

CATEGORIZATION OF FOREST ROADS ON THE BASIS OF THEIR MULTIPLE USE AND SOCIAL NEEDS

1. Introduction

Road means life – the sentence is originated from old Rome. From the very beginning roads are closely connected to humanity. Old cultures have been aware in importance of good traffic connections for military and merchant purposes. Yet the first road connections in Slovenia come from the Roman's period. In that time forest represented the source of energy what had the great importance in 14th century for mining and iron-works. Glass works were also presented in Slovenian forests. Introduction of the steam machine meant a revolution – water saw-mills were moved closer to forests. Thus wood became the good. In 1849 Ljubljana and Trieste were connected by the railway what represented woods as the goods. The first notes about the forest roads arose from Trnovski gozd at the end of 19th century. Planning of the forest roads also comes from that period. Railway and carts put by animals to the carriage were substituted by motor wheels after 2nd World War. Forest roads were adapted to the means of wood transport. Opening up of the forests started by introduction of machine construction of the forest roads. Nowadays, there are approx. 12,650 km forest roads in Slovenia that perform the solid base for the quality forest management – what is hardly realized without forest communications (POTOCNIK 1993).

Especially the forest roads are necessary for the management with forests. The forest roads are the base for connections among other communications in the forests. Traffic on the forest roads rises from:

- the forest management which is the fundamental role of the forest roads,
- other users of the forest space (hunting, cattle-breeding, gathering, recreation, tourism, tripping, mountaineering, etc.),
- traffic through the forest space but not directly connected to it (opening up the farms, hamlets, villages, hunting cottages, etc.).

Forest roads with heavier traffic load (rised by productive, social or ecological function) have to be complied to higher demands in mean of quality, maintenance, transportability. On the other hand the forest roads loaded with lighter traffic could be more simple.

Demands for social and ecological functions of the forests are getting strength due to development of society. The forest roads must be adapted to demands – they perform many of non-production tasks which are the consequence of modern living way. The consequences of these trends will indicate as traffic increasing on the forest roads. The forest roads with heavier traffic load will have to be enabled for the increased traffic additionally. Higher share of non-forestry uses on the forest roads will demand higher standards of transportability, road equipment and maintenance of the forest roads. As a result of these reasons standards of maintenance, road equipment and using of the forest roads should be ordered for each category of the forest roads.

¹ Biotechnical Faculty Dep. of Forestry and Renewable Forest Sources Vecna pot 83, 1000, Ljubljana, Slovenia, Fax.: +386-61-271-169, Email: igor.potocnik@uni-lj.si

2. Working method

The first part of the research will analyze the traffic of the forest roads in details. We analysed almost 1/6 of the whole forest roads in Slovenia (approx. 2.000 km of 12.500 km). Special inquiry list was formed where we followed several data: name and position of the forest road, ranks of existing services of forest roads (productive and social), the estimated period of lasting of particular service, transportability of the forest road and some others. Numbers of district foresters were asked to take part in the research and we managed to cover all the typical regions in Slovenia.

3. Results

3.1. Analysis of the forest roads' uses

We analyzed 15 of the most important uses (productive and social) of the forest roads:

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|----------------------------------|----------------------------------|
| 1. forestry use | 2. opening up the villages |
| 3. hunting | 4. opening up the cottages |
| 5. opening the farms | 6. opening the hunting cottages |
| 7. opening the wildlife reserves | 8. opening the mountain cottages |
| 9. transit use | 10. tourist use |
| 11. police use | 12. agriculture use |
| 13. military use | 14. gathering use |
| 15. sport and recreation. | |

In sample of 2,172.6 km of the forest roads we found out 33 % of main roads, 32 % of turnings of the 1st level, 13 % of dead-end turnings, 13 % of turnings of the 2nd level, 6 % of transit forest roads, 2 % of turnings of the 3rd level and 0 % of turnings of the 4th level. Therefore Slovenian particularities are not wide forest areas but incorporation of minor forest areas into urban landscape.

