An Overview of Forest Management in the Republic of Korea

Hyein Shin

Abstract – Nacrtak

By the 1950s, Korean forests had become very devastated after the Korean War. Since then, the forest area and the growing stock have recovered in remarkable speed. Through various forest restoration policies, now 63% of Korea is covered with forests, which amounts to 6.335 million ha. Currently, the growing stock of Korean forests is showing an increase every year. On the contrary, forest area is decreasing because of the so called »Forest Land Conversion« project. Due to the project, forests have been converted for other purposes such as new roads, housing construction, industrial complexes, etc. In 2015 the growing stock was 924.81 million m3, higher by 15.6% than in 2010. This is a 12.4-fold increase from 1973, when the »Erosion Control and Greening Project« began. The main conifer species in Korea are red pine (Pinus densiflora Siebold & Zucc.), Korean pine (Pinus koraiensis Siebold & Zucc.), Japanese larch (Larix kaempferi Lamb.), Pitch pine (Pinus rigida Mill.) and Hinoki cypress (Chamaecyparis obtusa Siebold & Zucc., Endl.) and Oak species (Quercus spp.), Japanese chestnut (Castanea crenata Siebold & Zucc.), Black locust (Robinia pseudoacacia L.) and Birch (Betula spp.). The percentage of forestry vehicles such as harvesters, tower yarders and processors is remarkably low in South Korea. Short-wood logging method with a chain saw for felling and bucking the trees and excavators equipped with grapples for timber extraction are the most widely used harvesting system in South Korea. The current density of Korean forest roads is only 3.32%.

Keywords: Korean forests, forestry overview, red pine, wood grab

1. Introduction – *Uvod*

By the 1950s, Korean forests had become very devastated after the Korean War. Since then, the forest area and the growing stock have recovered at remarkable speed. Korean forest management played a large role in the basis of this growth (Kwon 2014). Through various forest restoration policies, now 63% of Korea is covered with forests. Currently, the growing stock of Korean forests is showing an increase every year. On the contrary, forest area is decreasing. Furthermore, although the growing stock is showing an upward trend, Korean timber self-sufficiency still remains low. This situation in Korea has been caused by a combination of factors such as forest management methods and social situation in Korea. To solve these problems, the forest management of Korea focuses on sustainable forest development.

2. History of forest management *Povijest gospodarenja šumama*

This chapter was written with reference to documents of National Archives of Korea (2018). The history of forest management in Korea can be divided into five major periods.

2.1 After liberation (1946–1966) – *Nakon oslobođenja* (1946–1966)

At the time of independence, forests of Korea were extremely devastated. The procurement of war materials during Japanese colonial period, the population growth after liberation, the Korean War, the demand of material for post-war recovery and the disappearance of forest management function have resulted in the degradation of forest resources.

In addition, in the 1940s and 50s, there was little alternative for fuel besides forest fuel wood, so a huge amount of wood was consumed. The total forest land was 6.81 million ha, and the amount of tree stock was around 5.4 million m^3. The forest policy and business of Korea were abolished after the Korean War in 1950, but they resumed their activities in January 1952 after the promulgation of »Temporary Law for Forest Protection«.

2.2 Since the launch of the Korea forest service (1967–1972) – *Nakon pokretanja Korejske šumarske službe (1967–1972)*

Since the enactment of Temporary Law for Forest Protection, the government has struggled to recover the devastated forests, and planted the fast-growing species like Japanese alder, Pitch pine, Black locust, etc. However, due to lack of resources, lack of skills, and poor follow-up management, ruined forests were not restored properly. With the launch of the economic development project, much improvement has been made in the forestry policy sector, and the Forest Law representing the basic forestry law, was enacted.

In 1967, the forest administration organization belonging to the Ministry of Agriculture was launched separately as »Korea Forest Service« and a »7-year Forest Protection Project« was established.

For the purpose of recovering desolate forests, 412,000 ha of forest for fuel wood production, 332,000 ha of seedling forest, 2000 ha of bamboo groves and 222,000 ha of improved poplar were planted. In order to eliminate the forest destruction source, the government promoted the arrangement of shifting cultivation together with creating forest for fuel wood exploitation.

