*Article*

# Income Differentiation as a Factor of Unsustainability in Forestry

**Mansoor Maitah [1], Daniel Toth [2,*], Luboš Smutka [3], Kamil Maitah [3] and Veronika Jarolínová [4]**

[1]  Department of Economics, Faculty of Forestry and Wood Sciences of the Czech University of Life Sciences in Prague, 16500 Prague, Czech Republic; maitah@pef.czu.cz

[2]  Department of Economics, Faculty of Economics and Management, Czech University of Life Sciences in Prague, 16500 Prague, Czech Republic

[3]  Department of Trade and Finance, Faculty of Economics and Management, Czech University of Life Sciences in Prague, 16500 Prague, Czech Republic; smutka@pef.czu.cz (L.S.); maitahk@pef.czu.cz (K.M.)

[4]  Department of Law, Faculty of Economics and Management, Czech University of Life Sciences in Prague, 16500 Prague, Czech Republic; jarolinova@pef.czu.cz

*   Correspondence: tothd@pef.czu.cz; Tel.: +420-606-810-534

**Abstract:** Environmental policy is a set of objectives put in place for the protection of natural resources including water, air, soil, food, and other renewable resources. In addition, it has a considerable impact on the labor market and the income of employees in the environmental and forestry sectors. Environmental policy both directly and indirectly creates new jobs, the so-called green jobs. These jobs are designed to be long-term and sustainable, working towards both environmental and socio-economic stability. The aim of the research was to determine if there was a difference in income between the forestry and the environmental policy sectors. The primary objective of this paper was to propose ideas and instruments for strengthening the income of employees in both sectors to the creators of the new State Environmental Policy. This objective was met through appropriate research methods, including the field survey technique. In terms of statistics, we used descriptive characteristics and tested the hypothesis using a T-test. The data from 70 respondents were collected from January 2019 to December 2019. Half of the respondents were from the forestry sector, and the other half worked in environmental protection. Their total income was compared by using two selective T-tests, and the results showed a strong discrepancy. The analysis indicated that the average incomes in forestry are significantly lower than incomes in the environmental protection sector (in the Czech Republic). The statistically higher income of environmental workers reflects that the State Environmental Policy is effective, which improves the position of employees in the labor market. The forestry sector deserves similar concentrated state assistance, and therefore we recommend that the new State Environmental Policy in the Czech Republic also addresses the problem of low income in forestry.

**Keywords:** environmental protection; environmental policy; income; forestry; forest economy; environmental economy

## 1. Introduction

Environmental policy is defined by the EU legislation as a set of objectives that aim to protect the environment. The environment is based on Articles 11 and 191–193 of the Treaty on the Functioning of the European Union. Under Article 191, combating climate change is an explicit objective of the EU environmental policy. Sustainable development is an overarching objective of the EU, which is committed to a high level of protection and improvement. However, the environmental policy also has an impact on socio-economic development, including the qualitative and quantitative

development of employment. Almost 120,000 people in the Czech Republic work in the field of environmental protection, and about 13,000 people work in the forestry [1,2]. Throughout the European Union, the number of people employed in environmental protection increased from 1.4 million to 4.2 million [1,2], making it the fastest-growing area in the labor market. Over the past fifteen years, the number of employees in environmental protection has increased by 49 percent.

The European Statistical Office Eurostat reports that between 2014 and 2019, the number of people employed in environmental protection increased from 1.4 million to 4.2 million [1,2]. This large growth in jobs was mainly due to the increasing capacity of renewable energy sources and the growing interest of Europeans in saving energy and heat. This makes environmental protection part of the green economy and bioeconomics [3]. As such, it has a significant impact on labor markets and employment. The green economy requires skilled, educated, experienced, and motivated workers, leading to the qualitative development of human capital [4].

The practical reason for conducting the following research is to determine if there is a difference in income in the forest and environmental sectors. The difference, if there is one, would present a socio-economic disparity that affects the protection of the environment and the conservation and sustainability of natural resources.

To analyze the income of employees in the environmental sector in the Czech Republic, it has been determined that the average gross monthly wage of environmental employees in the Czech Republic (in the year of 2019) was 1212 EUR [5]. However, average salaries are not the same as wages, making it necessary to conduct a sample survey. By implementing a questionnaire, we can determine the total annual income of an employee in environmental protection. A respondent in our research is a worker who fulfills the criterion of being engaged in environmental work, including forestry and natural resource protection. This includes employees who work for the protection of renewable resources like water, soil, and air, as well as those who examine the relationship between organisms and the environment in which they are located. Respondents also include environmental employees who collect, analyze, and interpret data obtained from field and laboratory research, as well as workers who conduct studies on the effects of human activity on the environment.

The following research was conducted to compare the income of environmental workers and employees in forestry. Currently, the income gap is widening. Although forestry workers can be included in the environmental employment sector, this research set out to determine whether there are statistically significant differences in the income of workers in environmental protection versus those in forestry. The decision to carry out this research was driven by the fact that the income of forestry and environmental workers is commonly considered to be the same. We subsequently formed a null hypothesis about the averages in income and agreement of variance for both groups of respondents.

The null hypothesis was that there is no difference in the average income (and variance) between forestry and environmental workers in the Czech Republic. Income means personal performance valued in cash, which is accompanied by a real inflow of funds. It is necessary to distinguish income from revenue as revenue may not always represent a real inflow of funds. This research examined whether there is evidence that the income of workers in environmental protection is not just the result of supply and demand. Workers in the field of environmental protection often benefit from wage subsidies and the policies of both the European Union and the Czech Republic. These benefits promote employment in the field of environmental protection and may temporarily affect the turnover of employees and the number of job seekers in forestry, which does not have the same support.

