REVIEW

ON THE EVALUATION OF THE DOCTORAL DISSERTATION "RESEARCH IN THE EFFECTS OF THE APPLICATION OF AMELIORATIVE AND CARE MEASURES IN THE FORESTS ON THE NORTH SLOPES OF THE MOUNTAIN RANGE JAKUPICA" BY MA KIRO DELOV, SUBMITTED AT THE FACULTY OF FORESTRY IN SKOPJE

The Academic and Scientific Council of the Faculty of Forestry in Skopje, at the session held on 15.09.2015, formed a Commission for evaluation of doctoral dissertation of the candidate, MA Kiro Delov titled "Research in the Effects of the Application of Ameliorative and Care Measures in the Forests on the North Slopes of the Mountain Range Jakupica" consisting of:

Kole Vasilevski, PhD, Full Professor, Faculty of Forestry, Ss. Cyril and Methodius University - Skopje (Mentor)

Nikolcho Velkovski, PhD, Associate Professor, Faculty of Forestry, Ss. Cyril and Methodius University -Skopje (Chairman)

Jane Acevski, PhD, Full Professor, Faculty of Forestry, Ss. Cyril and Methodius University -Skopje

Nikola Nikolov, PhD, Full Professor, Faculty of Forestry, Ss. Cyril and Methodius University - Skopje (member), and

Vlatko Andonovski, PhD, Associate Professor, Faculty of Forestry, Ss. Cyril and Methodius University -Skopje (member).

The Commission in the above composition carefully reviewed and evaluated the doctoral dissertation and it hereby submits to the Academic and Scientific Council of the Faculty of Forestry in Skopje the following

R E P O R T

The doctoral dissertation of the candidate MA Kiro Delov, titled "Research in the Effects of the Application of Ameliorative and Care Measures in the Forests on the North Slopes of the Mountain Range Jakupica" contains 173 pages of computer processed text in Georgia font, with 1.5 spacing and 12 font size.

The doctoral dissertation contains 78 tables, 61 charts, 19 histograms, 2 maps and 23 figures presented in 12 chapters.

The material covered in the doctoral dissertation is divided into:

Abstract in Macedonian and English on two (2) pages;

Contents on two (2) pages;

Introduction on two (2) pages;

Subject and Purpose of the Research on one (1) page;

Methodology of Operation in four (4) pages;

Area of Research on 2 (two) pages;

Natural Conditions on 25 (twenty five) pages;

Forest and Vegetation Characteristics on twelve (12) pages;

Condition of the Forests on ten (10) pages;

Anthropozoogenic Impacts on the Forests on four (4) pages;

Introduction of Non-indigenous Tree Species on eleven (11) pages;

Research Results with Discussion on 89 (eighty nine) pages;

Conclusions on 6 (six) pages;

Bibliography on eight (8) pages.

The material is systematically divided into items and sub-items with titles and subtitles, whereby it is ensured that the material which is the subject of the research can be easily understood.

The Introduction chapter provides an overview of the need for research on the effects from the application of ameliorative and care measures to forests on the north slopes of the mountain range Jakupica where branching, the traversed form and size of the mountain range along with the climate and soil properties have conditioned the emergence of many forest communities. It is stated that planned forest management has been carried out for several decades in the studied region. However, in many parts some degradation of forests, primarily due to zoo-anthropogenic effects is noticeable even today. In order to improve the forests, forest amelioration and care measures have been undertaken in a large part of the areas. In

many places non-indigenous species have been introduced. Some of them have quite successfully developed and show better results compared to indigenous species from this region. However, the results of these activities have not been summarized and scientifically processed in order to determine their effects, so the author has stated that this research will contribute to the same.

In the Subject and Purpose of the Research chapter it is stated that the subject of research of this doctoral dissertation are the effects of the application of ameliorative and care measures in the forests of the north slopes of the mountain range Jakupica, as well as the natural conditions of the region and the biological and ecological characteristics of indigenous and non-indigenous species present in the studied region. The purpose of the research is to provide relevant data on the effects that are achieved with the application of ameliorative and care measures in forest plantations. It also states that the data obtained should also be the basis for future scientific and practical activities, because it will be determined scientifically and professionally which measures and activities are best suited for specific types of forests.

