

3. ЛІСОТРАНСПОРТНЕ ОСВОЄННЯ ТА ІНФОРМАЦІЙНІ ТЕХНОЛОГІЇ

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HISTORY AND IMPORTANCE OF "OPERATION ROADS" IN JAPAN

In Japan, the forest road standard is prescribed by Forest Road Regulation. A forest road is fit for truck transportation. In this report we will use the term "operation road", instead of spur road. Operation roads are constructed for certain forestry vehicles such as forwarders and small trucks. Operation roads in Japan have been constructed and developed by eager foresters according to the local conditions of forestry. Operation roads have simple structures and only a small earth work is required for construction. There are so many original ideas in different regions. A dense forest-road network enables not only low cost harvesting but also all forestry operations such as pruning and thinning. Operation roads in the plantations will save the natural forest resources, and those in the natural forests realize a low-intensity and high-frequency selection cutting system. When a road is constructed, photosynthesis of trees facing the road is increased and the amount of leaves is also increased resulting in the promotion of root growth. Increased roots will make porous soil and hold soil and rocks, and retain more water. This is the effect of road network on water and soil conservation. If operation roads are constructed appropriately according to the plan, they will contribute to sustainable forestry and global environment.

Keywords: environmental conservation, forest road, operation road, sustainable forestry

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Історія та важливість "господарських доріг" в Японії

В Японії діє лісовий дорожній стандарт, згідно якого лісова дорога призначена для перевезення вантажів автомобілями. В цій статті замість терміну лісовозний вус використовується термін "господарська дорога". Такі дороги створюються для певного виду лісотransпортного засобу, наприклад: сортиментовоз чи мала вантажівка. Господарські дороги в Японії проектується та будуються працівниками лісових підприємств згідно місцевих вимог. Вони споруджуються, як правило, простої структури і не потребують виконання великого об'єму земляних робіт. В різних регіонах існує багато оригінальних ідей щодо будівництва цих доріг. Щільна мережа лісових доріг забезпечує низьку вартість не тільки лісотransпортних операцій, але й інших лісogосподарських робіт. Господарські дороги сприяють збереженню природних лісових ресурсів, дають змогу реалізовувати часті вибіркові рубання з низькою інтенсивністю. В дерев, що ростуть біля узбіччя покращується фотосинтез, зростає кількість листя і, як результат, збільшується кореневий ріст. Збільшення коріння робить ґрунт пористим, сприяє утриманню в ньому вологи та каміння. В цьому полягає вплив дорожньої мережі на збереження водних та ґрунтових ресурсів. Якщо господарські дороги будувати відповідно до плану, вони сприятимуть сталому розвитку лісового господарства та довкілля в цілому.

Ключові слова: збереження довкілля, лісові дороги, господарські дороги, сталий розвиток лісового господарства.

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Introduction

The forest-road network is indispensable for practicing forestry operations. The forest road network is composed of forest roads and spur roads. Spur roads usually have a lower standard than forest roads and supplement forest roads.

In Japan, the forest road standard is prescribed by Forest Road Regulation (Table 1). A forest road is fit for truck transportation. A spur road is also called, strip road, hauling road, yarding road, or skidding road, but in this report we will use the term "operation road", which is a direct translation from the Japanese term, instead of spur road. Operation roads are constructed for certain forestry vehicles such as forwarders and small trucks. Logging trucks sometimes cannot use operation roads.