2.3 The first erosion control and greening period (1973–1978) – *Prvi projekt kontrole erozije i pošumljavnja (1973–1978)*

The first »Forest Protection« regulations and »Greening Period« were established when the rural development movement was actively promoted. As the national income increased, fuel wood was replaced with alternative fuels such as anthracite. The first 10-year, »Erosion Control and Greening Project« was planned to manage the forest resources in terms of national land conservation and development. The goal of this project was reforestation of the country. By the »Associate Erosion Control and Greening Project« with rural development movement, the forests around rural areas were planted and protected by residents themselves, and community-based forest activities were also promoted. Also, the planting proportion of long term growing species and fast-growing species was set to 3:7. At this time, follow-up management was thoroughly carried out by the seedling inspection system. The plan was originally planned for ten years from 1973 to 1982, but achieved its goal in 1978, four years ahead of its original timescale. Afforestation of about 1.08 million hectares, silviculture of about 4.213 million hectares of lands, and the erosion control project of 42,000 hectares were completed together with production of 3454 million tree seedlings. Although the goal was achieved, the fundamental problems such as the problem of ownership or the management of small-scale forests, reachable funds, the tax system, and the necessity of legal modification were still present.

2.4 The second erosion control and greening period (1979–1987) – *Drugi projekt kontrole erozije i pošumljavnja (1979–1987)*

Because of the export-led industrialisation policy and economic policies focusing on heavy chemical industries in the 1970s, the proportion of the agriculture and forestry sector declined sharply during this period. Due to the rapid population growth, economic development, and improved living standards, the demand for timber has increased. At the same time, the import volume of overseas timber gradually increased after the liberalization of imports of timber, and the self-sufficiency rate, which was 21% in the 1970s, gradually decreased to 15% in 1980. The second »Erosion Control and Greening Project« began in 1979. As a result of the second erosion control and greening project, 80 large-scale economic forests were established and continuous silviculture was carried out in natural forests.

2.5 After the forest restoration period (1988–today) – *Nakon razdoblja obnove šuma (1988–danas)*

The forest restoration was resolved to some extent through the 1st and 2nd erosion control and greening projects. Therefore, from this time on, Korean forest management set the goal to maximise the productivity of the mountain areas through harmonious promotion of development of forest resources and for social benefit. 320,000 hectares of economic forests were afforested, and the silviculture of 303,000 hectares of forests was carried out. Furthermore, with the goal of establishing sustainable forest management infrastructure, 12 laws were created, including the Forest Basic Act and the Mountain Management Act. The conservation management system for mountain areas was also established.

3. Forest resources – *Šumska područja*

3.1 Forest area and growing stock – *Šumske površine i drvna zaliha*

The total forest area of South Korea is 6.335 million ha, which is 63.2% of Korea's land area. The ratio of Korean forests is high enough to rank fourth among OECD member countries, following Finland (73.1%), Japan (68.5%) and Sweden (68.4%).

As shown in Fig. 1, after the liberation from Japan in 1945, the forests in Korea were very devastated and the forest area was 6.415 million ha. The forest area recovered rapidly through the »Forest Protection Project« and the 1st and 2nd »Erosion Control and Greening Project«, but since then, the forest area has been decreasing. In 2015, the forest area decreased by an annual average of 6846 ha over five years since 2010, reaching 6.335 million ha. This is a 0.54% decrease from 2010.

The reason why Korea's forest area is decreasing every year is the »Forest Land Conversion« project. As forests have been converted for other purposes such as new roads, housing construction, industrial complexes, etc., the forest area has been decreasing. The main causes for the forest land conversion are roads (23.8%), building sites (19.8%), factories (10.9%) and agricultural lands (7.1%). In other words, non-agricultural reasons (54.6%) other than agricultural are prevailing (Korea Forest Service 2011). If forest management is maintained at the same level as now, the forest area is expected to decrease continuously to reach 6.225 million ha in 2030.