The Methodology of Operation chapter explains the manners and methods by which the research was carried out. Moreover, it points out that field and academic research was carried out. With the academic research academic information was collected on the activities that have been undertaken in the forests in the previous periods and which are subject of this research. The entire available literature from the Republic of Macedonia and from abroad related to similar research has been analyzed and studied simultaneously. With the field research trial areas have been set-up on representative locations that have produced data which have been further processed by standard mathematical and statistical methods and compared with respective data on the same tree species and types of plantations from other sites determined by research of other authors from the Republic of Macedonia and abroad. According to the orthogonal method the author has set-up 14 trial areas with different sizes from 500 to 2000m², from which data on the situation of the surveyed plantations was collected. Whereby, for each tree the following was individually measured and evaluated: diameter in two directions (east-west and north-south) measured at 1.30m above the ground; tree height; biological position of trees according to the Kraft Classification; stem quality and crown quality. From the collected data and performed calculations and analyzes the author has obtained the results laid out in respective tables, charts and histograms.

The Area of Research chapter deals with the research carried out in the mountain rage Jakupica located in the central part of the Republic of Macedonia, southwest of Skopje, stretching from the northwest towards the southeast. It is noted that the mountain range Jakupica is a rather large and branched region with several types of forest communities, which have major significance for the forest diversity. Due to the size of the mountain range Jakupica and the specifics of its north slopes the research covered by this doctoral dissertation was

carried out on its north slopes. This part of the forests is administratively covered by three forest management units, as follows: Markova River, Kadina River 2 and Kitka. These forest management units are managed by PE Makedonski sumi, branch Forest Management Karadjica - Skopje.

In the Natural Conditions chapter the author gives an overview on the overall natural conditions that give special features to the researched area and have an impact on forest vegetation. In separate sub-titles the following are studied: the orographic conditions, hydrographic conditions, geological conditions, pedological and climate conditions. From the research made, the author has concluded that the natural conditions of the north slopes of Jakupica mountain are favorable for the development of forest vegetation and allow the development of many different types of trees and that all these factors together greatly affect the quality and composition of forest plantations and plant species that are present there and in their close surroundings.

The Forest and Vegetation Characteristics chapter is a description of forest communities. Thus, the author has found that there are 9 forest communities in the studied area as follows: community of *Querco-Carpinetum orientalismac*. (Rud.) Ht which represents 20.6% of the forest area, community of *Quercetum confertae-cerris macedonicum* (Oberd. Emd. Ht) spread over 5.7% of the area, community of *Orno- Quercetum petraea*, Em spread on 23.0%, community of *Festuco heterophylae- Fagetum*, Em on 12.9%, community of *Calamintho grandiflorae-Fagetum*, Em which covers the largest area of research and is spread over 32.1 % community of *Fagetum subalpinum scardo pindicum* (Ht). Treg. on 1.3%, community of *Abieti-Fagetum macedonicum* Em spread on 0.9%, community of *Fago-Abietum meridionale* Em on 1.5%, and community of *Pinetum mughi macedonicum* Ht which occupies about 2.0% of the territory under forests of the studied region.

In the Condition of the Forests chapter the author has stated that the total area of the studied region is 19 694.45 hectares. Out of this area, 15 593.54 hectares or 79.2% of the total area is forests, and the forest land that is mostly meadows, pastures and barren land covers an area of 3 042.15 hectares or about 15.5%, while 105.26 ha or 0.5% of the total area is used for other purposes, such as roads, buildings and the like. Forests and other areas that are privately owned, i.e. non-forest land in this region lie on about 953.50 hectares or occupy about 4.8% of the total land of the region. According to the type of care, a larger area of the studied region is occupied by low-growing forests which extend on over 9027.82 hectares or 57.9% of the total area, while tall-growing forests occupy a smaller area of approximately 6565.72 hectares or 42.1% of the total area. According to species composition, mixed plantations are present over a larger area which occupies 51.3%, while pure plantations occupy 48.7% of the total area. The largest area of the studied region is under beech plantations, which covers 78.2%.

