Attachment 4

to the application for conducting the habilitation assessment process

SUMMARY OF PROFESSIONAL ACHIEVEMENTS

presenting academic achievements and the summary description of the habilitation candidate's scientific achievements

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Sękocin Stary 2018

1. Name and surname

Piotr, Tadeusz Gołos

2. Diplomas, scientific degrees along with names, places, and dates of award, as well as the title of thesis

1988 – Forestry Technician – Forestry Technical Secondary School in Zagnańsk

1994 – M.Sc. Engineer in Forestry

Faculty of Forestry, Warsaw University of Life Sciences – SGGW in Warsaw

M.Sc. thesis title: "The state and organization of private forest companies in Poland" („*Stan i organizacja prywatnych firm leśnych w Polsce*").

Supervisor: dr hab. Janusz Kocel

2001 – PhD in Forestry

Faculty of Forestry, Warsaw University of Life Sciences – SGGW in Warsaw

Dissertation title: "The assessment of economic value of forest's recreational function as exemplified by Promotional Forest Complex Gostynińsko-Włocławskie Forests" („*Wycena wartości ekonomicznej rekreacyjnej funkcji lasu na przykładzie Leśnego Kompleksu Promocyjnego Gostynińsko-Włocławskiego*").

Supervisor: Prof. dr hab. Andrzej Klocek

Reviewers:

Prof. dr hab. Tomasz Borecki

Prof. dr hab. Hubert Szramka

Additional Education

2009 – Faculty of Law and Administration, University of Warsaw, Postgraduate Studies of Property Appraisal, Real Estate Agency and Management

Diploma thesis title: "The comparison of tree stands' value assessed with an investment method (Net Present Value – NPV) and according to "Tables of stand value coefficients on the example of pine stands of Brzeziny RDLP Łódź Forest District". („*Porównanie wartości drzewostanów oszacowanej metodą inwestycyjną (Net Present Value – NPV) oraz według „Tablic wskaźników wartości drzewostanów na przykładzie drzewostanów sosnowych Nadleśnictwa Brzeziny RDLP Łódź*").

3. History of hitherto employment at scientific/artistic entities

1. **1994 - 2001** – Assistant, Department of Forest Economics and Forest Policy, Forest Research Institute.
2. **2002** to date – Assistant Professor, Department of Forest Resources Management, Forest Research Institute.

4. Scientific achievement being the basis for the habilitation procedure in accordance with Article 16 item 2 of the Act of March 14, 2003 on academic degrees and title and degrees and title in the arts (Journal of Laws of 2003, No. 65 item 595 as amended in Journal of Laws of 2017 item 1789.):

a) The title of the scientific/artistic achievement:

Monograph title: "Social and economic aspects related to non-productive functions of forest and forest management – results of public opinion survey" (*„Społeczne i ekonomiczne aspekty pozaprodukcyjnych funkcji lasu i gospodarki leśnej – wyniki badań opinii społecznej"*).

b) (Author/authors, publication title/titles, issue year, publisher's name, publisher's reviewers):

Piotr Gołos, "Social and economic aspects related to non-productive functions of forest and forest management – results of public opinion survey" (*„Społeczne i ekonomiczne aspekty pozaprodukcyjnych funkcji lasu i gospodarki leśnej – wyniki badań opinii społecznej"*), 2018, Forest Research Institute.

prof. dr hab. Stanisław Zając (Forest Research Institute),
dr hab. Adam Zydroń (Poznań University of Life Sciences).

c) The description of the scientific/artistic objective of the abovementioned body of work/works and achieved results accompanied by the discussion on their possible use.

Introduction

The purpose of the dissertation is to present the selected social and economic determinants accompanying the use of public functions of forest and forest management, assessed based on the results of social surveys using an interviewer questionnaire, including in detail the matters related to the use of forest areas as the place of leisure and recreation by residents and tourists.

The monograph comprises two main parts:

1. The overview of subject matter literature, with the purpose to provide theoretical and methodological bases which enable the correct interpretation and analysis of presented results of social surveys carried out by the author. The following subjects have been discussed in six chapters:

- the state of environment and nature related awareness among Polish people, developed based on the analysis of results of social surveys conducted by research agencies in Poland after 1990, on nationwide representative samples of residents in Poland, and the critical analysis of selected literature items, discussing the results or surveys carried out locally,
- the theoretical bases for the sensory perception of natural environment by man,
- the importance of human preferences, motives, and needs in a decision making process, including decisions related to the use of goods and services of forest and forest management,
- the description of non-market functions of forest and forest management, as the category of public goods and external effects along with the presentation of subjects related to the mentioned group of goods from the perspective of the value theory,
- the description of the Contingent Valuation Method (CVM) applied in the author's own studies in order to estimate the monetary (quasi market) value of selected non-market goods and services of forest and forest management or exclusively the recreational function.

2. The results of author's own studies, including: the qualitative studies carried out in two focus groups amounting to eight persons each, and the quantitative studies carried out in the years 2000-2013 at the Forest Research Institute using interviewer questionnaires on samples which differed from one another in the selection manner (random and purposeful), size, place where the survey was conducted (home and forest), type of respondents (residents and tourists) and respondents' place of residence (residents of rural and city areas). The presented results

have been developed based on 12 surveys (Table 1). The total number of 7006 interviews were carried out, among which:

- 5283 interviews were carried out in respondents' houses,
- 3780 interviews were carried out on representative random samples,
- 1723 interviews were carried out on *ad-hoc* samples, in different forest sites.

The respondents' answers to questions included in the interviewer questionnaire enabled the identification of respondents' needs, motives, and preferences (declarative attitudes) in relation to the most important public goods and services of forest and forest management, including in particular the recreational use of forest areas. In every interview, respondents were asked a question whose purpose was to establish a monetary value of benefits related to the use of the most important non-productive functions of forest or just a recreational function. For this purpose, a CVM (Contingent Valuation Method) method was applied with a question regarding WTP (WTP – Willingness To Pay). The respondents' answer to the mentioned question was a declaration to spend a hypothetical amount of money, which reflects the value of non-market goods and services of forest and forest management.

The results of quantitative studies were presented as collective lists and comparative analyses, with particular attention given to the following:

- the social importance of the selected most important functions of forest and forest management (use and non-use functions),
- the monetary (quasi market) value of the stream of goods and services related to non-market functions of forest or exclusively the recreational function, including in particular the identification of subjects who could finance the supply of non-market benefits of forest and forest management,
- the evaluation of elements related to the recreational forest management, regarding the preferred leisure sites in forest, the ways to manage forests for tourist purposes, forest appearance with the method of oral description and the set of photographs, the elements which determine tourist attractiveness of forest areas, the elements of tourist infrastructure using the method of oral description and the set of photographs.

In the quantitative studies, an interview method was applied using an author's questionnaire (PAPI – Paper and Pencil Interview technique), which was prepared with regard to various objectives which were supposed to be achieved in carried out projects. For the abovementioned reason the applied study tools differed among one another in: the number of questions, selection categories in closed-ended sets, the sequence of questions in the questionnaire, the contents and subject matters that they referred to. Certain questions were repeated in selected studies, using

the same or similar sets of selection categories in a set. Due to the above, it is possible to compare and synthesize the obtained results. In the part which presented the quantitative studies, the results have been included of studies carried out:

1. On representative samples including: three surveys conducted on nationwide samples and one survey among the residents of Warsaw (surveys No. 1-4).
2. In three Promotional Forest Complexes applying the same interviewer questionnaire (surveys No. 5-7).
3. In Śląskie and Podlaskie Province, similarly as above, applying the same interviewer questionnaire (surveys No. 8 and 9).
4. In urban forests of Łódź (No. 10).
5. In Krościenko Forest District (survey No. 11-13) and in Beskid Śląski (surveys No. 14-16). Surveys were carried out in every mentioned site simultaneously using the same interviewer questionnaire, prepared in three variants which differed in:

- The format of question regarding WTP in CVM method (open-ended, bidding, and payment card questions were applied),
- The sequence of selection categories in sets of several questions, including the ones which referred to preferences regarding use and non-use functions.

Due to different purposes, scopes, and study sites, sample features and sizes, as well as the diversity of methodological assumptions of qualitative studies, describing the methodology of presented studies in detail has been abandoned, and common and general methodological assumptions were presented, which included the following:

1) the application of a study tool in the form of an interviewer questionnaire carried out by a trained interviewer,

2) the use of closed-ended questions with the selection categories (set of answers) in the interviewer questionnaire,

3) the application of pilot surveys, which enable to evaluate the correct formation of questions, their sequence in a questionnaire, and the questionnaire construction,

4) the compliance with the principle that the sets of questions should include understandable terms describing an investigated phenomenon excluding forestry specific terms or abbreviations, which could make it difficult or prevent understanding a question by respondents,

5) carrying studies in a forest, apart from those carried out by OBOP (*Public Opinion Research Center*) at the request of the Forest Research Institute (No. 1-4) and surveys carried out in Podlaskie and Śląskie Provinces (No. 8-9),

6) using the Contingent Valuation Method (CVM) and WTP measurement in order to estimate the economic value of public functions (the recreational function) of forest, most frequently in the form of a question with a payment card, and in selected surveys, also as a bidding question and an open-ended question,

7) estimating the social significance of two values of non-use functions (existence and bequest value) and the values of option and willingness, which are classified as the use features (No. 4, 11-13, and 14-16),

8) using, in all questions with a long list of selection categories in sets, the cards of responses presented to respondents when reading a question by the interviewer,

9) using a set of photographs in certain surveys (No. 3, 5-7, 8-9, 10),

10) applying three response patters in closed-ended questions, where a respondent could:

- indicate only one category out of all suggested in a question,
- indicate the maximum of three responses, sometimes using grades which enable to estimate the significance of indicated categories, in the case of a larger number of categories (10 and above),
- dividing 100 points among the suggested categories in such a manner that the established structure reflected their significance for respondents.

Multithreading of presented analyses, which draw knowledge from economy, as well as psychology and sociology, resulted in the fact that in many cases in the thesis, certain problems are only touched, and the content of chapters does not exhaust subjects included in the titles. In a discussion on presented results, the particular attention was given to the results of nationwide studies assuming that they are the only ones that are fully comparable, since they were carried out in similar cultural, social, and economic conditions, and with an approximate level of society's environment and nature awareness.