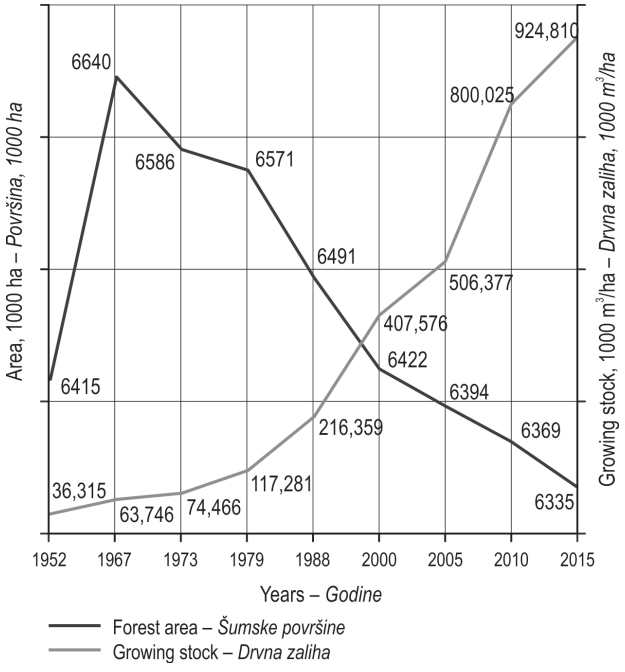

Fig. 1 Forest area and growing stock in South Korea from 1952 to 2015 (Korea Forest Service 2015)

Slika 1. *Šumske površine i drvna zaliha od 1952. do 2015. (Korejska šumarska služba, 2015)*

On the other hand, the growing stock in South Korea is increasing every year (Fig. 1). Growing stock in 2015 was 924.81 million m^3, higher by 15.6% than in 2010. This is a 12.4-fold increase from 1973 when the »Erosion Control and Greening Project« began. The reason for the rapid increase in the growing stock is that 9.5 billion trees planted through the »Forest Protection Project« and the »Erosion Control and Greening Project« reached the young matured stand of 31–50 years also as a result of the forest resource management implemented by the Korea Forest Service in 1998.

The growing stock is expected to exceed 1000 million m^3 by 2020 and 1176 million m^3 by 2030. The growing stock per ha has also increased from 6 m^3/ha to 145.99 m^3/ha since 1952 (Fig. 2). In 2030 it is expected to be 189 m^3/ha with the further decrease of the forest area and increase of the growing stock.

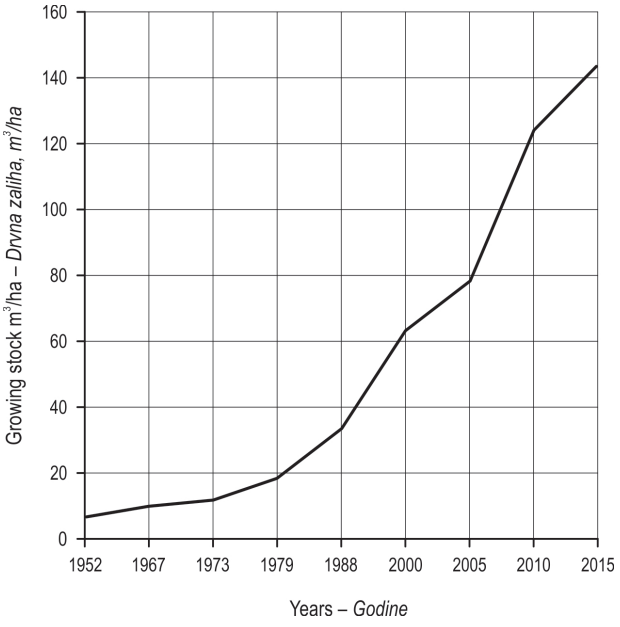

Fig. 2 Growing stock per ha in South Korea from 1952 to 2015 (Korea Forest Service 2015)

Slika 2. *Drvna zaliha u Južnoj Koreji od 1952. do 2015. (Korejska šumarska služba, 2015)*

3.2 Forest ownership – *Vlasništvo*

Due to the national forest expansion policy that promotes social values of forests and expands carbon sinks, the national forest area is increasing, while the amount of private forests is decreasing.

