The willingness of inhabitants in medium-sized city and the city’s surroundings settlements to pay for recreation in urban forests in Poland

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The aim of the study was to determine the willingness-to-pay (WTP) in exchange for recreation, to determine the dependency between the frequency of visits and willingness of forest users to make contributions for urban forests and the appearance of the forest, as well as the sociological characteristics of the respondents. The research was carried out on the example of the medium-sized city of Tarnów, southern Poland. To this aim, a survey was conducted on a group of 309 adult respondents inhabitants of Tarnów city and city’s surroundings settlements. For statistical analysis, the Classification And Regression Trees (CART) method was used to determine the dependency between the declared contributions and the characteristics of respondents, and the Principal Components Analysis for examining the dependency between WTP and the appearance (structure) of the forest. The dependency between the frequency of visits to urban forests and the demographics was analysed by chi-square test and one-way analysis of variance. The results showed that 97% of respondents are willing to make payments for urban forests, the amount of which differed depending on their place of residence, education, and age. Also, the vast majority of respondents make their WTP contributions dependent on the appearance of the forest. This applies in particular to a multi-stratum, multi-species forest with the undergrowth and recreational infrastructure. In addition, the frequency of visits to the area is affected by gender and place of residence. The obtained results are especially important for the recreation function of urban forests including willingness of inhabitants in Tarnów city and surroundings settlements.

Keywords: Recreation, Urban Forests, Willingness To Pay, Visual Aspect of Forest, Preferences of Tourist, Tarnów

Introduction
Green areas, including urban forests, are basic elements in the ecological structure in the city. Nowadays, urban forests are more appreciated by the inhabitants because of diversity of vegetation (Fornal-Pieniak et al. 2019), health benefits such as reduction of air pollution, or potential for recreation in metropolitan areas (Nitoslawski et al. 2017). Preferences for recreation in forest areas are the subject of many research studies (Hammit & Patterson 1993, Janeczko et al. 2017, Mandziuk et al. 2019a, Arnberger et al. 2020, Carrus et al. 2020) focusing on time spent on recreation, e.g., collecting the products of forest undergrowth (Remm et al. 2018) and enjoying the benefits of leisure in forests (Mandziuk et al. 2020). Urban forests are forest areas under the management of city or town authorities, usually located within or near the territorial range of urban agglomerations. In Poland, their area covers 615,206 ha, which includes 598,340 ha under the management of the State Forests National Forest Holding and 16,866 ha as other forms of ownership (Statistics Poland 2019). Urban forests managed by the State Forests account for 8.7% of the total forest area in Poland. In compliance with the Forest Act of 1991 (Polish Journal of Law 1991), forests within the range of city or town impact are considered protected. This concerns forest areas within the administrative borders of cities and towns and up to 10 km from the borders of cities and towns with over 50,000 inhabitants. Due to their location, urban forests are very often a place of public recreation (Janeczko et al. 2017, Chen & Qi 2018, Szczepańska & Senetra 2019). Their attractiveness also results from the presence of recreational values, location, as well as diversified and well-maintained recreational infrastructure (Chen et al. 2020, Zhang et al. 2020). Another, and often the most important factor, is the appearance of the forest (De Meo et al. 2015).
and the richness of its species (Fornal-Pieniak et al. 2014). Urban forests are the subject of studies in the light of the valorisation of forest landscape (Fornal-Pieniak et al. 2018, Abedi & Abedi 2020) and problems with achieving the main forest management objectives (Fornal-Pieniak et al. 2019, Adams et al. 2020). One of the most frequently used methods to determine the economic value of recreational forest areas is the Contingent Valuation Method, CVM (Walsh et al. 1984). It considers the non-market character of the tourist and the recreational function of forests. The CVM method consists in asking potential users of a public good about their Willingness To Pay (WTP) for it. Where consumers are willing to pay for a good or service more than it actually costs, they benefit from it (Moore et al. 2011), including recreation function of forests. It is assumed that the measure of the value of a good is the highest amount the consumer is able to spend on it. The measure of this value is WTP (Walsh et al. 1984) for purchase or access to some goods. The tool for disclosing the WTP values is a survey questionnaire. For this purpose, a substitute or hypothetical market is created for a given good or service (Riera et al. 2012). The surveys are based on interviews in which respondents provide information on how much a given good or service is valued by them (Moore et al. 2011). It is assumed that individual consumers are able to answer questions that reveal their preference for public goods and services (Moore et al. 2011) which include tourist and recreational benefits of forest areas. Research on the WTP for recreation in forest areas has been conducted on many occasions (Riera et al. 2012, Gergiczcy et al. 2014, Zydron et al. 2014, Sklodowski & Golos 2016, Chen & Qi 2018, Mandziuk et al. 2019b). There are also many research studies carried out in the area of urban forests (Rosenberger et al. 2012, Bertram & Larondelle 2017) as well as forests with different ownership forms (Lindhjem 2007, Czajkowski et al. 2016). In this paper, we present the willingness of inhabitants in medium-sized city and the city’s surroundings settlements to pay for recreation in urban forests in Poland. Cities of medium-sized are predominant in Poland and all over Europe (EUROSTAT 2019). The dependency between the frequency of visits and willingness to make payments for Tarnów Urban Forests (TUF) and the appearance of the forest as well as the sociological characteristics of the respondents were also examined. To this end, the following research hypotheses have been defined: (i) users of urban forests are WTP a small contribution in exchange for access to TUF; (ii) the amount of declared payments is influenced by the characteristics of respondents such as gender, age, education, and place of residence; (iii) the frequency of visits to TUF depends on gender, age, education, and place of residence of respondents.