Study results

The results of qualitative studies took three areas into consideration (their presentation includes terms and phrases used by responding persons):

1. Emotional, which may be put into five groups of human needs:

1) Peace and rest, which forest provides enabling relaxation, separation, isolation, the departure from the problems of everyday life, and regaining balance and harmony.

2) Activity and adventure, taking place in forest areas through organizing cycling tours, excursions, jogging or night escapades.

3) Proximity of nature, which helps to oxygenate and charge batteries, enjoying the wild nature.

4) Freedom, feeling of no supervision, freedom to move when there are not any people around.

5) Indulgence in hobbies and interests through watching animals or taking pictures of interesting places.

2. Rational, which referred to terms and definitions, the frequency of visits to forest, the means of transport which enable getting to a forest and a preferred forest site, as well as forest appearance. The presented views enable to describe a forest in which respondents would like to rest as a forest of various height, with old, high trees, as well as a forest with lakes, ponds, fallen trees and stumps where an individual could rest, a forest with a clearing, a fireplace, a shelter, where there are excavations, sand, bluffs, or a forest with wild and unavailable places.

3. A study area related to the preparation of forests for recreation purposes, among which respondents paid attention to the intensity of development, and the need to designate zones of various tourist development level. The respondents created a description of a perfect forest, drawing attention to a pine forest with some additional deciduous species, with parking places, playgrounds on the border, little shops, and clearings encouraging relaxation, designated grilling and fire places, with various plants and with a pond, a water spring or a stream.

Table 1

Specification of surveyed samples in the years 2000-2013 in IBL's studies on social and economic aspects of non-productive functions of forest and forest management

No.	Year of Study	Study Area	No. of Interviews	Format of Question about WTP in CVM Method	Purpose of Question about WTP	Place of Interviews
1	2	3	4	5	6	7
1*	2000	Poland	1082	card	non-productive functions of forest	home
2*	2001	Poland	1106	card	recreational function of forest	home
3*	2008	Warsaw	500	card	non-productive functions of forest	home
4*	2013	Poland	1001	open-ended	non-productive functions of forest	home
5	2001	Promotional Forest Complex Lasy Oliwsko-Darżlubskie	150	card	recreational function of forest	forest
6	2001	Promotional Forest Complex Lasy Janowskie	113	card	recreational function of forest	forest
7	2001	Promotional Forest Complex Lasy Beskidu Śląskiego	81	card	recreational function of forest	forest
8	2002	Śląskie Province	908	card	non-productive functions of forest	home
9	2002	Podlaskie Province	595	card	non-productive functions of forest	home
10	2004	Urban forests in Łódź	624	bidding	recreational function of forest	forest
11	2005	Krościenko Forest District	100	open-ended	non-productive functions of forest	forest
12	2005	Krościenko Forest District	100	bidding	non-productive functions of forest	forest

13	2005	Krościenko Forest District	100	card	non-productive functions of forest	forest
14	2009	Beskid Śląski Forests	125	open-ended	non-productive functions of forest	forest
15	2009	Beskid Śląski Forests	137	bidding	non-productive functions of forest	forest
16	2009	Beskid Śląski Forests	180	card	non-productive functions of forest	forest

* Studies on representative random samples

The results of quantitative studies provided information on selected social and economic aspects related to the use of non-productive functions of forest. In the most important results presented below, references were made to the numbering of surveys adopted in Table 1:

1. Based on the nationwide studies in Poland in 2013 (No. 4), it needs to be stated that the society has limited knowledge of the State Forests National Forests Holding (*Państwowe Gospodarstwo Leśne Lasy Państwowe/PGL LP*). Only 31.3% respondents indicated correctly the share of forest areas managed by PGL LP in the total forest area, and 40% respondents indicated the correct name of an organization which carries out management activities in the state forests. What is interesting, a relatively large share of respondents (i.e. 68.5%) gave the correct response to the question on whether timber from the state forests is the certified timber.

2. The level of respondents' knowledge on the state forests remains in sharp contrast to their preferences expressed in the same survey, and related to timber as the natural raw material used for multiple purposes and in various products. A willingness to possess: a house of wood was indicated by 27% respondents, and parquet or floor boards were indicated by nearly 60% respondents. A similar number of respondents (60%) indicated solid wood or glued timber as the material for window manufacturing, and over 80% respondents indicated wood or panel doors. The supplement to the mentioned preferences is the 55% share of respondents who would like to have wooden furniture. In addition, a significant part of respondents indicated wood, briquette, and pellet as the source of heating.

3. The structure of social preferences towards the investigated functions of forest and forest management, estimated based on 4237 correctly filled-in questionnaires (6 surveys in various forest sites and 3 polls carried out on representative samples) indicates that the most important for respondents was the function of forest as the living environment of fauna and flora (23.1 points), further, the air protection function (22.4 points). The third one was the recreational function of forest (13.7 points).

4. The analysis with Ward's dendrograms does not indicate explicit dependencies in the manner of grouping examined functions of forest and forest management (function clusters) by respondents. Dendrograms present various structures of clusters and crosslinks for evaluated functions. Among investigated sub-samples, the similarity in grouping may be noticed between a group of persons who declare the value of WTP>0 and all respondents.

5. The Principal Component Analysis (PCA) indicates that the two functions are the most strongly correlated with PC1 and PC2 variables, i.e.: forest as the living environment of fauna and flora, and air protection. The share of aggregate explaining variability and the diversity of respondents' evaluations is high, and it is rated for all respondents (not distinguishing with regard to the readiness to declare a WTP amount) from 47.9% to 69.2% respectively in nationwide surveys from 2013 (No. 4), and in Krościenko Forest District (No. 11-13).

6. The analysis of variance analysis on data from Krościenko Forest District (No. 11-13) and Beskid Śląski (No. 14-16), indicates statistically significant differences of average valuations of functions depending on their position in a set of answers to the question. In the first area, significant differences between averages occurred for four out of seven valuated functions – a provider of wood raw material, a place for gathering fruit and fungi, nature conservation, and water conservation. In the second survey, the analysis showed the significant differences in averages for six out of eight valuated functions. Only in the case of forest function as an element which shapes the climate, and the function related to water conservation, no statistically significant differences were stated.

7. The analysis of difference significances in the valuation of examined functions of forest and forest management by respondents with regard to their socio-economic variables, including sex, and transcoded to dichotomous variables – age and education, as well as WTP variable (a dichotomous variable – WTP>0 and WTP=0) indicate as follows:

- women and men evaluated the significance of functions differently in eight cases: in three cases, men valued the water conservation function of forests higher than women, and in one case men valued higher the function of forest as a provider of wood raw material, whereas women valued higher the function of forests as the natural environment of fauna and flora, forest as a supplier of forest fruit and fungi, as well as the recreational function of forest,
- respondents of working age and of retirement age differed in their valuation of investigated functions in nine cases, i.e.: persons of working age valued higher air conservation functions,

forest as a source of forest fruit and fungi, and three times functions of forest as the natural environment of fauna and flora, whereas retirement age respondents valued higher (in one case) the function of air conservation, forest as a source of forest fruit and fungi, and in two cases, the recreational function of forest,

- respondents of different education level (university and other) valuated the investigated functions differently in fourteen cases, i.e.: respondents who completed university education valued higher the most important environment functions, and other respondents, in two cases, valued higher the water conservation function, and in one case, the functions of forest as a source of wood raw material,

- respondents, who declared WTP>0, valuated environment functions higher, whereas respondents, who did not declare WTP>0 amount, valuated water conservation function of forest higher in two cases and, in individual cases, they valuated air and soil conservation function higher, at the same time valuating higher the functions of forest as the source of wood and the supplier of forest fruit and fungi (productive functions).

8. The results of valuation of non-use functions in Krościenko Forest District (No. 11-13), Beskid Śląski (No. 14-16), and the nationwide survey (No. 4) indicate that the greatest importance for respondents is the bequest value. For this value, respondents declared: 29, 30 and 32 points respectively. The second highest valued element was the willingness (to stay in forest). In nationwide and Beskid Śląski surveys, respondents declared over 27 points for this value, and in Krościenko Forest District, over 26 points. Other values indicated by respondents are the existence and the option.

9. The analysis of variance carried out for investigated non-use functions (average values) in Krościenko Forest District (No. 11-13) and Beskid Śląski (No. 14-16) confirmed the impact of valuated categories' place in a set of answers on obtained results. In every examined area statistically significant differences in average values were noted in three out of four examined functions (values). In Krościenko Forest District, statistically significant differences were noted for the values of option, existence, and willingness, and in the second study area statistically significant differences also occurred for three values (option, bequest, and willingness).

10. The analysis of difference significances in respondents' valuation of non-use functions with regard to three socio-economic variables, including dichotomous variable (sex) and

transcoded to dichotomous variables – age and education, as well as WTP variable, as a dichotomous variable i.e. WTP>0 and WTP=0, indicates that:

- women rated the bequest value higher in the nationwide survey (No. 4),
- persons of retirement age rated the bequest value higher in the survey in Beskid Śląski (No. 14-16), and, at the same time, rated willingness value lower than persons of working age,
- respondents in nationwide surveys (No. 4), with a university degree ranked the values of option and willingness higher, and ranked the bequest value lower than persons with lower education,
- respondents, who declared WTP>0 in surveys on the representative sample ranked the value of willingness higher, whereas in surveys in Beskid Śląski (No. 14-16) the value of option was ranked higher.

11. A WTP>0 value was only declared by a part of respondents. The share of respondents who declared WTP>0 was from 22% in Śląskie Province (No. 8) to 96% in Krościenko Forest District (No. 11-13). The average share of such persons in all presented surveys was 48%. In the representative surveys (No. 1, 2, and 3), a WTP>0 was declared by 46%, 43%, and 51% respondents respectively, though in survey No. 4 only 24% respondents declared. Also, average WTP values are different, and range from PLN 41 to 156 per year per household. In the representative surveys (No. 1, 3, and 4), in which respondents valued a group of non-productive functions of forest, an average WTP amount was respectively PLN 52.42, 52.81, and 71.10 per year per household, and in case of the recreational function of forest (No. 2) PLN 40.80 per year per household, and in the case of the recreational function of forest (No. 2), it was PLN 40.80 per year per household.