Table 1 Forest area and growing stock by ownership structure from 2010 to 2015 (Korea Forest Service 2015)
Tablica 1. *Šumske površine i drvna zaliha po vlasništvu od 2010. do 2015. godine (Korejska šumarska služba, 2015)*

Ownership *Vlasništvo*	2010				2015			
	Area *Površina*		Growing stock *Drvna zaliha*		Area *Površina*		Growing stock *Drvna zaliha*	
	ha	%	m^3	%	ha	%	m^3	%
Total forest area – *Ukupna površina šuma*	6,369,000	100	800,025,000	100	6,335,000	100	924,810,000	100
National forest area – *Državne šume*	1,543,000	24.2	229,113,000	28.6	1,618,000	25.5	264,191,000	28.6
Public forest – *Javne šume*	488,000	7.7	60,179,000	7.5	467,000	7.4	72,831,000	7.9
Private forest – *Privatne šume*	4,338,000	68.1	510,734,000	63.9	4,250,000	67.1	587,787,000	63.5

The growing stock per ha is the highest in national forests where systematic management is carried out based on forest management projects such as afforestation, forest conservation, and logging.

In the case of private forests, only 40% of forests are managed by forest management project. The average area of private forests is small - about 2.1 ha, so the management and investments are not done properly.

3.3 Tree species – *Vrste drveća*

As of 2015, coniferous forests (2.339 million ha) accounted for the largest portion of Korean forest area (Table 2), but have decreased steadily since 2003 because of their vulnerability to forest fires and pine wilt disease. The percentage of conifer forests in the growing stock per hectare is also the highest.

Fig. 3 shows the share of the most important tree species in South Korea. The main conifer species in Korea are Red pine (*Pinus densiflora* Siebold & Zucc.), Korean pine (*Pinus koraiensis* Siebold & Zucc.), Japanese larch (*Larix kaempferi* Lamb.), Pitch pine (*Pinus rigida* Mill.) and Hinoki cypress (*Chamaecyparis obtusa* Siebold & Zucc., Endl.). Red pine is the most common one, accounting for 35.8% in all forests in the state. Other pine species, like Korean pine and pitch pine, also account for a large proportion of Korean coniferous trees.

The major broadleaved species in Korea are Oak species (*Quercus* spp.), Japanese chestnut (*Castanea crenata* Siebold & Zucc.), Black locust (*Robinia*

Table 2 Share of forest area and growing stock by forest types in 2015 (Korea Forest Service 2015)
Tablica 2. *Udjeli šumske površine i drvne zalihe po vrstama šume u 2015. godini (Korejska šumarska služba, 2015)*

Species – *Vrsta šume*	Growing stock *Drvna zaliha*	Forest area *Površina šume*
	%	%
Coniferous *Četinjače*	38.1	38.5
Broad-leaved *Listače*	33.2	33.4
Mixed forest *Miješane šume*	28.7	28.1

