cable skidding mainly (Table 9).

**Table 9: Distribution of the forest area (in %) according to the skidding distance in Alpine part of Slovenia and the rest of the country**

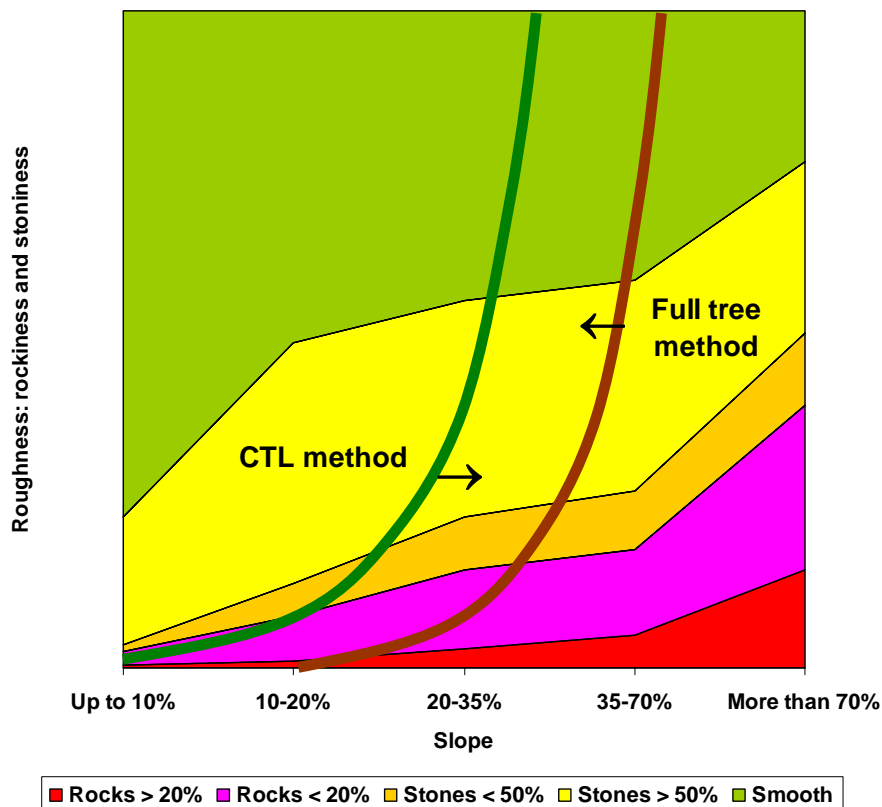
	Slovenia without Tolmin and Bled						Total
	Up to 200	200- 400	400- 600	600-800	800-1200	Over 1200	
				%			
Cable crane	0,3	0,6	0,2	0,1	0,1	0,0	1,3
Cable+hand skidding	0,1	0,4	0,3	0,1	0,1	0,0	1,0
Hand skidding	0,3	0,3	0,1	0,0	0,0	0,0	0,7
Tractor+hand skidding	3,4	8,5	5,4	2,3	1,4	0,5	21,5
Tractor skidding	13,4	27,0	17,7	8,7	5,4	3,3	75,5
Total	17,5	36,7	23,8	11,2	7,0	3,9	100,0
				Tolmin+Bled			
Cable crane	1,2	3,8	2,2	1,0	1,3	0,0	9,5
Cable+hand skidding	0,0	0,2	0,5	0,4	0,2	0,3	1,7
Hand skidding	2,1	2,5	1,5	0,6	0,6	0,0	7,3
Tractor+hand skidding	3,2	10,0	6,7	4,4	3,7	2,9	30,9
Tractor skidding	8,8	23,2	10,7	3,3	4,4	0,3	50,6
Total	15,3	39,7	21,7	9,6	10,2	3,4	100,0

The use of gravity long distance cable cranes has been for long time traditional in Slovenia, but last years have seen decline of these old machines. In the middle of eighties however the first modern all-terrain cranes emerged (Wanderfalke/Sherpa U III), despite the technique of the all-terrain skidding has been known before (Košir, 1991a,b). Most efficient cable cranes Syncrofalke have been purchased in the middle of nineties (Košir, 2003a, b). Syncrofalke design was welcomed by four forest companies, and showed great advantages. More and more obsolete machines have been put out of work, what is especially true for the classical one drum and long distance gravity cable cranes.

Chainsaw is major tool for felling and processing the trees in Slovenia today. On tractor terrain the cut-to-length technology with harvesters will soon prevail. Difficult terrain and unfavourable ownership structure put severe restrictions on mechanised cutting. The tendency is still to replace manual and motor-manual work in the forest by mechanised cutting (Krč, Košir, 2002, 2003, 2004). On steep terrains cable cranes offer possibility to operate with processor mounted on the body of the truck. Such practice has already proved good results in some countries, as well as in Slovenia.

However the following questions have still to be solved: 1) how and where to transport branchy trees to the roadside, 2) how to process hardwood species, 3) where we can obtain sufficient wood concentration

per line to operate economically, 4) what to do with cutting residues along the roadside. Utilisation of forest residues for energy purposes has already begun, but the systems are still in development. Difficult terrain makes the introduction of such technologies more difficult, but on the other side full tree methods make possible considerations of possible whole tree biomass utilisation.