Considering the different uses of the forest roads beside their presence is important in general their duration per year. Therefore we added the time dimension for measuring their relative importance. We implemented as an unit the product between the length of the forest road and the duration of the particular use per year (daykilometers – daykm). On an average we found 3.8 uses of the forest roads for each of the analyzed forest roads. We considered two most important uses of the forest roads as they contribute the most to the total traffic load of the forest roads.

The forestry use of the forest roads is the most important. Other interests on the forest roads are strongly represented as well. Regarding the whole opening up of the farms and hunting are important. The main forest roads and turnings of the 1st level have the highest traffic load – 2/3 of uses of the forest roads perform on them. Turnings of the 2nd level and dead-end turnings have approx. 11 % of the total use of the forest roads. Turnings of the 3rd and 4th level have the least traffic loading.

As a whole the forestry use of the forest roads presents 40 % of the total use of forest roads. Hunting and opening the farms are the uses which are relatively important. Together they present 70 % of the total use of the forest roads.

The forestry use of the forest roads performs 16 % on the main forest roads and 12 % on the turnings of the 1st level according to the total use of forest roads. There are also important the uses like hunting and opening the farms on the main forest roads and on the turnings of the 1st level and hunting on the dead-end turnings.

Table 1. Contributions of particular uses and situations of the forest roads to total traffic use of the forest roads

USE OF FOREST ROADS	Main forest road (%)	Turning of the 1 st level (%)	Turning of the 2 nd level (%)	Turning of the 3 rd level (%)	Turning of the 4 th level (%)	Dead-end turning (%)	Transit forest road (%)	TOTAL (%)
Forestry	15.90	12.30	4.10	0.53	0.07	4.71	2.47	40.08
Hunting	5.98	5.36	1.72	0.33	0.00	2.61	0.77	16.76
Farms	6.79	2.59	1.14	0.17	0.12	1.05	0.87	12.74
Wildlife reserves	1.49	2.46	1.84	0.04	0.00	0.34	0.24	6.41
Villages	2.39	0.67	0.15	0.00	0.00	0.93	0.96	5.11
Transit	1.10	1.49	0.25	0.05	0.00	0.00	1.00	3.89
Tourism	2.05	0.42	0.38	0.11	0.00	0.25	0.17	3.37
Sport+ Recreation	1.63	0.26	0.12	0.13	0.02	0.17	0.16	2.48
Cottages	1.00	0.54	0.04	0.02	0.06	0.53	0.02	2.21
Police	0.39	0.47	0.46	0.18	0.00	0.19	0.11	1.79
Hunting cottages	0.80	0.61	0.06	0.00	0.00	0.01	0.11	1.60
Gathering	0.46	0.28	0.12	0.00	0.02	0.17	0.14	1.19
Military	0.42	0.26	0.20	0.09	0.00	0.33	0.00	1.30
Agriculture	0.18	0.19	0.07	0.01	0.00	0.10	0.02	0.57
Mountain cottages	0.26	0.17	0.02	0.02	0.00	0.00	0.00	0.48
TOTAL	40.83	28.08	10.69	1.69	0.28	11.39	7.04	100.00

3.2. Analysis of the forest roads' transportability

The importance of the forest roads and the particular use of the forest roads were analyzed by the transportability of the forest roads (POTOCNIK 1996). We paid attention to examining the exploited transportability of the forest roads. Thereby we are able to compare the importance of the forest roads' uses from the local point of view. The majority of the uses of the forest roads exploit the transportability of the forest roads between 50 % and 70 %. The uses of opening the farms and villages perform the highest level of exploited transportability.

Main forest road

The uses of the forest roads at opening up of the farms and villages exploit transportability in whole. They are followed by uses like forestry, hunting and police with 3/4 of exploited transportability. 2/3 of available transportability exploit uses like tourism, transit, opening up of cottages and hunting cottages. 1/2 of available transportability exploit uses like sport and recreation, military and opening up of wildlife reserves. Agriculture and gathering exploit transportability of the forest roads to 1/3.

Turning of the 1st level

Opening the farms and villages exploit transportability of the forest roads completely. Agriculture and gathering exploit 1/4 of available transportability. Majority of uses of the forest roads exploit less available transportability comparing to the main forest roads.

