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# ШУМАРСКИ ПРЕГЛЕД
# FOREST REVIEW

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**115** ГОДИНИ ОД РАЃАЊЕТО НА ХАНС ЕМ
YEARS OF HANS EM'S BIRTH

**60** ГОДИНИ ШУМАРСКИ ПРЕГЛЕД
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# PREFACE

*Dear Colleagues and Readers,*

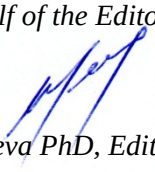
*We are happy to announce the online publication of the 44th volume of Forest Review! Furthermore, this is a special year because we celebrate two great jubilees- 60 years since the first volume was published and 115 years of Acad. Hans Em's birth.*

*During our past 43 volumes, we had an excellent cooperation, especially with the faculties of forestry from the Balkan and South-eastern European countries. We hope this volume will be interesting in particular, due to the last year efforts of the Editorial Board, making the Forest Review an International Scientific Journal, and this year result to become a member of ISSN network online, beside the international print standard.*

*This year we have published articles from various countries, and we hope that the next edition will be even more interesting. Articles treat different forest-based issues, and are peer-reviewed by significant forestry authorities from different countries.*

*Many thanks to all authors and members of the Forest Review, as well as to all peer – reviewers for the participation.*

*On behalf of the Editorial Board,*



*Prof. Irena Papazova-Anakieva PhD, Editor-in-Chief*


***... Front cover of the 1st volume of Forest Review published in January 1953***

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# BIBLIOGRAPHY OF Acad. HANS EM

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ABSTRACT: Acad. Hans Em is one of the founders of modern forestry in Macedonia and the Faculty of Forestry in Skopje. He was the only forest-sector member of the Macedonian Academy of Sciences and Arts, a distinguished professor and dean of the Faculty of Forestry in Skopje. Acad. Em has discovered many new woody species for the forestry science, new founding sites of plants and new forest communities for the time he researched. He was author and co-author of more than a hundred very important papers and vegetation maps concerning the Macedonian and Balkan dendroflora and forest vegetation. This 2013 is a jubilee year - 115 years of his birth. Therefore, in this monograph article are previewed all paper works of Acad. Hans Em i.e. his bibliography and most important scientific achievements.
Keywords: bibliography, monograph, Hans Em.

## 1 PROFESSIONAL BIOGRAPHY OF Acad. HANS EM

Hans Em was born on 6th June 1898 in Maribor, Slovenia. He was Austrian by origin and his mother was Slovenian.

He graduated at the College of Agriculture - Department of Forestry in 1924 in Vienna.

His professional career started same year in the Forestry office in Aleksinac; afterwards he has served in Prishtina, Kosovska Mitrovica, Prizren, Kichevo and Ivangrad. He moved to Skopje in 1924 and has worked there in the Forestry Head office. In 1934 he was appointed chief of resin harvesting as a senior forestry adviser and remains there until 1941. During the Second World War he was an officer of Forest Inspection.

After liberation he was appointed director of the newly established Institute of Forestry. He was nominated by the Ministry of Agriculture and Forestry to be a member of the Board for the establishment of the Faculty of Agriculture and Forestry.

With the opening of the Faculty of Agriculture and Forestry in Skopje in 1947 he was nominated associate professor of dendrology, and in 1958 he was promoted full professor.

He was elected Dean of the faculty for the period 1952-1953.

In 1947 when he was elected professor, on his own initiative takes the responsibility to establish:

- Arboretum in Trubarevo and the dendropark around the building of the Faculty
- Scientific herbarium and collection of preserved plant specimens (herbarium) for the students which also includes collection of fruits, seeds, winter shoots and xylotheque.
- Different types of distribution maps, images and similar materials.

In 1968 he retired as full professor of the Faculty of agriculture and forestry in Skopje.

For Corresponding member of the Macedonian Academy of Sciences and Arts he was elected on 4 may 1972, and as a full member on 22 December 1976.

He has received several awards: Order of Merit to the People III class, Order of Labour I class, Order of Labour II class, and in 1967 he has received the Life-time achievement award.

Hans Em died on 9th July 1992 in Skopje.

**Figure 1:** Hans Em (Maribor, 6.VI 1898 - 9.VII 1992, Skopje)

In 1931 together with Dr. D. Petrovic, H. Em created forest-economic study, in which of special importance is the Map of the forests by species composition. This map refers to the whole territory of Macedonia, and it is the only map of such type. In the years 1928 and 1929, Em and Petrovic have fulfilled the field activities, and in the next two years the maps are printed in scale 1:100.000 and 1:200.000. In 1949 H. Em together with famous phytocoenologist (phytosociologist) Horvat created the vegetation map of Pelister.

His research activity was focused in two directions: to explore Macedonian dendroflora and forest vegetation.

Problems of endemism and relictism of woody plants were always his major preoccupation. In one of his publications he reveals very interesting observations about the ecological valence of some endemic species,

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such as: *Picea omorika, Pinus heldreichii, Pinus peuce, Aesculus hippocastanum* and *Syringa vulgaris*.

Especially interesting is the versatile elaboration of the Tertiary relic species– *Arbutus andrachne*. He has thoroughly studied its biology as well as both refugial localities where this species occurs.

Analyzing a large number of representatives of the Macedonian dendroflora, he indicates that more than 80 species reaches their ultimate areal boundaries, and that the largest numbers of them are Mediterranean species that reaches their northern limit. In correlation with this, of particular interest are those species of Balkan-Asian (Asia Minor) and Apennine-Balkan-Asian distribution, which in Macedonia can be found only in the western regions, and they are spreading through Greece to Asia Minor and Asia. These are primarily relic species.

During his regular field research he often surprises with the discovery of new or unknown taxa. Such is the case with *Daphne kosaninii* in Suva Gora (Gostivar area), which was known only in the mountains in Bulgaria.

For our science of particular importance is his research of forest vegetation. In recent years his attention was particularly orientated on pine and fir forest associations, which develop on the territory of Macedonia. In order to get a complete picture for the composition, variability, ecology and the distribution of the associations, he has studied the plant (in particular forest) communities from all parts of Macedonia.

Comparing the associations with other forest communities from other areas of Yugoslavia H. Em came to the conclusion that in the Macedonia can be separated following plant communities, which are specific to this area:

- *Fageto - Abietum meridionalis* Em ass. nov. Due to the grouping of all fir associations in a single association, separated and described are four sub-associations: *dentarietosum, coryletosum, myrtillo - luzuletosum* and *rubo saxatilis - sorbetosum*.
- Relic and recent pine forests in Macedonia H. Em has grouped into 3 basophilic relic associations:
  - *Pulsatillo macedonicae - Pinetum nigrae (palasianae)* Em;
  - *Seslerio - Pinetum nigrae* Em;
  - *Lathyro versicoloris - Pinetum nigrae* Em.

All associations are characterized by the presence of a numerous relic and endemic species. Especially important is that the author presents us a new for the science alliance- Orno - Pinion Em, which is continuation of Orno - Ericion from Dinaric area, in this way, filling a gap that is felt in our sintaxonomy.

- Exploring beech forests located in the lower areas and developing on acidic foundation, H. Em considers that these associations form a special acidophilic community *Bruckenthalio - Myrtillo - Fagetum*. According to him, this community is a historically and edaphically conditioned occurence that certainly comes from an era of conifers of postglacial development of plant cover, and later with the expansion of beech, settled in habitats that are inappropriate to its normal development.

As with dendroflora where he manifests a special interest on endemism and relictism, H. Em gives special attention to relic swamp forests that grow near the relic swamps. These forests which are commonly found in a fragmented state are with glacial age. These are *Periploci - Fraxinetum angustifoliae* Em, at Negorska Banja (Gevgelija area), *Periploci - Alnetum glutinosae* with *Nephrodium thelypteris* and *Osmunda regalis* at Banja Bansko (Strumica area), (from *Alnion glutinosae*) on Mavrovsko Pole, *Blechno - Pinetum* Em on Kozhuv (Nidje) and as. *Alnus glutinosa - Carex bryoides* in Gostivar area.

In addition to fundamental research H. Em remains closely linked to practice. In one of his publications he gives several years observations of the intensity growth of *Metasequoia glyptostroboides* in the Skopje Basin and the conditions for its cultivation as a decorative tree.

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# THE STATE OF FOREST ROADS AND DETERMINING AN OPTIMUM DENSITY OF A FOREST ROAD NETWORK USING GIS

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ABSTRACT: This paper presents an analysis of forest roads and suggests new routes to increase the openness of FMU "Borovik", one of the least open forest management units in FE "Vranje" and thereby reduce the cost of skidding. The current openness of this management unit is only 2.96 m/ha, while its relative openness reaches 33.60%. Three new routes have been proposed, in order to achieve a density of 6.82 m/ha, i.e. the relative openness of 61.88%. The construction of these roads would reduce the total costs of skidding by 35%.
Keywords: planning of a forest road network, optimal density, forest opening.

## 1 INTRODUCTION

The establishment of an optimum forest road network in the field develops through several phases of work (Ryan, *et. al.,* 2004), including the planning, design, routing, construction and maintenance of roads. The planning of a forest road network is performed at forest area level and developed in detail in the *Program of construction and maintenance of forest roads*, which is an integral part of the *Development plan of that forest area*. This document serves as a review and analysis of the state of a forest road network. It also provides an insight into the need for the planning and expansion of that forest road network in accordance with the established functional units and purpose of the forest. The planning of a forest road network does not allow stereotypes and always represents original work, because each area has both a number of specific internal features and external diversity, so that each planning process requires a specific approach. The planning of a forest road network is a difficult and time-consuming task (Abdi, *et.al.,* 2009). The analysis of alternative routes in an office using the geographic information systems (GIS), can save days and even weeks during the planning process, and finally a better solution can be reached than by using traditional means (Rogers, 2005). Generally, the planning of a forest road network depends most on the economic and social criteria (Nasiri, *et. al.,* 2012).

This paper presents the planning of a forest road network in MU "Borovik", one of the least open management units in FE "Vranje". This planning was performed using GIS and, given that economic forests are concerned, the primary criteria included the economic, technical and technological principles.

## 2 METHOD

The determination of the optimum density of the forest road network was carried out in four phases, including development of the study area GIS, an analysis of the existing primary network of forest roads, design of possible routes of future forest roads, and an analysis of the newly designed forest roads.

An analysis of the existing forest road network includes the following (Pentek, *et. al.,* 2005):

- Classification of the infrastructure within the existing forest road network,
- determining of the current mean transport distance,
- determining of the current cost of skidding,
- calculation of the aimed mean transport distance,
- an analysis of the relative openness for a specific mean aimed transport distance and
- defining and identification of unopened areas.

The development of the study area GIS was performed using the ESRI ArcGIS 9 program (ArcMap 9.3). By connecting a database to a digitized map, the necessary information about each stand were obtained, which served as a basis for the production of the needed thematic maps.

The analysis of the existing forest road network was performed using detailed field observations and data on the length of roads were obtained by categories. The current mean transport distance was calculated using the centre of gravity method. The skidding costs were calculated for the LKT 81 Turbo transport vehicle that is commonly used in this forest estate for the first phase of transport. The mean aimed transport distance was determined on the basis of the optimum distance between the forest roads.

The relative openness was determined using the method of confined surfaces, with double target transport distance taken as the distance from a forest road to the edge of the confined surface. The unopened parts of the management unit were defined on the basis of the produced maps of relative openness and the maps of unit costs and total costs of skidding.

Given the purpose of the forests, the basic aspects of optimization were the economic, technical and technological principles. Therefore, the primary objective of conceptual routes was to open certain parts of the forest management unit with the largest felling volume, in order to reduce the mean transport distance and hence the cost of production.

After construction of the new routes of forest roads, we carried out the analyses of classical (absolute) and relative openness, mean transport distance and skidding costs.

## 3 RESEARCH AREA

This research was conducted in the management unit "Borovik", which is managed by the forest estate "Vranje" from Vranje and is part of the public enterprise "Srbijašume". The forest estate "Vranje" belongs to the South Morava forest area of the Republic of Serbia.

The total area of the management unit is 3449.36 ha. An area of 3116.21 ha within this unit is covered by state owned forests and the remaining area of 333.15 ha is

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occupied by privately owned forests. High forests occupy 33.87% of the territory, 40.38% is covered by coppice forests, and the rest is occupied by artificially established stands, scrub, brushland and bare forest land.

According to the applicable *Special forest management plan for MU "Borovik"* (2011-2020) , the total annual felling volume for the whole period amounts to 62 748.3 $m^3$, i.e. on average 6 274.8 $m^3$ per year.

In accordance with the site and stand conditions, the type of management prescribed for the South Morava forest area is stand management. The method applied for felling and cutting of assortments in this management unit is the assortment method, with the production of assortments carried out in the stump area of the felling site. The skidding of technical wood to the landing located near a hard forest road is performed mechanically using LKT cable skidders. Firewood is usually skidded by a horse-drawn carriage or sold directly in the stump area.

## 4 RESEARCH RESULTS AND DISCUSSION

The GIS data for the management unit "Borovik" were taken from the *Special forest management plan of MU "Borovik" (2011-2020).* A thematic map of felling volume was produced on the basis of these data for each department. Felling volume was the starting point in the design of new routes. A digital terrain model (DTM) was produced for this management unit in order to analyze terrain slope and exposure, as important factors in the planning of a road network.

Although MU "Borovik" involves both public (asphalt) roads and gravel and unpaved forest roads, this management unit is still one of the least open units of the forest estate "Vranje". The length of roads passing through this management unit is only 1375 m, while 12914 m of forest and public roads or 77.6% of the length of all roads pass near the edge of the forest or up to 300 m from forest edge, which limits the skidding to one side of the road. In the calculation of forest openness, only 50% of the length of forest roads is calculated as their length (Šikić, *et. al.*, 1989). In the calculation of the current openness of MU "Borovik" unpaved forest paths with truck road elements were also calculated, even though they are usually not taken into account. Together with these paths, the current openness reached only 2.96 m/ha.

The mean transport distance was obtained using the centre of gravity method (Fig. 1). The shortest distance from the centre of gravity of each stand to the nearest forest road was determined automatically using the ArcMap 9.3 program. The mean transport distance was obtained as the mean weighted value multiplied by a 1.44 terrain correction factor. This coefficient was taken as the average value for the hilly and mountainous regions (Abbeg, 1978). The mean transport distance of the study area was 1357 m.

After determining the daily cost of skidding with a cable skidder, the unit costs were calculated (Fig. 3), which was followed by the calculation of the total costs of skidding for all stands in which felling was planned (Fig. 2). The daily skidding output of the LKT 81 Turbo cable skidder at the mean transport distance of 1357 m was 18 $m^3$, and the price of skidding amounted to € 6.59/$m^3$. The total costs of skidding for the entire observed area amounted to € 393437.

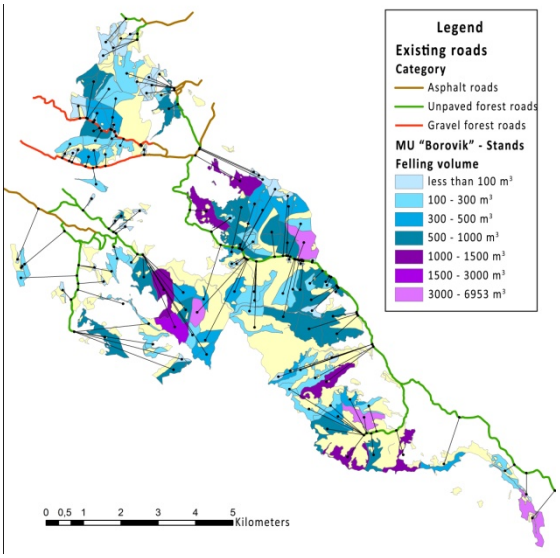


**Figure 1:** Felling volume and the shortest distance from the gravity centre of the stand to a forest road

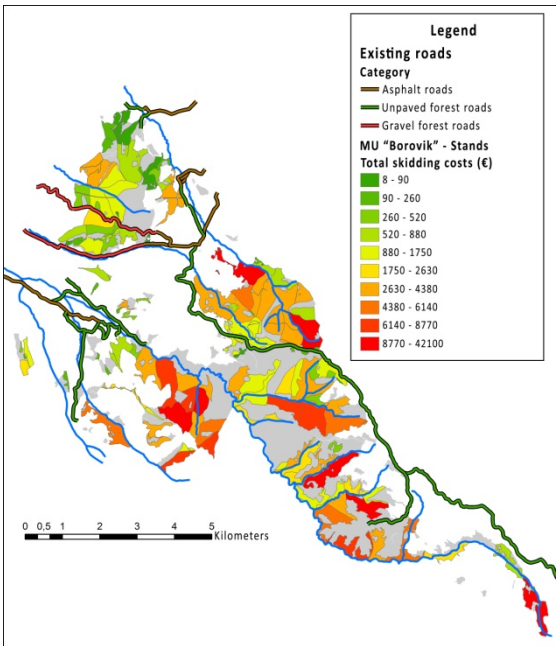


**Figure 2:** Total costs of skidding

The aimed mean transport distance was calculated on the basis of the optimum distance between forest roads. The optimum distance for this management unit was 1175.4 m and it was calculated using the formula (FAO, 1998):

$$S = \sqrt{\frac{4000 \cdot R}{h \cdot V}}$$

where: $S$ – the optimum distance between forest roads (m); $R$ – the costs of construction and maintenance (€/km); $h$ – unit costs of assortment skidding (€/$m^3$/100 m); $V$ – total felling volume obtained during the existence of a forest road ($m^3$/ha).