This study tested the hypothesis that the annual income is the same in environmental protection and forestry. Both sectors appear to be very similar in the labor market, and therefore it is assumed that the incomes for employees in these fields will be the same or similar. Using empirical research and testing, we wanted to verify whether or not this is the case. We must also assume that the income of environmental workers improves subsidies for the sector since support for environmental protection is more systematic and substantial than in forestry. In the Czech Republic, ownership in forestry and protected areas is divided between different owners. In 2019, the ownership structure

was as follows: state forests 59.8%, forest owned by individuals 19.3%, communal and municipal forests 16.8%, legal persons 2.9%, and forests cooperatives 1.2%. In the Czech Republic, forestry is undergoing transformation due to climate change, the bark beetle calamity, drought, and increased unplanned harvesting. It has been published that 15.5 million cubic meters of wood were harvested annually until 2016 [1,2,6]. This year, the production of spruce wood is estimated at a volume of about 60 million cubic meters. It is historically the largest calamity in the history of the Czech Republic, which is caused by a biotic factor. As a result, the income of companies in the forestry sector is decreasing, which is reflected in the total annual income of forestry employees. In contrast, environmental protection workers are comprehensively supported and receive higher wages. We will also decipher whether the State Environmental Policy of the Czech Republic [6], a binding strategic document, supports the socio-economic position of workers in environmental protection.

## 2. Materials and Methods

In the initial phase, the following three criteria were defined for inclusion in the analysis: 1. The respondent has been working for more than 12 months in a position appropriate to the job sector; 2. The respondent's total income includes only wages from the industry; 3. The respondent worked in accordance with the Labor Code and was not a subcontractor or self-employed. Currently, 12,800 workers work in the forestry sector [1,2,5].

In the second phase, multiple respondents in the given sectors were addressed and, after the briefing, the respondents filled in a questionnaire. They reported their individual monthly earnings separately and anonymously. We found that in the Czech Republic the average monthly income of a forestry worker was almost identical to the average gross monthly wages (1074 EUR) [5]. Wages in forestry jobs were strongly influenced by the region in which the respondent worked and, for our research, job classification was important. The research was a comparison of net income (after tax) in forestry and environmental protection.

The research included respondents who were employed within the field of forestry. This included loggers, foresters, forest mechanics, forest timber transporters, forestry machinery and equipment drivers, forestry operators, forest methodologists and workflow controllers, machine operators, employees who worked with animals such as draft horses, and helicopter pilots. These were employees in both state forestry and private forestry. This sector also included the clerk of forest management, the clerk of forest road construction and maintenance, the loader operator clerk of forest protection, the clerk of wood material against harmful agents, and the clerk of forest protection against damage caused by game management. Other respondents were workers who observed the impact of pests on seedlings, who selected seedlings and trees that meet prescribed logging parameters, who selected and marked sick and infected trees for logging, and who were responsible for supplies in expedition warehouses. These job positions ranked 411th in the income ranking of professions in the Czech Republic. The proportion of women employed in forestry was 0% in this sample.

Employees in the environmental protection sector worked as environmentalists, water managers, and in soil and atmosphere conservation. State agencies, national parks, non-governmental organizations (NGOs), and private agencies employed environmental protection workers. They placed 316th in the income ranking, which is relatively low, considering that most environmental workers are highly educated. The proportion of women in the ecologist position was 50%. The average age of a person employed as an ecologist is 35 years, and the average age of the respondents was also 35 years old. The questionnaire we used was the standardized one used by the ILO (International Labour Organization) [7] and met the research requirements. The respondents filled in individual questionnaire boxes based on their net monthly income. Then we used this data to determine the total sum of income for the year of 2019. Half of the respondents worked in the forestry, and the other half worked in environmental protection. The sample was representative. Respondents were asked whether they worked constantly in the selected sectors of forestry or environmental protection. Respondents met the conditions of working in the sector continuously and for a long time (more than one year). The sets were divided into two groups ($A_{(f)}$ and $B_{(ep)}$) so that a

two-sample t-test could be used. Since the files were independent, the following hypothesis test could be performed ($p_A = 0.156$ and $p_B = 0.444$).

The two sets were defined as set A(f),…,xn~N(μ1,σ21) and set B (ep),…, ym~N(μ2,σ22) with the calculation of the standard deviation. We formulated the null hypothesis as follows, which showed that the incomes of forestry and environmental workers were not different:

$$H0: \mu1 = \mu2 \tag{1}$$

We formulated an alternative hypothesis as follows:

$$HA: \mu1 \neq \mu2 \tag{2}$$

This is a two-way alternative, or more precisely:

$$HA1: \mu1 > \mu2 \tag{3}$$

$$HA2: \mu1 < \mu2 \tag{4}$$

The calculation is a one-sided alternative. The calculation of the test criterion *t* is based on parameter estimates for the sample sets. We compared the calculated test criterion with the table critical value (1-a/2) quantile of Student's *t*-distribution. First, we defined the variance as the mean square deviation of the quantity from the mean value.

$$\sigma^2 = \frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2 \tag{5}$$

where *n* is the number of observations, $x_i$ is the concrete realization of quantity *X*, and *x* is the simple arithmetic mean of quantity *X*. The standard deviation is calculated as the square root of the variance. As with variance, the population standard deviation $\sigma$ is differentiated:

$$\sigma = \sqrt{\sigma^2} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2} \tag{6}$$