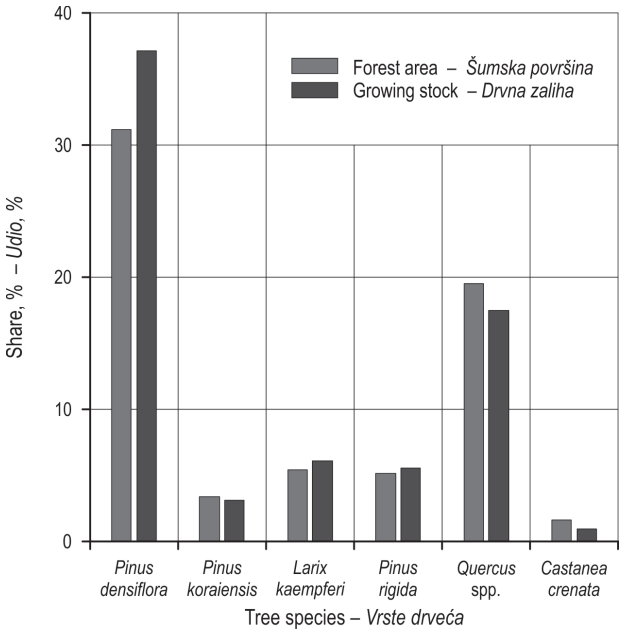

Fig. 3 Forest area and growing stock by key tree species in 2015 (Korea Forest Service 2017)
Slika 3. *Šumske površine i drvna zaliha po vrstama drveća u 2015. godini (Korejska šumarska služba, 2015)*

Table 3 Age structure of South Korean forests in 2015 (Korea Forest Service 2015)
Tablica 3. *Dobna struktura šuma Južne Koreje u 2015. godini (Korejska šumarska služba, 2015)*

Categories*	Total	Age					
		I (1–10)	II (11–20)	III (21–30)	IV (31–40)	V (41–50)	VI (>50)
Forest area – *Površina šuma*, 1000 ha	6074	203	160	1334	2831	1137	409
Growing stock – *Drvna zaliha*, 1000 m^3	924,810	–	7481	158,980	454,191	217,563	86,595

*Without degraded forest land, bamboo groves

pseudoacacia L.) and Birch (*Betula* spp.). Out of these, Oak species account for 22.3% of the forest area in Korea.

3.4 Age structure – *Dobni razredi*

As shown in Table 3, around 70% of the forest stands belong to the age classes IV, V and VI. The proportion of the forest stands under 30 years of age continues to decline. The 21–50 year-old forests account for 80% of the forest area, indicating that the age structure of Korean forests has shifted to young matured stands. This is the result of afforestation of 3.7 million hectares in the period 1962–1987.

4. Harvesting systems and forest roads *Sječni sustavi i šumske prometnice*

4.1 Harvesting systems – *Sječni sustavi*

The percentage of forestry vehicles such as harvesters, tower yarders, processors is remarkably low in South Korea (Table 4). Short-wood logging method with a chain saw for felling and bucking

Table 4 Forestry machinery and equipment in 2016 (Korea Forest Service 2017)
Tablica 4. *Šumarska vozila i strojevi u 2016. godini (Korejska šumarska služba, 2017)*

Machinery and vehicles *Strojevi i vozila*	Institution – *Poduzeće*			
	R.S. Intendancy *Regionalne šume*	Provincial government *Šume lokalne samouprave*	National Forestry Cooperative Federation *Državne savezne šume*	Total *Ukupno*
Chain saw – *Motorna pila*	768	5140	1354	7262
Excavator – *Utovarivač*	83	64	80	227
Bucket capacity 0.3 m^3 or less *Obujam radnoga tijela do 0,3 m^3*	74	55	55	184
Bucket capacity 0.4–0.7 m^3 or less *Obujam radnoga tijela od 0,4 do 0,7 m^3*	7	6	23	36
Bucket capacity 0.8 m^3 or more *Obujam radnoga tijela iznad 0,8 m^3*	2	3	2	7
Tractor – *Poljoprivredni traktor*	94	60	12	166
Winch – *Vitlo*	170	961	85	1216
Chute – *Točilo*	25	484	30	539
Tractor skidder – *Poljoprivredni traktor s vitlom*	120	55	21	196
Excavator skidder – *Utovarivač s vitlom*	41	15	9	65
Forwarder – *Forvarder*	29	16	15	60
Tower yarder – *Žičara*	9	8	7	24
Processor – *Procesor*	12	-	2	14
Skidder – *Skider*	1	-	1	3
Skyline – *Šumska žičara*	1	-	1	2
Wood grab – *Hvatalo*	88	59	70	217
Other – *Ostalo*	12	35	-	47
Total – *Ukupno*	1453	6897	1688	10,038

the trees and excavators equipped with grapples (so called wood grab) for timber extraction is the most widely used harvesting system in South Korea (Seol 2016).