The optimum mean transport distance is S/4, i.e. 293.9 m.

The optimum openness of the forest management unit is 8.51 m/ha, and it was calculated using the formula:

$$Oopt = \sqrt{\frac{100000 \cdot h \cdot V}{4 \cdot R}}$$

The relative openness of the forest management unit is 36.20%, (Fig. 4) which means that this unit is insufficiently opened and marked with mark 1 (one) according to Pentek, *et. al.* (2005).

Given that one of the main tasks of optimizing the existing road network is the reduction of skidding costs, the parts of the forest area where it is necessary to expand the existing network were identified on the maps of unit and total costs of skidding and a map of relative openness of the management unit.

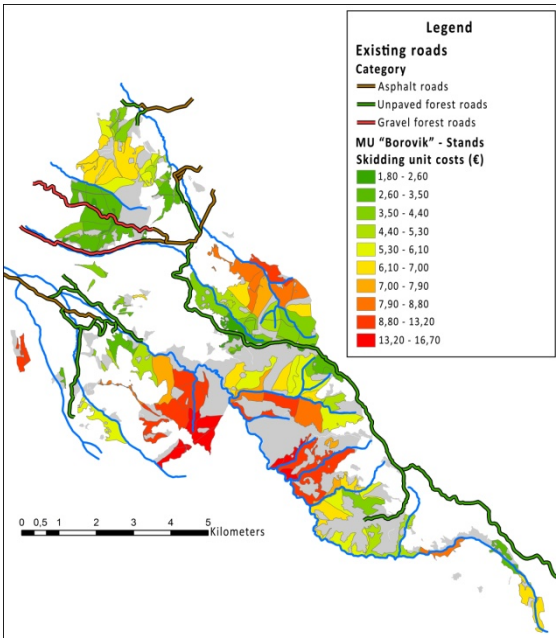


**Figure 3:** Current unit costs of skidding

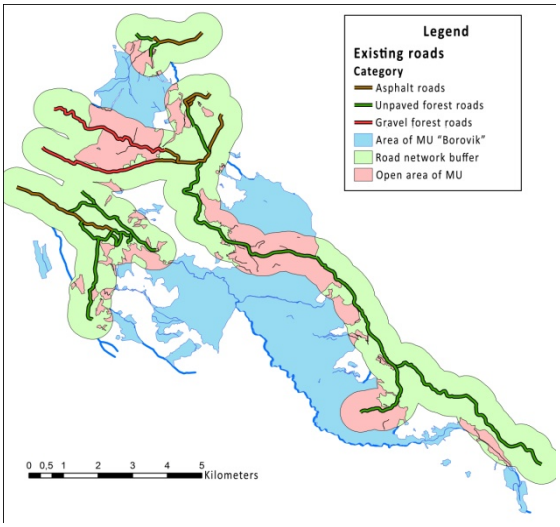


**Figure 4:** Current relative openness

The unit costs of skidding were the highest in the stands with the longest mean transport distance, i.e. the stands that are the farthest from the existing landings (Fig. 3). The total costs of skidding are the highest in the departments that have large felling volumes and those remote from the existing landings (Fig. 2). Looking at the map of the total costs of skidding, we can immediately see that the costs are the highest in three parts of the management unit. These parts should further be opened and new road routes should be designed in them.

After defining the insufficiently opened parts of the management unit and areas suitable for road construction, we started designing the conceptual routes and care was taken that the future routes meet all aspects of optimization, i.e. the economic, technical, technological and environmental principles. Considering all the above mentioned facts, three newly designed routes were proposed in this article (Fig. 5).

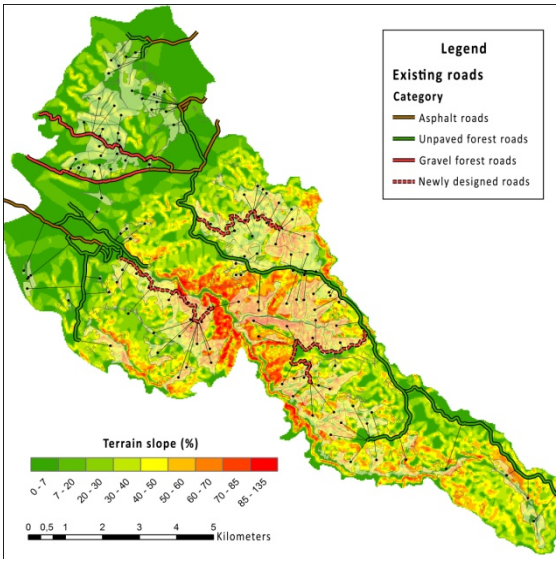


**Figure 5:** Terrain slopes and distances from the centre of gravity of a stand to the nearest road

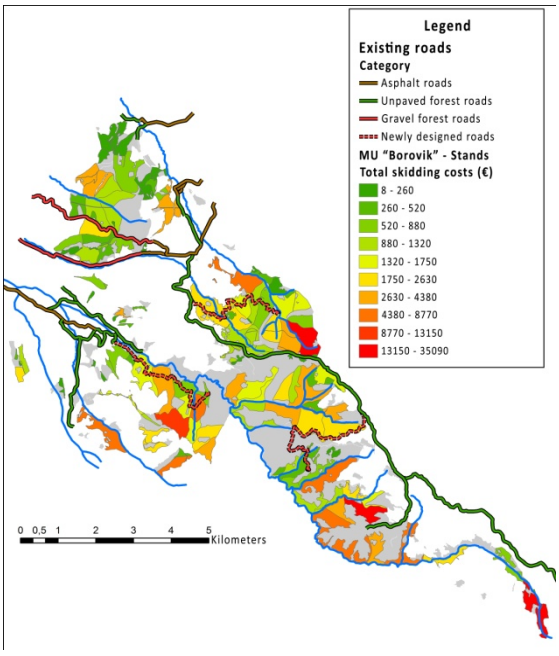


**Figure 6:** Total costs of skidding after construction of the newly designed roads

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The construction of three newly designed roads, with a total length of 13344 m, would open the three parts of MU "Borovik" that have so far been completely unopened. Therefore, the mean transport distance would be significantly reduced to 674 m. This would be reflected in a higher daily output of the LKT 81 Turbo cable skidder that would reach 29 $m^3$ at this distance. The cost of skidding for the mean transport distance of 674 m would amount to € 4.19/$m^3$ (Fig. 7), and the total costs of skidding would reach € 257895 (Fig. 6).

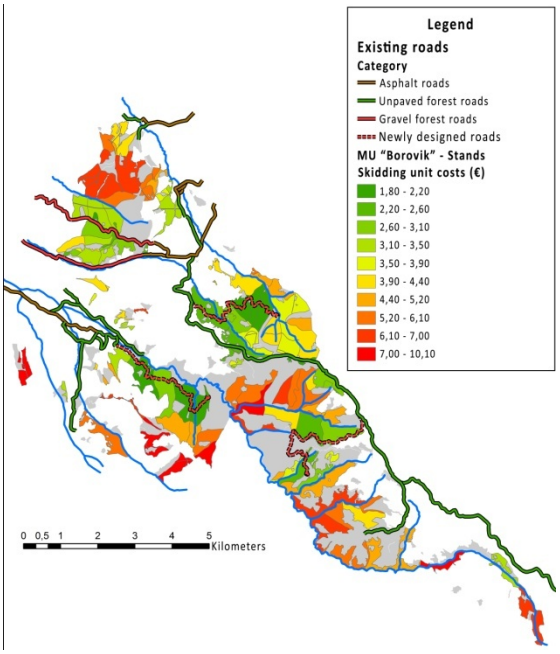


**Figure 7:** Unit costs of skidding after construction of the newly designed roads

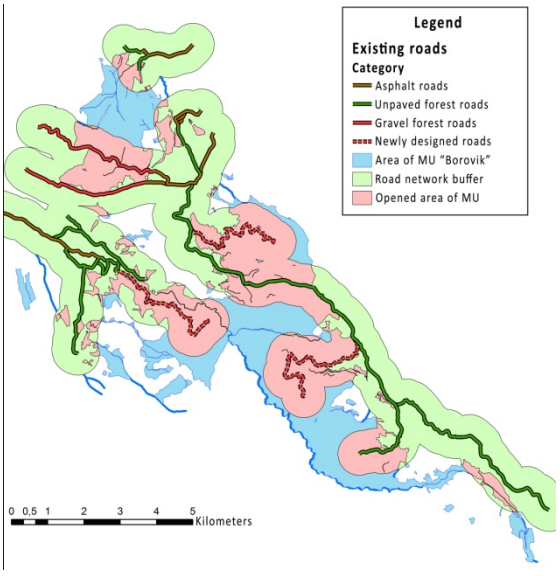


**Figure 8:** Relative openness after construction of the newly designed roads

The construction of newly designed roads would increase the density of the primary network to 6.82 m/ha, which is lower than the optimum density of 8.51 m/ha. It would also increase the relative openness of the management unit to 61.88% (Fig. 8). Despite a significant increase in the relative openness of MU "Borovik" it would still be considered low and marked with mark 2 (two).

## 5 CONCLUSIONS

The following conclusions can be presented on the basis of this research and the analyses performed:

- The optimization of a network of roads was performed in MU "Borovik" with special attention paid to the economic, technical and technological aspects;
- The program of opening that envisages the construction of three forest roads with a total length of 13.34 km was produced for MU "Borovik". These three roads should open the parts of the management units that are completely unopened, where the felling of 23673 $m^3$ of wood was planned;
- The current density of the forest road network in MU "Borovik" is 2.96 m/ha, when all the roads with truck road elements are taken into account (asphalt roads, gravel and unpaved forest roads). The optimum density for this management unit is 8.51 m/ha, and after construction of the newly designed routes this density would reach 6.82 m/ha;
- The current relative openness of MU "Borovik" is 36.20%, and after construction of the newly designed routes it would be increased to 61.88%, which still represents low relative openness;
- The current mean transport distance is 1357 m and the unit costs of skidding amount to € 6.59/$m^3$. The total costs of skidding amount to € 393437 for the entire management period;
- In addition to increasing the density of the forest road network, the construction of the newly designed routes would reduce the mean transport distance to 674 m and the unit costs to € 4.19/$m^3$. The total costs of skidding would be reduced by nearly 35% and amount to € 257895;
- The required workload in terms of days needed for the skidding of the total volume of wood assortments would be reduced from 3137 to 1947 days.

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# LINED IRRIGATION CANALS IN FIELD HUNTING GROUNDS OF VOJVODINA AND THEIR INFLUENCE ON WILDLIFE

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ABSTRACT: Irrigation canals lined with smooth materials (e.g. geomembrane, concrete) are potential barriers which disturb and restrict wildlife movement in numerous field hunting grounds in Vojvodina. The adverse effect of lined irrigation canals can be additionally increased due to drowning of both wild and domestic animals, or because of a permanent fence erected along some lined irrigation canals. This paper presents the results of multiannual monitoring of wildlife behaviour related to the lined irrigation canal "Kula-Mali Iđoš" (Bačka region), with special emphasis on wildlife overpasses and their efficacy in connecting the parts of the fragmented habitat. The study results show that the overpasses are used by different wildlife species, the most frequent of which are brown hare (*Lepus europaeus*), roe deer (*Capreolus capreolus*) and fox (*Vulpes vulpes*).
Keywords: irrigation canal, fragmentation, wildlife overpasses, Vojvodina.

## 1 INTRODUCTION

Vojvodina is the most significant agricultural region in the Republic of Serbia, thanks to good-quality soil types of high production value (chernozem and humogley), large water resources (Danube, Sava, and Tisza), the canal system (Danube-Tisza-Danube), and temperate continental climate. Agricultural land occupies more than 80% of its total area (2.15 million hectares), and the percentage of arable land is about 75%. Forests and forest lands occupy about 140,000 ha (6.5%). In all municipalities, agricultural land occupies above 70%, except for Beočin (45.6%), Sremski Karlovci (50.4%) and Šid (59.7%). The structure of agricultural land shows the prevalence of arable-vegetable farming, because ploughland and gardens account for 90% of farmland [11]. Agricultural land (field hunting grounds) supports many small and big game species, among which roe deer, brown hare and pheasant have the highest biological and economic significance in hunting economy. However, their populations are increasingly threatened by the intensification of agricultural and industrial production, the use of plant preservatives and mineral fertilisers, disasters (floods and droughts), road infrastructure (emission of exhaust gases, game disturbance and wildlife-related traffic accidents, fragmentation of habitats), predator species, and man-made specific effects (e.g. illegal hunting, nomadic pastoralism, concrete and plastic lining of irrigation channels) [3, 10, 13].

Based on the Law on Game and Hunting (Official Gazette RS, number 18/10), the Provincial Secretariat of Agriculture, Water Economy and Forestry has established altogether 147 hunting grounds, of which 18 are specific-purpose hunting grounds (they are managed by Public Enterprise "Vojvodinašume" (17 hunting grounds) and the National Park "Fruška Gora"), 13 hunting grounds in the area of registered fishponds, 115 hunting grounds in the wild (the so called "open hunting grounds" managed by Hunting Associations), and one private hunting ground [10]. In hunting grounds managed by Hunting Associations (about 90% of the total hunting area in Vojvodina), roe deer is the principal and almost the only reared big game species. The dominant land use type in the hunting grounds is arable farmland which occupies about 17,470 km$^2$ or 87.9%. Forests and other wooded land occupy about 530 km$^2$ or 2.7%. The low percentage of forests and wooded land has an adverse effect on the survival and density of principal reared small game species (brown hare and pheasant).

Lined canals are potential barriers which disturb the wildlife movement and can cause their drowning [4, 7, 8, 9]. In the field hunting grounds of Vojvodina, wildlife drowning in irrigation canals lined with plastic was frequent during the late eighties. Despite that, with the exception of recording the total number of drowned individuals of the principal wildlife species (roe deer and brown hare), adequate protection measures have not been defined and some of the proposed technical solutions have not been tested (e.g. wooden stairs for wildlife escape from the canal). Because of the lack of financial means (disintegration of the former SFRY and economic sanctions), almost all activities on irrigation canal construction and lining were stopped. At the present time, in the region of Vojvodina, the canals on porous soils are lined to mitigate the effects of severe and frequent drought periods. Also, each year, high financial means are invested in the construction of the commenced regional hydrosystems (Bačka and Banat). These systems cross many field hunting grounds and supply water to the areas with water shortage and they are long-term water potentials for the expansion of the area of irrigated lands. Some of the newly constructed canals are lined with plastic to preserve water, prevent seepage into adjacent land or roads, and enable reduced and faster maintenance. Also, the bed and sides of lined channels are more stable and thus less susceptible to erosion.

To prevent or mitigate the wildlife drowning risk and the site fragmentation, to solve this problem adequately, and harmonise the relations between agriculture and hunting (Public Water Management Company "Vode Vojvodine", agricultural enterprises, and hunting associations), large-scale research on the lined irrigation canal "Kula-Mali Iđoš" started in Vojvodina for the first time in the spring 2008 [2, 3]. This paper presents a small part of the results of multiannual monitoring (2008-2013) of the wildlife and the canal, with special emphasis on wildlife overpasses (3 concrete bridges) and their efficacy in connecting the parts of the fragmented habitat.

## 2 MATERIAL AND METHODS

The study area is the canal "Kula-Mali Iđoš" located along the border between the municipalities Kula and Vrbas (Bačka region). The canal is 5 km long, about 10 m wide and 2.5 m deep. The pumping station is in the suburb of Kula, on the bank of Veliki Bački Kanal, from

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which it pumps 1.2 $m^3/s$ of water to the plateau of the Telečka Visoravan, directly to the canal "Kula-Mali Iđoš". The canal carries water for about 7-8 months/year (March to September/October). The entire canal runs through the agricultural landscape (altitude 95-125 m).

The canal was constructed and lined with plastic (polyvinyl chloride) during 2008, during the first phase of the subsystem "Mali Iđoš" and the regional hydrosystem "Severna Bačka". Several months later, a permanent fence, between 1.2 and 1.5 m high, was erected along the canal (Fig. 1). Its aim was to prevent wildlife and domestic animals from falling and drowning, and to direct their movement to overpasses.

There are three bridges built over the canal during different periods. Two bridges (B1 and B3) were built in 2008, and the third one (B2) in the spring 2010. They are similar in sizes, length about 25 m, width of the central part 8 m, and width of the approach span about 15 m. The composition of natural vegetation on the bridges was determined based on the samples collected in September 2009 and June 2013.