Table 1. History of operation roads in Japan

1943	The optimum forest road space theory by Donald Matthews.
1945	End of World War II.
1955	Forest Road Regulation was enacted.
<i>Fuel revolution</i>	
1956	Reinforcement Plan of Productivity for national forests was established and forest-road network plan was established.
1959	Rationalization of Forest Road Task Prospectus in national forest. It was decided that forest rail ways must be converted to forest road.
1963	FAO/ECE Symposium on forest-road network at Geneva.
1963	Three wheeled forwarder was developed (Figure 1).
1964	Concept of operation roads by H. Steinlin was introduced by S. Kato.
1964	Forestry Basic Law was enacted.
1965	First Forestry Structure Improvement Project for private forests, which emphasizes consolidation of forest road, started.
1968	Operation trails for silviculture were subsidized by the government.
1969	Development of high-density forest road networks in national forests started.
1970	Statistics of operation roads started.
1971	Four wheeled forwarder was developed (Figure 2).
1973	Forest Road Regulation was revised. Factor of vehicle speed was introduced.
<i>Second Structure Improvement Project, that emphasized strengthening of the management of forest owners' associations, started</i>	
1973	First oil crisis.
About 1979	Mini-forwarders with rubber crawlers were introduced mainly on Shikoku island (Figure 3).
1979	Third Structure Improvement Project started.
About 1980	Back hoes began to be used for forest road construction instead of tractor shovels.
1983	Forest Road Regulation was revised. Lowest standard was added.
About 1986	Hydraulic grapple loaders became popular (Figure 5).
About 1989	Processors and harvesters were introduced.
1990	Fourth Structure Improvement Project, that emphasized the introduction of processors and harvesters, started.
<i>Domestic tower yarder was developed</i>	
1996	Fifth Structure Improvement Project started.
2000	Sixth Structure Improvement Project started.
2002	Forest Road Regulation was revised. The monorail was added.

Operation roads in Japan have been constructed and developed by eager foresters according to the local conditions of forestry. There are so many original ideas in different regions, and the forest-road network reflects the policy of forest owners or forestry leaders in the region.

This is a report on the development of operation roads in Japan and the role of operation roads in forestry and environment management. Temporary roads such as skidding trails are classified into logging facilities, and are not included in a forest-road network.

Introduction of the concept of operation road

After World War II, Japanese people planted coniferous trees sugi (*Cryptomeria japonica*) and hinoki (*Chamaecyparis obtusa*), year by year. A fuel revolution occurred in the mid-fifties and accelerated the conversion of broad leaved trees to conifers. Plantations have now reached 10 millions hectares, and they occupy 41 % of forest area that equals about a quarter of land.

The main harvesting system of private forestry in Japan before forestry mechanization was sledding by manpower or horses. In the early seventies, small-size machines of yarders and forwarders were introduced, and in the mid-seventies most of the harvesting systems were mechanized (Figures 1 and 2). Forestry Structure Improvement Project played an important role in mechanization of small-scale forestry.



Figure 1. Three wheeled forwarder on an operation road 2 m in width (1982) [2]



Figure 2. Prototype four wheeled forwarder on the operation road (1981) [2]

The concept and significance of operation roads [4, 5] were introduced from Europe by Seihei Kato in 1964. At that time operation roads meant temporary trails for logging. Hans Steinlin emphasized intensive utilization of forest area, and noted that every stand must be connected to *Forststrasse* by *Rückgasse*. For introducing machines and vehicles, logs at the operational site must be carried to forest road in a short distance at a low cost, and at the same time, the remaining growing trees must be protected. His concept was surprisingly identical to the concept on operation road we have today.

At that time the Japanese economy was just achieving rapid growth. Before the proclamation of the Forestry Basic Law in 1964, whose main target was the increase of forestry production, improvement of productivity, and the increase of income for forestry workers, the forest road was recognized as infrastructure of forestry, and policy on forest road was discussed enthusiastically. The recognition of the importance of forest roads seemed based on the practical use of mechanized road construction.

In about 1975, the plantations began to require thinning, and such various small harvesting systems for thinned logs such as mono-cable, monorail, and mini-forwarders were developed. Mini-forwarders were accepted widely by small-forest owners.



Figure 3. Mini-forwarder with rubber crawlers on an operation road 1.5 m in width (1984) [2]

Taking opportunity of the oil crisis in 1973, construction of operation roads increased instead of forest roads of high standard, and various combinations of operation roads and mini-forwarders remarkably spread among private forestry for the thinning of plantations (Figures 1, 2, and 3). Technologies of operation road construction were born naturally and different among regions (Figure 4) [1].

However loading, unloading, and preheating were practiced by manual work. Loading logs on the loading platform of forwarders was heavy work. Fortunately, grapple loaders were introduced from Scandinavia in about 1986, and the operational efficiency of loading and unloading was greatly improved (Figure 5). Operational systems of processors and harvesters have spread not only in national forests but also private forests since about 1989. Recently construction technology has advanced markedly owing to the new development of road-making machines (Figure 6) [2].