**Materials and methods**

**Research area**

Tarnów is a city located in the southern part of Poland (Fig. 1). We chose this city, because it represents a medium-sized city with 108,000 inhabitants in Poland. Medium-sized cities are dominated in our country from the whole cities. The forest area of the city of Tarnów is 285 ha, of which 125 ha are managed by the State Forests National Forest Holding, 68 ha are municipal forests, and 87 ha are owned by privates. The forestation rate of the city of Tarnów is 3.9% (Statistics Poland 2019). There are various forms of green areas in the city, including urban forests. The largest complexes of urban forests accessible to the population are located in the northern and north-eastern parts of the city of Tarnów (Fig. 1). Tarnów Urban Forests include: Lipie Forest (21.81 ha), the Forest on St. Martin’s Mountain (38.56 ha), and Soslina Forest (21.25 ha).

**Survey**

The survey was conducted in the period from May to September 2020 on a group of 312 adult respondents, who were inhabitants of Tarnów city and the surrounding settlements. The questionnaires for voluntary inhabitants were available in the municipal offices. Due to incorrectly com-
completed questionnaires, 3 of them were rejected, while the remaining 309 were analysed. The average time to complete the survey was about 10 minutes. When collecting the data, the distributed survey technique was used, which has the advantage of high return rate. The survey questionnaire included questions aimed to examine the sociological structure of the respondents (the demographics): age, gender, place of residence, education, and income. The respondents answered a question about the frequency of visits to TUF area (question 1). Then they were presented with 4 schemes of forest appearance (Fig. 2), showing the structure (morphology) from the simplest to the most complex one: (A) single-stratum, single-species forest without shrub layer with poor undergrowth; (B) single-stratum, multi-species forest without shrub layer with rich undergrowth; (C) multi-stratum, multi-species forest with shrub layer and rich undergrowth; (D) multi-stratum, multi-species forest with shrub layer and rich undergrowth as well as recreational infrastructure. On their basis, the respondents determined the frequency of visits to TUF, depending on the appearance of the forest (question 2), and indicated which forest they would choose as resting place depending on its appearance (question 3). Frequency of access to TUF was recorded by choosing among the following options: daily; once a week; once a month; several times a month; several times a year; once a year. The next questions concerned the definition of the WTP for TUF (question 4). Respondents were presented with a hypothetical situation where voluntary contributions would be needed to finance TUF’s activities. The open question format was used for this purpose. If the answer was negative, the respondents were asked to indicate the reasons for their refusal. The last question was aimed to indicate the dependency between the amount of declared contributions (WTP) for TUF and the appearance of the forest (question 5).

In questions 2, 3 and 5, the respondents had the following answer options: definitely yes; rather yes; it is hard to say; rather no; definitely no.