Bridge B1 is located at the 1+700 km (Fig. 1), B2 at the 2+500 km (Fig. 2), and B3 at the 3+350 km (Fig. 3). Initially, the main function of the bridges B1 and B3 was to enable the people, vehicles and agricultural machines to cross the canal. During the following year, the upper surface of the concrete lining was covered with soil (10 cm deep), which was soon naturally grassed. Additionally, after two years, a new bridge (B2) was built in the middle part of the canal in the aim of better connection of fragmented habitats and for wildlife crossing and migration. For this reason, there were no concrete paths for pedestrians, and the bridge approach span was in the shape of a funnel.

**Table I:** Monitoring the use of fauna passages

| Month | | Number of track recording days | Number of days | % |
|---|---|---|---|---|
| 2009 | | | | |
| June | | 30 | 30 | 100.0 |
| July | | 27 | 31 | 87.1 |
| August | | 25 | 31 | 80.6 |
| | Σ | 82 | 92 | 89.1 |
| 2010 | | | | |
| June | | 26 | 30 | 86.7 |
| July | | 29 | 31 | 93.5 |
| August | | 30 | 31 | 96.8 |
| | Σ | 85 | 92 | 92.4 |

Bridge monitoring was conducted by standard and well-known methodology [6] during the period June-August 2009 and 2010 (Table I). The canal and the bridges were monitored for 167 days over two time periods (early morning – mainly from 05:30 to 08:30; and early evening – mainly from 17:30 to 20:45), which accounts for 90.8% of the total number of days. The use of bridges was evaluated by counting the tracks on the sand strip installed in the middle section of the bridge, and in a few cases directly, using a binocular or a camera. The sand strip was 6 m wide, which was the entire width of the bridges. Its length varied depending on the bridge – 3.5 m on bridge B1, 3.4 m on bridge B2, and 2.2 m on bridge B3. The sand strip was smoothed with a rake after each visit and prepared for the following track recording.

**Figure 1:** Lined irrigation canal "Kula-Mali Iđoš" (start)

**Figure 2:** The first bridge (B1) at the 1+700 km

**Figure 3:** The second bridge (B2) at the 2+500 km

**Figure 4:** The third bridge (B3) at the 3+350 km

Low land coverage with shrubs and trees made it possible for the bridges and the entire canal to be viewed from a covered and high look-out erected behind the bridge B2. Wildlife crossing was monitored using the binocular Praktica Falkon (magnification 10×50) and OpTisan PRO-III (magnification 10~40×60).

## 3 RESULTS

Complete monitoring of the canal "Kula-Mali Iđoš" was conducted during June-August 2009 and 2010 (Table I). The most frequent wildlife disturbing factors were tractors with various implements, combines, centre pivot irrigation systems, vehicles (Lada Niva, small trucks, Yugo 45, and Zastava 101), domestic dogs, local population (motorcyclists, cyclists and pedestrians), workers in the fields, the police (the training ground near Kula), bee keepers, and hunters.

The strongest adverse effect on wildlife was that of domestic dogs running in small groups along the canal and resting on the bridges for quite a long time. They kept barking and making a lot of noise, and continued attacking and chasing the individuals of various species.

**Table II:** Number of crossings per bridge (VI-VIII)

| User | 2009 | | 2010 | | | Σ |
|---|---|---|---|---|---|---|
| | B1 | B3 | B1 | B2 | B3 | |
| Motorcar | 16 | 1 | 20 | 3 | - | 40 |
| Truck | 3 | - | 1 | 2 | 1 | 7 |
| Tractor | 19 | 1 | 19 | 1 | 2 | 42 |
| Combine | 2 | - | 4 | - | - | 6 |
| Van | - | - | 1 | 1 | - | 2 |
| Motorcycle | 12 | - | 15 | 4 | - | 31 |
| Bicycle | 25 | - | 11 | 2 | - | 38 |
| Pedestrian | 21 | - | 18 | 2 | - | 41 |
| Σ | 98 | 2 | 89 | 15 | 3 | 207 |

**Table III:** Number of crossings by wild and domestic mammals (June-August)

| Species | 2009 | | 2010 | | | Σ |
|---|---|---|---|---|---|---|
| | B1 | B3 | B1 | B2 | B3 | |
| Brown hare | 576 | 152 | 451 | 461 | 177 | 1817 |
| Roe deer | 18 | 21 | 113 | 26 | 22 | 200 |
| Fox | 9 | 6 | 44 | 76 | 25 | 160 |
| Badger | 2 | 1 | 8 | 32 | 18 | 61 |
| Wild boar | - | 1 | - | - | 1 | 2 |
| Martens | - | 7 | - | - | 1 | 8 |
| Dog | 165 | 119 | 51 | 48 | 41 | 424 |
| Cat | 28 | 4 | 7 | 13 | 1 | 53 |
| Unknown | 1 | 5 | - | 4 | 6 | 16 |
| Σ | 799 | 316 | 674 | 660 | 292 | 2741 |

The use of various irrigation systems in the wider area along the canal "Kula-Mali Iđoš", especially on the large plough fields (more than 500 ha), caused essential changes and the deterioration of living conditions for many wildlife species as regards food and shelter. On such plough fields, at the annual level, there were minimum two harvests, primarily thanks to intensive irrigation and the application of modern machinery and chemicals for the control of weeds, insects, rodents and plant diseases, as well as thanks to favourable climate conditions. For instance, during the period May 25$^{th}$ - June 6$^{th}$ 2009, together with the harvest of peas on a large plowed field between the bridges B1 and B2 (Fig. 3), the second sowing was prepared by the ploughing of crop residues. Soon after that, between June 8$^{th}$ and 15$^{th}$, the field was seeded with sweet corn (*Zea mays saccharata*).

Tractors, pedestrians, cars, bicycles and motorcycles were the most frequent users of the bridges, accounting for 92.7% of the total number of crossings. The use of the bridges B1 and B3 was similar in both years (Table II), although bridge B2 was built between them in the spring 2010. The highest number of crossings during June-August was recorded on the bridge B1 (98 in 2009 and 89 in 2010), and a considerably lower number on the bridges B2 and B3.

The use of bridges by wild and domestic mammals was not related to the extent of traffic along the canal during the period June-August (Table III). Along the canal, there were several earthen roads for vehicles and agricultural machines, stretching as far as the pumping station about 100 m behind the bridge B3. Also, there were several small farm settlements, and two of them were about 50 m far from the canal, before bridge B1. When agricultural works were intensive and all field roads passable, the extent of traffic along the canal was low, and even lower when the weather was bad. The intensity of human activities in the wider area along the canal was the lowest during heavy rains, especially after the rain stopped and until the ground was dry, whereas at the same time the wildlife activity was the most frequent.

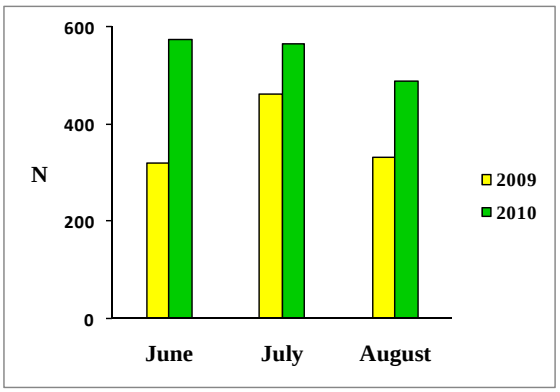


**Figure 5:** Monthly distribution of crossings by wild and domestic mammals

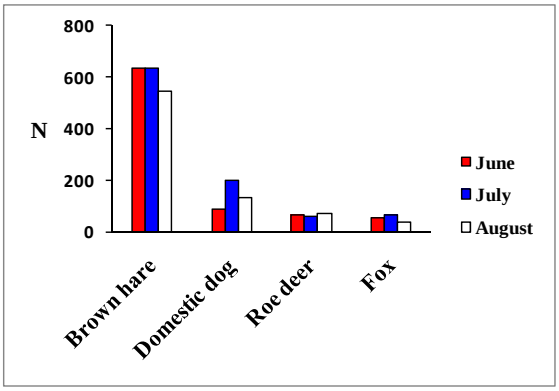


**Figure 6:** Number of crossings by species

All the three bridges on the canal "Kula-Mali Iđoš" are well installed and their width is adequate (8 m). Over the 6-month study periods (June-August 2009 and 2010), wild and domestic mammals crossed the bridges 2248

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and 477 times, respectively. Of the total number of crossings on the bridges, there were more crossings during the second year (2010) caused by the construction of the bridge B2 in the middle part of the canal (Fig. 5). The greatest number of crossings was recorded on the bridge B1 (799 in 2009 and 674 in 2010), and the lowest number on the bridge B3 (316 in 2009 and 292 in 2010). Brown hares and domestic dogs were the bridge frequent users, accounting for 81.8% of the total number of crossings, roe deer (7.3%) and foxes (5.8%) (Fig. 6). Wild boar and martens crossed only sporadically. Roe deer crossings were recorded more often on bridge B1 in June-August 2010 than in June-August 2009 (113 versus 18 passages).

In September 2009, natural ground cover on bridge B3 consisted of more plant species than that on bridge B1 (20 and 12, respectively). In June 2013, five years later, 32 plant species were identified on the bridge B1, 34 on the bridge B2, and 27 on the bridge B3. In all samples, the most numerous were plant species graded in the group of poor quality and worthless plants.

## 4 DISCUSSION

It is well known that droughts, depending on the intensity and duration, can cause a significant decrease in the yield of agricultural crops. In Vojvodina, droughts are becoming increasingly frequent, and especially severe droughts occurred in 2000 and 2003. Droughts are mainly the worst in July and August, when the plant need for water is the highest. On average, only 17 years out of 100 years have normal quantity and good distribution of rainfall, whereas rainfall deficit occurs in about 50 years, when drought is more or less intensive [11]. The territory of Vojvodina consists of 45 municipalities with altogether 463 settlements. There are water supply systems for various purposes, so water supply of 396 settlements is organised through the public water supply, while water for technical needs is supplied by a developed system of surface drainage network [12]. The land suitable for irrigation occupies about 1.15 million hectares, but the use of irrigation water is not at a satisfactory level (altogether about 50 million $m^3$/yr). The areas under irrigation systems cover about 80,000 ha, but these systems are not adequately equipped and the degree of their utilisation is low. Based on the estimation performed by water management organisations, less than 50,000 ha are irrigated at present time. Consequently, the management of drainage and irrigation areas is the strategic priority in the aim of more effective water utilisation, and efficient operation of the canal network [11].

The Danube-Tisza-Danube Hydrosystem (HsDTD), as a multi-purpose system and one of the largest hydro-engineering structures in the world, has a special significance for irrigation [15]. The main functions of DTD hydro-system are: drainage of internal waters, flood control and conveyance of waters from the neighboring countries, supply of irrigation water, supply of water for fishponds and industry, navigation, collection of waste waters, fishery, tourism and recreation. HsDTD consists of a network of canals (14 navigation canals, total length 694.2 km, of which 600.6 km are navigable), hydro-engineering structures (17 ship locks, 26 floodgates and 4 pumping stations), and other structures which enable normal function and maintenance (e.g. electro-movable, concrete, and metal bridges, power transmission lines, and access roads).

The main HsDTD canal network irrigates about 510,000 ha of agricultural land, of which 210,000 ha in Bačka and 300,000 ha in Banat. Water for the irrigation of other agricultural land is supplied by regional water systems, e.g. "Severna Bačka" with 7 subsystems for 132,000 ha, and "Srem" with 4 subsystems for 225,000 ha [11]. A great number of irrigation systems were built during the period 1986-1991. This can be presented based on the data for Zapadna Bačka (Table IV), which occupies about 168,000 ha on the territory of the municipalities Sombor and Apatin, and a part of the municipalities Odžaci and Kula. These systems differ depending on the construction type and technical solutions of irrigation systems: centre-pivot irrigation (equipment rotates around the pivot fixed to the circular foundation), linear move (equipment moves in a straight line along the pipeline with hydrants), Ranger (equipment moves in a straight line along the open canal), and lateral move - the older system with lateral wings [14].

There are no complete data referring to the total number and length of lined canals, and their effect on wildlife in the field hunting grounds in Vojvodina has not yet been researched in detail.

**Table IV:** Some irrigation systems in the West Bačka region

| Irrigation system | Total area (ha) | Year of construction |
|---|---|---|
| Telep | 445 | 1986 |
| Kendija | 206 | |
| Kronić | 95 | 1987 |
| Bački Brestovac | 210 | 1988 |
| Istočna Gradina | 113 | |
| Staparc | 340 | 1989 |
| Čonoplja | 399 | |
| Cigan Hat | 668 | |
| Matarić | 113 | |
| Bački Gračac | 287 | 1990 |
| Srpski Miletić | 972 | |
| Prigrevica | 105 | 1991 |
| Juranović | 310 | |

The main function of the canal "Kula-Mali Iđoš" is to supply water for the irrigation of about 5,000 ha of arable land. The canal is located on a loess terrace which is an unfavourable foundation because of its characteristic structure and porosity. Water tends to destroy the primary structure of loess surface zone which turns into liquid silt of very low internal strength. For that reason, it was necessary to protect the canal bed and slopes, to restrict water leaking and prevent soil flooding [1].

Soon after canal lining with plastic (PVC), there were a few drowned animals, mainly roe deer, brown hares, foxes and domestic dogs. A permanent fence was then erected along the canal, on both sides. It was 1.2-1.5 m high, made of wire and fixed to concrete posts buried in the ground at a distance of 4 m. The canal monitoring during the period 2009-2011 showed that the permanent fence was an efficient physical barrier, which prevented the crossing of the canal and the drowning of larger animals. Some authors reported that the permanent fence along the road was most frequently destroyed by people, wild boars, and agricultural machines [5]. Similarly, the permanent fence along the canal "Kula-Mali Iđoš" was mainly damaged by people and agricultural machines, but

the damage did not affect the fence efficacy because it was regularly controlled and maintained. There are 13 gates along the canal, 4 gates at each concrete bridge, and one at the beginning of the canal near the pumping station. Our monitoring proves that the workers engaged in the canal maintenance did not always close the gates (after grass mowing between the fence and the canal), but that was not the cause of animal falling in the canal.

Habitat fragmentation caused by road and canal construction has the strongest effect on animal species that populate large areas and are characterised by low population density. Small mammals are less threatened because their populations occupy the areas fenced by road and canal networks, which are often sufficiently large for their successful reproduction and survival. The area along the canal "Kula-Mali Iđoš" is a field habitat in which roe deer is the most frequent large game. There are three concrete (multi-purpose) bridges, two were built in 2008 (B1 and B3), and the third one was built in the spring 2010 (B2). The distances between the bridges are similar (800 m between B1 and B2, and 850 m between B2 and B3), although some authors claim that the optimal spacing for roe deer should be 1,500-2,500 m [5]. Our results show that the bridges are frequently used by different wildlife species together with domestic dogs, people, vehicles and agricultural machines (Tables II and III), which indicates that their width in the middle part is adequate (8 m) and that they are well distributed along the canal.

## 5 CONCLUSION

Irrigation canals lined with concrete and plastic are potential barriers which disturb and restrict wildlife movement in numerous field hunting grounds in Vojvodina. The adverse effect of lined irrigation canals can be additionally increased as a result of drowning of both wild and domestic animals, or because of a permanent fence erected along some lined irrigation canals.

The permanent fence along the lined irrigation canal "Kula-Mali Iđoš" was an effective physical barrier that prevented the canal crossing and the drowning of larger animals. Other protection measures such as multipurpose concrete bridges and GEOWB steps made it possible to prevent or significantly reduce the effects of lined irrigation canals on wildlife, but their efficiency should be additionally tested in natural conditions (e.g. lined irrigation canal without a permanent fence).

## 6 ACKNOWLEDGEMENTS

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# TECHNOLOGICAL ADVANCEMENT IN THE EFFICIENT USE OF WOOD AS ENERGY SOURCE

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ABSTRACT: During the last decade, Albania has faced a steady increase in the energy demand. This results in rising environmental problems due to the additional use of fossil fuels, and the need for the new power plants construction sites. According to INSTAT (2012), Albania has a population of 2.8 million inhabitants, where 46.5 % of inhabitants is living in rural areas. Firewood is the main source used by rural families for heating and cooking. On average, at the national level one family in rural areas use 5 $m^3$ of wood fuel for cooking and heating. Existing residential buildings in rural areas use fireplaces and stoves, with a low energy efficiency causing problems in terms of indoor air quality and firewood consumption.

This paper focuses on the importance of using new environmental friendly technologies – such as boilers and thermo-stoves – at the household level especially in Albanian rural areas. According to the economic analysis carried out in this paper, the use of energy efficient technologies (boilers and thermal-stoves) could reduce the expenditures for timber purchase about 50-78% and indoor and outdoor $CO_2$ emissions of 0.18-0.25 tonne $year^{-1}family^{-1}$. In order to develop a sustainable energy system in Albania, there is a urgent need to undertake some measures in the residential sector (improving energy efficiency) and in the use of renewable energy.

Keywords: firewood**,** energy saving, thermal generators, energy efficiency.