In the Anthropozoogenic Impacts on the Forests chapter it is noted that the forests in the studied region are under strong anthropozoogenic impact. The impact of illegal logging carried out by the local population is especially noticeable. Thus, in the 2005-2014 period 19,376 m³ of illegally logged forest were recorded which is mostly performed in low-growing plantations. Wildfires were common for the forests of the studied region thus in the same period 70 forest fires were registered which burned an area of about 2 134.30 hectares. Other damage was also recorded for the studied region arising from livestock grazing, outbreaks of insects and other, but these were small scale occurrences.

The Introduction of Non-indigenous Tree Species chapter provides an overview of biological and ecologic characteristics of the species of trees that have been introduced in the studied region. Moreover, it was noted that the introduction of non-indigenous tree species as an ameliorative measure was carried out in order to improve the quality and economic value of the plantations, mostly in degraded forest plantations in this regions. For this purpose, as well as for the enrichment of the forests, in the 50s and 60s of the last century, certain tree species were introduced at different locations and different vegetation places, such as: *Sequoiadendron giganteum* (Lindl.) Buch.), *Pseudotsuga mensiesii* (Mirb.) Franco), *Pinus strobus* (L.), *Pinus silvestris* (L.), *Pinus nigra* (Arm.), *Chamaecyparis lawsoniana* (Parl.) and *Larix deciduas* (Mill.) (Larix europaea (DC.)). Whereby, the author has also described the manner of forestation, as well as the status and development of the artificial plantations.

In the Research Results with Discussion chapter, the results from the research have been elaborated on 89 pages. At the same time, other similar studies have been included in order to compare the obtained results. The author conducted specific research on: the number of trees per unit area and their biological structure, biological position of the trees, quality structure of the trunk and crown, as well as the structure at various heights. At the same time, large-scale variations have been determined regarding the number of trees per unit area, depending on the age, as well as depending on the implemented or lack of implemented care measures at the forest plantations. The number of plantations of Pseudotsuga mensiesii ranges from 540 trees per 1 ha at the plantations with conducted spacing, up to 1540 trees per 1 ha at the plantations where no care measures have been implemented. All plantations of Pseudotsuga mensiesii are 46 year old. The plantations of Pinus strobus are 42 years old, and the number of trees per unit area ranges from 500 trees per 1ha for the plantations where spacing has been implemented, up to 1460 trees per 1 ha for the plantations without any implemented care measures. Regarding the 46 old plantations of Larix deciduas where no spacing has been introduced, the number of trees per 1 ha is 760. The number of these introduced types per unit area is smaller than the number of trees at the 53 year old low-growing forests of Quercus petraea with implemented spacing, for which the author has determined 855 trees per 1ha, as well as their number is smaller than the 40 year old non-spaced low-growing beech plantations, the number of which ranges between 1020 and 4320 trees per 1ha. There are 1040 trees per 1ha at the mixed plantations of Pseudotsuga mensiesii, Strobus and Pinus nigra, 2340 trees per 1 ha at the mixed plantations of Chamaecyparis lawsoniana and Carpinus orientalis, and 1400 trees per 1ha at the mixed plantations of Pseudotsuga mensiesii, beech and Carpinus orientalis. With regard to the biological position of

the trees in the researched trial areas and with regard to the artificially raised plantations, the author has determined that the number of trees was the highest in II and III class, while the number of trees was lowest in V class. The above points out that the plantations are in a growth phase in which most of the tress are equally developed and dominant trees have not been differentiated yet, nor trees that significantly fall behind with the growth. In relation to the quality structure of the trunk and the crown, the author determined that these are with medium quality, which is result of the insufficient implementation of care measures at the plantations, while the medium height of the plantations varies between 14 and 22m, whereby maximum heights were achieved by the plantations of Pseudotsuga mensiesii. The author in this chapter points out that the results from the application of direct amelioration method without protection of the parent plantation on round areas and rows, as well as the indirect amelioration methods – conversion by means of resurrection cutting (clear cutting) in the economy subclass L2 and selective-regenerative cutting (spacing) in the economic subclasses L1 and N1 gave good results. Other care measures also had effect over the good growth of the introduced plantations, and these are: protection of the seedlings against cattle herding and illegal cutting. The *Abies* seed planted on the non-regenerated parts was successful in the first years, however, due to the inappropriate care and lack of care measures including cutting for lighting purposes and clean-cuttings of the seedlings, the seedling in most cases withered.