**Figure 2: Approximate delimitation between CTL and full tree methods (Košir, 2005) in Alpine region (small-scale forestry is not considered, based on real data from Slovenian forest inventory data bank)**

#### 4. Challenges and perspectives

Even if the situations of the forest enterprise based in the Provinces and Regions of the North-eastern Italy are different, the problems are similar, as come out in the meetings with the forest entrepreneurs. One of the most important issues consists in the difficulty in finding qualified manpower, especially from the same area where the enterprise is based. As considered previously, the use of workers coming from non EU Countries is growing day by day. Among the factors that seem to make the forest work less attractive for the young generations, work seasonality and salary, especially when compared to the conditions under which forest work is carried out, are considered.

Another issue is represented by the difficulties in managing the depreciation of the investment in machinery and tools when compared to the income. The forest enterprises consider crucial to introduce machines that allow the increasing of the operations efficiency and the modification of the work systems and they know the opportunities represent by the public funding, but they are aware about the fact that the investments are difficult to be depreciated during the machines and tools useful life, considering their limited use. The difficulty in planning the enterprise activity for more than one year period leads the enterprises to act with circumspection and sometimes to leave the regional and provincial funding unused.

One problem concerns the forest road network, not from a qualitative point of view, but from a quantitative one. Some forest roads, built with cutting the uphill edge and filling the downhill one, are not

able to support the weight of tractor and trailers which loading capacity is increased in the last few years. Another disadvantage is linked to the curves radius which, sometimes, have been designed to allow transportation of four meters long wood assortments. In most cases it is not possible to transport long wood assortments (eight or twelve meters) which is requested by sawmills, and which demand is increasing.

Other problems mainly regard forest enterprises specialized in firewood procurement. The coppice forests are not always supplied by a road network that allows an economic exploitation of such forests and the Municipalities that own the forests are not interested in enhancing the road network sometimes. As consequence the coppice forests are abandoned and forest enterprises buy firewood outside the area, mainly from Eastern Europe Countries but also from Central Europe ones (Austria and Germany) to cope with the market demand of firewood.

Finally the forest enterprises report that the present administrative procedures applied in allotting the cutting areas and verifying a wood sale do not fit properly the wood market dynamics and the sawmills requirements. The evolution of sawmill sector, that tends to take on peculiarities similar to the industrial sector, as for instance the criterion of *just in time*, is not well suited to the time needed for local wood procurement; sawmills have to buy wood from foreign countries markets that can guarantee wood assortments with length on demand and supplying time reduced to few days.

In order to let the forest enterprises from Bolzano Autonomous Province, Trento Autonomous Province, Veneto Region, Friuli-Venezia Giulia Region to continue performing their fundamental role, that overcomes the simply wood procurement function, and considers also the environment protection and the landscape enhancement, it is necessary to promote interventions able to increase the enterprise standard both from technical and managerial point of view.

Really important could be delegating the forest enterprise to carry out operations provided by the management plans of the public forest properties. The forest enterprises, once established the forest policy objectives and known the control methods by the Public Administration, should plan the operations and organize themselves in order to carry out such operations in a cost-effective scheduling of the works (Tollot, 2001).

Finally associations among forest enterprises should be improved with the aim of giving them more appearance also in the institutional centres, and changing from “object” to “subject” of the forest policy. The experiences carried out up to now show how the forest enterprises associations can provide information to the members, through periodical meetings in which are discussed topics related to wood market, technologies and work systems, relationships with Public Bodies, opportunities of new works, either in areas not considered previously by the forest enterprises because to far from the enterprise office or of different type in respect to the traditional ones, thank to the cooperation among forest enterprises that share machinery and experiences. The consciousness reached inside a forest enterprises consortium in Veneto Region, that counts as members 55 among forest enterprises and sawmills, is pushing toward the establishment of a regional association as already done in Lombardia Region (A.R.I.B.L., 2003) and in Umbria Region (Grohmann e Savini, 2004).

Major investments in forest road construction are not to be expected in Slovenia in next years. Many reasons support this estimation. If discussing the future role of cable skidding we may rely on old saying: »Where the wheel use is possible, the line is more expensive«. The situation in competition between tractor and cable skidding has been changing since modern cable cranes and full tree method came into operation. The old saying has to be proved with fresh calculations, where cutting and skidding costs of both systems are taken in consideration.

There is however a great area of hand skidding and hand-tractor skidding today (altogether more than 20% of forest land in Slovenia), where a competition between »wheel« and »line« will be won by those, who can offer more environment friendly and more economical skidding. Modern cable cranes have great opportunity just here, as less and less people are capable of heavy forest work on difficult terrain. In

many occasions the construction of the skid track on steep and sensitive terrain is to be restricted by environmental aspect as well as economic reasons, and that is the opportunity for the use of modern cable cranes too. Another step is to be done also toward the combination of cable crane and wood processing by the roadside (delimiting, bucking, sorting). This is hardly to be expected very soon and in great extent, as such method is dependent upon the way of forest management too.

## 5. Discussion

European Union enables new thinking, which was already present on some parts of the continent centuries ago. Those parts of the Europe were at that time parts of the historical empires which united vast areas of that time. Today's Europe makes possible thinking of regional development with no borders again. Alpine region is one of them - with unique terrain, climate and similar forestry tradition. New born union makes possible discussions about the common markets of goods, technologies and human resources.

Difficult terrains in both countries have been in history challenge for survival and struggle for economically acceptable production. That has been reason for similar technical tradition in forestry in the whole Alpine area. Technology exchange begins with the exchange of information, and this paper should be a step forward in this kind of thinking.

It would be of great advantage for all partners if forestry faculties succeeded in closer cooperation, which is today possible within institutional and many informal connections. This article has ambition to be a start of new cross border cooperation between University of Padova and University of Ljubljana.

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