Turning of the 2nd level

The level of exploited transportability is similar to turnings of the 1st level. Uses in opening up of the farms and villages exploit transportability most completely. We found out 2/3 of exploited transportability at uses like forestry, transit, police, military and opening up of wildlife reserves.

Turning of the 3rd level

There are uses of the forest roads which exploit available transportability completely (opening up of farms and mountain cottages, military and police). On the other hand there are uses with decreasing level of exploited available transportability (for instance forestry, hunting, gathering).

Turning of the 4th level

The absence of majority uses is significant. For all those, the uses of opening up of the farms and cottages exploit available transportability.

Dead-end turning

Transportability is well exploited by the uses of opening up of the farms, villages, military and worse exploited by both seasonal uses (agriculture and gathering). More than 1/2 of available transportability exploit the uses like police, opening up of cottages, hunting, tourism, forestry and opening up of hunting cottages.

Transit forest road

The majority of uses on the forest roads exploit the transportability between 1/2 and 2/3. Opening of the hunting cottages stands over an average and gathering stands below an average with 1/5 of exploited available transportability.

3.3. Categorization of the forest roads

On the base of the performed analysis we could conclude that the forestry use is the most important and – according to this statement – subordinate required technical elements, road equipment and maintenance of the forest roads. Beside that, a factor that would consider life interests for presence of the particular use of the forest roads, is missed. Earlier we discussed about the level of the exploited transportability of the forest roads. Exactly that factor is the one that contains the social point of view – interest.

Therefore we divided the uses of forest roads into 4 groups:

- Uses which exploit transportability of the forest roads by around 100 % are presented: opening up of the villages and farms. The group presents 10.7 % of the analyzed roads.
- Uses which exploit transportability by more than 75 % – opening up of the mountain cottages, cottages and hunting cottages, military, police and transit. The group represents 9.8 % of the analyzed forest roads.
- Uses which exploit transportability of the forest roads by 66 % – forestry, hunting, tourism, sport, recreation and opening up of the wildlife reserves. The group represents 75.5 % of lengths of the analyzed forest roads.
- Uses that exploit available transportability by less than 50 % – seasonal uses (agriculture and gathering) are presented. The group represents 4 % of the analyzed lengths of the forest roads.

According to the Slovenian forest legislation (1994, 1996) we merged the groups into three main categories of the forest roads.

Table 2. The united uses of the forest roads

USE OF THE FOREST ROADS	Length of the forest roads (km)	Duration of the use of forest roads (daykm)	Exploited transportability of the forest roads (%)	Description	
Villages	3.0 %	5.2 %	100.0 %	Category 1	Marked public use, high level of exploited transportability; local communities take-over their management
Farms	7.7 %	13.0 %	99.1 %		
Transit	3.5 %	4.5 %	89.2 %		
Mountain cottage	0.4 %	0.5 %	87.9 %		
Police	1.4 %	1.8 %	93.4 %	Category 2	Important public use, level of exploited transportability is variable
Military	0.9 %	1.2 %	86.6 %		
Cottage	2.0 %	2.3 %	79.2 %		
Hunting cottage	1.6 %	1.6 %	74.7 %		
Tourism	3.5 %	3.3 %	67.4 %		
Sport and recreation	2.8 %	2.4 %	61.1 %		
Agriculture	0.9 %	0.6 %	48.4 %		
Gathering	3.1 %	1.3 %	31.0 %		
Hunting	18.2 %	16.7 %	67.5 %	Category 3	Marked forest management's use of forest roads including wildlife management
Wildlife reserve	8.2 %	6.3 %	57.7 %		
Forestry	42.8 %	39.2 %	65.3 %		

Category 1: Mark GI/1. Public use of the forest roads is stressed and predominated. Public traffic is presented daily and it is important for the life of people. Uses like opening up of the farms, villages, mountain cottages and other tourist objects and transit use of the forest roads are presented in the group GI/1. High level of the exploited transportability is significant. The group represents 14.6 % of analyzed forestry roads' lengths. Calculating of all the forest roads in Slovenia the group GI/1 would present 1,850 km of the forest roads.