The question about possible payment was worded a bit differently. We did not ask for approval (or rejection) of predetermined fee. Instead, we asked for the value at which respondents evaluate an ecosystem service. The choice of this method resulted from a smaller number of questionnaires and better adaptation to cultural context (people are used to financing ecosystem services through taxes rather than by direct payments). Additionally, a main goal of our research was the recognition of possible dependencies between forest structure and attractiveness, not a precise estimate of a forest value.

Statistical analysis
The willingness to make payments in return for access to forests is set out in question 4. The distribution of declared payments for TUF has been analysed. Then the dependency between the declared payments (WTP) and the characteristics of respondents such as age, gender, place of residence and education was investigated. The Classification And Regression Trees (CART) method was used for this purpose. Due to the fact that the dependent variable is a continuous variable, a regression tree analysis was applied. Independent variables, on the other hand, were: age (continuous); place of residence and education (ranking); and gender (categorical/binary). The dependency between the declared amount of payments (WTP) and the structure of the forest was assessed using the Principal Components Analysis (PCA). A set of ranking variables was created for the analysis on the basis of questions 1, 2 and 3. For questions 2 and 3, the preferences for each of the forest schemes (appearance) were different variables. The obtained main components were correlated with the answers to question 4. In addition, the dependency between the frequency of visits to TUF and the gender, education, and place of residence of respondents was analysed. Since the variables were of a categorical or ranking type, they were compiled in the form of contingency tables and the relevance of the dependency was examined using the chi test. The dependency between the frequency of visits and the age of respondents was examined by means of a one-factor analysis of variance. As a result, our variable describing the willingness to pay was a simple continuous variable (but not normal), not a binary or series a binary variables. Therefore, logit models cannot be used in our case. The statistics used does answer the same questions as the logit models (dependency between willingness to pay and respondent traits).

Results
Nearly all respondents (97%) declared potential willingness to support TUF with the amount from 0 to 150 PLN, on average 41.07 PLN (median 40 PLN, standard deviation 20.604 – Fig. 3, Tab. 1). The total declared amount was PLN 12,690. The remaining 3% of the respondents indicated in their justification that forests should be fully financed from the State Treasury budget.

The dependency between the declared contribution and the questions included in the questionnaire demographics was examined using the CART method. The analysis considered gender, age, place of residence and education of respondents. The analysis showed that the main criterion differentiating the WTP contributions for TUF maintenance is the place of residence of the respondents (Fig. 4). Village inhabitants are willing to pay less than tourists from localities with over 50,000 and over 100,000 inhabitants. Among the inhabitants of towns and cities (over 50,000 and

![Fig. 3 - Distribution of declared WTP values (1 PLN ~ 0.22€ or 0.27$).](image)

| Parameter | Value |
|-----------|-------|
| N         | 309   |
| Mean      | 41.07 |
| Median    | 40    |
| Min       | 0     |
| Max       | 150   |
| Standard deviation | 20.604 |
over 100,000 inhabitants), education is the key factor. Persons with higher education declared their WTP higher contributions. In the last stage of the dependency analysis, there are differences in the WTP due to age. Older persons declare their WTP a higher contribution. At no stage of the analysis does gender appear as a differentiating criterion.

The results of the question concerning the amount of the hypothetical contribution for TUF depending on the appearance of the forest indicate that most respondents would rather (answer: “rather yes”) take into account the appearance of the forest in the situation of TUF financing: A = 61%; B = 63%; C = 72%; and D = 61%. In the case of schemes A and B, the answer “hard to say” stands out (A = 30%; B = 34%), as well as “definitely yes” for the remaining schemes: C = 25%; D = 33%. The other response options did not exceed 3% (Fig. S1 in Supplementary material).

As a result of the PCA analysis, a basic gradient was determined, corresponding to the preference for more complex forests with recreational infrastructure elements (schemes C and D) or simpler ones (schemes A and B). The amount of the declared contribution (WTP) is consistent with this gradient. The higher the respondents' preference for resting in multi-stratum, multi-species forests with rich undergrowth, the greater their WTP contribution to TUF (Fig. 5).