12. The results of Kruskal-Wallis test show that there are statistically significant differences between average WTP values set using three different formats. In Krościenko Forest District (No. 11-13) the average WTP in an open-ended question differs significantly statistically from the average in a bidding question and a question with a payment card. In Beskid Śląski (No. 14-16), the average WTP in an open-ended question differs significantly statistically from the average in a question with a payment card. No significant differences in the average were stated in a question with a card and an open-ended one.

13. The results of logistic analysis show that the readiness to declare WTP depends on social variables. Along with the increase of education level, the readiness increases by: 80%, 102%,

68%, and 230%. Similarly, the readiness to declare WTP grows along with the increase of household income above the average in enterprises in the year of study - by 85% and 108% respectively. Men in survey No. 3 and 14-16 proved to be less willing to declare WTP>0 amount by 39% and 44%. The chance to declare WTP>0 for single men compared to single women in survey No. 3 was less by approx. 40%, and at the same time, the chance to declare WTP>0 for persons in a relationship in survey No. 3 did not depend on the sex. The probability to declare WTP>0 value by persons in relationships in surveys 8-9 and 14-16 is higher by 13%, 112%, and 101% respectively. In survey No. 8, the greater readiness to declare WTP>0 value was proven by respondents of right-wing views.

14. The average WTP estimated based on data after trimming 10% of the quantity of declared maximum values decreased, retaining from 48% to 87% of the initial average value. Trimming 10% of the highest and the lowest values reduced the average value by 3% to 46%. After trimming 10% of the lowest values, the average increased, although the increase was not as great as the decrease of the value after trimming the highest values. The highest increase, up to 113% of the average value was recorded in surveys in Podlaskie Province (format with a payment card – survey No. 9).

15. Both, the results of qualitative, as well as quantitative studies show that respondents would like to rest in a forest which is high, old, and lighted. The mentioned features were indicated by 88%, 77%, and 71% respondents respectively. In addition, 63% of all respondents prefer mixed forests (comprising coniferous, as well as deciduous species). Surprising may however be only 55% share of respondents who indicated a sparse forest. The least unanimous, mainly due to the greater possibilities of choice, were respondents in relation to the variety of forest fruits and fungi, although, on average, 42% respondents preferred forests with fungi.

16. In summer, everyday visits to forest were declared by 13% respondents in Śląsk (No. 8), 19% residents of Podlasie (No. 9), and 17% residents of Łódź (No. 10), and visits a few times a week, were declared, as above, by 20%, 36%, and 35% respondents respectively. The surveys in Śląskie and Podlaskie Provinces showed that forest is the place of leisure for 87% and 84% respondents (No. 8 and 9), and 31% and 26% respondents in Śląskie and Podlaskie Provinces respectively spend from 21% to 50% of their spare time there. Based on surveys in urban forests of Łódź, the duration of visits is from 3 to 5 hours (60% respondents), and nearly 90% respondents spend from 2 to 8 hours in a forest. The similar duration of visits to forest was

declared by respondents in Beskid Śląski – the average duration of a visit to forest is approx. 3 hours.

17. The results show that from 28% to 47% respondents indicated a preferred place of their stay in forest to be a forest located on the shore of a body of water (apart from the surveys in Beskid Śląski – No. 7 and 14-16) and clearings, also apart from surveys in the mountains (No. 7 and 14-16) and in Promotional Forest Complex by the seaside (No. 5). In surveys among the residents of Warsaw, Śląsk, Podlasie, and Łódź (No. 3, 8, 9, and 10) respectively 43%, 38%, 44%, and 33% respondents chose leisure deep in the forest. The category "in wild and unavailable places", similarly as "in developed places", was put into three questionnaires. The first one of the mentioned categories was indicated by 23% responding residents of Warsaw (No. 4) and 1% of respondents from Śląsk and Podlasie (No. 8 and 9). The second category was indicated by 20% residents of Warsaw, and 8% respondents in Śląsk and Podlasie.

18. Two most important features of forest areas, which determine the quality of leisure are peace and quiet, as well as clean environment. At subsequent places, respondents indicated the presence of water bodies (No. 6 and 10), which in case of surveys in Promotional Forest Complex Lasy Oliwsko-Darżlubskie and Promotional Forest Complex Lasy Janowskie, determined the attractiveness more than forest itself. In addition, for residents of Śląsk and Podlasie, Warsaw, and Beskid Śląski (No. 8, 9, 10, and 14 – 16) the appearance of forest is of significant importance.

19. As far as devices of forest recreational infrastructure expected by respondents in Podlaskie and Śląskie Province (No. 8 and 9) are concerned, the similar number of respondents pointed out rubbish bins i.e. 67% and 66% respondents respectively. In addition, respondents indicated information boards and tourist line infrastructures, i.e. walking paths, cycling paths, and tourist routes. The tourist attractiveness of a clean forest is confirmed in surveys No. 3 and 10, in which the majority of respondents indicated rubbish bins, i.e. 72% and 65% respondents respectively. The greater number of surveyed tourists (No. 3 and 10) than surveyed residents (No. 8-9) indicated such devices as washing facilities (35% and 45% respondents) and drinking water intakes (28% and 37% respondents). The information boards are of particular importance for residents of Podlaskie and Śląskie Provinces (55% respondents in both surveys), whereas only 36% of tourists visiting forests around Warsaw, and 38% visitors to urban forests in Łódź considered them to be important devices for leisure in forests.

20. Risks, which respondents mention, include the contamination of rivers and threats from the side of other people visiting forests (in forests around Warsaw 38% and 21 % respondents respectively). The mentioned risks are noticed in Łódź urban forests in the sequence as above by 76% and 60% respondents. The results obtained in two surveys show different respondents' feelings regarding possible risks related to a stay in forest. Whereas, the risk of fire was only pointed out by 18% respondents in Warsaw, in the urban forests of Łódź it was a group of 66% respondents. The residents of the capital city consider dumping sites to be a huge threat (76% respondents), whereas they do not constitute a great problem for residents of Łódź (25% respondents).

Conclusions:

1. The perception of autotelic values in the natural environment by respondents is a positive phenomenon. The fact is visible even in the high valuation of the function of forest as the living environment of fauna and flora, or through paying particular attention to the bequest value among the non-use functions. Unfortunately, the mentioned functions contradict the instrumental values, identified e.g. as a common willingness to be surrounded by wooden products. There is an urgent need to identify a layer which would enable the combination of the mentioned social expectations, eliminating the sources of possible conflicts.

2. Undertakings related to the society environmental education carried out by foresters, as well as the informative activity of the State Forests and scientific communities, should take more into account the idea and the significance of those functions of forests and forest management, which, in public opinion, are valued below their actual importance for the natural environment and man. The particular attention should be given to functions related to the protection of water and soil, which are ranked the lowest in public opinion. The consolidation in the social awareness of the negative impact of wild dumping sites in forest areas on the quality of mentioned features may result indirectly in the reduction of this activity.

3. Applying traditional formats of questions regarding WTP in CVM method (a payment card or a bidding question) requires a detailed interviewers' training, as well as planning and devoting more time to interviews in the case of the latter format.

4. Difficulties in carrying out studies with CVM relate to two groups of factors. The first one relates to the lack of interviewers' experience in the valuation of goods not present in the market (public goods and external effects). On the other side, the second group of factors, which should be mentioned, refers to the miscellaneous, though mostly low level of the society's knowledge about the impact of the natural environment, including forests, on the quality of man's life, as well as the terms of carrying out forest management.

5. In order to limit the impact on survey results using interviewer questionnaires (average values), of such effects as priority and freshness, in closed-ended questions with the number of selection categories in answer sets over six, and related, at the same time, to problems which are abstract or unknown to respondents, at least three variants of interview questionnaires need to be applied with a random sequence of categories applied in a set of answers.

6. The logistic analysis shows that the readiness to declare a WTP amount, as well as its average value, are not only impacted by the valuation subject features, or the survey organization way (tool, sample, and study context), but also the typical socio-economic features of respondents. Requesting for an average WTP value should take into account the impact of social and economic variables of an investigated sample.

7. The average WTP amount after trimming 10% of their quantity (the highest and the lowest or both the highest and the lowest amounts simultaneously) is changed. Changes are more significantly impacted by trimming the maximum values than the minimum values or simultaneous decrease in the quantity of mentioned ranges. In order to retain the reliability of WTP average amounts' presentation, the results should take into account the presentation of two averages – a WTP>0 amount estimated based on all declarations, and based on data from which 5% or 10% number of maximum declarations were removed. In order to interpret the obtained valuation results appropriately, on the operational level in particular, the information regarding an average WTP should be supplemented by an indicator of a per cent share of respondents who declared WTP>0.

8. The results of surveys carried out at different times, on various samples, and different sites show that the majority of visitors to forests expect leisure in a forest which is clean and without rubbish, in peace and quiet. For the majority of visitors to forest areas, the condition of tourist infrastructure, including the one which enables qualified tourism, is of no significant

importance. The expectations in the mentioned scope are reported by few respondents. This fact should be taken into account in tourism related concepts and development plans for every forest area. Bearing in mind the expectations expressed in surveys, more attention should be given to marking forest areas to reduce the fear of being lost in a forest.

9. Walking in a forest during a visit which lasts around 3 hours, in summer and autumn period, combined with gathering of fungi and forest fruit along with the indication of a forest which is high, old, and lighted, rather mixed as far as species composition is concerned, as the model one, enables assessing the expectations of the majority of forest area users as unsophisticated and undifferentiated. This is valuable and important information for foresters, which allows the assumption that an average user in the area of his/her residence is able to satisfy the needs for the contact with forest environment, in a forest which does not require any special efforts.

10. The changing social and economic conditions, including the growing level of society's knowledge, affluence, and awareness, the increase in the amount of free time, the speed and ease of moving at increasingly larger distances from the place of residence, as well as shrinking areas of natural features (parks, meadows, agricultural areas excluded from use) pose a serious challenge upon persons responsible for forest management and forest owners. The forest management should undertake intensive actions in order to finalize works on "the forest constitution." Such document constituting a special social agreement would enable setting the proportions among the most important functions of forest and forest management, which would warrant the balance between economic functions and the benefits of public goods' features or the ones which constitute the external effects of forest management.