For the sample we used the following formula:

$$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2 \tag{7}$$

This formula compares the data that make up the "matched variation series" from the subjects that were measured. We made two measurements for the different sets. In our case, these were revenue measurement sets in the two sectors. The test is based on the differences in the measured values in the compared variation series. We tested the hypothesis that the mean of the measurement is equal (or that the difference of the mean of the measurement is zero). First, we calculated the differences of the paired values in the set (*n*, number of pairs) and then the arithmetic mean and the standard deviation *s* (or the variance denoted as *SS*). Then we calculated the test criterion (statistic) *t*:

$$t = \frac{(M_1 - M_2)}{\sqrt{(S^2M_1 + S^2M_2)}} \tag{8}$$

whereas:

$$S_p^2 = \frac{(df_1)}{(df_1 + df_2)} \cdot s_1^2 + \frac{(df_2)}{(df_2 + df_2)} \cdot s_2^2 \tag{9}$$

and

$$S^2 M_1 = \frac{S_p^2}{N_1} \tag{10}$$

as well as:

$$S^2 M_2 = \frac{S_p^2}{N_2} \tag{11}$$

To find the table critical value, it is necessary to determine the degrees of freedom of the sample n = n−1 and select the significance level a. The calculated statistic t is compared with the table critical value t1-a/2(n) where n = n−1. We chose a level of significance of 0.05 (Quantiles t1-$\alpha$/2(n) of Student's t-distribution, if t £ t1-a/2(n)). If Þ is a statistically insignificant difference, using m1 and m2 with the chosen alternative, then the null hypothesis would apply. If there is agreement on this level of significance, then we do not reject the null hypothesis H0. The mean value of the measurement is p > 0.05 if t > t1-a/2 (n). If there is a statistically significant difference Þ between m1 and m2 (a = 0.05) or a statistically significant difference (at a = 0.01), then we reject the null hypothesis *H0*, since the mean value of the measurement differs from the mean value.

### 3. Results

The results of our research were significant, showing the total income of 70 respondents: 35 who worked in forestry and 35 who worked in environmental protection. After meeting the criteria, they were included in the respective group. The survey yielded economic data monthly since respondents reported aggregate earnings from January to December 2019. Table 1 shows the total income of each respondent. This means that our findings were based on the sum of net income for all months of the year. We did the same procedure with the second sample of respondents. The data are displayed in Table 1. The first column shows the sum of each respondent's income, the second column shows the differences (the deviations from the mean), and the third column shows the standard deviation and variance. This data can then be used to test the hypothesis.

**Table 1.** Reported average incomes (in EUR) in the forestry and environmental protection sectors in the Czech Republic from January to December 2019.

| A Incomes in Forestry in EUR; Average Value; 35 Respondents (January–December 2019) | | | B Incomes in Environmental Protection in EUR; Average Value; 35 Respondents (January–December 2019) | | |
|---|---|---|---|---|---|
| **$n_a$ (EUR)** | Difference (X−M) M: 11,093 EUR | Square Difference (X−M)$^2$ SS: 42,045,096.74 | **$n_b$ (EUR)** | Difference (X−M) M: 13,126.54 EUR | Square Difference (X−M)$^2$ SS: 101,141,792.69 |
| 10,117 | 218.91 | 952,743.32 | 10,616 | −2510.54 | 6,302,825.44 |
| 10,273 | −202.09 | 672,540.58 | 11,418 | −1708.54 | 2,919,118.69 |
| 10,447 | −623.09 | 417,426.75 | 11,813 | −1313.54 | 1,725,394.84 |
| 10,905 | −996.09 | 35,376.24 | 12,051 | −1075.54 | 1,156,792.44 |
| 10,927 | −952.09 | 27,584.46 | 13,433 | 306.46 | 93,915.98 |
| 11,142 | −1413.09 | 2392.61 | 14,006 | 879.46 | 773,444.87 |
| 12,025 | −1215.09 | 868,464.24 | 14,441 | 1314.46 | 1,727,797.58 |
| 11,948 | 218.91 | 730,878.44 | 14,976 | 1849.46 | 3,420,491.72 |
| 12,422 | −202.09 | 1,766,013.18 | 15,251 | 2124.46 | 4,513,318.15 |
| 12,944 | −623.09 | 3,425,883.69 | 15,271 | 2144.46 | 4,598,696.44 |
| 13,086 | −1215.09 | 3,971,707.35 | 16,002 | 2875.46 | 8,268,253.78 |
| 13,877 | −976.09 | 7,750,178.75 | 16,199 | 3072.46 | 9,439,992.89 |
| 13,262 | −820.09 | 4,704,189.18 | 15,369 | 2242.46 | 5,028,614.04 |
| 12,702 | −646.09 | 2,588,605.18 | 14,423 | 1296.46 | 1,680,801.12 |
| 11,941 | −188.09 | 718,958.64 | 14,180 | 1053.46 | 1,109,771.95 |
| 11,717 | −166.09 | 389,269.04 | 12,564 | −562.54 | 316,454.47 |
| 11,312 | 48.91 | 47,923.46 | 12,051 | −1075.54 | 1,156,792.44 |
| 10,891 | −1215.09 | 40,838.64 | 11,320 | −1806.54 | 3,263,597.09 |
| 10,470 | −1279.09 | 388,235.81 | 10,273 | −2853.54 | 8,142,706.84 |

| 10,097 | 218.91 | 992,186.75 | 10,488 | −2638.54 | 6,961,908.41 |
| 10,141 | −202.09 | 906,467.21 | 11,450 | −1676.54 | 2,810,795.95 |
| 9680 | −623.09 | 1,996,811.24 | 11,814 | −1312.54 | 1,722,768.75 |
| 9878 | −996.09 | 1,476,433.29 | 11,853 | −1273.54 | 1,621,911.41 |
| 11,312 | −952.09 | 47,923.46 | 15,369 | 2242.46 | 5,028,614.04 |
| 10,891 | −1413.09 | 40,838.64 | 14,423 | 1296.46 | 1,680,801.12 |
| 10,470 | −1215.09 | 388,235.81 | 14,180 | 1053.46 | 1,109,771.95 |
| 9878 | 218.91 | 1,476,433.29 | 12,564 | −562.54 | 316,454.47 |
| 10,117 | −202.09 | 952,743.32 | 11,450 | −1676.54 | 2,810,795.95 |
| 10,273 | −623.09 | 672,540.58 | 11,814 | −1312.54 | 1,722,768.75 |
| 10,447 | −1215.09 | 417,426.75 | 11,853 | −1273.54 | 1,621,911.41 |
| 10905 | −976.09 | 35,376.24 | 11,813 | −1313.54 | 1,725,394.84 |
| 10927 | −820.09 | 27,584.46 | 12,051 | −1075.54 | 1,156,792.44 |
| 11,142 | −646.09 | 2392.61 | 13,433 | 306.46 | 93,915.98 |
| 9878 | −188.09 | 1,476,433.29 | 14,006 | 879.46 | 773,444.87 |
| 9814 | −166.09 | 1,636,060.26 | 15,211 | 2084.46 | 4,344,961.58 |

Source: Data were analyzed using software STATISTICA 13 EN.