When examining the respondents’ preferences for choosing TUF as a place of rest depending on the appearance of the forest, it can be seen that they most often responded that it would “rather not” be their place of rest (A = 70%; B = 54%). The fewest persons indicated the option “definitely not”/A (9%) and “rather yes”/B (6%). None of the respondents chose the answers “definitely yes” and “rather yes”.

The highest number of respondents evaluating schemes C and D indicated the answer “rather yes” (C = 67%; D = 71%). Only 3% of the respondents indicated answers “it is difficult to say”/C, “rather not”/D and “definitely not”/D (Fig. S2 in Supplementary material). All respondents stayed at TUF area for one day. Taking into account the frequency of visits, almost half (42%) of the respondents indicated that they visit TUF once a week, and 25% of respondents once a month. The smallest group (5%) are persons resting in TUF area every day (Fig. S3 in Supplementary material). When considering the frequency of visits against the appearance of the forest, it can be seen that in the case of the largest group of respondents, the appearance of the forest did not affect the frequency of visits to TUF (schemes A and B). The most frequently indicated answers were: “it is difficult to say” (A = 63%; B = 64%; C = 46%; D = 34%) and “rather yes” (A = 35%; B = 26%; C = 45%; D = 57%). The other response options did not exceed 15% of the total (Fig. S4 in Supplementary material). As a result of the statistical analysis carried out with the PCA method, no correlation was found between the frequency of visits to TUF and preferences in terms of forest appearance differentiation (Tab. S1 in Supplementary material). The results of the statistical analysis of the frequency of visits to TUF indicate a significant differentiation by gender (p < 0.001) and place of residence of respondents (p < 0.001). Differentiation by education (p = 0.08) and age (p = 0.12) proved statistically insignificant. In terms of gender of the respondents, we recorded that women clearly visited TUF more often than men. A noticeably larger group of women visit the forests daily and once a week, while men tend to visit once a year (Fig. S5 in Supplementary material). The inhabitants of the city visit TUF much more often. In this group, the majority of respondents declared that they visited the forest every few days, once a week and every day. Among the village inhabitants, most of the respondents declared visits once a year or once a month (Fig. S6 in Supplementary material).

Discussion

Nowadays, there is a growing public interest in recreation in the forests as a result of their increased role in performing many social and protective functions and due to the fact that the society has enriched and is able to devote more time off work to leisure and hobbies. In the light of recent research, it can be seen that short
in American studies (Barrio & Loureiro 2010) indicat-
ing that the willingness to pay for recre-
ation in the Iberian Peninsula. For example, the inhabi-
ators of the Apennine mountain commu-
nia (Tyrväinen & Väänänen 1998) reported that the gender and level of edu-

cation of respondents did not affect the av-

erage value of WTP. Our results shows that the higher the in-

come or education the respondents had, the higher the WTP amount they declared, with women more likely to indicate higher values than men.

In this study, there was no dependency between WTP amount and gender. On the other hand, Tyrväinen & Väänänen (1998) showed that the gender and level of edu-
cation of respondents did not affect the av-
erage value of WTP. Our results shows that the major-

Conclusions

The results of this study are very impor-
tant for shaping urban forests in terms of recre-
ation. The preferences of respon-
dents, residents of a medium-sized Polish city, together with respondents from neighboring smaller localities, were investi-
gated. The obtained results confirmed the formulated starting hypotheses. Further research aimed at obtaining appropriate economic indications related to the man-
gement of urban forests in terms of the needs of the society will be developed in the next future.

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pends on many social characteristics of the respondents. In the case of Tarnów urban forests, these were the respondents’ place of residence, their education and age. Per-
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the city believe that financial support could be important in special situations for the protection and management of urban forests.

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Supplementary Material

Fig. S1 - WTP readiness depending on the appearance of the forest.

Fig. S2 - The urban forests of the city of Tarnów as a recreation site.

Fig. S3 - The frequency of visits in Tarnów urban forest.

Fig. S4 - The frequency of visits in Tarnów urban forests depending on the appearance of the forest.

Fig. S5 - The frequency of visits in Tarnów urban forests depending on the gender by means of a one-factor analysis of variance.

Fig. S6 - The frequency of visits in Tarnów urban forests depending on residence of the respondents.

Tab. S1 - Results of the PCA analysis.

Link: Mandziuk_3758@suppl001.pdf