5. Summary of other scientific and research achievements.

My scientific activity in the Forest Research Institute resulted in 27 original and review scientific publications published in reviewed journals **(II.A)**[1]., including 11 publications from the ministerial list A of scientific journals (one publication before PhD) and 16 publications from the list B of scientific journals **(II.B)**.

The scope of studies at the Institute carried out at the request of different commissioning parties, including the General Directorate of the State Forests (*Dyrekcja Generalna Lasów Państwowych/DGLP*) and the Ministry of Environment allowed me to participate as the leader or the team member in 34 research projects, whose subject matter area focused on issues related to forestry economics and forest policy. All completed projects resulted in the development of the partial and final scientific and technical documentation, which included the origin of investigated phenomena, the purpose and scope, as well as the studies' methodology along with the presentation of results and the discussion **(II. E.)**.

The experience gained enabled me to apply successfully for public funds from the former Committee for Scientific Research (*Komitet Badań Naukowych*) in three projects (one supervisor's, before PhD) and two own projects, in which I held the position of the leader **(II. I)**.

I presented the research results, which provided answers to multiple problems of forest management during the 38th conference **(II. K)**., and I published thirteen presented papers in post-conference materials (one speech before PhD).

As the chairman of the organizing committee or the coordinator, I organized 3 national conferences **(III. C)**.

My scientific work at the Institute was accompanied by the academic activity which I conducted for 1st degree students of forestry (full time studies in forestry at the Branch of University of Lodz in Tomaszów Mazowiecki and the Faculty of Environmental Management and Agriculture at the University of Warmia and Mazury in Olsztyn), at postgraduate studies, doctoral studies, as well as training courses mainly for foresters or public administration employees (*starostwa*) **(III. I)**.

[1] Numbering corresponds to the division suggested in the model list of achievements in the area of natural sciences, agriculture, forestry, and veterinary at the site of the Central Commission for Degrees and Titles, and in Attachment 4 which constitutes "The list of published scientific papers or creative professional works, and the information on didactic achievements, scientific cooperation and popularization of science".

In the years 2012-2013, I gained experience as an expert at the Centre for the Forestry and Preservation of Nature Statistics of the Statistical Office in Białystok, undertaking the cooperation in the scope of methodological and analytical works regarding forestry satellite account. I participated and leaded the development of 11 scientific expert's reports, including two before PhD **(III. M).**

I have prepared 12 reviews of scientific publications, including: 7 for Folia Forestalia Polonica journal, and one for every of the following journals: Forest Research Papers (*Leśne Prace Badawcze*), Journal of Water and Land Development, Small-scale Forestry, Baltic Forestry, and Roczniki Bieszczadzkie **(III. P).**

I participated in four trips abroad, including the consulting visit in Latvia, the training and as an adviser for foresters in Georgia (two trips), and a trip to Switzerland for a week long training. As for the record of other publications, I have prepared 4 scientific contributions, including one before PhD, and 28 scientific and popular science publications (6 publications before PhD) **(III. Q.).**

My scientific activity in planning and organizing research studies, the development of their methodological assumptions, as well as the participation in their execution and preparation of scientific reports presenting the achieved results focused on the following four areas connected with forestry economics:

1. The valuation of resources and streams of forest and forest management goods and services, with particular attention to the non-market part (non-productive functions of forest) along with social aspects intended to identify expectations and preferences as regards goods and services of the mentioned part of the forest sector, particularly in the scope of the recreational function of forest.

2. The issues related to the social and economic aspects of forest management in private forests (owned by individual persons), including specifically farmers, as well as land and forest communities.

3. The aspects related to the assessment of the role and significance of forest and forest management in social and economic development of forestry environment on the regional and national level.

4. The problems related to the use of wood from forests for energy purposes, including with particular attention to its use for the above purpose at an industrial scale.

In the further part of this Summary of Professional Achievements, in the order as above, I present the summary of results of the completed studies, referring to published original and review scientific works (26 publications) and publications in conference materials.

Re. 1. The research studies, which I carry out, on the broadly understood issue of valuating non-market goods and services of forest and forest management, constitute the continuation of studies undertaken during the works on the doctoral dissertation. In the subsequent years, I broadened this direction by social aspects, whose main purpose was seeking an answer to the question, i.e. what are the needs and preferences of forest visitors in the scope of public functions of forest and forest management, including the recreational function of forest? When carrying out surveys, I improved the methodological basis for the valuation of non-market benefits of forest and forest management at different forest sites and on various samples, using the question regarding the readiness to finance non-market goods and services (WTP – Willingness To Pay) in the Contingent Valutaion Method (CVM).

My first publication titled *"The social needs and preferences as regards the recreational function of forest"* (*„Społeczne potrzeby i preferencje w zakresie rekreacyjnej funkcji lasu"*), which presents the study results, was published in conference materials **(Gołos P.,** Zając S. **2004. Problems related to sustainable development of tourism, recreation, and sports in forests./Problemy zrównoważonego rozwoju turystyki, rekreacji i sportu w lasach. Warszawa, AWF, pp. 93-108).** The purpose of the studies carried out in the years 2001-2003 using the interviewer questionnaire was an attempt to estimate the social value of non-productive functions of forest using CVM method, and to identify social preferences and expectations towards them. The work presents the structure of respondents' answers which indicate purposes and motives for visiting forest, specifying the appearance of forest and forest sites where respondents are most willing to relax. In addition, the recreational devices expected by respondents were indicated, and the readiness to co-finance the recreational function of forest by users was estimated based on declarations of hypothetical amounts of money (WTP).

During the international "Forest and Water" conference in Mrągowo on September 14 – 17, 2008, in the paper titled *"The value of the water-protecting function of forest"*, I presented the possibilities of valuating the water-protecting function of forest. I published the presented results in the form of a review article under the same title **(Gołos P. 2009. Journal of Water and Land Development, No. 13a, pp. 187-204).** In the publication, I presented the estimated value of the water-protecting function of forest determined using the relative value in use method (WWU) and Contingent Valuation Method (CVM). To estimate the value of water-protecting function, the average WTP amount was used, as well as the percentage structure of respondents' indications settled in surveys, which enabled the assessment of the significance of the selected non-market goods and services of forest and forest management. The estimated value of assessed public functions of forests in CVM method was nearly PLN 748 million, out

of which over PLN 86 million constituted the value of water-protecting function of forest (9.40 PLN/ha/year). Its value with the relative value in use method, in which the results of the function significance evaluation from CVM method were used, amounted to PLN 1 177 million (684 PLN/ha/year).

In a presentation titled *"The importance, problems, and development directions of public functions of forest management" („Znaczenie, problemy oraz kierunki rozwoju publicznych funkcji gospodarki leśnej")*, given during the 1st Session of the Winter Forestry School, which was further published in post-conference materials **(Golos P. 2009. Multifunctional forestry – current state and future. Materials of the Winter Forestry School at the Forest Research Institute/Leśnictwo wielofunkcyjne – stan obecny i przyszłość. Materiały Zimowej Szkoły Leśnej przy Instytucie Badawczym Leśnictwa, Sękocin Stary, pp. 69-83)** I pointed out the economic role of public functions for forest management. I attempted to identify current problems in the development of public functions of forest and forest management. In the paper, I also presented the predicted directions of further development for the mentioned area of forest holding operation. The selected subject matters from the research studies carried out at the Forest Research Institute in the years 2001-2008 formed the basis for the analyses in the scope of using public functions of forest.

The results of seven studies using interviewer questionnaires were presented in the publication titled "*Social importance of public forest functions – model of tree stand and forest desirable for recreation and leisure" („Społeczne znaczenie publicznych funkcji lasu – pożądany dla rekreacji i wypoczynku model drzewostanu i lasu")* **(Golos P. 2010. Leśne Prace Badawcze. Vol. 71 (2), pp. 149-164).** The publication presents the results of the identification of tree stand features, which, in respondents' opinion, create optimal conditions for leisure and recreation. The publication also includes indications regarding the functions of forest preferred by respondents (use and non-use).

In a publication titled "*Assignment of recreational function of forests and forest management in urban areas" („Delimitacja rekreacyjnej funkcji lasów i gospodarki leśnej na terenach zurbanizowanych")* **(Golos P.,** Zając S. **2011. Leśne Prace Badawcze. Vol. 72 (1), pp. 83-94),** the importance and determinants of the recreational function of urban forests were discussed. Particular attention was given to the possibility of assigning the recreational function of forest in urbanized areas, using the example of Warsaw surrounding forests. The delimitation recreational forest use zones around Warsaw was done based on the actual intensity of recreational traffic in those forests, estimated in social surveys, and taking account of the natural features and social conditions. As a result, 4 zones were delimited around Warsaw of the total

space of 3196 thousand ha, including 573 thousand ha of forests which are located in areas differing in the population density and afforestation rate. The results also enabled to identify forest management products and services, which residents and tourists may use.

In the review publication titled *"The economic and financial aspects of the recreational and tourism-related function of forest" („Ekonomiczne i finansowe aspekty rekreacyjnej i turystycznej funkcji lasu"* **(Gołos P. 2011. Leśne Prace Badawcze, Vol. 72 (3), pp. 241-251),** I presented the economic aspects of the public functions of forest, the specifics and diversity of goods and services provided by forest and forest management, starting from market goods (wood raw material), through external effects (the recreational function of forest), and up to public goods (nature conservation). In the study, I have undertaken theoretical considerations regarding potential opportunities for financing goods and services of forest management. The publication also included the summary list of the most important functions of forest, preferred by respondents, which were determined based on own research.

I presented the issues which showed the impact of a multifunctional forest holding model executed by the State Forests on its economic situation in a paper titled *"The structure of non-productive functions of forest and their impact on the forest management economic condition" („Struktura pozaprodukcyjnych funkcji lasu i ich wpływ na sytuację ekonomiczną gospodarki leśnej")* published in materials from the Winter Forestry School, i.e. *"The development strategy of forests and forestry in Poland to 2030" („Strategia rozwoju lasów i leśnictwa w Polsce do roku 2030")* **(Gołos P.,** Referowska-Chodak E. **2011. Materials of 3rd Session of the Winter Forestry School at the Forest Research Institute/Materiały III Sesji Zimowej Szkoły Leśnej przy IBL, Sękocin Stary, March 15-17, 2011, published by Forest Research Institute, Sękocin Stary, pp. 235-266).** The paper includes a historical overview related to the development of multifunctional forest management, and refers to contemporary regulations (Forestry Act and the National Forest Policy) which determine the structure of non-productive functions of forest and forest management. Discussed are selected aspects of assessment and valuation of economic importance (value) of non-market services, referring to the results of analysis which determined the share of forests in creating added value for other economy sectors.