Table 1 shows the summaries of annual income from individual respondents (35 respondents in forestry and 35 respondents in environmental protection). The second column shows the deviations from the average revenue. The average income in the forestry sector in 2019 was 11,093 EUR (Table 2). The official statistics of the Czech Statistical Office showed the average wages in forestry as 1074 EUR per month. In environmental protection, the average gross nominal wages in the Czech Republic were around 1164 EUR [5]. Our research determined that the average income of environmental workers in 2019 was 13,100 EUR [5]. The data obtained corresponded to official statistics.

**Table 2.** Mean, variance, and standard deviation of the two sets.

| Selective File A | Selective File B |
| --- | --- |
| **The Income in Forestry** | **The Income in Environmental Protection** |
| NA: 35 | NB: 35 |
| dfA = N−1 = 35−1 = 34 | dfB = N−1 = 35−1 = 34 |
| MA: 11,093 EUR | MB: 13,127 EUR |
| SSA: 42045096.74 $s_A^2 = \dfrac{SS_A}{(N-1)} = \dfrac{42045096.74}{(35-1)} = 1236620.49$ | SSB: 101141792.69 $s_B^2 = \dfrac{SS_B}{(N-1)} = \dfrac{101141792.69}{(35-1)} = 2974758.61$ |

Source: Data were analyzed using software STATISTICA 13 EN.

The table above shows partial results (Table 2). The data were derived from the arithmetic mean of income in the sample ($M_A$ and $M_B$), the standard deviation ($SS_A$ and $SS_B$), and the mutual variance ($s_A$ and $s_B$). The variance is needed to calculate the T statistic, which is shown in the following table (Table 3). This table shows the procedure for calculating t-statistics (Table 3). In the first step, the total variance of both samples was calculated. In the second and third steps, the t-statistic was calculated. The result was −5.89. The following is a calculation of the p-value, which was <0.001. The result was significant, and the *p* value was significantly less than the confidence interval of 0.05. This means that the null hypothesis at the significance level of 0.05 could be rejected. Therefore, the summaries of revenue in 2019 between forestry and environmental protection were different. It can also be argued that there was a statistically significantly higher income in environmental protection than in forestry.

**Table 3.** The calculation of *t*-value: procedure.

| First step | $s_p^2 = \dfrac{(df_A)}{(df_A + df_B)} \cdot s_1^2 + \dfrac{(df_B)}{(df_B + df_B)} \cdot s_2^2 = \dfrac{34}{68} \cdot 1236620.49 + \dfrac{34}{68} \cdot 2974758.61$ $= 2105689.55$ |
|---|---|
| Second step | $s^2 M_A = \dfrac{s_p^2}{N_A} = \dfrac{2105689.55}{35} = 60162.56$ $S^2 M_B = \dfrac{S_p^2}{N_B} = \dfrac{2105689.55}{35} = 60162.56$ |
| Third step | $t = \dfrac{(M_A - M_B)}{\sqrt{(s^2 M_A + s M_B)}} = -\dfrac{2033.46}{\sqrt{7120325.12}} = -5.86$ |
| Fourth step | The *t*-value is −5.86212; *p*-value is < 0.00001. |

Source: Data were analyzed using software STATISTICA 13 EN.

The null hypothesis of equal average incomes in forestry and environmental protection was rejected (t-stat: −5.86, *p*-value < 0.001). It can also be argued that there was a significantly higher income in environmental protection than in forestry (Table 3). The calculation was based on the data showing a significant difference between the incomes in the forestry sector and those in the environmental sector. The procedure that led to the calculation of T-statistics (−5.86) is shown in Table 4. The value of the T-statistic was well below the reference level, suggesting that the null hypothesis was rejected at the significance level of 0.05. This means that the annual income in both groups was not the same. In the following table, there is a connected value that is equal to 2.405402.

**Table 4.** The calculation of t value: summary of results.

| Group A/B | *t*-Test for Independent Samples Note: Variables were Treated as Independent Samples | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean A | Mean B | t-Value | d$_f$ | Valid N$_A$ | Valid N$_B$ | Std. Dev. | Std. Dev. | F-Ratio | p |
| A/B | 11,093 | 13,127 | −5.86212 | 68 | 35 | 35 | 28,148.21 | 43,656.07 | 2.405402 | 0.012370 |

Source: Data were analyzed using software STATISTICA 13 EN.

The Q-Q chart shows the distribution of annual incomes in forestry (a) and environmental protection (b) (Figure 1). The left graph (Figure 1) shows that the distribution of income was not even. The highest frequency of income in forestry (a) was between 9460 and 10,248 EUR per year. In our sample of respondents in forestry (35 respondents) there were employees who received average or below-average wages in comparison to the average in the Czech Republic (13,400 EUR). Only 1.5 percent of respondents said they had annual revenues of 14,175 EUR per year. On the other hand, in the field of environmental protection (b), almost half of all respondents in the quantile of incomes were between 13,789 and 15,763 EUR per year.