Category 2: Mark GI/2. Public use of the forest roads is important, but not as much as local communities would take-over their maintenance. The uses like tourism, sport, recreation, police, military, agriculture, gathering, opening up of the hunting cottages and cottages are presented. The group GI/2 represents 16.2 % of the analyzed forest roads' lengths. The level of exploited transportability of the forest roads is variable and with a local character. Calculating of all the forest roads in Slovenia, the group GI/2 would include 2,050 km of the forest roads.

Category 3: Mark GII. Group is the most extensive and represents 69.2 % of the analyzed forest roads' lengths (8,750 km in Slovenia). Uses are presented as rising due to management with forest's ecosystem (not only forest management but wildlife management as well). The combination of uses is professionally correct. According to the extension of the group it is reasonable to divide it into 2 subgroups: the main forest roads (GII) and the side forest roads (GIII). The average traffic load of 12 vehicles per forestry exploited day is proposed as a delimitation among the main and the side forest roads (counting at a junction of forest road to a public road).

4. Standards of maintenance, road equipment and way of use of the forest roads

The group of the forest roads which has the different traffic load has to be complied to the specific requires (technical elements, standards of maintenance and road

equipment). Forest roads with marked public traffic have to be complied to the different standards as those with marked forestry traffic. Therefore we defined wider frames of standards of maintenance, road equipment and way of use.

Category GI/1

Public traffic is predominated. Due to the character of the traffic local communities take-over their management. Regular maintenance and whole-year-lasting transportability should be ensured. In case that local communities are not available to take-over their management, roads are classified to the category GI/2.

Category GI/2

MAINTENANCE: roads should be transportable the whole year. Regular maintenance of carriage-way, culverts, ditches, etc. and winter maintenance (ploughing, sanding) should be ensured.

ROAD EQUIPMENT: at the beginning of the forest road there are placed marks which are showing the road is a forest road, with necessary sign-posts, other warnings (speed limit, general warnings, allowed axle pressure, etc.). In front of the dangerous sites there should be placed signs of warnings and metal parapets.

WAY OF USE: no limits for personal traffic, the possibility of truck traffic regarding the temporary restriction of axle pressure (after long-lasting rains and during the period of thawing).

Category GII

MAINTENANCE: roads should be transportable the whole year. Regular maintenance of carriage-way, culverts, ditches, etc. and winter maintenance (ploughing, sanding) should be ensured.

ROAD EQUIPMENT: at the beginning of the forest road there are placed marks showing that road is a forest road, the category of the forest road, necessary sign-posts, other warnings (speed limit, general warnings, allowed axle pressure, etc.). In front of the dangerous sites signs of warnings and metal parapets should be placed.

WAY OF USE: no limits for personal traffic, possibility of the truck traffic for temporary restriction of axle pressure (after strong rains and during the period of thawing).

Category GIII

MAINTENANCE: only regular maintenance of culverts, ditches, etc. should be ensured. Maintenance of carriage-way and winter maintenance are irregular – according to needs of the forest management. Roads are not necessarily transportable the whole year.

ROAD EQUIPMENT: roads have no signs and road furniture.

WAY OF USE: roads can be closed for the public traffic. Roads could be closed for the truck traffic after strong rains and during the period of thawing.

5. Summary

Forest communications (especially the forest roads) are necessary for the management with forests. The forest roads are the base for connections among other communications in the forests. Traffic on the forest roads rises from:

- the forest management which is the fundamental role of the forest roads;
- other users of the forest space (hunting, cattle-breeding, gathering, recreation, tourism, tripping, mountaineering, etc.);

- traffic through the forest space but not directly connected to it (opening up the farms, hamlets, villages, hunting cottages, etc.).

Forest roads with heavier traffic load have to be complied to higher demands in mean of quality, maintenance, transportability. On the other hand the forest roads loaded with lighter traffic could be more simple.

Demands for social and ecological functions of the forests are getting strength due to development of society. The forest roads must be adapted to demands – they perform many of non-production tasks which are the consequence of modern living way. The consequences of these trends will indicate as traffic increasing on the forest roads. The forest roads with heavier traffic load will have to be enabled for the increased traffic additionally. Higher share of non-forestry uses on the forest roads will demand higher standards of transportability, road equipment and maintenance of the forest roads. As a result of these reasons standards of maintenance, road equipment and using of the forest roads should be ordered for each category of the forest roads.