Wood grab (Fig. 4) is now being used for the collection and loading of timber as well as during construction of skid roads. When producing short-wood with the use of a wood grab, production costs can be reduced, but only cheap raw materials such as pulp, boards, or sawdust are usually produced (Choi 2012). This method is inefficient because it does not use wood biomass and is not suitable for the production of wood with larger diameters (Kim and Park 2013). Driving excavators in forests is also a major cause of road erosion and soil runoff and these vehicles cause serious damage to forests especially on sloped terrain (Park 2004). The same

Fig. 4 Wood grab on a forest road (source: www.alamy.com)
Slika 4. *Utovarivač s hvatalom na šumskoj cesti (izvor: www.alamy.com)*

Table 5 Forest road length and density (Korea Forest Service 2018)
Tablica 5. *Duljina šumskih cesta te gustoća cesta (Korejska šumarska služba, 2018)*

Categories *Vlasništvo*	Forest area *Šumska površina* 1000 ha	Construction of forest roads until 2014, km *Izgradnja šumskih cesta do 2014., km*	Construction of forest roads, km *Izgradnja šumskih cesta, km*			Construction of forest roads until 2018 *Izgradnja šumskih cesta do 2018.*			
			2015	2016	2017	Total *Ukupno*		Commercial forests *Gospodarske šume*	
						Length, km *Duljina, km*	Density, % *Gustoća, %*	Length, km *Duljina, km*	Density, % *Gustoća, %*
Non- national forest *Privatne i javne šume*	4717	13,257	438	407	427	14,529	3.08	6858	4.1
National forest *Državne šume*	1618	5820	213	209	293	6535	4.03	4341	6.55
Total *Ukupno*	6335	19,077	651	616	720	21,064	3.32	11,196	4.8

author concludes that 48.77 % of Korean land has slopes above 60 %, while 34.05 % has slopes between 37–60 %.

4.2 Forest roads – *Šumske prometnice*

As shown in Table 5, the current density of Korean forest roads is only 3.32%, which is insignificant compared to other countries. In addition to the problem of insufficient mechanisation level in timber harvesting, the main obstacle in harvesting timber in Korea is the low density of forest roads. Even when the forestry mechanisation is updated, if forest road facilities are not designed and built properly, it will be difficult to achieve high efficiency.

Currently, Korean forest resources reaching the final age are increasing. However, forestry machinery and infrastructure are poor (Kim 2013). Solving these problems will increase domestic timber production, so continuous investments in infrastructure are essential.

5. Final remarks
Zaključna razmatranja

Growing stocks in Korea are increasing, while forest areas are decreasing and in spite of the increase of the growing stock, Korean timber procurement and sustainability is low. Effective forest management and policies are urgently needed to solve these problems.

Currently, the forest resources of Korea are mature enough and it is expected that it will be possible to increase the growing stocks and timber self-sufficiency more efficiently by providing adequate forest infrastructure. Continuous investments to increase the density of forest roads are essential

and by improving the outdated and poor forestry machinery, the lack of labour force will be compensated (Kim 2013).

It is also necessary to establish policies to increase the production of timber in private forests and private forests should be more included in the sustainable development of Korean forests.

6. References

Chang, C., Seok, H., 1997: Prediction of Forest Land Decrease and Preservation Planning. Forest Economics Research, 5(1): 1–12.

Jeon, Y., Woo, L. J., Mi, S., Woo, H. S., Choi, Y. H., Kim, M. J., 2005: The Current Status and Improvement of Forest Conversion in Korea. Korean Society of Environmental Ecology, 2005(1): 100–101.

Kim, K., 2013: Application of The Delphi Technique to Increase Domestic Timber Supply: Policies and Prospect. Agricultural Life Science Research, 47(5): 43–53.

Korea Forest Service 2015: Timber Supply and Demand Planning. http://www.forest.go.kr/newkfsweb/html/HtmlPage.do?pg=/resource/resource_040301.html&mn=KFS_02_01_04_03_01 (accessed on 14.6.2018).