The thorough analysis of the abovementioned problem was included in a paper titled "*The public functions of forest in the economic calculation of forest holding" („Publiczne funkcje lasu w rachunku ekonomicznym gospodarstwa leśnego")* published in materials from the international conference *"Current problems in forestry economics" („Współczesne problemy ekonomiki leśnictwa")* organized by the Forest Research Institute **(Gołos P. 2011. The public**

functions of forest in the economic calculation of forest holding/Publiczne funkcje lasu w rachunku ekonomicznym gospodarstwa leśnego. In: Current problems in forestry economics/Współczesne problemy ekonomiki leśnictwa. The International Conference organized under the patronage of the Chair of the Polish Forest Association and the Director General of the State Forests, Puszczykowo, June 7-9. Sękocin Stary, Forest Research Institute/ Polish Forest Association, 2011, pp. 373-389). The list of direct costs related to performing non-productive functions of forest, presented in the publication indicates that their total level in the years 2007-2009 in the State Forests National Forest Holding (PGL LP) scale amounted to over PLN 530 million (5.5 PLN/m^3 of harvested timber and 80 PLN/ha of the forested area). The paper also includes the analysis of advantages and disadvantages of theoretical financing ways (supply) of non-market goods using the means from the outside of forest management.

The publication titled "*The costs of forest management to provide non-productive functions, as exemplified by the Regional Directorate of State Forests in Katowice*" (*„Koszty świadczenia pozaprodukcyjnych funkcji gospodarki leśnej na przykładzie Regionalnej Dyrekcji Lasów Państwowych w Katowicach"*) **(Gołos P. 2012. Leśne Prace Badawcze, Vol. 73 (3), pp. 209-220)** presents the results of a detailed cost calculation related to providing non-productive functions of forest with account given to: the direct and alternative costs, as well as the value of losses in forest management in the Regional Directorate of State Forests (RDLP) in Katowice in the years 2005-2009. The total costs of providing the non-productive functions of forest amounted to over PLN 73 million in the mentioned period, i.e. approx. 120 PLN/ha and 4 PLN/m^3 of harvested timber. The cost of forest management in the form of unearned income also refers to wood raw material of PLN 326 million left as dead wood in the forest. The total costs (PLN 73.3 million) constitute the equivalent of over 490 thousand m^3 wood (3% volume of harvested wood), at the average price 150 PLN/m^3.

The publication titled *"The value of forest resources in Poland"* (*„Wartość zasobów leśnych Polski"*) **(Gołos P. 2013. Sylwan R.157 (1), pp. 3-16)** constituted a contribution to the periodically emerging debate regarding the economic value of forest resources. An attempt was made to assess the value of forests under all forms of ownership on the basis of the first stage of the Large–Scale Forest Inventory completed in 2009. Its purpose was to present the estimated value of forest resources in Poland divided into public and private owned forests, and within the individual forms of ownership by available and unavailable forests, taking into account the value of forest land resources, as well as tree resources. The results of the assessment of forest land resources relate to the period of 2007–2009, which enabled to assess the dynamics and

direction of changes. The value of timber resources is of major importance for forest land estates, as they constitute 80% of forest resources value. In addition, undoubtedly, forests available for harvesting are dominant (mainly the forests of the State Forests National Forest Holding/PGL LP), whose value constitutes 95% of the total value of forest resources in Poland. The total value of Polish forest lands amounted to PLN 27 961 million in 2008, i.e. 3084 PLN/ha. The value of forest lands in public forests constitutes 82.2% of the total value (3098 PLN/ha). The value of forest lands in private forests was PLN 4 934 million (3018 PLN/ha).

In the publication titled *"The recreational functions of Warsaw's urban and suburban forests"* (*„Rekreacyjna funkcja lasów miejskich i podmiejskich Warszawy"*) **(Gołos P. 2013. Leśne Prace Badawcze, Vol. 74 (1), pp. 57-70)**, I presented the results of surveys on the random representative sample of 500 residents of Warsaw. The main two objectives of the survey were: to identify opinions and views of Warsaw residents regarding the non-productive functions of forest, including the recreational forest management, and to assess the readiness to co-finance the non-productive functions of forest using Contingent Valuation Method (CVM), which included a question which allowed acquiring the information regarding the hypothetical monetary amount that the residents of Warsaw would be willing to allocate to financing the recreational management of forests in their immediate surrounding (the amount was specified as WTP – Willingness To Pay). The preferences indicated by Warsaw citizens show that a particular place for leisure is the inside of forest, where there should be elements facilitating and increasing the attractiveness of the dominating recreational activity in the forest, i.e. walking. Respondents specifically appreciate peace and quiet, as well as they pay particular attention to order and cleanliness. When preparing plans related to the recreational management of forests, it is necessary to take into account the expectations of those individuals who prefer the management of forest for tourist purposes, as well as those who prefer the natural forest with no tourist devices. The mentioned user groups are similar as regards the response share, i.e. 23% and 20% respondents respectively.

The selected social and economic aspects related to the public functions of forest, with particular focus on the recreational function based on the results of surveys conducted in the years 2000-2009 were presented in the review publication titled *"Selected aspects of the forest recreational function in view of its users"* (*„Wybrane aspekty rekreacyjnej funkcji lasu w opinii użytkowników"*) **(Gołos P. 2013. Leśne Prace Badawcze, Vol. 74 (3), pp. 257–272)**. The analysis of results shows that it is the forest characteristics that decides most about respondents' preferences regarding leisure places in the forest, including the type of dominating tourist value which determines the type of tourist activity in the forest (walking, cycling, bathing, sunbathing,

and fishing). In addition, different places are indicated by residents and tourists, which is due to a different sense of security level in the forest. Based on the opinions acquired, a thesis may be formulated that the most important elements which influence the attractiveness of forest areas are those that determine the quality of leisure activity. In the opinion of forest visitors, peace and comfort of leisure in forest are more important than the infrastructure condition, forest availability, or exceptional (additional) values of forest areas.

The results of surveys on a sample of 335 visitors to forests in 2012, carried out in the forests near Gołdap, Białowieża, Pisz, Kraśnik, Warsaw, and Zakopane were presented in the joint authorship publication titled *"The preferences of visitors to selected forest areas for tourism and recreational purposes" („Preferencje osób odwiedzających wybrane kompleksy leśne w zakresie turystyki leśnej i organizacji wypoczynku")* (Skłodowski J., **Golos P.**, Skłodowski M., Ożga W. **2013. Leśne Prace Badawcze, Vol. 74 (4), pp. 293-305)**. Respondents declared that they spend approx. 3 hours in a forest during one visit, and in selecting their preferred type of tree stand, respondents slightly more frequently chose coniferous forest. The types of forests chosen decidedly more frequently were those with undergrowth, open forests, old forests, dry forests and those growing more sparsely. Respondents undertook various forms of activities in different parts of the forest. There was a tendency to choose the interior of the forest to pick berries, and nature was observed in clearings. Active recreation, associated with running and cycling, is decidedly more frequently carried out on paths and trails, while walks were taken along forest edges and on trails, passive recreation, on the other hand, in clearings. According to respondents, the most important functions of a forest are: a place where animals and plants live (24.98±0.99%), a place of recreation (19.71±0.79%), and air protection (19.02±0.78%).

The attempts to define, based on public survey results, the preferred types of forests stands and factors which effect the tourist attractiveness of a forest were presented in the publication, titled *"Preferred type of forest stand and factors deciding about the tourist attractiveness of the forest" („Preferowany typ drzewostanu i czynniki decydujące o atrakcyjności turystycznej drzewostanu w opinii społecznej")* (Skłodowski J., **Golos P. 2015. Sylwan 159 (9), pp. 747–756)**. In the surveys carried out in 2013 by TNS OBOP on the random representative sample of 1000 respondents, the surveyed persons did not indicate unequivocal preferences for a forest stand type (deciduous or coniferous). On the other hand, respondents' preferences regarding the leisure in a forest turned out clearly attributable to the natural forest features, i.e. the appearance, the abundance of nature, terrain layout, quiet or the presence of nature reserves. Only at the following place did respondents indicate tourist infrastructure, forest availability,

the presence of water bodies, and the least, the presence of culture and historic sites. Respondents with higher education (university degree) relate forest attractiveness with its availability and the presence of waters, which suggests the recreational character of their interest in forests. For respondents with the lowest education level, the most important features that influence forest attractiveness are: the nature along with its abundance of species (including fungi and undergrowth fruit plants). Similar results were obtained from the analysis carried out with account to the declared level of respondents' affluence. Respondents, who are in the best financial situation, declare the forest appearance and the presence of lakes and rivers (interest in recreation) to be the most important factors which decide about tourist attractiveness of a forest. Respondents, who depict their financial situation as poor and very poor, indicated nature along with the abundance of species (possible gathering of forest fruit), the availability of forest, places related to culture and religion, nature reserves, and tourist infrastructure.

The study titled *"Social and economic conditions for providing public forest services in the State Forests National Forest Holding"* (*„Społeczne i ekonomiczne uwarunkowania realizacji publicznych funkcji lasu w Państwowym Gospodarstwie Leśnym Lasy Państwowe"*) **(Gołos P,** Kaliszewski A. **2016. Sylwan 160 (2), pp. 91–99)** includes the analysis of social and economic conditions, as well as the overview of development directions of non-productive functions of forest and forest management. One of the most important conclusions drawn up after the analysis indicates that the forest management (PGL LP) may shortly approach the limit of economic efficiency. After reaching that level it may be enforced to seek the external source of financing, particularly of goods and services, which are not the source of revenues (public functions of forest). Maintaining economic factors of forest management in the years 2020 and 2030 on the same level as in 2009 is possible, provided one of the two below presented scenarios takes place indicating the necessity:

1) to increase timber prices up to the level of 200 and 294 PLN/m^3 respectively or to increase harvesting and sale of timber up to 45 and 61 million m^3 annually, which would enable to maintain the employment on the level of 25 thousand persons, and the growth dynamics of average salary on the level from the years 2000–2009 (46% within 10 years),

2) to reduce employment at PGL LP to the level approx. 18 and 13 thousand persons, maintaining at the same time the volume of timber sales on the level of 33 million m^3, and the raw material price growth dynamics on the average level from the period of 2000–2009 (i.e. 9%).