## 1 INTRODUCTION

Albania is a small country situated in the western Balkan peninsula, with an overall area of 28748 square kilometre and a forest cover of 1.5 million ha [2]. As in many developing countries, the incidence of poverty is highest in rural areas, where most of population depends on agriculture, livestock and forestry. The last population census conducted on 2011, showed that resident population in Albania was 2.821 million where 53.5 % live in the urban areas and 46.5 % lived in rural areas. The number of private households is 722 262 of which 56.7 per cent were located in urban areas and 43.3 per cent in rural areas. Heating systems in Albania dwellings consist mainly of separate equipment like stoves (e.g. owned by 63.3 percent of the households), air conditioners, electric heaters, while central heating systems within the building were owned only by 3.2 per cent of households [5].

In rural areas firewood continued to be the main type of heating meeting 57.5 percent of the households, followed by gas 20.8 percent and by electricity with 15.4 per cent. In comparison with 2001, the use of firewood has been decreased by 12.3 percent, while is increased by 14.9 percent the number of households using gas. In urban areas, the distribution of households by main type of energy used for heating was more balanced. Thirty six percent of households are heated with wood, 24.0 percent with electricity and 31.3 per cent with gas [5]. Firewood remain an important source of energy at national level providing about 208 ktoe or 14 percent of energy demands [1]. Various studies has shown that firewood consumption at the national level ranged from 1.5 million $m^3$ to 1.7 million $m^3$ [3], if the fuel wood consumed in schools, kindergarden and other institutions is considered.

One of the critical issues in using firewood in Albania is the use of low efficiency thermal generators like chimney and stoves, not only in rural areas but also in some urban areas. Their use likely is increasing the firewood consumption and indoor air pollution. Indoor and outdoor wood-smoke emissions by firewood burning can be reduced by using efficient (and well maintained) appliances and well-seasoned (e.g. dry) wood. Nowadays the modern furnaces (boilers) has shown an increasing efficiency in wood burning and reducing the wood consumption.

The new European Union Renewables Directives has set a mandatory target for Albania of 36% till to 2020, for increasing the proportion of energy from renewable sources in the energy, transport and heat [6]. Achievement of this manadatory target could require a radical policy about how the required volumes of Renewable Energy Sources (RES) will be sourced from domestic resources. One of the possible directions of this policy concerning RES is the sustainable and efficient use of current forest resources as well as of efficient thermal technologies. The recognition of the impact that high efficiency thermal generators have on wood consumption and monoxide carbon releasing in the atmosphere was the objective of this study.

## 2 THERMAL EFFICIENCY OF TRADITIONAL AND MODERN GENERATORS

Thermal generators are divided in two categories:

- Conventional thermal generators (fireplaces and stoves), and
- Modern thermal generators(thermal generators and wood boilers).

These devices varies in burning efficiency and their power (Table I).

**Table I:** Thermal generators and their energy efficiency

| Nr | Thermal generator | Energy efficiency (%) | Thermal generator power (kW) |
|---|---|---|---|
| 1 | Chimney | 15-20 | 1-3 |
| 2 | Stoves | 40-65 | 3-12 |
| 3 | Thermo stoves | 60-80 | 7-10 |
| 4 | Wood boiler | Over 90 | 10-1000 |

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Some of the characteristics of these thermal generators used at rural areas in Albania are as follows.

**Figure 1:** Traditional fireplaces used in rural areas in Albania *(Source: Toromani & Çollaku, 2009)*

2.1 Fireplace

The chimney is an ancient traditional thermal generator. It is impossible to arrange the primary and secondary air flux in order to improve the exchange or the diffusion of heat. A considerable amount of heat is diffused out of the dwelling through the chimney tubes. This type of generator is less efficient, because only 15-20% of the energy produced from wood is used for heating or cooking. This type of generator needs also a special service of maintenance in order to remove the ash produced after combustion. This appliance is widespread mainly in the northern part of Albania and it is one of the thermal generators used not only for cooking but also for heating (Fig. 1).

**Figure 2:** Stoves traded in the local market which are used from households in rural areas

2.2 Stoves

Stoves used at households are constructed from metallic and ceramic material and are quite different from fireplaces, because the wood combustion takes place in a closed room which in the front side is composed of metal or glass. In this thermal generator it is possible to arrange the flux of primary air. The heat released by wood fuel is absorbed from the stove and it is diffused in the room environment. There are a lot of stove models in the market. The efficiency of this thermal generator is 40-65%. Stoves have a power of about 3-12 kW depending on the amount of wood fuel and on the efficiency. For their installation the house needs kin and a levelled pavement. These thermal generators (e.g. Fig. 2) are mainly used in rural areas in the central and southern part of Albania.

2.3 Thermo-stoves

Thermo-stoves (Fig. 3) have a higher efficiency compared to normal stoves. The hot air is collected and sent in the heat diffuser where, within metallic tubes, it passes through the thermal vector and it is diffused in the dwelling rooms. The combustion is controlled through an air arrangement and, in more sophisticated models, through secondary air. The efficiency of this thermal generator is 60-80%, compared to wood energy content. They use mainly firewood and pellets. The stoves with pellets that are sold in Albania have a power of 7-10 kW with a price 144 000-219 000 ALL. They consume 0.7-1.5 kg/hour of pellets. The $CO_2$ emitted from these stoves range from 0.013% (7 kW) to 0.015% (10 kW). They are constructed according to the European Standards EN 14785: 2006.

**Figure 3:** Thermo-stoves using pellet

2.2 Wood boilers

Wood boilers are the most sophisticated thermal generators (Fig. 4). They warm the environment through sanitary water that is circulated through the radiator located in the dwelling rooms. This type of generator has higher efficiency than other generators. They are able to control the primary and secondary air flux because they contain a lambda stylet and a system of dust circulation into the burning room. They have an efficiency about 90% of wood energy content, with a power ranging from 10 to 1000 kW.

**Figure 4:** Boiler with wood *(Source: Mori et al., 2007)*

## 3 ESTIMATION OF THE THERMAL GENERATOR POWER

In order to estimate the power of a thermal generator, the following variables must be taken into account:

- The volume of dwelling for heating
- The type of windows (single or double glasses)
- The structure of building
- The minimal outdoor temperature of the area and the temperature that should be reached through the thermal generator
- The distribution of thermal demand per year and the maximal amount of energy produced

The thermal generator power is estimated with the following formula [6]:

$$Q=E \times S \times F_{tm} \times F_{te}$$

where:

- Q is the maximal power of the thermal generator (kW)
- E is the specific thermal demand (FTS) ($W/m^2$)
- S is the area of the dwelling ($m^2$)
- $F_{tm}$ is the correction factor applied basing to the minimal temperature of the area
- $F_{te}$ is the correction factor based on the type of building

The thermal specific demands depends on: type of the building, thermal isolation, rooms height and glass type of windows (Table II).

**Table II:** Thermal specific demand for various buildings ($W/m^2$)

| Type of building | Thermal isolation | Type of glass | Room height | FTS ($W/m^2$) |
|---|---|---|---|---|
| Old | partial | Double | >2.5m | 130 |
| Old | partial | Double | <2.5m | 110 |
| New | yes | Double | <2.5m | 90 |
| New | yes | Triple | <2.5m | 70 |

*(Source: Mori et al., 2007)*

Thus we have calculated the power of a boiler for heating in a typical residential dwelling in Albania rural areas with such characteristics: average housing area 180 $m^2$; partly thermal isolation; old building with rooms height over 2.5 m; outdoor minimal temperature -6 ° C ($F_{tm}$=0.76). The maximal power of boiler for heating will be:

$Q = E \times S \times F_{tm} \times F_{te} = 130\ W/m^2 \times 180 m^2 \times 0.76 \times 1 =$

17784 W=17.8 kW

This energy is equivalent with the power of 6 fireplaces, 2 stoves and 1 furnace (boiler).

## 4 ESTIMATION OF ECONOMIC AND ENVIRONMENTAL BENEFITS FROM EFFICIENT THERMAL GENERATORS

Firewood is one of the most important renewable energy sources for inhabitants in rural areas which is used in various thermal generators with different energy efficiency. The use of firewood has a lot of advantages from both the economical and environmental point of view. For that reason, we have investigated and assessed the economic (wood saving) and environmental benefits ($CO_2$ emission reduction) of above-mentioned thermal generators which use wood as fuel.

**Table III:** Economic and environmental benefits of various thermal generators

| Type of generator | Fireplace (n=7) | Stoves (n=5) | Therm. stoves (n=2) | Boilers (n=1) |
|---|---|---|---|---|
| Efficiency % | 20 | 40 | 65 | 90 |
| Energy demand per family (kWh $yr^{-1}$) | 26 700 | 26 700 | 26 700 | 26 700 |
| Quantity of wood (kg $family^{-1}$) | 33 375 | 16 687 | 10 269 | 7 417 |
| Production of coppice (t $ha^{-1}$) | 14.8 | 14.8 | 14.8 | 14.8 |
| Forest Area (ha $family^{-1}$ $yr^{1}$) | 2.25 | 1.13 | 0.69 | 0.5 |
| Forest Area at national level (ha $yr^{-1}$) | 943 870 | 474 480 | 289 726 | 209 947 |
| Expenditures for same level of energy (ALL $yr^{-1}$) | 92 340 | 46 375 | 28318 | 20 520 |
| Money saving (ALL) | 0 | 45 965 49.8% | 64 02 69% | 71 820 78% |
| Quantity of $CO_2$ emissions (t $yr^{-1}$ $family^{-1}$) | 0.81 | 0.41 | 0.251 | 0.181 |

*(Source: Toromani & Çollaku, 2009)*

The heating of an old building with an area of 180 $m^2$ (power of generator 17.8 kW) with 1 500 hour of work $year^{-1}$, requires 26 700 kWh $yr^{-1}$. In case of use of seasoned wood as fuel wood, which own an energy

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content of 4 kWh $kg^{-1}$, one family needs 6 675 kg (or 6.675 tons fuel wood). Let's take into account four types of thermal generators using fuel wood as raw material with various energy efficiency. The most common firewood used in rural areas in Albanian is originated by oak species. According to the last Albanian National Forest Inventory [2], the average volume of coppice forests is 22.8 $m^3$ $ha^{-1}$ with a production of 14.8 t $ha^{-1}$ (22.8 × 650 kg =14 820 kg). The cycle of production for coppice forests is considered to be 30 years. Based on the above- mentioned data we have calculated the economic and environmental benefits for various thermal generators (Table III).

This analysis reveals clearly the economical benefits in terms of forest area and money saving for timber purchase and consumed at family and national level. The use of modern and efficient thermal generators like: thermal-stoves and wood boilers, reduce the money expenditures from 69 to 78 percent for each family in rural areas. On the other hand the use of such modern devices has a great impact on the reduction of firewood consumption ranged from 69 to 76 percent compared with firewood used in fireplaces. These estimations also put lights on the importance of the usage of efficient thermal generators for reduction of $CO_2$ emissions release and improvement of indoor air quality at dwelling level.

## 5 CONCLUSION ABOUT BIOMASS ENERGY USAGE IN ALBANIA

The study conducted on the energy efficiency and the role of thermal generators on firewood consumption, environmental protection and indoor air quality life has attained the following findings:

- Firewood is the main source for heating in Albanian, especially in rural areas
- Low energy efficiency generators consume more fire wood than most efficient technologies.
- The coppice forest area production in Albania doesn't cover the demand for firewood at national level in rural areas. The estimated forest area (943840 ha) needed for meeting the firewood demands is much higher than coppice forest area (623799 ha) in Albania [2]. Taking into account the distribution of coppice forests and the population density in some villages it can be said that coppice forest resources in some areas do not meet the demands for fuel wood.
- As result of technology improvement the rural families save about 70% of their budget for the same amount of energy production.
- The use of efficient technologies at household level will improve indoor air quality creating a friendly environment family members.
- The carbon dioxide emissions released as result of high energy efficiency thermal generators is reduced 69-78% compare with traditional appliances.

## 6 RECOMMENDATIONS

Some of the recommendations drawn based on the findings of the study were:

- The improvement of technology for wood burning at household level should be a priority in order to promote energy, biomass, and financial savings.
- Beside wood burning technology improvement another opportunity to save energy is the improvement of the thermal isolation of houses and windows (e.g. double glasses not only in new but also in old buildings).
- Governmental and non governmental agencies should undertake initiatives and support the use of new technologies for wood burning in rural areas.
- Government should support the construction of "passive houses" with 15 kWh per square meter for heating as main type of dwellings for energy saving.

## 7 ACKNOWLEDGEMENTS

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# TRANSPORTATION COSTS AS AN INDICATOR FOR DETERMINATION OF THE OPTIMAL ROAD DENSITY

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ABSTRACT: The main purpose of this scientific paper is to offer a new model of optimal forest road network density in high mountain regions. The model should establish a connection between the density of the road network and costs incurred in the transportation of wood during forest utilization. The new model is based on the relationship between the minimum cost of wood transport and optimal density of the road network.
Costs that arise from the building of road network show complex mathematical dependence that can be solved with differential calculations or the first derivative of the total cost of transportation. This method can easily reach the optimal density of the road network.
Keywords: forest, optimal road, network, skidding, costs.

## 1 INTRODUCTION

In practice, the question for optimal road density for transport of wood assortments has often been an issue. Overall, we can assume that the transport in forests could be distinguished according to the following characteristics: the natural features of the area, the technology of work, the potential of the forest, as well as the methods of forest utilization.

The optimal road network explains the smallest production costs in the phase of wood transport, where all the work tasks which arise with one contemporary forest management will be accomplished, and the environmental i.e. the protection function of the forest will be fulfilled as well.

At the same time the forest road network should evenly open the whole area, where the evenness does not apply to the distance between roads, but to the economic requirements, and to the economic importance of some parts of the forest.

The different situations that happen during the process of wood transport could be presented with the transport costs which are under the influence of the road network density, through complex mathematical variations, or rather with differential calculations, i.e. with calculating the first deduction from the total costs of transport.

In this paper, the research was made in three different ways of skidding: skidding with animals (horses), skidding with adapted tractor Ford 5600 and skidding with cable railway (type KOLER). This is old machinery which often suffers from breakdowns. The research was conducted on Plackovica and Kozuf mountains in the Republic of Macedonia. The gradient of the terrain varied from 30 to 45 %, and the dominant wood type is beech, with assortment wood structure: 60% firewood and 40% technological tree or logs. In this research the skidding with the animals and the tractor was mostly done in fall, only a small part was done in increase, whereas with the cable railway the total skidding was done in increase.

## 2 METHOD

When calculating the optimal forest road network, as basis we took the ideal model, i.e. one can start from the following conditions:

The density of truck roads is calculated with the equation (1):

$$Gkp = \frac{Lkp}{F} \qquad (1)$$

*Gkp* - density of truck roads
*Lkp* - length of truck roads
*F* - area

This methodology takes as basis all the dependably changeable parameters of the forest road density. It could be simplified i.e. some elements can be set as a constant of some factor, or to be compounded if there are more input parameters which could make a certain process or factor more precise.

The optimal density of road network is calculated with the help of differential calculations of the total transport costs, i.e. defining the minimum costs. The equation (2) is used to calculate the optimal density of truck road network.

$$\frac{DTsum}{DGkp} = 0 \qquad (2)$$

*Tsum* - total skidding costs
*Gkp* - density of truck roads

This method allow us to make different analyses through which a certain factor could be tested within the framework of its minimum and maximum span.

The methodology of work is presented in the scientific paper of Z. Trajanov [8] and the scientific paper of Z. Trajanov and Lj. Nestorovski [9].

## 3 RESULTS

According to the research of Z. Trajanov [8,9], with an assumed period of 100 years, i.e. the felling cycle of reproductive woodcutting, the volume of wood which is to be used in the area is being defined, on average $Q[m^3/ha] = 300$, which equals 3 $m^3/ha$ average annual increase. With that, according to the differential method, i.e. equation (2), the following results have been acquired for the real situations researched on field.

**Table I:** The optimal road network density for the researched skidding models.

| *Models* | *Gkpa* | *Gkpt* | *Gkpz* |
|---|---|---|---|
| *Gkp[300m/ha]* | 24,99 | 21,64 | 17,07 |

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From the chart one can see that the optimal density of the forest truck road network varies from 17,07 *m/ha* when skidding with forestry cable crane (*Gkpz), 21,64 m/ha* when skidding with a tractor (*Gkpt),* to 24,99 *m/ha* when skidding with a horse (*Gkpa).*

The economic model also allows us to come to the solution by using a graphic chart (Fig. 1). The results acquired could be seen in the graphic presentation of the diagram, where the relation of the costs for wood transport with the density of the forest truck roads is shown. The minimum costs present the point of optimal density of road network.

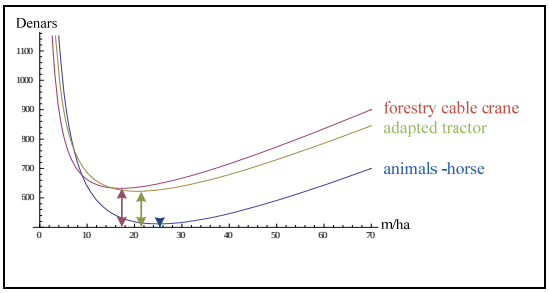


**Figure 1:** Relation of the costs for wood transport to the optimal density of the researched skidding models

Despite allowing the determination of the optimal density, this model also allows further analyses. In this situation, the influence of the used volume of wood, i.e. the production capacity of a certain forest has been elaborated on. The results acquired for the optimal density of truck road network are shown in Table II.