Korea Forest Service 2017: Forestry Statistics Yearbook, http://www.forest.go.kr/newkfsweb/cop/atDt=&ntcEndDt=&orgId=kfs&mn=KFS_02_03_06 (accessed on 14.6.2018).

Korea Forest Service 2018: Status of Forest Facilities by Year. http://www.forest.go.kr/newkfsweb/html/HtmlPage.do?pg=/conser/conser_0302 html&mn=KFS_02_01_05_02 (accessed on 14. 6. 2018).

Kwon, O., 2014: An Analysis on the Economic Effects of Forest Management Extension Service. Forest Economics Research 21(1): 13–26.

Lee, S., Jung, B., Kim, K., Jeon, H., Jo, M., 2017: An Analysis for the Economic Impact of Forest Road Investment. Journal of the Korean Forest Science Society 106(2): 219–229.

Kim, M. K., Park, S. J. 2013: An Analysis of the Operational Cost in the Whole-Tree and Cut-to-Length Logging Operation System. Journal of the Korean Forest Science Society, 102(2): 229–238.

National Archives of Korea 2018. http://theme.archives.go.kr/next/forest/outline/greenKept.do (accessed on 14.6.2018)

Park, S., 2004: An Analysis of the Yarding Operation System with a Mobile Tower-yarder. Journal of the Korean Forest Science Society 93(3): 205–214.

Seol, A., Han, H., Jung, Y., Chung, H., Chung, J., 2016: Analyzing the Economic Efficiency of Short-wood Wood Grab Logging and Whole-Tree Cable Logging Operations. Journal of the Korean Forest Science Society 105 (2): 231–237.

Sažetak

Pregled gospodarenja šumama u Južnoj Koreji

Nakon korejskoga rata šume Južne Koreje bile su devastirane, ali od tada do danas šumske površine i drvna zaliha obnavljaju se velikom brzinom. Zbog raznih propisa vezanih uz zaštitu šuma danas je 63 % površine pod šumom, što čini ukupno 6,335 milijuna hektara površine. Drvna je zaliha u Južnoj Koreji u porastu pa je tako 2015. godine iznosila 924 810 000 m^3, dok se površina šuma s vremenom smanjuje. Zbog projekta »Konverzije šumskih površina« mnoge se šumske površine prenamjenjuju najčešće u građevinske površine na kojima je potom moguća izgradnja javnih prometnica, naselja ili industrijskih pogona. Drvna je zaliha 2015. godine bila 15,6 % viša nego 2010. godine, što čini porast od 12,4 puta u usporedbi s podacima iz 1973. godine kada je na snagu stupio državni projekt »Pošumljavanje i kontrola erozije«. Najčešće su vrste drveća u Južnoj Koreji crveni bor (Pinus densiflora Siebold et Zucc.), korejski bor (Pinus koraiensis Siebold et Zucc.), japanski ariš (Larix kaempferi Lamb.), smolasti bor (Pinus rigida Mill.) i hinoki pačempres (Chamaecyparis obtusa Siebold et Zucc. ex Endl.), ali i razne vrste hrasta (Quercus spp.), japanski kesten (Castanea crenata Siebold et Zucc.), bagrem (Robinia pseudoacacia L.) i vrste breze (Betula spp.). Broj šumarskih vozila i strojeva, kao što su harvester, šumska žičara, procesor i slično, ne zadovoljava te je potrebna modernizacija sustava pridobivanja drva. Drveće se najčešće siječe motornom pilom lančanicom, a vrlo je i česta uporaba građevinskih strojeva prenamijenjenih za rad u šumarstvu, npr. utovarivač s ugrađenim hvatalom. Gustoća je cesta u Južnoj Koreji na niskih 3,32 %.

Ključne riječi: šume Južne Koreje, pregled gospodarenja šumom, crveni bor, utovarivač s hvatalom

Authors' address – *Adresa autora:*

Hyein Shin, MSc.
e-mail: stardust8554@gmail.com
109-902, 595 Seoljuk-ro
Buk-gu, Gwangju
REPUBLIC OF KOREA

Received (Primljeno): August 01, 2018.
Accepted (Prihvaćeno): October 26, 2018.