(**a**) The income in forestry in EUR　　　　　　　(**b**) The income in natural protection in EUR
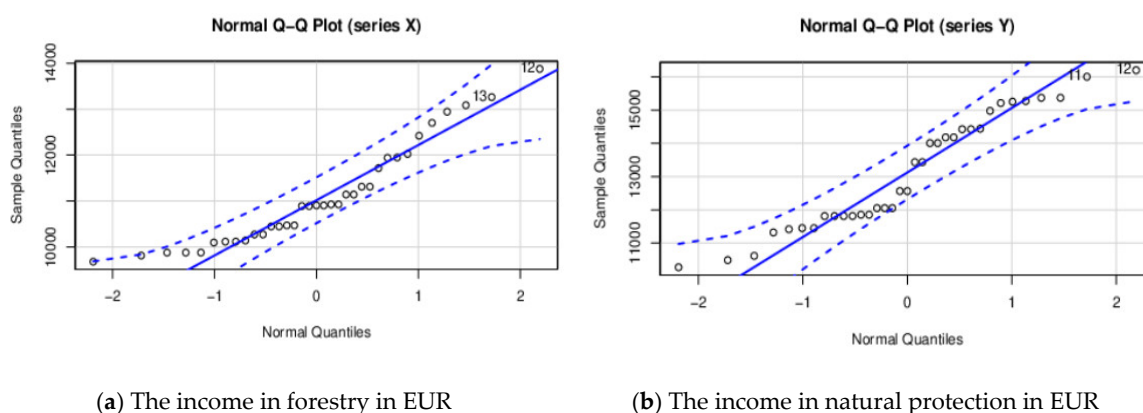
**Figure 1.** Comparison of income Q-Q plot; Source: Own calculation.

The histograms in Figure 2 show that there was an unequal distribution in income between forestry (a) and environmental sectors (b). In forestry (a), respondents reported the highest incomes

in the lower categories. More than half of the respondents had an annual income below the forestry sector average. In environmental protection (b), respondents showed an even distribution. Roughly half of the income in the environmental sector was below average, while the other half of employees had income above the forestry sector average. Comparative histograms (Figure 2) show the distribution of annual incomes in both forestry and environmental protection. More than half of respondents reported an annual total income in forestry between 9456 and 11,828 EUR per year. The remaining forestry respondents reported incomes between 11,821 and 14,181 EUR per year. These figures differed significantly from environmental protection revenues, where there were two income groups. The first group of workers showed an annual income of around 11,821 EUR per year. Almost half of all respondents were between incomes of 13,789 and 15,763 EUR per year.
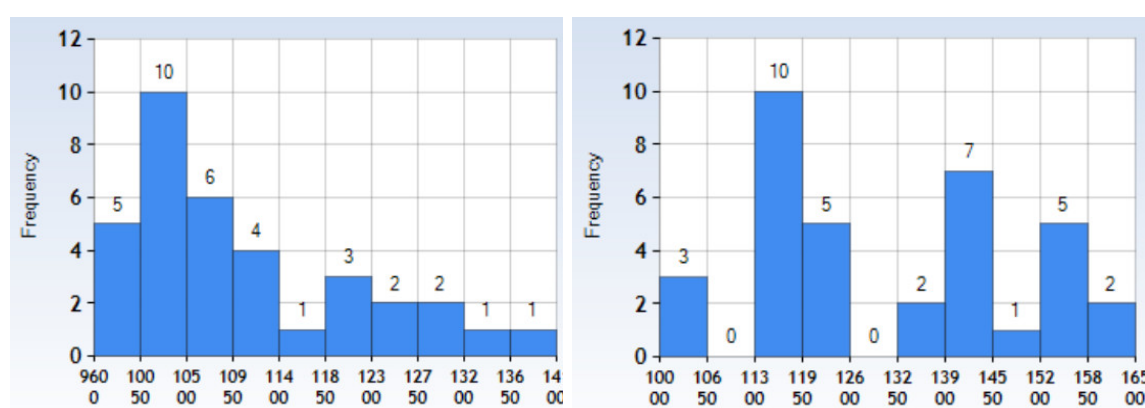


(**a**) The income in forestry in EUR   (**b**) The income in natural protection in EUR

**Figure 2.** Comparative histograms of incomes in forestry and environmental protection. Source: Data were obtained from own research.

The results of the calculations showed the quintile frequencies in the incomes (Table 5). In forestry, the highest frequency was of incomes that were below average since more than half of respondents received below-average annual income. Only 1.5 percent of respondents reported annual revenues of 14,175 EUR per year. However, the income of respondents in environmental protection was evenly distributed.

**Table 5.** Frequency of incomes.

| Frequency of Income in Forestry Table A | | Frequency of Income in Natural Protection Table B | |
|---|---|---|---|
| Class A Forestry | Count | Class B Nat. Protection | Count |
| 9600–10049 | 5 | 10000–10649 | 3 |
| 10050–10499 | 10 | 10650–11299 | 0 |
| 10500–10949 | 6 | 11300–11949 | 10 |
| 10950–11399 | 4 | 11950–12599 | 5 |
| 11400–11849 | 1 | 12600–13249 | 0 |
| 11850–12299 | 3 | 13250–13899 | 2 |
| 12300–12749 | 2 | 13900–14549 | 7 |
| 12750–13199 | 2 | 14550–15199 | 1 |
| 13200–13649 | 1 | 15200–15849 | 5 |
| 13650–14099 | 1 | 15850–16499 | 2 |

Source: Data were obtained from own research.

## 4. Discussion

Environmental protection has more economic, legal, managerial, and political tools and support than forestry. The development of forestry employment in Europe was addressed in this study in order to estimate the human resource needs for the next decade [8]. We collected material from the ČSÚ (Czech Statistical Office) [5]. In this study, we were looking at the human resources that are desirable for the forestry sector and nature conservation, as well as forest productivity and incomes [8]. We mainly included European countries in our research [9] and analyzed forestry in terms of economic benefits, appreciating the French and Swedish approaches in particular. However, countries such as Bulgaria and Hungary were also included. This study showed how wood harvesting and logging technologies accelerate productivity in forestry [10]. Technological developments (such as in Sweden and Germany) have also led to an increase in the wages and incomes of forestry workers [11].