**Table II:** Relation of the road network density to the amount of the volume of wood.

| volume of wood | animals -horse | adapted tractor | forestry cable crane |
|---|---|---|---|
| *Q[m³/ha]* | | *Gkp [m/ha]* | |
| 100 | 13,3 | 11,1 | 8,4 |
| 200 | 20,1 | 17,1 | 13,3 |
| 300 | 25,0 | 21,6 | 17,1 |
| 400 | 28,9 | 25,1 | 20,1 |
| 500 | 32,2 | 28,1 | 22,7 |
| 600 | 35,1 | 30,7 | 24,9 |

The data from Table II is graphically presented in Fig. 2.

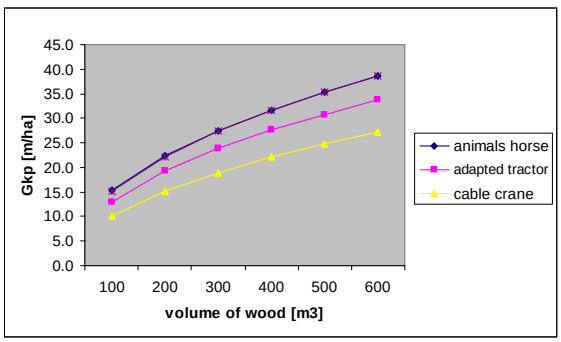


**Figure 2:** Relation of the road network density to the amount of the volume of wood

From the diagram on Fig. 2 can see that with the increase of the volume of wood, the density of the optimal road network also increases.

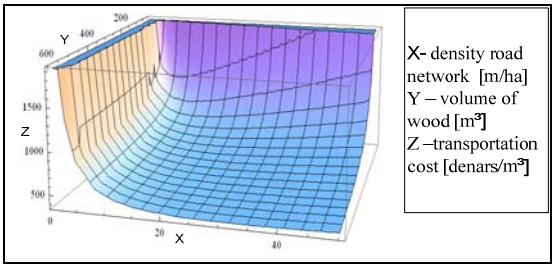


**Figure 3:** Relation of the total costs at horse skidding, to the volume of wood and the density of the road network

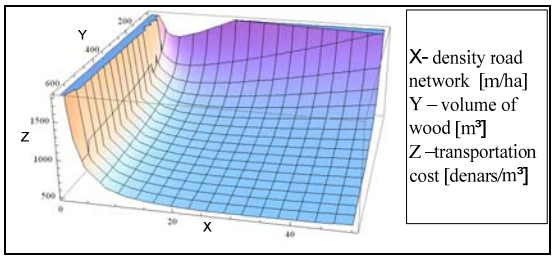


**Figure 4:** Relation of the total costs at adapted tractor skidding, to the volume of wood and the density of the road network

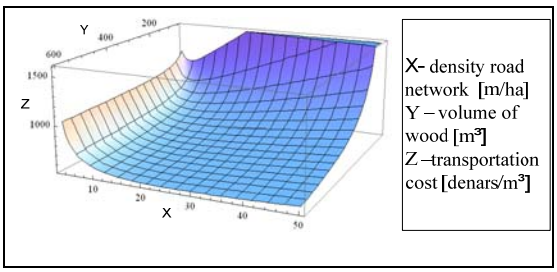


**Figure 5:** Relation of the total costs at forestry cable crane skidding, to the volume of wood and the density of the road network

The Figs. 3, 4 and 5 show the interrelation of: the transport costs, the volume of wood that is used during the period of 100 years, and the density of the road network at the skidding with horses, tractor, and forestry cable crane. In these diagrams one could notice more regularities and tendencies which present a clear guideline in which direction the network of forest roads should be developed:

- The means of skidding affects the density of the road network, at that with all means of skidding the same tendencies have been noticed.
- The transport costs are reduced with the increase of the volume of wood which is being used.
- The transport costs are in relation to the density of the road network.
- The transport costs are very high when the density of the road network is small; with the increase of density, the costs are quickly reduced and reach the minimum; in extension to this the costs have a slight increase with the increase of the density of the road network.

- The point of minimum transport costs presents the optimal density of the road network.

The diagrams determine the negative moments which must be very careful avoided in the forestry practice when projecting and measuring the dimensions of the road network. The situations when there is small volume of wood which is to be used, and when there is a very low openness of the forest, have a very negative influence on the transport costs. The diagram with red shades shows the area of big costs, which in practice should be avoided, in order to keep the profitability of the work.

The diagrams also determine the positive moments which should be favorized in practice. Thus, the increase of the exploitation of the volume of wood, and the higher extent of openness, have a positive influence on the reduction of the transport costs, up to a certain point. The diagram with blue shades shows the area of small costs, which in practice should be used, in order to keep the profitability of the work.

The diagram also determines the optimum, i.e. the minimum costs which in practice are most wanted. At this, the minimum itself is not a very distinguished point, but with small deviations it is kept both in the part with a smaller density, as well as in the part with the bigger density of roads. However, the part with higher density is more lenient, that could lead one to a conclusion that if a deviation is needed to be done, it should be done at the expense of the increase of the road density.

## 4 CONCLUSIONS

- There is no universal solution to the problem of optimal density of the road network. A reason for that are the many parameters which are changeable, but have an influence on the optimization of the transport costs.
- The economic method of minimum costs presents useful information about the trends and relations of the optimal truck road network.
- The point of minimum transport costs presents optimal density of the road network.
- The optimal density of the forest truck road network at the research model, i.e. the average use of 300 $m^3/ha$ in a period of 100 years, is within the range of: 17,07 *m/ha* when skidding with forestry cable crane, *21,64 m/ha* when skidding with a tractor, and 24,99 *m/ha* when skidding with a horse.
- In practice the best financial results would be acquired if one could project an ideal road network which is in correlation with minimum transport costs. If deviations are needed, it is better to make them at the expense of the increase of the density of the road network, because in that case smaller losses are made.

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# RURAL TOURISM IN PROTECTED AREAS: A CASE STUDY FROM KURE MOUNTAINS NATIONAL PARK-TURKEY

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ABSTRACT: The harder people work, the more essential they see their holiday needs. Besides sea, sun, sand tourism, cultural tourism and religious tourism, alternative and special interest tourism activities have been more popular recently. Although the term of "rural tourism" was started to be known early 1990s, it has become important in Turkey recently. Lots of projects were started for rural tourism in Turkey. The most important one is in Kure Mountains National Park which is the one of 9 European biodiversity hotspots in Turkey. It is crucial both national and international biodiversity. Küre Mountains National Park is certified as Protected Area Network Parks (PAN Parks) in April 2012 as a result of Global Environment Facility (GEF) supported "Enhancing Forest Protected Areas Management System in Turkey Project" activities, becoming the first PAN Park in Turkey and one of only 13 parks in the selective PAN Parks network in Europe.
This paper provides a comprehensive description of the rich biodiversity in KMNP and describes the sustainable tourism strategy approach. Moving from PAN Park process of KMNP case, current state of the protected area is discussed and suggestions are made.
Keywords: PAN Park, Kure Mountains National park, protected areas, rural tourism.

## 1 INTRODUCTION

Forests are crucial for the well-being of humanity. They provide foundations for life on earth through ecological functions, by regulating climate and water resources and serving as habitats for plants and animals. Forests also furnish a wide range of essential goods such as wood, food, fodder and medicines, in addition to opportunities for recreation, spiritual renewal and other services. Forests cover 23.789.216 ha which is approximately 30% of surface area of Turkey (OGM, 2012). Forests are the most popular ecotourism destinations because of their unique values for tourists interested in nature, local value and culture. Sustainable development approach in the management of mountains and forests is very important because biodiversity must be conserved in the long term to minimize the negative impacts of tourism.

A biodiversity hotspot is a biogeography region with a significant reservoir of biodiversity that is under threat from humans (Myers, 1990). In 1988 British ecologist Norman Myers led to determine "Hotspots" that means priority area in nature conservation. In this context, Myers and Conservation International (CI) determined 25 hotspots that cover 1.4% of the world surface (Kalem, 2005). Vegetation was considered as a priority to determine hotspots in order to affect primary of the productivity of an ecosystem. These are the areas are known "Global Biodiversity Hotspots" that show the geographical and ecological diversity from the tropical parts of the Andes in South America to the islands of Polynesia (Kalem, 2005).

Nowadays, over 50 percent of the world's plant species and 42 percent of all terrestrial vertebrate species are endemic to the 34 biodiversity hotspots. The biodiversity hotspots hold especially high numbers of endemic species, yet their combined area of remaining habitat covers only 2.3 percent of the Earth's land surface. Each hotspot faces extreme threats and has already lost at least 70 percent of its original natural vegetation (Conservation International, 2012).

### 1.1 The case of Turkey

Turkey has a special location in the Global Biodiversity Hotspots Map of CI. Because the territory of Turkey is located in three of these 34 major areas that are Mediterranean Basin, Irano-Anatolian and the part of Caucasus vegetation (Conservation International, 2012; Medail and Quézel, 1998). It is a scientific truth that Turkey has one of the richest natural heritage in temperate zone with approximately 11.000 plant taxa-one thirds of them are endemic, 160 mammal, 450 bird, 120 reptile, more than 500 fish species and habitats provide living area for them (Conservation International, 2012; Guner *et.al.* 2000; Kalem 2008).


**Figure 1**: Map of hotspots in Mediterranean Basin


**Figure 2:** Map hotspots in Irano-Anatolian&Caucasus

Turkey contains a great variety of natural habitats, ranging from Mediterranean, Aegean, and Black Sea

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beaches to towering coastal and interior mountains, from deeply incised valleys to expansive steppes, from fertile alluvial plains to arid, rocky hillslopes. A myriad of community types and habitat mosaics occur, containing a rich mixture of plant and animal species, many of which are endemic (Guclu and Karahan 2004).

**Table I:** The Number of Species in three major areas and Turkey (Conservation International, 2012)

| | Mediterranean Basin | Irano-Anatolian | Caucasus | Turkey |
|---|---|---|---|---|
| Flora | 22,500 | 6,000 | 6,400 | 11.000 |
| Fauna | 1,240 | 728 | 739 | 80,000 |
| Endemic species | 11,917 | 2,554 | 1,653 | 3,500 |

Turkey's diverse natural ecosystems, its geological history and its geographical position between three continents have given rise to an astonishing plant and animal diversity. Three WWF "Global 200" ecoregions and three global biodiversity hotspots are located in the country, and the national network of protected areas comprises more than 4.1 million ha, or about 5 percent of the total territory of Turkey (UNDP, 2012). 1856 protected areas are found in Turkey as it can be seen on Table II.

**Table II:** Number of protected areas in Turkey (Ministry of Forestry and Water Affairs, 2012)

| Conservation Status | Nm | Related Law |
|---|---|---|
| National park | 40 | Law on National Parks |
| Nature reserve area | 31 | Law on National Parks |
| Nature parks | 182 | Law on National Parks |
| Wild life reserve areas | 80 | Law on National Parks |
| Conservation forest | 55 | Law on Forest |
| Genetic conservation areas | 14 | Law on Forest |
| Seed stands | 337 | Law on Forest |
| Specially protected areas | 15 | Law on environment |
| Nature sites | 1273 | Law on Conservation of Cultural and Natural Heritage |
| Ramsar sites | 13 | Ramsar Convention by-law on Conservation Wetlands |

Over 100 forests are located in Europe and its environs according to WCMC (World Conservation Monitoring Centre), WWF (World Wild Fund) and few experts in 1999. These areas were chosen by taking into consideration such specialties that were biological richness, the representation of specific forest types in Europe and magnitude. Nine of European Hotspots are in Turkey (Fig. 3) (Kalem, 2005).

One of the biodiversity hot spots of European forests is the Kure Mountains in Turkey. 37.000 hectares area was declared as "National Park". About 50 rural settlements of 8 counties are located in the buffer zone around the area. One of the sources of living for these rural settlements is tourism lately.

## 2 PROTECTED AREAS

Protected areas are locations which receive protection because of their recognized natural, ecological and/or cultural values. There are several kinds of protected areas, which vary by level of protection depending on the enabling laws of each country or the regulations of the international organizations involved (World Database in Protected Areas, 2012). Protected areas are the cornerstone of global biodiversity conservation. Over the past 40 years, governments and non-governmental organizations alike have made unprecedented investments in the establishment of protected areas around the world. As a result, the world's terrestrial protected areas encompassed more than 18 million sq km in 2011, compared with just over 2 million sq km in 1970 (Rosser, *et .al*., 2012). Protected areas are expected to do more- in terms their ecological, social and economic contributions-than ever before. Not only are they expected to provide habitat for endangered wildlife, but also to contribute to livelihoods for local communities, to generate tourism revenues to bolster local and national economies, and to play a key role in mitigation of an adaptation to climate change, among many other diverse functions and contributions (PAN Parks, 2012). The following report looks at how changing 21st century expectations about the roles and functions of protected areas are beginning to shape protected area management around the world and identifies emerging best practices for protected areas under a new paradigm that views protected areas as part of a planetary life support system. The report is based on case studies drawn largely from the portfolio of projects financed by the Global Environment Facility (GEF) through the United Nations Development Program (UNDP). The GEF is the world's most significant multilateral funding source for protected areas. Since the Convention on Biological Diversity's Program of Work on Protected Areas was ratified in 2004, UDNP/GEF has supported work in more than 700 protected areas around the world, covering nearly every goal, target and action under the Program of Work (UNDP and Ministry of Forestry and Water Affairs, 2012).


**Figure 3:** 9 Biodiversity Hotspots in Turkey *(Source: Blumer, 2010; Sustainable Tourism Development Strategy of Kure Mountains National Park, 2007; pg: 6)*

There are 6 IUCN protected area categories:

- Strict Nature Reserve
- Wilderness Area
- National Park
- Natural Monument or Feature
- Habitat/species Management Area
- Protected Landscape/Seascape
- Protected Area with Sustainable Use of Natural Resources (IUCN, 2012).

All protected areas in all categories in the world like in Turkey should aim to:

- Conserve the composition, structure, function and evolutionary potential of biodiversity
- Contribute to regional conservation strategies (as core reserves, buffer zones, corridors, stepping-stones for migratory species etc.)
- Maintain diversity of landscape or habitat and of associated species and ecosystems
- Be of sufficient size to ensure the integrity and long-term maintenance of the specified conservation targets or be capable of being increased to achieve this end
- Maintain the values for which it was assigned in perpetuity
- Be operating under the guidance of a management plan, and a monitoring and evaluation program that supports adaptive management
- Possess a clear and equitable governance system (OECD, 2012).

## 3 METHODOLOGY

Case study method was used in this study. All data were collected through literature review, observations and interview.

### 3.1 Literature review on Kure Mountains National Park

#### 3.1.1 General characteristics of National Park - valuable biodiversity

Located on the Kure Mountains, on the west of Black Sea Region, the National Park bears all the characteristics of a plateau. The area of the KMNP is 37.753 ha, whereas the surrounding buffer zone accounts for 134.366 ha. Daily life activities around the National Park do not spread into the boundaries of the National Park; consequently there are not any settlements within the boundaries. In other words, the National Park, located on an east-west axis, is a physical and social barrier for its surrounding (KMNP, 2012). Located on the Kure Mountains, on the west of Black Sea Region, the National Park bears all the characteristics of a plateau. Kure Mountains start from Bartin River on the west and runs 300 kilometers on to Kizilirmak River toward the east. Thanks to its varied topographical structure, the area hosts a diverse landscape. It owes its rich habitat, which include all the main ecosystem types such as forest, maquis, cliffs, caves, river, coastal and traditional agricultural areas, to being a part of the coastal mountain system that covers the north of Anatolia from one end to the other. There is both national and international importance of this area. This area is located in "North Anatolia and Caucasia Temperate Zone Forests" that is prior to in terms of natural protection of WWF on a global scale. Two endangered plant taxon in the world that are *Acer cappodocicum* var. *stenocarpum*, *Trifolium euxinum* are in this area. Thirty-three endangered plant taxon in Europe are in this area, too. It is also one of the Important Plant Areas (ÖBA) and Important Natural Areas of Turkey. Twelve endangered plant taxon were found on a national scale. As stated above, it is one of the nine hotspots in Turkey. It has rich landscape, habitat diversity and also species varieties (675 plant, 40 mammals, and 129 bird species) (Ekim et al, 2010). National Park holds the character of a tableland reaching forth east to west and it is a threshold for its neighborhood. There is no accommodation in the national park; social life is still going on in immediate surroundings. . The buffer zone surrounding the park comprises approximately 60 villages with a total of 20,000 to 30,000 inhabitants, mainly middle-aged and older. The main economic activities include forestry, agriculture, apiculture, wood-carrying, weaving, chestnut farming and tourism. The average annual income is below € 400 per capita. The settlements in the buffer zone are rich and diverse in folklore. In addition to the natural assets of the park, these folkloric values and traditional wooden houses are highly important for tourism. The area represents a unique carstic system which is the result of a malm-crertaceus old shallow marine transgression as well as wildlife and old-growth forest formation, which are of both social and environmental values. The Kure Mountains provide a rich variety of habitat diversity (Gunes and Hens, 2007). The western section of the mountains has been identified as one of the 122 important plant areas in Turkey. The site represents the best remaining example of the deciduous and coniferous forests of the North Anatolia sub eco-region as well as one of the highly endangered carstic mountains of the Black Sea humid forest ecotype. There are 80 endemic and 45 endangered plant taxon, 32 of which are rare species. The Kure Mountains are also one of the important bird habitats of Turkey. Additionally, they provide habitats for approximately 30 of the 132 mammal species of Turkey like Bobcat (*Lynx lynx*), Catamount (*Felis sylvestris*), otter (*Lutra lutra*), grizzly bear (*Ursus arctos*) and deer (*Cervus elaphus*) (Gunes and Hens, 2007). It is known that there are 129 bird species living in the area. Especially high rocky places which are faced towards broad valleys are suitable places for some kind of animals to shelter like; vulture, falcon, eagle and other night predators. With this feature it is one of the 255 Important Bird Areas (IBA) of Turkey. There are approximately 100 caves that are situated on Kure Mountains. According to recent studies around 200 species collected, and there are five new species which is likely to belong to the Crustacea, Arachnida, Myriapoda classes (KDMP, 2012).