The results which present the effect of social and economic variables on the readiness to finance non-productive functions of forest in the form of a hypothetical WTP amount

declarations have been included in the publication titled "*Hypothetical readiness for financing the most important public functions of forest and forest management*" („*Hipotetyczna gotowość finansowania publicznych funkcji lasu i gospodarki leśnej*") **(Gołos P.,** Ukalska J. **2016. Sylwan 160 (7), pp. 597–608)**. The analysis shows that in a general model, the growth of probability to declare WTP>0 is noted among those respondents, for whom the most important element determining the attractiveness of leisure in a forest is peace and quiet. In addition, more willing to declare a WTP>0 amount were respondents who prefer to rest in deep forest and indicate the recreational function to be the most important out of all evaluated public functions. In detailed models, the growth of probability to declare WTP>0 was noted in those groups of respondents who indicated the absence of parking places, as well as nature and educational walkways (model I), paid attention to the contamination of water bodies, streams and rivers, and the absence of guarded car parks (model II), indicated unsightly forest stand, broken branches, and damaged benches, roofing elements, and rubbish bins (model III), and considered that the most needed devices in forest areas around Warsaw are shelters, roofing, various places to sit, benches and tables (model IV).

The readiness to declare WTP amounts to finance the recreational function of forest was presented in the publication titled *"Value of leisure–related function of forest in view of the results of nationwide survey in Poland"* („*Wartość rekreacyjnej funkcji lasu w świetle wyników ogólnopolskiego badania opinii społecznej*") (Skłodowski J., **Gołos P. 2016. Sylwan 160 (9), pp. 759–766).** Out of 1000 respondents, a WTP>0 amount was declared by 29% respondents (296 subjects). After excluding amounts from the lower and upper quartile, the analysis of WTP>0 values was carried out based on 205 amounts declared per household, i.e. a family, and 175 amounts per person. Respondents, who preferred a forest with poorer infrastructure, declared higher amounts per household (PLN 13.59±0.84) than respondents who selected a better developed forest (PLN 12.86±0.88, PLN 12.91±1.46). It was surprising that significantly higher average WTP amounts/household were declared by respondents who indicated forest without tourist infrastructure, i.e. PLN 16.31±2.76. The average declared WTP amount per person increased from PLN 0.84±0.34 to PLN 2.76±1.26 in line with the limiting forest tourist infrastructure, the differences however were not significant. The declared average WTP amounts per household did not depend on the respondents' education level, but it depended on the respondents' age and family situation.

Respondents' preferences regarding tourist infrastructure elements were presented in the publication titled *"Usability of the tourist trails and infrastructure elements according to the nationwide public opinion survey"* („*Przydatność szlaków turystycznych oraz elementów*

infrastruktury w świetle wyników ogólnopolskiego badania opinii społecznej") (Skłodowski J., **Gołos P. 2016. Sylwan 160 (3), pp. 238–246**). According to respondents, the most desired are walking and hiking trails. The obtained results are correlated with the popularity of walking in a forest, which does not require any significant effort or additional financial contributions in order to spend spare time in a forest. On the second place, there were nature, cycle, fauna, and health paths. According to respondents, the sequence from the most to the least needed elements of infrastructure in the trails, included the following: waste bins, information boards, benches and tables, toilets, water intakes, shelter and roofing, fire places, and playsets for children and fitness equipment. In addition, in the sequence from the most to the least needed, respondents indicated the following: terrain marking (signposts, information boards), parking lots, animals and birds observation places, resting places (roofing structures, tables, etc.), overlooks, designated places for grilling or making fires, piers, playgrounds for children with equipment, rope parks on trees, and designated areas for paintball.

Re. 2. The constantly growing social an economic significance of privately owned forests (increased surface, wood resources, as well as the high evaluation of nature values) and the commissioning of programs for their financial support under the Rural Development Program (*Program Rozwoju Obszarów Wiejskich/PROW*) resulted in the natural need for monitoring social and economic changes, which take place in private forests, which exceed the scope of information gathered in the system of official statistics at the Central Statistical Office (*Główny Urząd Statystyczny/GUS*).

In response to the identified needs, a project was launched, which was financed by the Ministry of Environment, i.e.: "Analysis of Private Forest-Agricultural Properties in Poland-Network Design of Test Properties" („Analiza prywatnych gospodarstw rolno-leśnych i leśnych w Polsce - projekt sieci gospodarstw testowych"). The project was carried out in the years 2003-2006. The survey was conducted on a sample of 500 agricultural farms which owned a forest, collected from the registration data of the county offices with the highest index of woodland area in provinces layout (no ability to access the nationwide representative sample frame).

As a result of the project, the joint authorship publication was prepared and titled *"Legal forms of associations of private forest owners"* (*"Prawne formy zrzeszeń prywatnych właścicieli lasów")* (Zając S., **Gołos P.**, Geszprych M. **2004. Sylwan No. 4, pp. 40-52).** The publication presented possibilities of solving one of the important problems related to associating private forest owners, i.e. the ability to associate private forest owners in imitation of solutions adopted in other EU countries. The publication included advantages and

disadvantages of establishing forest owners associations in the contemporary legal order under the Act of April 7, 1989 Law on Associations (Journal of Laws of 1989 No. 20 item 104).

The summarized history of emergence and development of forest commons, legal bases of their operation, general characteristics of their forest management, their number and distribution throughout the country were presented in the publication titled *"The commons – the traditional form of collective land management" ("Wspólnoty gruntowe – tradycyjna forma gospodarowania lasami")* **(Gołos P. 2008. Sylwan No. 2, pp. 54-68).** Due to the execution of the above project, based on the information from 81% administrative districts in the country, 1588 land commons were identified (farmlands, farmlands–forestlands or forestlands), located in 13 provinces and 158 counties. In total, the inventoried commons managed the land of 81,875.43 ha in 2005, including 48,339.17 ha of forests. The selected results of project works were included in the publication titled *"The status of privately owned forests in Poland" („Stan lasów prywatnych w Polsce")* **(Gołos P. 2008. Leśne Prace Badawcze. Vol. 69 (4), pp. 321-335).** The results of surveys conducted among forest owners enabled the detailed description of forest management in privately owned forests as at the end of 2003. The studies allowed to estimate data for all households in the country in forestry land surfaces classes, including social data regarding forest owners, and economic information about privately owned forests (methods and volume of timber use, breeding activities, estimated surface of lands excluded from farming, where forest tree species renewed as a result of natural succession, owners basic forestry equipment, plans for the future, knowledge regarding the ability to associate). Due to the research carried out, it was possible to set, for the first time, an estimated surface of lands excluded from agricultural production, where forest communities appeared as a result of succession. The surface of approx. 300 thousand ha estimated at that time was in the following years verified up to the level of 600 thousand ha.

The surveys carried out among forest owners also allowed to note, based on respondents' opinions and after the acquaintance closely with the issue of forest management in privately owned forests, the absence of organized knowledge of county office's representatives and foresters, who supervise forests which are not the ownership of the state. For the purpose of at least slight improvement in the mentioned scope, I organized a training: *"Legal and economic aspects related to the supervision of privately owned forests" ("Prawne i gospodarcze aspekty nadzoru lasów prywatnych")*, which was delivered on May 30 – June 2, 2005 in Jedlni-Letnisko, and was addressed to specialists and foresters who supervise private forests.

The results of research were also presented during three conferences, and further published in post-conference materials:

1) *"Small-scale Forestry in Poland – Results of the Project on the Forest Accountancy Data Network"* **(Gołos P.,** Geszprych M. **2005. In: Small-scale Forestry in a Changing Environment. International Symposium IUFRO, Small-scale Forestry. Lithuanian Forest Research Institute, Kaunas, pp. 185-190),**

2) *"The condition of privately owned forests and their development perspectives" („Stan lasów prywatnych i perspektywy ich rozwoju")* **(Gołos P.,** Zając S. **2005. In: The State Forestry Policy and the National Forestry Program/Polityka Leśna Państwa i Narodowy Program Leśny. Materials from the conference, May 18, 2005, Jedlnia-Letnisko. Published by The State Forests Information Center/Centrum Informacyjne Lasów Państwowych, Warsaw, pp. 35-48),**

3) *"Privately-owned forests in Poland – current condition and trends" ("Lasy prywatne w Polsce – stan obecny oraz kierunki zmian")* **(Gołos P. 2007. In: Quo vadis forestry?, Materials from the international conference, Sękocin Stary, June 29-30, 2006 pp. 105-124).**

The methodological solutions proven in the abovementioned project which allowed carrying out surveys among private forests' owners were further improved in the own project, which the Institute obtained in 30th competition of the Scientific Research Committee (2 P06L 007 30) titled *"Economic and social aspects of forestry management in small ownership forests (farmers) – the network of test forest holdings"*. The surveys were carried out among forest owners (farmers) who formed a nationwide representative and random sample of 1100 agricultural farms including forests. The representative sampling frame included data from the Agricultural Census Data by the Central Statistical Office (GUS). The subject of investigation in the abovementioned projects also included forest land communities – the unique in Europe historical form of private forests management, which found its legal bases in dead letter regulated by the Act of June 29, 1963 on land communities management (Journal of Laws of 1963 No. 28 item 169).