Forest roads in Slovenia have the tradition of planning. They constitute an important part of the Slovenian road network. Forest roads are destined to forest managing and to other non-forestry users. In the present research 15 most frequent uses of the forest roads were analyzed. Intensive particular uses of the forest roads influence upon the quality of their maintenance, road equipment and way of their use. Considering this fact as a base we performed the categorization of the forest roads

The forestry use of the forest roads is the most important and presents 40 % of the total use of the forest roads followed by the hunting (17 %) and opening the farms (13 %). 2/3 of the total use of the forest roads are performed on the main forest roads and turnings of the 1st level. The least loaded are the turnings of the 3rd and 4th level.

The local characteristics influence upon the importance of particular use. We improved the results of the previous analysis by the analysis of the transportability of the forest roads. The majority of the uses of the forest roads exploit the transportability between 50 % to 70 %. On the base of the exploited transportability we joined the uses of the forest roads into 4 groups:

- in the 1st group there are the uses which exploit the transportability of the forest roads by approx. 100 % (opening the farms and villages),
- in the 2nd group there are the uses which exploit the transportability of forest roads by more than 75 % (opening of the mountain cottages, cottages and hunting cottages, police and transit),
- in the 3rd group are appear the uses which exploit the transportability by around 60 % (forestry, hunting, sport and recreation and opening the wildlife reserves)
- in the 4th group are found the uses which exploit the transportability by less than 50 % (agriculture and gathering).

Finally 4 groups were joined into 3 categories:

- marked public use, high level of exploited transportability, local communities take over their managing,
- important public use with variable level of exploited transportability,
- marked forest management's use including the wildlife management. According to the extension of the group, it is divided into 2 subgroups: the main forest roads (GII) and the side forest roads (GIII). The average traffic load of 12 vehicles per forestry exploited day is proposed as a delimitation among the main and the side forest roads.

The framed standards of the maintenance, the road equipment and the way of use are prescribed for the particular categories of the forest roads. The categories with important public (non-forestry) use should fit to higher demands as the categories with less intensive and first of all forestry traffic.

6. References

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Доц. В.І. Вовк¹, к.ф.-м.н. – м. Київ

УКРАЇНСЬКА ДІЙСНІСТЬ В КОНТЕКСТІ ЕКОЛОГО-ЕКОНОМІЧНОГО ВЧЕННЯ Й СЦЕНАРІЇВ СВІТОВОГО РОЗВИТКУ

Становлення України як сучасної розвинутої держави і спроможність забезпечувати свої національні інтереси значною мірою залежать від її повноцінного входження у світовий цивілізаційний процес. Вирішення цього завдання вимагає формування стратегії розвитку України, що базується на сучасних світоглядних принципах, враховує фундаментальні тенденції розвитку сучасного світу та здатна дати дороговкази у гідне майбутнє.

Doc. Victor Vovk² – Kyev

Ukrainian reality in the context of Ecological-Economic Doctrine and scenario of world development

Formation of Ukraine as contemporary developed State and capability to support national interests in many respects depends on its competent entering into world civilization process. For this task solving it's necessary to elaborate the Development Strategy for Ukraine on the base of modern Weltanschauung, takes into account fundamental tendencies of development the present-day world and is able to give the directions towards respectable future.

Еколого-економічне вчення та глобальні сценарії розвитку

Як відомо, сучасна індустріальна цивілізація, що стрімко розростається, почала вичерпувати існуючу ресурсно-екологічну нішу та входить в епоху планетарної кризи, що охоплює різноманітні аспекти людського життя. Недопущення розгортання цієї кризи є головним завданням людської цивілізації у ХХІ столітті. Тому природними є спроби розробити певні довгострокові прогнози та сценарії світового розвитку як на основі математичного моделювання, так і на базі суспільно-інституційного аналізу.

¹ Заст. директора Інституту сталого розвитку

² Deputy director of Sustainable Development Institute