Natural and old forests are forests in which there is no production of wood or usage of other sources, in which humans don't have negative effect on the balance of nature and in which there are relationships between components that constitute natural ecosystem. The most distinctive feature of these forests is that there are not only young individual, but also old trees with folded, brittle and dry trees. Natural old forests declining rapidly in the world hold key for their healthy structures and biodiversity. High carstic plateaus such as the region Kizilcasu, between Cide-Azdavay, in the Kure mountains; Sorkun uplant near Pinarbasi and the region Zoni near Arıt constitute rich plant composition with their old trees and forest meadows. Linden tree (*Tilia rubra*), hazel (*Corylus colurna*), ash-tree (*Fraxinus*

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*angustifolia*), ilex (*Ilex aquifolium*), elm tree (*Ulmus glabra*), sycamore (Acer platanoides), Uludağ abies (*Abies nordmanniana* ssp. *bornmuelleriana*) and oriental beech (*Fagus orientalis*), which reach preternatural length and diameter, show maturity of ecosystem. In region Bartın, virgin forests reach the present day in places that are hard to reach because of rocky structure. Söğütlü Village in Arıt the forest, almost 1000 hectares, located in North of Gürdek have the distinct characteristics of virgin forests (KDMP, 2012).

3.1.1 Geographical structure (canyons, caves, waterfalls and other carstic shapes)

Kure Mountains National Park is in the west Black sea region carstic zone. There is an interesting range of national and international examples of four basic abrasion surfaces because of the lower-middle Miocene geomorphologic processes. National Park is regarded as one of the richest geographical formations that are occurred after the rain both in Turkey and in Europe. There is a living hydrologic system in Kure Mountains, ground and surface waters are still forming different structures. Kure Mountains National Park which hosts approximately 100 caves is a west-east ranging mass of chain mountains. With this characteristic, it is the second National Park hosting that much caves coming after Carlsbad Caverns in US. The most famous cavern in the Kure Mountains is Ilgarini Cave where there is a lot of historical remains, situated on Kastamonu. Horizontally it is 858meters long, and it is 250 meters deep. There are a lot of cemeteries, chapels and tombs thought to belong to Roman-Byzantine Empire. However in Bartin, Aşağıçamlıı Sipahiler and Söğütlü caves are rich in the visual context and can be reached easily by visitors. The biggest of all the canyons in Kure Mountains, Valla Canyon; with its 10 km length and 1120 meter depth and spectacular view is a significant landscape beauty. As the most important figures of Kure Mountains, canyons are very important with their peculiar botanic variety, wildlife and hydrologic function. Canyons in the region of Bartin, made by carstic reefs are more vertical and high. Karadere canyon which is a green canyon is an important carstic structure. Also, Ulukaya canyon where Ulukaya waterfall took source is an important value. The rocky and uneven territory and dense forest covered botanic texture of Kure Mountains contains not only caves and fountains, but waterfalls as well. Ilıca waterfall which is situated near Ilıca village, Ulukaya waterfall which is pouring down from 20 meters and Gölderesi waterfall which hides into the dense forest botanic texture are three of the well-known waterfalls (Arıcak, 2011).

3.1.3 Rural tourism and recreational values

Turkey has a continental characteristic with 77,1 million ha. There are only a few countries with such biotope diversities, except for tropic regions on the earth. Rural tourism is integrated to rural culture, natural environment and agriculture besides it is closely relevant to the other tourism types. Therefore it is varied by local, national and international enterprises attracted lots of people all over the world to the rural areas (Soykan, 2003). As the meaning of rural word in rural tourism concept is perceived directly as “rural areas” in Turkey, it is identified to tableland tourism, hunting tourism, speleological tourism, ecotourism and outdoor activities. As well as that is not wrong, the real aim in rural tourism to accommodate in a village, in a farm, in a bungalow etc., to meet rural culture and socialize that are differences because of aims and activities between the other tourism types and rural tourism. In recent years rural tourism becomes widespread in Turkey. Rural restaurants, handcraft stores, fish farms, rural ways meet to tourists or overnight tourists. In addition to individual trips, excursions or trips are arranged by travel agencies to rural areas contains them (Soykan, 2003).

All of these progresses in recent years are indicated that rural settlement is used by the purpose of tourism usage is widespread in Turkey. We all know there is a real great potential. Rural tourism features are as follows:

- Rural tourism is a type of tourism could be done in every season,
- Rural tourism is a balance element in the geographical distribution of tourism,
- Rural tourism is integrated to lots of tourism types,
- Recreational activities are various and characteristic in rural tourism,
- Tourist profile in rural tourism is different,
- Rural tourism contributes the protection of natural habitat and cultural heritage,
- Rural tourism serves the concept of sustainable tourism,
- Rural tourism is an important tool for the promotion of a country.

Kure Mountains with its internationally important biodiversity values, different habitats, canyons, caves, fountains, waterfalls, internationally significant history, architectural and cultural values; is the most significant natural protection area. Valla Canyon, Ilgarini Cave and the surrounding caves, Ilıca waterfall near Pınarbaşı, Çatak Canyon in Azdavay and Aydos Canyon in Cide, Ulukaya waterfall and canyon are remarkable visual values. Ilıca waterfall which is situated on the ending point of Horma Canyon can be reached with a short walk from Ilıca village. The refreshing water which is poured from approximately 15 meters high above could attract visitors. There is a historic Turkish bath which named the village over there near the waterfall. Gürdek reef situated in Arif has a spectacular view. Villages which forms the south wall of the National Park as Arpacik, Igneciler, Kadıkoy, Abdurrahman, Asagidere, Asagicerci, Cerde are very rich both visual beauty and botanic texture. Odaaryanı which is situated at the top is an old Byzantine settlement. There is a little path from the top to the Arit. Aşağıçamlı Village is a settlement which is nested with National Park. It is a village which is prominent by its natural beauty in Ulus-Drahna Valley region. Old wooden houses, Aşağıçamlı cave and Drahna-Kurucasile is the starting point of trade ways (Avcioglu, 2012). Kure Mountains are considered one of the richest spots regarding canyons and caves in Turkey. The Kure region is considered the Turkey’s second most important karstic area after the Taurus Mountains (Blumer, 2010). In a relatively confined area, there is a large diversity of vegetation structure and flora composition that make KMNP very valuable from the conservation point of view. The daily life in the rural areas is one of the most important cultural values of the area. Wooden houses, traditional colorful clothes worn by women, layback atmosphere in the villages especially during “tea time”, and local handicrafts make a rich cultural experience for travelers in the region. Delicious local cuisine and the slow-down path of life bring additional charm to the

present cultural assets. The rural population has limited alternative for development excepting their traditional activities, which has started to be abandoned by the younger generation that moved out from mountain communities. However, ecotourism can and already brings a new innovative economical activity that can stimulate local families and young people to remain and blend their traditions with the new activities necessary for developing a quality ecotourism. Tourism facilities are not very developed in the area (buffer zone). However, there are already options for accommodation both in the mountain communities and in the nearby towns. Subtotal bed capacity in Park area is 284 beds; near locations' are 2769 beds. It is possible to find kinds of tourism activities like hiking and backpacking trails, mountain biking and cycling, canyoning, wildlife and bird-watching, picnicking, nature sightseeing, rural heritage tours.

3.1 Interview

Mr. Ercan Yeni who is Bartın Regional Director of Forestry was interviewed about the projects in the region. KMNP's nomination of PAN Parks (since 2003) was accepted in April - 2012. 2011-2012 PAN Park management plan has been prepared by the project consultant Andrei Blumer and competent authorities. Also SWOT analysis has been done for KMNP (Yeni, 2012).

According to interview results:

The project "Enhancing Forest Protected Areas Management System in Turkey" started in 2008 and is implemented jointly with the General Directorate of Forestry within the Ministry of Forestry and Water Affairs, together with WWF Turkey as an NGO partner. Building on the foundation of an earlier GEF financed project, this project has focused on establishing the basic regulatory and operational mechanisms required to ensure conservation or sustainable management of 600,000 ha of globally significant old-growth forests and grasslands across nine forest hotspots. The starting point has been to develop models of good practice in the Kure Mountains National Park and its Buffer Zone (UNDP, 2012).

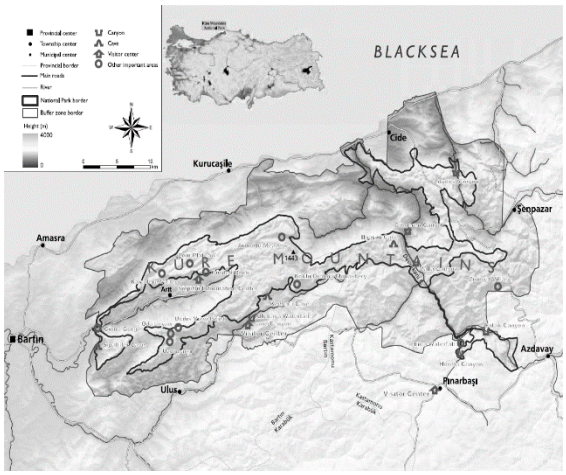


**Figure 4:** The Map of KMNP *(Source: Blumer, 2010; Sustainable Tourism Development Strategy of KMNP, 2007 32)*

The main objectives of the project are:

- to implement a cost-effective conservation management approach for forest protected areas at the Kure Mountains National Park,
- to demonstrate sustainable natural resource management at the buffer zone of Kure Mountains National Park,
- to disseminate the lessons learned from the pilot implantation at Kure Mountains National Park to other forest hotspots in Turkey, thus contributing to the improvement of national protected areas system (KDMP, 2011).

Besides this project, a number of projects were developed to involve these local communities. The second was implemented by the Kastamonu Foundation for Development, Health, Environment, Education and Tourism with financial support from WWF Mediterranean Program in 2000. Involving local communities in protecting their environment was the primary aim of the project. Ecotourism was identified as one of the best options for developing alternative livelihoods for these local communities. Educational activities for local communities and the local authorities included seminars on the sustainable use of forest resources and conservation of biodiversity. In addition, a traditional village house was renovated as an ecotourism center. After opening the Pinarbasi Ecotourism center in 2001, tourist guide training courses were organized and certificates were issued to 20 local nature guides. This number has been 37 in 2010. In 2002, ecotourism guide maps were published to inform both domestic and international visitors about multifunctional forests in the Kure Mountains. In 2003, income from the maps was used to establish the Kastamonu Ecotourism Association, which brings local nature guides together and aims to enhance the attractivity of the villages around the park for tourists. Both publication of the maps and the foundation of the Kastamonu Ecotourism Association helped to draw media attention to biodiversity conservation and ecotourism activities in the another successful undertaking is the Zumrut Village Ecotourism Project, financially supported by the UNDP Small Grants Program and executed by the Kastamonu Ecotourism association between 2004 and 2006. Zumrut village in Azdavay district in the southeast of the national park has more than 350 inhabitants, but only 35 of them live permanently in the village. Most of the people migrated to Istanbul to find a job or obtain education. The village has experienced economic loss as a result of the designation of the national park, which creates a negative attitude among local people towards the national park and nature conservation in general. Now 172 of them live permanently in the village (WWF, 2011). In 2006, a public awareness program was finalized; one village house and one mansion with 25 beds were restored in the traditional architectural style. The old village school building was refurnished as the Visitor and Public Awareness Center. The village house and mansion are now operated by the local public; training courses on packaging and preparation of organic products are very popular among women. Probably the most important contribution of the project to the local community, especially for women, foresters, and unemployed youth, was to offer alternative livelihoods in local nature guidance, organic and traditional hand-made products, bicycle and horse rental, and accommodation in village houses (Gunes and Hens, 2007). Setting an example as

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one of the 25 best practice examples of Turkey, the Kure Mountains National Park activities were promoted to thousands of participants of the UN Sustainable Development Conference in the Brasilian city of Rio de Janeiro (Rio +20) by way of speeches, posters, brochures and short films. The ''Enhancing Forest Protected Areas Management System'' project that is supported by the Global Environment Facility (GEF) in Küre Mountains National Park and the buffer zone around it has become a model implementation for protecting the environment, supporting sustainable development and green growth through tourism (UNDP, 2012).

## 4 RESULTS AND SUGGESTIONS

Nowadays nature conservation organizations are increasingly starting to realize that socio-cultural and economic sustainability in a region with a (protected) natural area are equally important when it comes to nature preservation. Tourism could be an instrument in sustainable development and nature conservation, giving nature economic value (and as such preserve it) and at the same time it benefits socio-cultural sustainability (e.g. improving quality of life and maintaining cultural heritage). This way a region can grow and develop itself in a sustainable and controlled way. Finally, careful planning and strategy formulation and management make it possible to minimize negative impacts and to maximize the positive impacts of a development. As such a region can develop in a sustainable way; therefore the formulation of a sustainable tourism development strategy is needed. According to Sustainable Tourism Strategy of of Kure Mountains National Park, some important rules are in the followings:

- Be educational and informative. Park visitors are particularly interested in discovering and learning about the park and adjacent region. For the most part, they also want to learn how to help sustain its character while deepening their own visitor experiences. Residents will also learn the value of resources they may have been taking for granted.
- Support the Values of the Region. International travelers to the region and the park are particularly interested in supporting the local values and resources. There they seek out businesses that emphasize local character in terms of architecture, cuisine, heritage, aesthetics, and ecology. Tourism revenues in turn raise local perceived value of those assets.
- Benefit local residents. Tour operators, particularly those from Turkey, should try to employ and train local people, buy local supplies, and use local services.
- Conserve resources. Environmentally responsible tourists prefer to support businesses that minimize pollution, waste and energy consumption, water usage, chemicals and toxic materials, and that provide accommodation which is respectful of the environment.
- Be sensitive to local conditions. Stakeholders anticipate development pressures and apply limits and management techniques to prevent unnecessary changes to the existing conditions. Local and external businesses cooperate to sustain natural habitats, heritage sites, scenic appeal, and local culture.
- Emphasize quality over quantity. Communities measure tourism success not by sheer numbers of visitors, but by length of stay, money spent, and quality of experience.
- Provide a quality travel experience. Satisfied, excited visitors bring new knowledge home and send their friends and relatives off to experience the same thing - which will provide continuing business for the region.

Management objectives:

- Developing good visitor infrastructure accommodating mainly day visitors
- Offering high quality nature interpretation and education
- High volume of visitors/ low environment and social impact
- Playing the function of hubs for the whole region

While those management objectives and necessities are overseen, mainly villages in the Southern part of Kure Mountains are determined as rural tourism hotspots (Table III).

**Table III:** Rural Tourism Hotspots in KMNP (Blummer, 2010; pg, 38)

| Name of Sub-Zone | Main Feature |
|---|---|
| Zone 2A- Aşağıçamlı- Kemerli | Traditional wooden houses preserved; Good local human resources for guiding/accommodation; Interesting surroundings; hiking to core area, natural forest, caves and etc. |
| Zone 2B- ZümrütEcovillage | Successful tourism projects: excellent start of community based tourism services; Beautiful cultural landscape; Well preserved wooden houses. |
| Zone 2C- Şenpazar | Handicraft project; Good basic effort agro-tourism |
| Zone 2D- Ilgarini | Good human resources for local guiding; Potential for local guesthouse development; |
| Zone 2D- Asagicerci | Women development Project |

Preserving wooden houses is given priority in villages in Kure. "Nature Guide" studies start. The term of "Nature Guide" means people are well educated about KMNP (flora, fauna education given also). When a tour comes to KMNP, nature guide meets them then tells everything about the national park. Modern villages markets start to open, villagers can sell organic food in the market. Village houses renovate as a pension/ guest house. While all things have been made, all villagers' demands have been considered. 17 of 35 villagers took donation fund to renovate their houses. Education of agro and eco tourism is going on rapidly. Natural beauties and tourism activities are determined as mentioned in the text before. After interview travel agencies, new tour programs for KMNP will start.

As a PAN PARK:

- Importance of natural and cultural values of KMNP will perceive better and contribute to the protection will be provided at the global level.
- Sustainable conservation policies in Turkey is not yet at the desired level, and most of the deterioration of the national park's resource values in KMNP will be reduced to minimize the risk of occurrence.