The methodological basis, purpose, and scope of research in the network of test holdings and the obtained results were discussed in the paper titled *"Private forests in Poland – the results of the questionnaire surveys covering the network of test forest holdings"* **(Gołos P. 2011. Folia Forestalia Polonica Vol. 53 (1), pp. 25-43).** The publication presents a variety of economic information items in 10 forest holding surface classes, the results of simplified economic calculation, as well as social data regarding forest owners. The average area of forest in an agricultural holding is 1.41 ha and is composed of two forest plots located about 2.4 km away from the place of residence of the owner. The annual volume of timber harvested on clear-

cutting (32.7% of the total volume of harvested timber) was 5.7 m3/holding and 2.1 m3/ha, i.e. over 3 times more than specified in the official statistics of the Central Statistical Office (GUS). The research results show that the real timber harvesting in private forests may even amount to 3 million m^3. The obtained results provided the detailed information on the current economic condition in private forests, in many cases verifying or supplementing the official statistics data considerably.

One of the practical outcomes of the presented project financed by the Scientific Research Committee (KBN) was the preparation of a handbook for owners of private forests titled *"Handbook for private forest owners" ("Poradnik dla właścicieli lasów prywatnych")* **(red. Gołos P. 2009. Forest Research Institute, Sękocin Stary, p. 252).** The publication comprises 10 chapters which present the characteristics of private forests, contemporary legal regulations, also related to the terms of supervision, the nature and economy related issues regarding a forest holding. The publication of this guide was positively evaluated by forest owners, who are the primary recipient of the book. The publication, as one of the first on the market, filled in a gap in the area of comprehensive practical guidebooks dedicated to private forest owners. The interest in the publication largely exceeded its moderate printing volume.

I continued my involvement in activities related to increasing the level of forest owners' knowledge cooperating with the Ministry of Agriculture and Rural Development on the preparation of the second handbook. The common initiative of the Forest Research Institute and the Ministry of Agriculture resulted in a publication titled *"Handbook for forest owners" („Poradnik dla właścicieli lasów")* **(red. Gołos P. 2011. Forest Research Institute, Sękocin Stary, p. 109).** The guide contains 6 chapters, which present the general characteristics of private forests, forest management issues, the description of actions available to forest owners under the Rural Development Program (*Program Rozwoju Obszarów Wiejskich*) for the years 2007-2013, legal, organizational, and practical issues related to the supervision over forest management in privately owned forests. In addition, advising related issues and ideas of private forest owners' associations were discussed.

The results of surveys in the network of private forest holdings constitute an exceptional achievement, in my opinion, as they were the first studies for such a large scale, which allowed to learn important features of this group of forest owners established after surveying the random, nationwide, and representative sample. They were used, along with other research results in the mentioned scope, to prepare speeches and publications at four conferences and two seminars:

1) **Golos P. 2017.** Market of forest services in private forests. Conference: "Forest services in private forests". Forestry Fair „Las i My", Agricultural Advisory Center in Szepietowo, October 7-8. (*Rynek usług leśnych w lasach prywatnych. Konferencja pt. „Usługi leśne w lasach prywatnych". Targi Leśne „Las i My", Ośrodek Doradztwa Rolniczego w Szepietowie, 7-8 października*).

2) Głaz J., **Golos P. 2012**. Problems and prospects for the development of private forests in Poland. In: Vision for the future of Polish forests and forestry by 2030, pp. 315-335. Conference of Polish Forest Society, Spała 2012, (*Problemy i perspektywy rozwoju lasów prywatnych w Polsce. W: Wizja przyszłości polskich lasów i leśnictwa do 2030 r., pp. 315-335. Konferencja Polskiego Towarzystwa Leśnego, Spała 2012 r.*),

3) **Golos P. 2011.** *The situation of non-state forests in Poland – the results of nationwide survey, 8-9.* In: Forest management in non-state forests, Regional Directorate of the State Forests in Białystok. Conference "Management in non-state forests", November 3-4, 2011, Osowiec-Twierdza, (*Sytuacja lasów niepaństwowych w Polsce – wyniki ogólnopolskiej ankiety, 8-9. W: Gospodarowanie w lasach niepaństwowych, Regionalna Dyrekcja Lasów Państwowych w Białymstoku. Konferencja „Gospodarowanie w lasach niepaństwowych", 3-4 listopada 2011 r., Osowiec-Twierdza*),

4) **Golos P. 2010.** Polish private forests in forest surveys – selected issues. Conference: Management of privately owned forests in Poland, Faculty of Forestry, Warsaw University of Life Sciences – SGGW, November 26. (*Polskie lasy prywatne w badaniach leśnych – wybrane zagadnienia. Konferencja Zarządzanie lasami prywatnymi w Polsce, Wydział Leśny SGGW. 26 listopada*).

5) **Golos P. 2009.** Economic and social aspects of forest management in small ownership non-state forests. General Directorate of State Forests Seminar. Jaszowiec, December 9-10. (*Ekonomiczne i społeczne aspekty gospodarki leśnej w lasach niepaństwowych drobnej własności. Seminarium DGLP. Jaszowiec, 9-10 grudnia*).

6) **Golos P. 2008.** "Possibilities of harvesting wood in forests which are not owned by the State Treasury". Ministry of Environment, General Directorate of State Forests Seminar titled "Tasks performed by organizational divisions of the State Forests National Forests Holding in forests which are not owned by the State Treasury", Ustroń-Jaszowiec, February 14-15. (*„Możliwości pozyskania drewna w lasach niestanowiących własności Skarbu Państwa". Seminarium MŚ, DGLP, pt. „Zadania realizowane przez jednostki organizacyjne PGL LP w lasach niestanowiących własności Skarbu Państwa". Ustroń-Jaszowiec, 14-15 lutego*).

Re. 3. My scientific interests also relate to the issue of forest management's impact on the development of its social and economic surrounding. The project, which awakened my interests in the mentioned research area, and allowed, at the same time, to show in detail the relations which connect forest economy with social and economic surrounding, was the research carried out in three forest districts of Białowieża Forest. The purpose of the expert's report titled *"The socio-economic importance of the forest districts of the Białowieża Forest for the region's economy – I-O analysis in 1998" („Znaczenie społeczno-ekonomiczne nadleśnictw Puszczy Białowieskiej dla gospodarki regionu – międzysekcyjne przepływy w 1998 r.")* completed at the request of the Ministry of Environment was to estimate the value and directions for the money streams incoming to the analyzed forest districts, as well as the ones transferred to the surrounding. The input-output analysis was carried out. The purpose of the expert's report was to evaluate the importance of forest management for the region of Białowieża Forest in the light of the first attempts of significant restriction of the scope of performed management tasks by the three forest districts in the mentioned region.

The research results were presented in the publication titled *"The role of forestry in the socio-economic development of Poland's agricultural region (input-output analysis)"* (Zając S., **Golos P. 2007. Folia Forestalia Polonica. Series A-Forestry, 49-50, pp. 70-79).** The obtained data allowed to estimate many important indicators picturing the role of forestry and timber sector in 1998, including:

- 15 jobs were created per 1,000 m^3 of harvested wood raw material in Białowieża Forest conditions (2 jobs in forest districts, 4 in the surrounding suppliers of goods and services, 9 in the recipients of wood raw material) – wood raw material of PLN 9.5 thousand generated one job,

- The amount of PLN 2,377,018.00 paid to the budgets of Białowieża Forest communities by forest and timber sector constituted in 1998 an important source of their income (32.7% of rural communities' own income, 18.2% of rural communities' own income along with Hajnówka city, 10.1% of joint income of rural communities, 5.5% total income of rural communities along with Hajnówka city,

- the volume of 127 thousand m^3 harvested in Białowieża Forest and processed internally in a plant was charged with taxes and fees in the amount of PLN 11,685,596.00, where: in the average price of 121 PLN/m^3 taxes and fees constitute 33% (PLN 40), and 1 m^3 of harvested and processed timber, whose average value in a ready product was PLN 340, was charged with taxes and fees in the amount of PLN 92 (27%), out of which PLN 73 went to the state budget, and PLN 19 to the Białowieża Forest communities' budgets.

The importance of forest management or, more broadly, the forest-timber sector as a component and a tool for the regional development is discussed in the joint authorship review publication titled *"The importance of forests and forest-timber sector as complements to agriculture and as tools for the regional development of Poland"* (Czerepko J., **Gołos P.**, Hilszczański J. **2016. Int. J. Agricultural Resources, Governance and Ecology, Vol. 12, No. 3, pp. 215-225).** The review character of the study using the analyses of literature from the preceding 20 years allowed the identification, in Polish conditions, of six areas, in which farmers and rural area residents may benefit in relation to forests and forest management. Among identified dependencies, which were the subject of the research and analyses, or whose scale may be pictured through public statistical data, the following should be specified:

1) Forest as the source of wood raw material used in farms and in farmers' households, as well as the source of additional income for rural families,

2) Forest and forest management as the creator of direct jobs in forestry and forest-timber sector, as well as indirect and induced jobs at entities economically related to forest and forest-timber sector located in rural areas,

3) Forest as the source of fungi and undergrowth crops, which are collected for the needs of farms and for sale,

4) Forest as an important element conditioning the effective operation of agritourism,

5) Forest and forest-timber sector as an important element in the creation of budgets o self-government units (municipalities),

6) Economic and environmental benefits from afforestation of lands excluded from agricultural production.

The importance of forests and forest management for the community is undoubtedly visible as exemplified by the use of undergrowth produce resources (forest fruit and fungi), mainly as an important source of the society's income, particularly for the residents of rural areas. The scale of this phenomenon is presented in the publication titled *"Economic importance of selected non–wood forest products in Poland" („Ekonomiczne znaczenie wybranych niedrzewnych pożytków leśnych w Polsce").* **(Gołos P.,** Kaliszewski A. **2016. Sylwan 160 (4), pp. 336–343).** The results of surveys carried out on the random representative sample of residents of Poland in 2013 prove that:

- calculated per the population of adult residents of Poland in 2013, approx. 71.4 thousand tons of edible fungi were picked, and based on the results of surveys presented herein, the estimated quantity of fruit collected in the whole country was 26.2 thousand tons of bilberries,

i.e. the quantity close to the volume of resource base of this species at the average abundance, estimated for 30.1 thousand tones.

- the value of collected bilberries and fungi calculated per 1 ha of forest surface was approx. 13% of the value of timber harvested on average from 1 ha in 2013, which indicates the considerable economic and social importance of non-wood forest products.