This study also pointed to large income gaps between Scandinavian countries, as well as the very low annual incomes of forestry workers in Bulgaria, Belarus, and Romania (around 4400 EUR per year). Using material from the CSU (Czech Statistical Office), we concluded that the Czech Republic had an average income of eleven thousand euros a year, which puts it in the middle of the European countries, including Bulgaria and Hungary. Technological developments have led to an increase in the wages and incomes of forestry workers in Sweden and Germany [11]. The Czech Republic is in the middle with an average income in forestry around 11 thousand euros a year. Another study [12] shows the importance of social criteria and indicators in forestry [13,14].

Other studies [3] show that the development of the so-called bio-based economy has a positive impact on the development of forestry and environmental employment [3]. This bio-based economy creates a space for new jobs, which we call green jobs. Research shows [15] that for the successful development of the environmental and forestry sectors, certain procedures for the preparation, education, and training of young employees are required. Based on this research, the Young Adult Employment Program [15] has been developed, a motivational program aimed at attracting new motivated employees, which also serves as a development program for specific knowledge and skills [16]. There is currently a strong demand for environmental innovation. These innovations [11], which are gradually being introduced, are the key to developing and increasing the attractiveness of employment in forestry and environmental protection [11,17]. The research shows that environmental innovation has a significant impact on employment dynamics [18] and offers new technological opportunities [19]. Other researchers [20] show that there is a gap in the labor market: on the one hand, there is a strong demand for an educated, motivated workforce; on the other hand, outdoor work in forestry is not exactly attractive to prospective employees [8,21]. However, the environmental protection sector provides varied, often complex, work (outdoors in nature, in the laboratory, and in the office) that is more appealing to applicants. For the formation of the so-called new employment [22], it is important that jobs are sustainable, long-term, and provide a good income. All environmental areas in the labor market (work in soil management, air protection, forest

protection and maintenance, and/or natural resource protection) require skilled and sufficiently motivated young workers [23].

The Czech Republic actively abides by the European environmental policy. The Treaty on the Functioning of the European Union states: "The EU has the power to act in all areas of environmental policy, such as air and water pollution, waste management, and climate change. Its scope for action is limited by the principle of subsidiarity and the requirement for unanimous adoption by the Council in the areas of fiscal matters, spatial planning, land use, water management, choice of energy sources, and energy supply structure" [24]. Czech national strategy papers are very closely linked to these European strategy papers. This is also the case with the State Environmental Policy [6]. The current State Environmental Policy of the Czech Republic (2012–2020) [6] defines a plan for the implementation of effective environmental protection in the Czech Republic by 2020. The main objective is to ensure a healthy and high-quality environment for citizens living in the Czech Republic through protecting all natural resources and minimizing the negative environmental impact of human activity, including transboundary impacts, thus contributing to improving the quality of life in Europe and worldwide [25]. The objectives of the State Environmental Policy of the Czech Republic are fully aligned with the European environmental policy in the following areas: protection and sustainable use of resources, climate protection and improvement of air quality, nature and landscape protection, and maintaining a safe environment. Resources for the implementation of the objectives of the State Environmental Policy of the Czech Republic [6] should include both state aid and private investment. It is assumed that the green sector, public support, and the state administration will influence all areas of the national economy to some extent, including support for employment in the environmental sector and forestry. It is therefore assumed that the successful implementation of the objectives of the State Environmental Policy of the Czech Republic (2020–2030) [6] should include socio-economic instruments. Currently, there are 116,000 employees in the Czech Republic's green economy and environmental protection sector. These are highly educated and motivated workers that bring innovation potential to economic reality. In neighboring Germany, employment in the environmental sector is more than 500 thousand employees [9,10]. Other countries also have a high percentage of environmental protection employees in the workforce. This trend will continue [26] and is aligned with the current shaping of the environmental policy, as well as the development of relevant legislation. The areas covered by the State Environmental Policy include combating climate change, biodiversity, land use and forestry, air pollution, resource efficiency, recycling, sustainable consumption and production, and the environmental management of chemicals and pesticides. New jobs are being created in these areas, with a demand for employees possessing top qualifications and a high quality of knowledge [8,11].

This is also reflected in the current course and implementation of the state environmental policy. In the coming year of 2020, the evaluation will be subject to socio-economic impact considerations. At present, it is necessary not only to assess the impacts of the State Environmental Policy but also to define a certain course of development for shaping the environmental policy in the coming decade. The direction of the State Environmental Policy in the next decade will regard socio-economic impacts, especially the development of employment. Undoubtedly, the new national environmental policy should also include support for forestry employment, including support for forestry income [27], since forestry revenues are below average and insufficient. Given that the forestry sector makes a significant contribution to improving the quality of life and protecting the health of the whole population [27], forestry work and forestry jobs need to be seen as beneficial to the public [28]. Forestry contributes to nature conservation, human health, regional development, and protection against climate change [28–36].

## 5. Conclusions

The study showed that there was a statistically significant difference in the sum of annual incomes between the two monitored areas of the labor market: forestry and environmental protection. This confirms the economic hypothesis that the labor market in environmental protection works more effectively than the labor market in forestry. The results of the research should serve to

improve the social status of forestry workers. They are responsible for the state of forests, nature, and landscape in the Czech Republic. In environmental protection, there are more sustainable jobs that are often full-time, based on long-term employment contracts, and of indefinite duration. All this points to better efficiency and functioning of the labor market in the field of environmental protection, especially since these jobs also bring greater social security and better career prospects.

Forestry jobs are often seasonal, and most of the work is outside, regardless of weather conditions. Often, outdoor work is risky and more demanding physically. In forestry, average wages are also among the lowest in the Czech Republic, and more half-time jobs are offered. These jobs often do not bring social stability to workers. A very significant cause of the income gap is the fact that the income of environmental workers is not entirely generated in a free market environment. These jobs are often subsidized or financially supported by the European Union's Structural Funds or from the budget of the public administration and self-government.