- It will be provided at the international area to create an alternative source of revenue with eco tourism activities of the local people living around protected area.
- It will be provided prestige for Turkey in the field of nature protection.
- It will create an example other protected areas in Turkey.
- Due to open to innovations for sustainable natural resource, flow of information will be provided fast globally.
- Especially, it will contribute to the exchange of the wrong understanding of tourism in and around protected areas.
- Protection of traditional culture will be important.

Before anything else, the expansion of network of PAN Parks includes Turkey will be a very big step. On the other hand, the targets of PAN Parks, aimed in the projects supported by UNDP, GEF and SGP being implemented by the Government of Environment and Forestry, around KMNP will be realized. Human resources and financial support on this field should be increased to become fast KMNP's accession process to PAN Parks by GEF, SGP and the Ministry of Environment and Forestry. Because of being one of nine hotspots in Turkey, KMNP is the only one and first PAN Park in Turkey and 13. In Europe besides it is also important globally to be old growth forest and its different characteristics as mentioned before. It is not enough only sense of protection causes conflicts with local people. However, people living in and around protected areas should be raised awareness, alternatives livelihoods should be created. If tourism is managed well, it can provide opportunity for these issues. Revenue from tourism can be used both area protection and raising awareness of local people for sustainable uses.

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# PLANNING OF URBAN GREEN AREAS OF ŠTIP

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ABSTRACT: The setup structure of functions for holiday and recreation in spare time of the citizens is a great worth. The needs of the urban population for rest and recreation are becoming larger, thus increasing the need for design and planning of green spaces (parks, gardens, etc.) not only in cities but also in their immediate environment. In many cities around the world for centuries been paid great attention to this area.
In this paper we try to present the main processes in the planning of urban recreational areas of emphasis of the Municipality of Štip.
Keywords: city, recreation, park, garden, planning, Štip.

## 1 INTRODUCTION

The art of the past greenness planning we talk superficially like because of insufficient evidence of gardens and parks in the past and because of the change of plant life over the centuries. For this art conclusions can be made only on the basis of written documents. The actual study of parks and greenness planning starts even with the emergence of Baroque renaissance and when exercised great artwork and greenness spatial and park art.

Park art is one of the oldest arts which dealt with the arrangement and shape of the compartment. It explores the relationship of man to nature, developed under the influence of society and the beginning tended to subdue nature to its influence, but later changed as the level of development of culture also changed the relationship to nature that now tend to be regulated and more to retain that natural. The landscape art in the past had huge approach of development, elaborating and creating areas around temples and mansions and establishing newborn park surfaces.

The establishment of green areas of a city is continuous process. It includes everything that is observed in the past and proposing future.

Planning green spaces in residential areas begins with the formation of larger cities and today it represents a very important element in modern planning and execution of new and reconstruction of old urban neighborhoods. Making green the living area is as old as mankind. Co over the centuries as developed cultures that evolved way of thinking and planning environment.

Application of making green in the space of residential blocks is very important and is based on knowledge of hygienic and health influence on making green on quality of life, and cosmetic application in decorating the space.

Green spaces in cities are one of the basic elements of hygiene in the city. They have the function of purifying air, recreation and aesthetic function. In complex urban green spaces refreshing act of respiratory organs and the nervous system of the people.

The green areas are significant regulating factor of the climate in the living estates. The temperature differences of minimum and maximum value are remarkably less in forest complexes than unsheltered open spaces. With creating green areas, the air humidity is regulated, so during the day it is increased and night time the air humidity is decreased. In the forests, the air humidity is higher up to 20 % than in city solitaries and the air temperature is 3° to 5 °C lower than the city.

From temperature differences in green areas and residential blocks resulting in permanent towns currents to equalize the temperature, especially if boxwood complex located above the settlement of mild slope. This summer airflow reduces the temperature in the neighborhood and in winter the process is reversed.

Hygiene biological effects of making green be accomplished with planning of green areas, the choice of plant life and their proper arrangement in space. Making green presents a series of phenomena that affect the improvement of life in the neighborhoods. Greenness planning in space can act as a free-standing individual, as a group or as a defense greening, in color during the flowering, height etc.

Green space laced in the form of ribbons around town and around the residential blocks and streets affects the reduction of urban noise, dust and smoke. CO green organic surfaces associated vacant urban land and a city block with them also decorate and suburban areas of terrain.

As from the rising cities and industry found need to pay more attention to what green spaces in urban areas function because there is a considerable number of bacteria in the air, than in forested areas and making green significantly affect the health of residents, from that point of view like many other previously mentioned should seek greenery to engage in all parts of the cities and towns; And also strives to be evenly and properly distributed. Improper and uneven distribution of green leads to some parts that are more hygienic in the green area, and others who are less hygienic**.**

## 2 PLANNING GREEN SPACES IN THE MUNICIPALITY OF ŠTIP

### 2.1 New fountain and Park of Generations in high school Vančo Prke

Unarranged space behind the high school Vančo Prke, which was set up makeshift shed and trade, now slowly getting deserved attention and looks. Municipality of Štip in collaboration with the high school and PE Isar recently began editing activity in this place which is located next to the garden and park at the Vančo Prke.

With intake, not arranged space is turned into a green area with new plantings of evergreen trees and the whole park is raised to a higher level with the construction of rustically stone wall (Fig. 1). On the place of a removed cabin, a beautiful fountain is constructed, which will transform this central position in an aesthetic, modern,

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urban space.

The unpleasant view in the core of the city is removed.

What was neglected location today is a wonderful place, ennobled by green space, a park, a new fountain and benches for rest and relaxation, which means the place as it befits a city.


**Figure 1:** Construction of a new fountain and the Park of Generations in high school Vančo Prke in Štip (before, during and after the greening)

2.2 Edit parks surfaces in municipality Babi

Municipality of Štip began editing two neglected areas in parks municipality Babi. It is about two sites located in the center of the district, where the location of the market is found. Parks areas are two collective residential buildings.

Editing began construction tracking walls, which projected park area would be prevented from entering the grass surface, forming a paving paths, planting new trees and horticultural landscaping. There will be placed unifying booths on the part projected for mini market place, and the whole area will be arranged.

2.3 Park of Pharmacy

Macedonia got the first pharmacy park located in the Municipality of Štip (Fig. 2). The park is located in Štip, Duzlak settlement. This surface of one hectare will be botanical garden same like the gardens in Bon, Vienna, Bern. It will be arranged in conjunction with University of Goce Delčev experts.

**Figure 2:** Park of Pharmacy - botanical garden in Štip, Duzlak settlement

2.4 Editing of the river bed Bregalnica neighborhood 8 November

Municipality of Štip initiated activities editing part of the river in the neighborhood Bregalnica 8 November. This is the area which is located near Kucuk Emir Sultan Bridge also known as the stone bridge. Above it, along the course of Bregalnica extends greater park area which will be enriched with two mini - fountains and along the bed of Bregalnica will form walkways and paving the entire area will be refined with benches, lampposts and horticultural concept (Fig. 3).

2.5 Edit the river Otinja

The project is made by PE Štip Project, Stipion and the Department of Urbanism of the Municipality of Štip. This project involves the excavation right through the water and river sediment Otinja on the left, where flooding is taken for bed. Scattering through the excavation of the right will provide land and left. According to the project, which will be done in phases, the bed will have three layers: the bottom (base) of fence riverbed, middle layer, and the upper (the walls) on the seafront.

The basin will be 4 meters wide, 14 meters middle layer and final layer the walls with a width of 3 meters. The width of the bed is about 27 meters. Nearby riverbed Otinja planned is lawn enriched with flowers and trees that will further beautify this central city area.

**Figure 3:** Editing of the river bed Bregalnica neighborhood 8 November in Štip

2.6 Horticultural arrangement of the new roundabouts on the Vančo Prke street.

Teams of PE Isar work of Horticultural islands of new roundabouts on the street Vančo Prke. The islands, planted flowers, green grass and shrublands trees and decoration are complemented by large decorative white sand. The next activity will be a new procedure for the large fountain roundabouts.

2.7 Sports - recreation centre Suitlak

City stadium, sport hall and play grounds, hotel resort, working and commercial objects, City Park and public parking space will be the content subjects in sport and recreational center Suitlak in Shtip.

The total area of 22.5 hectares, it is planned to build the southeast end of the city park area of the present park K'rteke. In the first phase will begin construction of a new football stadium, and the realization of the entire project will be gradual.

The content of the elements in this global mosaic will contribute this location to be an interest of all citizens of Štip, "from 5 to 85 years". It involves people who want free walk, sports recreation, football pitch, global events, new stadium or enjoying the aroma of coffee in natural environment with restaurants or hotel facilities.

The site occupies part of the space of the existing park K'rteke (Fig. 4). Located at the end of the metropolitan area, the southeast end of town is another confirmation of its location in the urban plan of the city. The total area covered under the described limit is 22.5 hectares. The site offers opportunities for construction of

facilities for sport and recreation, and small commercial buildings, offices and hotel complex, of course in proportion as it allows compatibility.

According to the plan and as designed, the sports recreation center will have a football field, a temporary playground, a sports field that will be substituted for the location Jackson because is scheduled to build a new residential complex, universal sports hall, two large parks, an amusement park and auxiliary fields.

One term will be an area of 22,532 $m^2$ or 10.2% of the total area. Since it will be 25,407 $m^2$ and 2,875 $m^2$ park protective foliage.

**Figure 4:** K'rteke park (present) and designed Sports - recreation centre Suitlak in Štip

2.8 New sports-recreation centre in the Duzlak neighborhood

Brand new sports park part Duzlak sprouted in the neighborhood where the former location is full of garbage, slowly gaining character of a sports complex that will include a footbal and basketball pitch while working on park system that will trim paths from block paving, benches, alleys, flowers and more. According the area, it would be the second largest park complex in Štip.

2.9 Sports complex Avtokomanda

The Municipality of Štip in cooperation with public enterprises and CPA - Štip slowly but certainly form horticultural arrangement of the new sports park complex in the neighborhood Avtokomanda in Štip.

Horticultural arrangement of the complex is starting to show a different picture of this former wreck at its location. Planted are several dozen evergreen trees and flowers so that the complex has gained the appropriate design. Situated are a few benches, but more will be followed and workers are already working on another small playground to meet interest and get more room for youth recreation.

Currently work is on the lower part of the complex, which is another form of paving walkway that connects the playground onto the street. The basketball court is already operational and the youth soon find its new place for sports recreation.

## 3 CONCLUSIONS

Application of making green in the space of residential blocks is very important and is based on knowledge of hygienic - health impact that has making green on quality of life, and cosmetic application in ornamenting the space. Green spaces in cities are one of the basic elements of hygiene city. They have the function of purifying air, recreation and aesthetic function. In complex urban green spaces refreshing act of respiratory organs and the nervous system of the people.

The modern city planning is indicating of connecting the greed open space with different use which includes areas and objects for body training, sport and recreation. Sport occupation and play in nature is becoming more comfort, approachable and predictable. Sport terrains are not isolated any more, only in recreational zones. The green system is connected in living and working areas, in sanitary and education institutions. Sport terrains becoming functional part of living spaces.

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# THE MAIN FUNCTION OF PLANT DESIGN OF PARKS AND GARDENS

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ABSTRACT: The parks and gardens, and public open spaces can be used for passive and active recreation. Thus they differ in size, shape - form and function they perform. Strategic approach should be set to assess community needs and to plan an enrichment of the green system network. Environmental characteristics of plants play an essential role in the scale - spatial composition of parks and gardens. The positive impact of plants on air, soil and water is undeniable, and their positive effect on the microclimate is an invaluable asset to an urban environment. The enormous possibilities of the trees and shrubs to protect the architectural buildings and parks space of wind, noise, dust and harmful gases should not be understated. Parks are formed on existing parks, on formed and shaped surfaces as well on completely unformed surfaces. Beside the environmental factors, the parks provide to establish and preserve the natural environment. areas for sports and recreation are planed as part of the parks.
Keywords: park, garden, design, landscape, vegetation.

## 1 INTRODUCTION

Parks and gardens are available for local residents; generally providing for rest and recreation, but can also provide a sense of identity and place in the community, especially when it incorporates important landscape features or historical feature.

The main theoretical productions in the park art are closely linked with the principles of the general theory of composition. The combination of plant design in greenness planning also obey the principles of unity, expediency, proportion, balance, etc. The specificity of the materials and the extent to which it is the volume-spatial composition of plant, require a special approach in the application of these principles in landscape design.

## 2 COMBINATION OF ARCHITECTURAL AND PLANT COMPONENTS IN PARKS AND GARDENS

Trees (woody plant species with trunks) and shrubs or shrubbery (relatively short woody stem which gives many branches) are the basic elements of a park area. Grass (herbaceous short stem) and flower surfaces complement the space and increase the effect of the sight and sites.

Environmental (ecological) characteristics of plants play an essential role in volume-spatial composition of parks and gardens. The positive impact of plants on air, soil and water is indisputable, and their positive impact on the microclimate conditions is an invaluable asset in an urban environment. The enormous possibilities of the trees and shrubs to protect the architectural buildings and parks space of wind, noise, dust and harmful gases should not be understated. The design of the parks are actively used and another important feature of the vegetation - aesthetic. This feature is its affordable and comprehensive feature the art park.

The specificity of the design of parks and gardens (design of the park) requires thorough knowledge of the building blocks - ornamental plants. Knowing the morphological, ecological and biological features of plants are of great importance in the design of parks and gardens.

After the determination of the composition of plant skeleton, next step is to begin developing a detailed plan separately for each park space. In this process there is a fundamental point of reporting all morphological, ecological and biological characteristics of the elements that act, namely plants with high urban ornamental values. Through those characteristics they are built in an area as large arrays of trees, shrubs as well as groups of trees and shrubs, and some accents in open spaces.

In practice, landscape designs are application of specific and numerous ventures, which are used extensively in the solution-space of plant and are closely related to the main compositional principles in art park.

The design of parks and gardens addresses two main issues: the composition of architectural planning paths (avenue network) and volume-spatial composition of plants (vegetation, often urban dendroflora). The first major composition is referred as horizontal elements (sidewalks, water areas, lawns, etc.). In terms of spatial composition the horizontal elements play a decisive role in plant scaling.

Groups of trees, shrubs and arrays, and structured park area of open and closed spaces, are built around the horizontal elements, and thus define the main sights.

The environment has great importance and interconnectedness that creates balance between plant and architectural content in the construction of parks on large areas. The complex nature of this process has emerged an obvious priority plant volume, offering significantly more favorable opportunities in building spaces for recreation in the park as well as in the urban environment.

In modern urban practice plant volumes (Fig. 1) are often used as the primary means of spatial structure on the larger public areas (a1, a2 and a3).

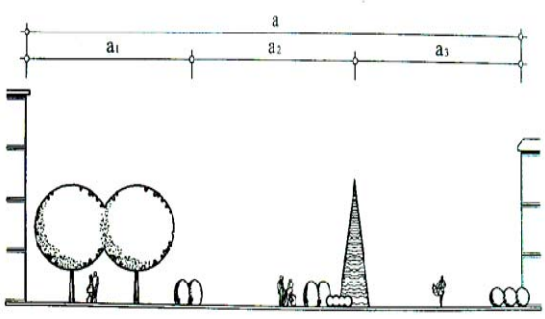


**Figure 1:** Plant volume as a prime structure of larger space

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In spatial arrangement of streets and boulevards crown of trees define the characteristic appearance of the silhouette of the street. Plant volumes (Fig. 2) absorb various architectural styles of the buildings (а) and combine the total scale of their walls (б).

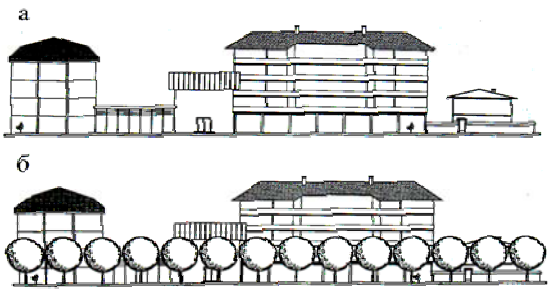


**Figure 2:** Plant volume as an absorber in urban architectural design

The habitus of the plants, their size, structure and texture of the crowns can define the horizontal and vertical structure of plant composition. Depending on these characteristics and the density of planting (Fig. 3), park spaces can be viewed as (а) open, (б) half-open, (в) semi-closed and (г) closed.

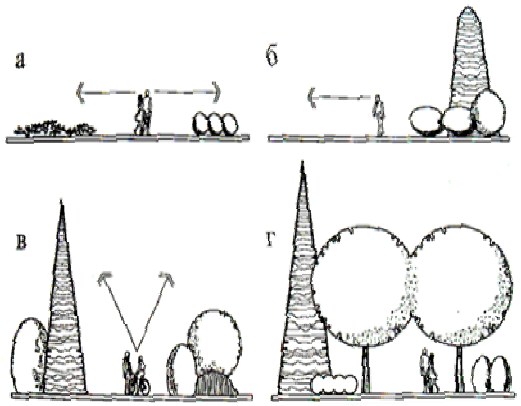


**Figure 3:** Park spaces in correlation with morphological characteristics of plants and the density of planting

Vegetation (Fig. 4) can visually soften (а) or stress (б) relief forms in park areas.