One of the factors which determine the forest management's contribution to the development of regions is a growing area of afforestation on post-agricultural lands, particularly, if the financial support available from Rural Development Program for afforestation is taken into account. The factors which decrease the growth dynamics of afforestation areas have been identified in the publication titled *"Factors limiting afforestation of post-agricultural lands in Poland according to the survey results"* (*„Czynniki ograniczające zalesianie gruntów porolnych w Polsce w świetle badań ankietowych"*). (Kaliszewski A., Młynarski W., **Gołos P. 2016. Sylwan, R. 160 (10), pp. 846–854).** Based on the information on the implementation of the National Program of the Forest Cover Extension (KPZL) in the years 1995–2013 from the Central Statistical Office (GUS), within 19 years of the program implementation, the total of 270.6 thousand ha were afforested, out of which 130.7 thousand ha (48%) on the State Treasury owned lands (the state owned lands) and 139.9 thousand ha (52%) on non-state owned lands (lands which are not owned by the State Treasury). The information on factors which limit the implementation of the National Program of the Forest Cover Extension (KPZL) was provided through the survey conducted by correspondence in all counties in the country (314 rural districts and 66 urban districts) in 2014. The results indicated that the rapid fall of afforestation dynamics observed from 2004 was related to the Poland's accession to the European Union, and social and economic changes taking place in rural areas. The main factors, which influence the collapse of the National Program of the Forest Cover Extension (KPZL) implementation ware of the long-term nature, therefore it is unlikely to reverse the unfavorable trend in the forthcoming years.

On the other hand, the paper titled *"Prospects for agricultural lands afforestation in Poland until 2020"*. (Kaliszewski A., Młynarski W., **Gołos P. 2016. Folia Forestalia Polonica, Series A – Forestry, Vol. 58 (3), pp. 163–169)** presents the possible growth of afforestation areas until 2020 r. It has been estimated that in the period 2015-2020, approx. 20 thousand ha of agricultural lands will be afforested, mostly private ones (75%). Throughout the period of the implementation of the National Programme for Expanding of Forest Cover (2001–2020), approximately 183 thousand ha would be afforested, which means 27% of the originally planned extent.

The subject of the article titled *"Basic assumptions for forest management and nature conservation from axiological, legal, and economic perspective"* (Czerepko J., Geszprych M., **Gołos P. 2017. Folia Forestalia Polonica, series A – Forestry, Vol. 59 (1), 68–78)** are mutual relationships between the nature conservation and forest management, considered from the axiological and legal point, as well as the economic and social conditions of forest management. The paper presents the place of regulations related to the forest management and nature conservation in the legal system, the convergence of nature conservation and forest management goals with attention given to the common elements, as well as the conflicts of values and divergences of interests.

The results of studies and analyses carried out allowed to prepare and present the following papers:

1) **Gołos P.,** Słoka P. 2017. The role and significance of forest management in the local and regional development. 10th Session of the Winter Forestry School at the Forest Research Institute titled "Forestry challenges towards changes taking place in the natural environment, social expectations, and economic and legal conditions". Sękocin Stary, March 14 – 16, 2017 pp. 379-397. *(Rola i znaczenie gospodarki leśnej w rozwoju lokalnym i regionalnym. X Sesja Zimowej Szkoły Leśnej przy IBL pt. „Wyzwania leśnictwa wobec zachodzących zmian w środowisku przyrodniczym, oczekiwań społecznych, uwarunkowań ekonomicznych i prawnych". Sękocin Stary, 14 - 16 marca 2017 r. s. 379-397).*

2) **Gołos P. 2014.** The sustainable model of forest-timber sector in Europe vs. its global competitiveness. The European Economic Congress, Katowice, May 7-9. (*Zrównoważony model sektora leśno-drzewnego w Europie, a jego globalna konkurencyjność. Europejski Kongres Gospodarczy, Katowice, 7-9 maj 2014*).

3) **Gołos P. 2013.** The social value of forest. Conference "Sustainable development economics and policy. Theory and statistical approach". Statistical Office in Białystok, Faculty of Economics and Management and Faculty of Biology and Chemistry at the University of Bialystok. Białowieża, December 4–6. (*Społeczna wartość lasu. Konferencja „Ekonomia i polityka zrównoważonego rozwoju. Teoria i ujęcie statystyczne". Urząd Statystyczny w Białymstoku, Wydział Ekonomii i Zarządzania oraz Wydział Biologiczno-Chemiczny Uniwersytetu w Białymstoku. Białowieża, 4–6 grudzień*).

4) Zajączkowski K., Tyszka J., **Gołos P. 2009.** Forest management and its impact on agriculture and environment. In: The future of agri-food sector and rural areas. Conference materials. 1st Congress of Agricultural Sciences, Puławy, pp. 141-146. (*Gospodarka leśna i jej*

wpływ na rolnictwo i środowisko. W: Przyszłość sektora rolno-spożywczego i obszarów wiejskich. Materiały konferencyjne, I Kongres Nauk Rolniczych, Puławy, s. 141-146).

Another factor, which contributed to the development of my scientific interests in the mentioned area, was my involvement in two undertakings at the Forest Research Institute, which were carried out in order to prepare guidelines for the National Forestry Program. In the first project, which was carried out in the period 2002-2004, I coordinated the preparation, and further development of the Regional Operational Programs for the State Forestry Policy (*Programy Operacyjne Polityki Leśnej Państwa*) (the technical papers which constituted the contribution to the Project of guidelines for the National Forestry Program) developed by the regional directorates of the State Forests. In the following project titled "Forestry Development Program" (*"Program Rozwoju Leśnictwa"*) implemented in the period 2013-2015, I coordinated the panel of experts "Forests as a factor in the development of civilization: the contemporary and future value of forests" (*"Lasy jako czynnik rozwoju cywilizacji: współczesna i przyszła wartość lasów"*), whose result was the monograph paper under the same title published by the Forest Research Institute in 2014.

Re. 4. No controversy has ever arisen around the natural and established in civilization use of timber, including from forest, as a source of heating energy, by individual users. However, due to changing social, economic, and political conditions, legal regulations have been adopted in order to increase the share of energy production from renewable sources, indicating forest wood to be an important part of the power produced by professional power suppliers. Such situation provoked the discussion, whether there is any space for the mentioned use of wood raw material in the light of growing deficit of wood for timber sector, and the plans to include forest areas as an essential element of the climate policy.

Investigating the conditions in the mentioned scope became possible due to financing obtained for the own project from the funds assigned to financing education titled ***"The natural, technological, and economic possibilities and conditions related to increasing the supply of wood for energy purposes" („Możliwości oraz uwarunkowania przyrodnicze, technologiczne i ekonomiczne zwiększenia podaży drewna do celów energetycznych"***) (NCN, N N309 110940. Competition 40).

The implementation of the project, which included the analysis of Polish and foreign literature presenting numerous aspects related to the use of wood for energy purposes allowed to prepare two reviewed scientific publications, organize the nationwide science and technical conference, prepare the monograph and one conference speech.

The first publication which presented the project results titled *"Predictions on availability and possibilities of the use of wood for energy purposes in Europe and in Poland"*. (Kaliszewski A., **Gołos P. 2014. Folia Forestalia Polonica, Series A – Forestry, Vol. 56 (2), pp. 71-78)** included data regarding the current consumption of wood for energy purposes in Poland and in the EU, as well as the predicted changes in the use of forest wood for energy purposes in the future. In 2010, approx. 804 million m^3 of wood biomass was used, 346 million m^3 of which was assigned for energy production. Households contributed to the largest extent to the overall consumption of wood for energy purposes (45%), and further the wood based industry (25%) and the power industry (24%). There is no comprehensive information about potential for forest biomass utilization in Poland. It is claimed that according to estimated data, the volume of wood harvested from forests in Poland, which may be intended for energy purposes, may amount to 4.0–8.2 million m^3. The estimated volume of wood biomass available for energy purposes in Poland was approx. 15 million m^3 in 2009. Wood biomass available from forestry comprises 41% of this volume, while wood biomass from timber sector constitutes 34%, and the remaining 25% are the wastes from households and agriculture.

The paper titled *"Aspects of using wood biomass for energy production" ("Wybrane aspekty wykorzystania biomasy drzewnej do celów energetycznych")* **(Gołos P.,** Kaliszewski A. **2015. Leśne Prace Badawcze 2015, Vol 76, 1, pp. 78-87)** includes the evaluation of the potential of forest wood production for energy purposes, as well as natural, economic, social, and technological aspects of forest biomass utilization for energy purposes. In 2012, Poland produced about 170 terawatt hours (TWh or 109 kWh) of electric energy. The production of such an amount of energy exclusively from wood combustion would require using 54 million m^3 of wood raw material. To compare, in 2012 Poland harvested 37.2 million m^3 of wood. The analysis of literature, which presents the above issues, brings about one general conclusion. Authors indicate that the combustion of forest wood seems an ineffective solution, taking into account the energy consumption of forest management and structural features of wood raw material. Manufacturing one ton of construction timber requires approx. 580 kWh of energy, while for manufacturing bricks, the energy used is four times higher, cement — five times, and plastic — six times higher. The production of 1 ton of aluminum uses on average 126 times higher energy inputs, compared to timber product manufacturing.

The practical effect of the above project implementation was the Science and Technical Conference on November 20-21, 2012 in Sękocin Stary, titled ***„The possibilities and conditions for the supply of wood for energy purposes" („Możliwości oraz uwarunkowania podaży drewna do celów energetycznych")*** (Leader of the Organizing Committee). The

speeches given at the mentioned conference were published in the monograph titled *"Forest biomass for energy purposes" („Biomasa leśna na cele energetyczne").* **(red. Gołos P., Kaliszewski A. 2013. Forest Research Institute, Sękocin Stary, p. 246).** The publication includes 13 papers which present both the results of original studies, as well as review works which discuss natural, economic, and technological conditions for the use of forest biomass for energy purposes. The scientific papers are supplemented with the texts which include practical aspects regarding the harvest and use of forest biomass, prepared by practitioners, who are involved in different stages of biomass preparation, including forest biomass for energy purposes.

I also presented the results produced during the project implementation in the joint authorship paper titled *"Demand for wood biomass for energy purposes – identification of present and potential sources"* (Janusz Czerepko, **Piotr Gołos**). The speech was given a the International Scientific Conference. Wood – Science – Economy, which was organized on October 6-17, 2017 in Poznań.

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Piotr Gołos