Figure 4. Advanced road construction on steep terrain (2000) [2]



Figure 5. Mini-forwarder equipped with a grapple loader on an operation road 2.3 m in width (1987) [2]

Difference in the function between forest roads and operation roads

If forest roads are compared to arteries, operation roads are capillary vessels. Forest roads develop like a line, and operation roads are distributed all over the forest area like a mesh. Function of the operation roads is the same as that of helicopters. But operation roads require less energy and can be used at any time. Operation roads support sustainable forestry management practically and substantially.

In Japan damage of forest roads by disasters is compensated by subsidy from government or municipality when suffered from disaster. But operation roads have no such subsidy because it benefits enterprises and is not covered by the Forest Road Regulation. Beneficiaries of operation roads must bear the maintenance and the cost for recovery from disaster.

Therefore operation roads must be located efficiently and designed skilfully adapting to natural conditions. Operation roads have simple structures and only a small earth work is required for construction. Thus undesirable effects on environment can be minimized and the recovery from disaster is easy.



Figure 6. New excavator that can rotate its arm (2003) [2]

Importance of operation roads

A dense forest-road network enables not only low cost harvesting but also all forestry operations such as pruning and thinning. A forest-road network is a fundamental infrastructure for intensive forest management.

Operation roads have multiple purposes and multiple functions, and are used repeatedly. They play a leading part in forest breeding. Operation roads in the plantations will save the natural forest resources, and those in the natural forests realize a low-intensity and high-frequency selection cutting system. By the low-intensity cutting, forests can be regenerated easily and maintain a healthy condition and biodiversity. As a result, natural forests keep a high land productivity. University Forest in Hokkaido, the University of Tokyo, has practiced selection cutting systems in natural forests constructing and using a high-density road network of more than 40 m/ha since 1958 [6].

When a road is constructed, photosynthesis of trees facing the road is increased and the amount of leaves is also increased resulting in the promotion of root growth. Increased roots will make porous soil and hold soil and rocks. Porous soil and increased litter retain more water. This is the effect of road network on water and soil conservation [3].

If operation roads are constructed appropriately according to the plan, they will contribute to sustainable forestry and global environment.

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БУДІВНИЦТВО АВТОШЛЯХІВ – ЗАПОРУКА ЕФЕКТИВНОГО РОЗВИТКУ ТУРИСТСЬКО-РЕКРЕАЦІЙНОЇ ІНДУСТРІЇ В УКРАЇНСЬКИХ КАРПАТАХ

Представлено інформацію про значення і стан гірських басейнових екосистем Українських Карпат. Обґрунтовано небезпеку, яка може викликати негативні наслідки у структурі і функціонуванні басейнових екосистем гірських рік. Пропонується будівництво автомобільних шляхів, які істотно зменшать антропогенне навантаження від розвитку туристсько-рекреаційної індустрії в Українських Карпатах.

Ключові слова: басейнова екосистема, функціонування, лісові ценози, автошляхи.

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Construction of motorways is the precondition of the effective development of the tourism-recreational industry in the Ukrainian Carpathians

The article depicts the information about the role and the state of mountain basin ecological systems of the Ukrainian Carpathians. The author substantiates the danger, which could lead to negative consequences in the structure and the operation of basin ecological systems of mountain rivers.

The author suggests that motorways are built, which will essentially decrease the anthropological load, which is caused by the development of the tourism-recreational industry in the Ukrainian Carpathians.

Keywords: basin ecological system, operation, forest centres, motorways.

У час прискореного науково-технічного прогресу проблема збереження природних екосистем, їх стабільності і біорізноманіття та раціонального використання природних ресурсів набуває важливого значення. Таким чином теза про те, що природне середовище є важлива умова життя людини стає все більш актуальною. Людство усвідомлює, що життя на планеті Земля може існувати тільки у взаємодії живих організмів із довкіллям.

Між людиною і природою постійно існує взаємозв'язок, який здійснюється у двох формах – екологічній і економічній. Екологічна форма зв'язку підпорядкована діючим законам природи, які зводяться до того, що природа

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