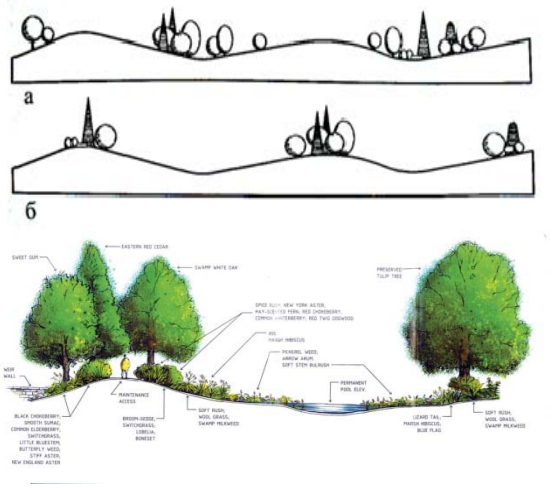


**Figure 4:** Visual influence of vegetation on relief forms

When composing an ornamental plant in groups of trees and shrubs (Fig. 5), it is recommended shrubs to be planted in chaotic separate small spots (а) and can be deployed and incorporated in compact groups in terms of trees (б).

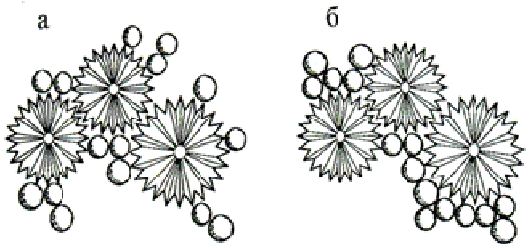


**Figure 5:** Combination in groups of trees and shrubs

By combining the deciduous and coniferous tree species in decorative groups, should be required of such available conifers which have characteristic of vertical impact and can serve as unifying elements of the composition: needle-leaf trees can both divide and unite the composition (Fig. 6).

**Figure 6:** Conifer in composition- a combination of group of decidious broadleaved trees and needle-leaf tree (both unifying and dividing visual element)

If there is a sufficiently close to each other species (Fig. 7; а), it is recommended to unify the scattered plants into a single composition by introducing additional trees or shrubs in the empty spaces in between (б).

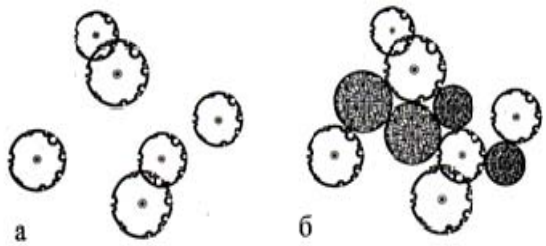


**Figure 7**: Unifying a composition by planting a number of woody plants in spaces between scattered individual trees or shrubs

When connecting strip of needle-leaf trees with strips of deciduous broadleaved species (Fig. 8) it is recommended not just to plant the species in places of connection (а), but to make two overlapping strips in place of their union (б), while coniferous go behind.

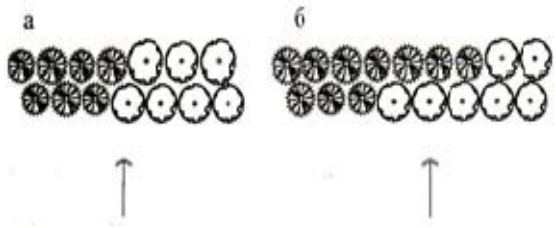


**Figure 8:** Linkage of decidous broadleaved and needle-leaf tree species

When creating decorative groups of trees and shrubs, the participation of the understory vegetation should be taken in to consideration i.e. shadow-tollerant species should be placed in the lower levels of the floral composition to avoid heavy mowing parts under the crown of trees (Fig. 9).

**Figure 9:** Decorative group

When a decorative group consists of a relatively small number of trees- up to seven (Fig. 10), it is better recommended the number of the species to be odd (б), because even number of trees (а) create a sense of tentativeness of the composition.

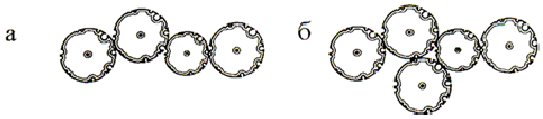


**Figure 10:** Comparison of even and odd number of trees planted in small groups

The normal perception of a given element of the park (plant group, solitaire, architectural sculpture or volume) is needed to provide the minimum distance from it by 2H (twice its height), which provides about 27 degrees vertical angle from the point of observation (Fig. 11).

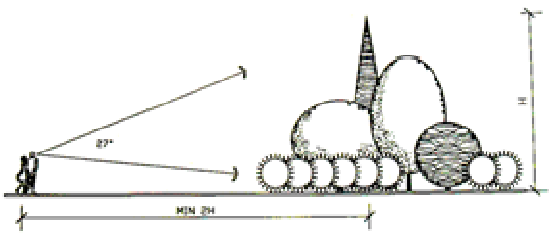


**Figure 11:** Minimum distance of the object and the bystander is twice as height of the object (2H) or about 27 degrees vertical angle from the point of observation

The overall silhouette of groups of trees, shrubs and other plants arrays of different sizes and shapes of crowns/habitus (pyramidal, spherical, oval, umbrella etc.) contributes to more vivid and dynamic form of their contours (Fig. 12).

**Figure 12:** Various habitus of the species contribute to the overall contours of the composition

The decorative groups of trees and shrubs from one plant species can be dominant in the composition and stand out among the rest either by its size or shape, or ornamental qualities (Fig. 13).

**Figure 13:** Dominant trees in the composition can have very high ornamental values

Pendulous habitus or weeping forms of creepers and vines can be used to visually reduce the height of retaining walls or other vertical surfaces. This morphological feature of some plants brings aesthetic characteristic of “life” to the monotonous and rough concrete surfaces (Fig. 14).

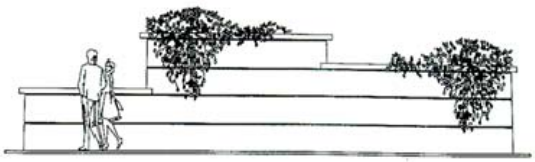

**Figure 14:** Creepers, vines and pendulous habitus of ornamental plants can visualy bring “life” to vertical surfaces

Ornamental plant species with darker foliage (Fig. 15) look optical closer to the observer (а). In reverse - plants with bright colored leaves look far distant (б).

When grouping ornamental plants, it is recommended that the plant with bright color of leaves to be positioned in front of those with darker leaf color (Fig. 16). These configurations depend on the intended point tracking and directly affect the overall perception of the group as a individual plant and compact composition.

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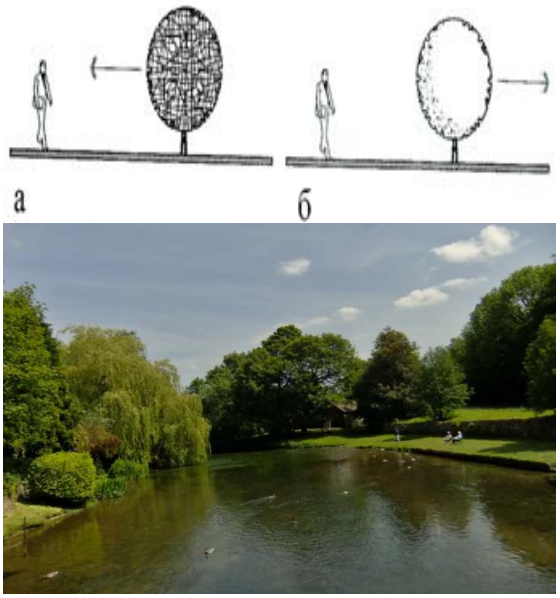


**Figure 15:** "Optical distance effect" of plants with darken and bright foliage

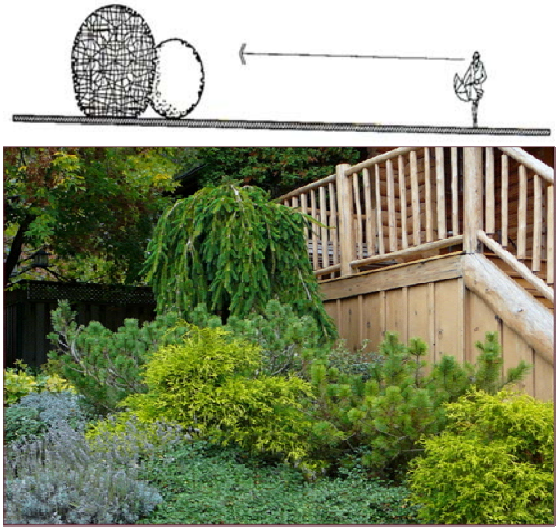

**Figure 16:** Position of trees and shrubs with bright leaves in front of species with dark foliage

Plants with rough leaf texture visually approach the observer and vice versa - with a smooth texture of the leaves seem distant in space (Fig. 17).

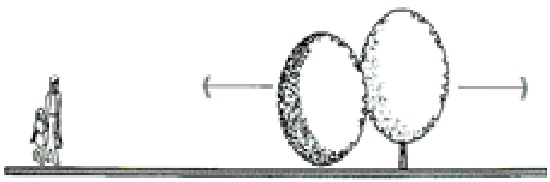

**Figure 17:** Effects of plants with rough and smooth leaf texture

To ease the strong contrast between the close plants with very bright and very dark leafage it is recommended to combine them into whole plants using medium or neutral tone of leaf colors (Fig. 18).

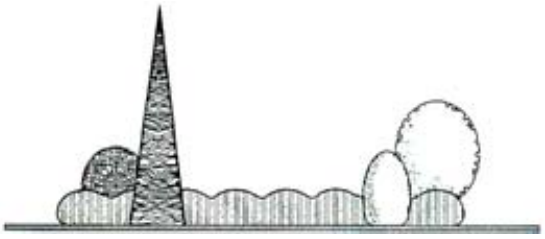

**Figure 18:** Contrast represented by the leaves of the vegetation

Plant composition with evergreen and deciduous species is interesting for planning because certain morphological characteristics of deciduous trees and shrubs are in particular ornamental during autumn and/or winter season. This composition is highly decorative if the background consists of coniferous and significantly affect the aesthetic value (Fig. 19).

**Figure 19:** Combination of deciduous (in front) and evergreen species (in background)

When plants with various form crowns are in groups, those with vertically elongated shapes are dominant in the composition (Fig. 20).

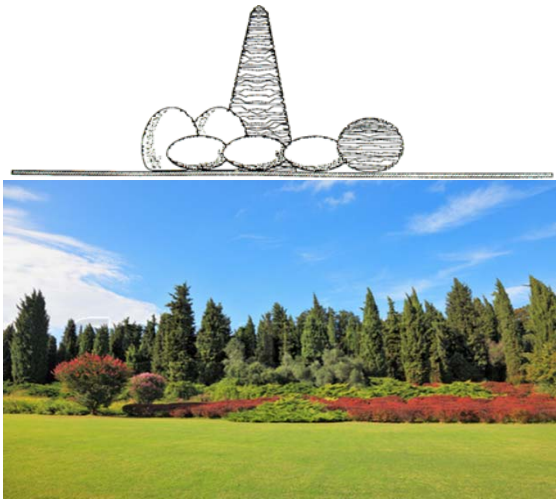

**Figure 20:** Dominance of elongate/columnar habitus in group combination

In a closed park area (Fig. 21; а) should be kept in mind that parts of borders planted with deciduous trees and shrubs with low density will let unilateral uncovering during autumn and winter (б). This provides seasonal dynamics of the space and uncover other parts of the vegetation and landscape.

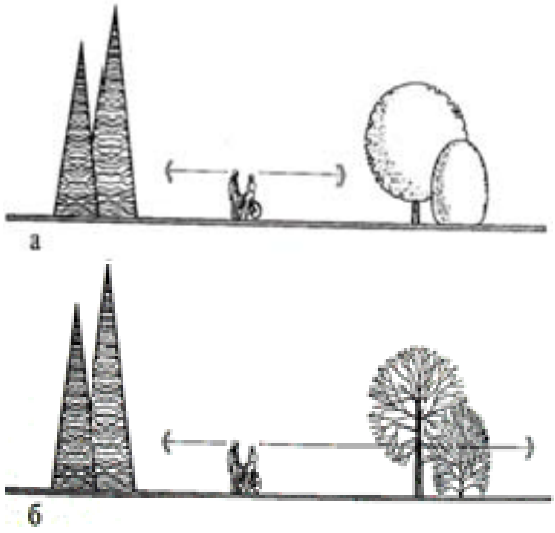


**Figure 22:** Deciduous trees and shrubs can uncover wide area in closed park composition during winter

It is recommended to plant deciduous broadleaf trees with large crowns on south-west side of the terraces (Fig. 23), playgrounds, recreational corners, etc. in order to prevent insolation from the afternoon sun during the summer months.

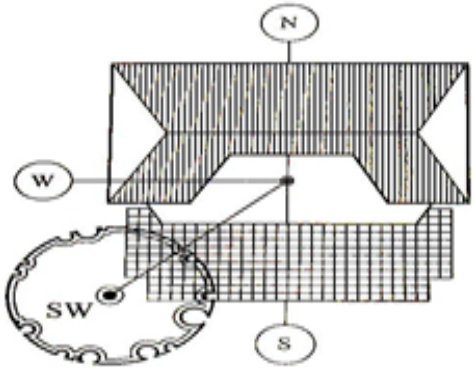


**Figure 23:** Deciduous broadleaf trees can mitigate insolation from afternoon sun when planted on SW side

In modern urban environment (Fig. 24; a), the use of plants to provide reliable protection of buildings from noise, dust and harmful gases, is of great importance. This can be accomplished by providing so-called transitional spaces between transport and communications entrances of houses (b).

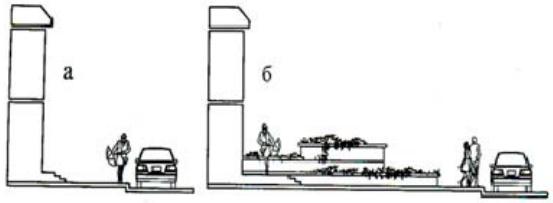


**Figure 24:** Transitional green spaces- squares, fixed beds with ornamental vegetation, retaining walls

Decorative vegetation can be successfully used for display signs and boards- to attract and focus the eye-catcher from afar (Fig. 25).

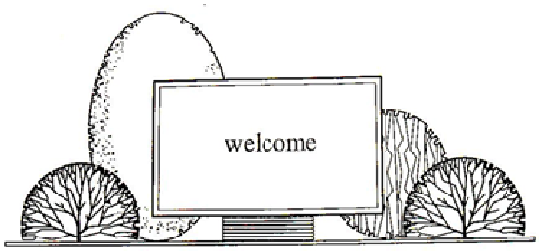


**Figure 25:** Ornamental trees and shrubs as an eye-catcher for signs and boards

Main backdrop for outdoor sculptures are “green walls”- background of densely planted species, sometimes even as hedges (Fig. 26).

**Figure 26:** “Green walls” of dense plant species make excellent background layer for outdoor sculptures

## 3 CONCLUSION

The most valuable contribution can be made in the first phase of the project when ideas can be generated along with the technical understanding and the creative flair for design, organization and use of space. The scenic architect should conceive the overall concept and prepare a plan of detailed drawing design and technical specifications. They can also review proposals and authorize and oversee construction. Other skills required are design impact estimates preparation, implementation of environmental auditing estimates, and expert witness requirements for land use issues.

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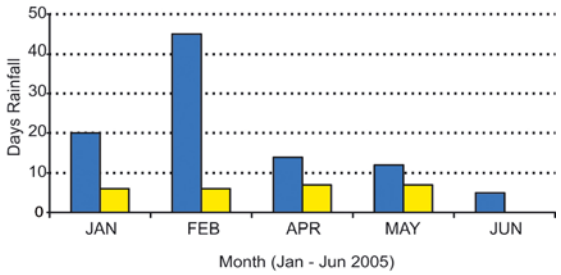


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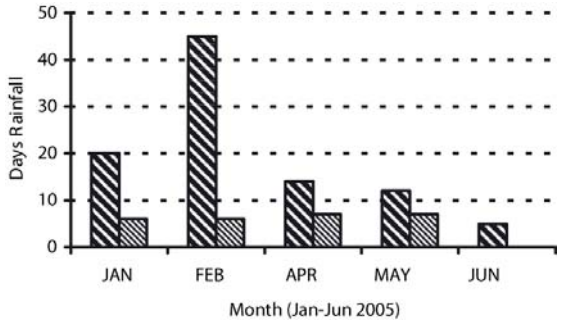


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**Table I:** Overview of biomass resources available

| Biomass Sources | Quantity | Moisture | Residue |
|---|---|---|---|
| Sewage Sludge | 1.86 | 1.73 | 1.40 |
| Septage | 0.32 | 0.28 | 0.16 |
| Fruit Pulp | 3.78 | 3.89 | 4.02 |

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