The wages of environmental workers are almost always based on the income of public administration workers. Salaries in public administration have been increasing rapidly in the last five years, which is why the incomes of environmental protection workers are also increasing. This is not the case in forestry. Forestry workers' income is much more dependent on the economic efficiency and profitability of the forestry sector in the Czech Republic and the countries where they export timber. Currently, the forest sector is negatively affected by bark beetle calamity, which has caused a sharp decrease in the market price of wood. This has led to an economic decline in forestry efficiency and is reflected in the income of workers in the sector. The overall stagnation of incomes of workers in forestry has been going on for more than three years, and it is apparent that the difference between incomes in forestry and the average gross nominal wage in the Czech Republic is widening. Possibly the worst affected are employees directly involved in forestry activities, such as forest workers and forest operators, for which gross nominal wages are growing at the slowest pace. The bark beetle calamity caused economic direct damage of 1.1 billion euros to the forestry sector, and the effects of this phenomenon are apparent in the low incomes of the workers in this sector. Therefore, in the future, it is necessary to support and subsidize forestry jobs similarly to environmental protection jobs.

The protection of the environment and natural resources is not possible without a coherent system of human resources management in forestry. Forestry in the Czech Republic requires concentrated state assistance since more than 6000 workers will be needed to restore forests. There are concerns that these workers will not be available on the Czech labor market, and therefore it will be necessary to improve forestry work in order to incentivize prospective employees. One of the tools used could be the newly prepared State Environmental Policy of the Czech Republic; selected materials and data were taken from the CSU (Czech Statistical Office) [6]. Based on our research, we recommend that relevant experts concentrate on the socio-economic impacts of forestry on nature conservation and sustainability in the Czech Republic. Means for this improvement can also be achieved by creating better socio-economic conditions for forestry workers. Systemic financial support for forestry should lead to the sustainability of the forestry sector as well as the environment as a whole, which is essential for future generations. The Ministry of the Environment of the Czech Republic, which created the new State Environmental Policy, mentions socio-economic aspects only marginally. A completely new approach and revision should be included in the chapter on green jobs, which are defined as jobs that make a significant contribution to environmental protection and recovery [6]. The increased need for motivated and adequately trained new employees should result in competitive and sustainable incomes in the forestry sector that are comparable to other environmental sectors.

Jobs in environmental protection and forestry are of more than economic importance. These are jobs with a broad public and social impact that contribute to improving the quality of life and the public health of the population. The public support for green jobs has a secondary but important impact on the development of public health quality. The practical usefulness of this research lies in demonstrating the need for systematic and strategic support of forestry as one of the bearers of nature and natural resources protection. The unsustainability of low incomes in forestry is a problem that

needs to be addressed in the long term and programmatically, which is a challenge for environmental policymakers in the next decade. It is a task not only for the Czech environmental policymakers but also for European institutions. The aim of environmental policies should be targeted to stabilize and sustain all sectors that care about the environment, the landscape, and natural resources for future generations.

**Author Contributions:** Conceptualization, D.T.; Data curation, D.T.; Formal analysis, K.M.; Funding acquisition, M.M.; Investigation, M.M.; Methodology, D.T.; Resources, M.M.; Supervision, K.M. and D.T.; Validation, M.M.; Writing, M.M.; Review and editing, V.J. and M.M.; Validation L.S. All authors have read and agreed to the published version of the manuscript.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. Eurostat. *Employment in the Environmental Goods and Services Sector*; Eurostat: Luxembourg, 2019; ISSN edseou.
2. Eurostat. *Production, Value Added and Employment by Industry Groups in the Environmental Goods and Services Sector*; Eurostat: Luxembourg, 2019; ISSN edseou.
3. Bennich, T.; Belyazid, S.; Kopainsky, B.; Diemer, A. The Bio-Based Economy: Dynamics Governing Transition Pathways in the Swedish Forestry Sector. *Sustainability* **2018**, *10*, 976, doi:10.3390/su10040976.
4. Forstater, M. Public Employment and Environmental Sustainability. *J. Post Keynes. Econ.* **2003**, *25*, 385–406.
5. ČSU. Průměrné Mzdy, Praha, Czech, 2018. Available online: https://www.czso.cz/csu/czso/prumerne-mzdy (accessed on 20 December 2019).
6. MŽP. Státní Politika Životního Prostředí České Republiky 2012–2020. 2018. Available online: https://www.mzp.cz/C1257458002F0DC7/cz/statni_politika_zivotniho_prostredi/$FILE/SOPSZP-Aktualizace_SPZP_2012-2020-20161123.pdf (accessed on 26 December 2019).
7. Poschen, P.; Blombäck, P.; Lövgren, M. GENEVA TIMBER AND FOREST DISCUSSION PAPERS Employment Trends and Prospects in the European Forest Sector A Study Prepared for the European Forest Sector Outlook Study (EFSOS) by ILO.; Geneva and New York. Available online: www:http://www.fao.org/3/a-ae888e.pdf (accessed on 6 May 2003).
8. Falxa-Raymond, N.; Erika, S.; Lindsay, C. From job training to green jobs: A case study of a young adult employment program centered on environmental restoration in New York City, USA. *Urban For.* **2013**, *12*, doi:10.1016/j.ufug.2013.04.003.
9. Horbach, J. The Impact of Innovation Activities on Employment in the Environmental Sector—Empirical Results for Germany at the Firm Level. *J. Econ. Stat.* **2010**, *230*, 403.
10. Horbach, J.; Klaus, R. Environmental innovation and employment dynamics in different technology fields—An analysis based on the German Community Innovation Survey 2009. *J. Clean. Prod.* **2013**, *57*, 158–165, doi:10.1016/j.jclepro.2013.05.034.
11. Triguero, Á.; Cuerva, M.C.; Álvarez-Aledo, C. Environmental Innovation and Employment: Drivers and Synergies. *Sustainability* **2017**, *9*, 2057–2057, doi:10.3390/su9112057.
12. Hwang, S.J.; Kim, K. An understanding on the relationship between the employment and the environmental policy. *J. Environ. Econ. Policy* **2017**, *6*, 361, doi:10.1080/21606544.2017.1319296.
13. Berck, P.; Hoffmann, S. Assessing the Employment Impacts of Environmental and Natural Resource Policy. *Environmental* **2002**, *22*, doi:10.1023/A:1015531702905.
14. Maczulskij, T. Employment sector and pay gaps: Genetic and environmental influences. *Labour Econ.* **2013**, *23*, 89–96, doi:10.1016/j.labeco.2013.04.009.
15. De Jong, W.; Pokorny, B.; Katila, P.; Galloway, G.; Pacheco, P. Community Forestry and the Sustainable Development Goals: A Two Way Street. *Forests* **2018**, *9*, 331, doi:10.3390/f9060331.