In the Conclusions chapter, among other things, the author states that the area – subject to research, offers favorable natural conditions for growth of natural beech and oak forest communities, as well as favorable conditions for growth of introduced forest plantations of Sequoiadendrum giganteum, Pseudotsuga mensiesii, Larix deciduas, Pinus strobus, Chamaecyparis lawsoniana etc. 9 forest communities have been registered in that area, whereby the beech prevails. Most of the forest areas, i.e. 57, 9% have low-growing origin, and the other 42,1% have generative (high-growing) origin. Despite the large proportion of the low-growing forests, they cover only 25,2% of the total tree mass, while 74,8% of the tree mass is concentrated in the high-growing forests. The large differences in the number of trees per unit area, as well as the high percentage of trees with medium trunk and crown quality appear as a result of the lack of implementation or untimely implementation of the care measures at these plantations. The care measure that was often used at the plantations in the researched area is the spacing with intensity 4-23%, regenerative clear cutting and group selective cutting. At the end the author concludes that the undertaken ameliorative and care measures, as well as the regenerative measures in the research area, have not been implemented in appropriate scale, i.e. they have been partially realized, and that the plantations at which care measures have been implemented, have better quality. For this reason, the care measure should be implemented with 25 to 30% higher intensity, which would improve the structure and the quality of plantations.

EVALUATION OF THE DISSERTATION

The doctoral dissertation of the candidate Kiro Delov MA, entitled „Research in the Effects of the Application of Ameliorative and Care Measures in the Forests on the North Slopes

of the Mountain Range Jakupica", represents a scientific research in the field: biotechnical sciences, scientific area: forestry and horticulture, scientific area: care of forests. The preparation of this doctoral dissertation by means of conducting a research resulted in collection of data which have clear scientific and practical application and which would help to recognize the effect of the undertaken ameliorative and care measures at the plantations, and the results from their application.

The doctoral dissertation of the candidate Kiro Delov MA, entitled „Research in the Effects of the Application of Ameliorative and Care Measures in the Forests on the North Slopes of the Mountain Range Jakupica" according to the opinion of the Evaluation Commission, meets the general conditions and standards for preparation of the doctoral dissertation. The conducted research, given the applied recognized methods in the scientific and research work, enable future application of the obtained results in practice. The candidate clearly and precisely defines the purpose of the research, and describes results in a professional and comprehensive manner, as well as represents the results from the research at high technical level, and clearly accomplishes the set goal. The author elaborates the problem methodologically and in details, and analyzes in details the results from the research, in such a manner that the drawn conclusions give an appropriate image for the research, which shows by itself that the results obtained from the research are scientifically based.

It can be concluded from the above that the candidate has mastered the methods of the scientific and research work, the paper is a result of his independent scientific work and successfully helped to solve the problem, and gave an analysis of the results and summarized the same into relevant conclusions, which as a whole, contributed towards enrichment of the knowledge in the researched area.

CONCLUSION AND PROPOSAL

On the basis of the above, it can be concluded that the doctoral dissertation prepared by the candidate Kiro Delov, MA, entitled „Research in the Effects of the Application of Meliorative and Care Measures in the Forests on the North Slopes of the Mountain Range Jakupica" represents genuine and independent scientific work which gives significant contribution to the forestry science and practice. The prepared scientific paper fully meets the required criteria for preparation of doctoral dissertation.

The topic covered with the studies in this doctoral dissertation is important, and the results obtained from the research have special meaning for the science and practice.

On the basis of the above, the Commission evaluated the doctoral dissertation with positive grade and it is honored to propose to the Academic and Scientific Council of the Faculty of Forestry in Skopje to accept the positive grade and to schedule a term for a public defense.

COMMISSION:

Kole Vasilevski, PhD, Ss. Cyril and Methodius University - Faculty of Forestry Skopje, mentor

Nikolcho Velkovski, associate professor, Ss. Cyril and Methodius University – Faculty of Forestry Skopje, president

Jane Acevski, PhD, Ss. Cyril and Methodius University – Faculty of Forestry Skopje, mentor

Nikola Nikolov PhD, Ss. Cyril and Methodius University – Faculty of Forestry Skopje, member

Vlatko Andonovski PhD, associate professor, Ss. Cyril and Methodius University, member