16. Zhang, H.; Kuuluvainen, J.; Ning, Y.; Liao, W.; Liu, C. Institutional Regime, Off-Farm Employment, and the Interaction Effect: What are the Determinants of Households' Forestland Transfer in China? *Sustainability* **2017**, *9*, 1885, doi:10.3390/su9101885.

17. Rahman, K.M.A.; Zhang, D. Analyzing the Level of Accessibility of Public Urban Green Spaces to Different Socially Vulnerable Groups of People. *Sustainability* **2018**, *10*, 3917.

18. Raff, Z.; Earnhart, D. The Effects of Clean Water Act Enforcement on Environmental Employment. *Resour. Energy Econ.* **2018**, doi:10.1016/j.reseneeco.2018.12.002.

19. Marušák, R.; Kašpar, J.; Vopěnka, P. Support Support Systems (DSS). *Forests* **2015**, *6*, 163–182.

20. Dong, Y.; Liu, H.; Zheng, T. Does the Connectivity of Urban Public Green Space Promote Its Use? An Empirical Study of Wuhan. *Int. J. Environ. Res. Public Health* **2020**, *17*, 297.

21. Gejdoš, M.; Vlčková, M.; Allmanová, Z.; Balážová, Ž. Trends in Workplace Injuries in Slovak Forest Enterprises. *Int. J. Environ. Res. Public Health* **2019**, *16*, 141.

22. Choe, C.; Van Kerm, P. Foreign Workers and the Wage Distribution: What Does the Influence Function Reveal? *Econometrics* **2018**, *6*, 41.

23. Jankovský, M.; Allman, M.; Allmanová, Z. What Are the Occupational Risks in Forestry? Results of a Long-Term Study in Slovakia. *Int. J. Environ. Res. Public Health* **2019**, *16*, 4931.

24. CONSOLIDATED VERSION OF THE TREATY ON THE FUNCTIONING OF THE EUROPEAN UNION; C 326/47. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:12012E/TXT&from=CS (accessed on 2 March 2012).

25. Sugiura, K.; Oki, Y. Reasons for Choosing Forest Stewardship Council (FSC) and Sustainable Green Ecosystem Council (SGEC) Schemes and the Effects of Certification Acquisition by Forestry Enterprises in Japan. *Forests* **2018**, *9*, 173, doi:10.3390/f9040173.

26. Toscani, P.; Sekot, W. Forest Accountancy Data Networks—A European Approach of Empirical Research, Its Achievements, and Potentials in Regard to Sustainable Multiple Use Forestry. *Forests* **2018**, *9*, 220, doi:10.3390/f9040220.

27. Alsaber, A.; Pan, J.; Al-Herz, A.; Alkandary, D.S.; Al-Hurban, A.; Setiya, P. On behalf of the KRRD Group. Influence of Ambient Air Pollution on Rheumatoid Arthritis Disease Activity Score Index. *Int. J. Environ. Res. Public Health* **2020**, *17*, 416.

28. Li, L.; Du, Q.; Ren, F.; Ma, X. Assessing Spatial Accessibility to Hierarchical Urban Parks by Multi-Types of Travel Distance in Shenzhen, China. *Int. J. Environ. Res. Public Health* **2019**, *16*, 1038.

29. Benz, J.P.; Chen, S.; Dang, S.; Dieter, M.; Labelle, E.R.; Liu, G.; Hou, L.; Mosandl, R.M.; Pretzsch, H.; Pukall, K.; et al. Multifunctionality of Forests: A White Paper on Challenges and Opportunities in China and Germany. *Forests* **2020**, *11*, 266.

30. Fuchigami, Y.; Hara, K.; Uwasu, M.; Kurimoto, S. Analysis of the Mechanism Hindering Sustainable Forestry Operations: A Case Study of Japanese Forest Management. *Forests* **2016**, *7*, 182.

31. Chen, R.; Chen, W.; Hu, M.; Huang, W. Measuring Improvement of Economic Condition in State-Owned Forest Farms' in China. *Sustainability* **2020**, *12*, 1593.

32. Toth, D.; Maitah, M.; Maitah, K. Development and Forecast of Employment in Forestry in the Czech Republic. *Sustainability* **2019**, *11*, 6901.

33. Benesova, I.; Maitah, M.; Smutka, L.; Tomšík, K.; Ishchukova, N. Perspectives of the Russian agricultural exports in terms of comparative advantage. *Agric. Econ.* **2017**, *63*, doi:10.17221/344/2015-AGRICECON.

34. Toth, D.; Maitah, M.; Maitah, K.; Jarolínová, V. The Impacts of Calamity Logging on the Development of Spruce Wood Prices in Czech Forestry. *Forests* **2020**, *11*, 283.

35. Hönig, V.; Prochazka, P.; Obergruber, M.; Smutka, L.; Kučerová, V. Economic and Technological Analysis of Commercial LNG Production in the EU. *Energies* **2019**, *12*, 1565.

36. Toth, D.; Maitah, M.; Stefkova, M. Comparative Research of Youth Employment in France and the Czech Republic. *Res. J. Appl. Sci.* **2014**, *9*, 1009–1015.