

Article

What the Fire Has Left Behind: Views and Perspectives of Resin Tappers in Central Greece

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Abstract: Resin tapping has long been an important traditional economic activity in less advantaged areas that serves as a source for income to local populations as well as an important management tool intricately linked with ecosystem services. In Greece, the majority of the remaining resin tappers are located in communities close to *Pinus halepensis* stands in the northern part of Evia Island. However, on 3 August 2021, a wildfire burned more than 50,000 Ha in the region, bringing the remaining resin tappers to a standstill. This paper aims to examine the views of 89 resin tappers in N. Evia and their perspectives on their profession as expressed during personal interviews. According to the participants' replies, resin production is expected to bounce back to pre-fire levels in 40 years. A considerable portion of those interviewed (39.3%) were forced to work in other professions near their communities during the period that followed the fire. They were very dissatisfied by the fire management and initial mitigation actions, and fairly satisfied by the ecosystem recovery works that followed. However, they have high expectations for employment in a seven-year long government-funded support program which will allow them to continue living in their communities, and in this context they are willing to make a professional shift to forest operations work. In this context, the role of state authorities is expected to be crucial. The provision of vocational training and financial incentives could be decisive in preventing them from transitioning to alternative production sectors.

Keywords: ecosystem services; employment; forest operations; job satisfaction; pine; traditional professions; wildfire



Citation: Tsioras, P.A.; Giamouki, C.; Tsaktsira, M.; Scaltsoyiannes, A. What the Fire Has Left Behind: Views and Perspectives of Resin Tappers in Central Greece. *Sustainability* **2023**, *15*, 9777. <https://doi.org/10.3390/su15129777>

Academic Editor: Grigorios L. Kyriakopoulos

Received: 17 May 2023

Revised: 8 June 2023

Accepted: 15 June 2023

Published: 19 June 2023



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1. Introduction

Resin tapping has long been an important activity in rural areas of the Mediterranean [1,2]. It has been a fundamental part of forest management of pine species, as in the cases of the Maritime pine (*Pinus pinaster* Ait.) in the Iberian peninsula and France, the Calabrian pine (*Pinus brutia*) in Turkey [3], and the Aleppo pine (*Pinus halepensis*) in Greece [4]. Resin is a natural forestry renewable resource of considerable economic value worldwide, constitutes a primary ingredient for the manufacturing of high-value chemical products [5–7], and is an important source of employment and income for local communities [8–10].

Resin represents much more than a precious resource; it is a material co-produced by nature and people [11] that facilitates the flow of ecosystem services to the local communities [12]. It entails close human intervention in ecosystems, at least during the tapping season, that could be better described as repeated reduced-impact forest cultivating operations. Such operations include thinning and fuel reduction operations, which are invaluable in the fire-prone Mediterranean forest ecosystems for better control and management of the wildfires when they occur [10,13]. Furthermore, resin tappers often serve as early detectors of fires, helping to alert authorities and facilitate a more rapid response. Their

actions, immediate or not, are directly connected to pivotal ecosystem services that include forest protection, soil conservation, water regulation [14], and carbon sequestration [15,16], among others. Furthermore, tapping as an activity lowers the need for investment in tending and silvicultural treatments, which are essential for maintenance of these traditional forest systems [9], especially when other traditional land uses are abandoned [17].

Pine stands have long been a source of additional income in the Mediterranean area, and European countries (Portugal, France, Greece, Portugal, and Spain) were major producers during the 1960s. A major decline in resin production took place in the decades that followed, in some cases leading to the abandonment of the activity in the 1990s. A combination of factors was responsible for this change, most notably the considerable drop in prices of local resins due to the availability of cheaper *Pinus massoniana* resin originating from China, which was coupled with increases in the cost of local manual labor [2,9,18]. As has happened to other traditional forestry-related activities [19,20], resin tapping is threatened with extinction for social reasons that include low professional profile and low job satisfaction. Nevertheless, in recent years efforts have been made to reactivate resin tapping, in recognition of its close relationship with ecosystem services and its links to the prosperity of rural areas [9].

Resin tapping in Greece goes back to ancient times [21]. Tapping has been reported for three pine species, *P. halepensis*, *P. brutia*, and *P. nigra*; however, in the last several decades it has been continued only in the case of *P. halepensis*, which offers the best combination of productivity and profit. Resin is collected from both privately owned and state-owned forests following the guidelines described in the relevant national legislation [22,23]. In the case of private forests, the forest owners receive a portion of the revenue generated from the sale of resin, and the specific percentage is determined through an agreement between them and the resin tappers. In contrast, the Greek State recognizes the valuable contribution of resin tappers, and provides them with the entire proceeds earned. Following the Second World War, national resin production reached 30,348 t in 1956, a value close to the highest recorded value of 30,775 t in 1938 [24]. In 1962, Greece and Spain were the top resin exporters worldwide [2]. Following a declining trend, the annual resin production was reduced to around 10,000 t in 1986 and currently is within the range of 4000–5000 t [4,8,25]. Employment in resin tapping has declined over the last fifty years. Resin tapper numbers amounted to 6000 in 1975, 4000 in 1987, and are currently less than 800, organized into 42 cooperatives [8,24].

Papajianopoulos [24] estimated in 2000 that Greek forests could produce 18,000 t of resin in a context of sustainable co-production of wood and non-wood forest products. More recently, Spanos et al. [4] estimated the area of pine forests available for resin tapping at 327,500 ha, of which that actually used was 147,500 ha. Currently, resin tapping is practiced in the Evia, Korinthia, Ilia, Attica, and Chalkidiki regions, among which the northern part of Evia represents the major contributor to national resin production, where tapping activity was reduced but never abandoned. Furthermore, Northern Evia has shown a considerable increase of 25.4% in the number of resin tappers, from 362 in 2014 to 454 in 2018, along with an increase of 31.1% in resin production from 1985 t in 2014 to 2603 t in 2020 [8,25].

Unfortunately, the recent revival of resin production in Northern Evia was abruptly halted by a catastrophic wildfire on August 3, 2021, which persisted for eight days and led to the destruction of 51,203 Ha of forest, accounting for almost 70% of the tapped forests in the region. This event dealt a significant blow to national resin production, 85% of which was concentrated in Northern Evia. The problems that resulted have a strong social dimension as well. If employment alternatives are not provided, certain resin tapping communities are expected to be largely abandoned, primarily by their younger and most productive members, who will need to seek other career opportunities. To avoid such undesirable developments, the Greek State has provided financial aid that was paid ten days after the fire as well as an income loss compensation. The latter support measure was dependent upon the applicant's personal resin production record the year before at a predefined

rate of EUR 0.40/kg of resin. Furthermore, resin tappers in the area were employed in restoration works in the burnt areas, and a seven-year long community support program was announced that, starting in 2022, would provide employment to former resin tappers in forest operations under the supervision of the local forest authorities.

It is challenging to assess the impacts of the fire in Northern Evia, as they are complex and interconnected with various factors influencing each other. Considering the importance of resin tapping and its linkages to ecosystem services, this paper focuses on the human capital of the area that has been undoubtedly affected the most. The objective of this paper is to investigate the attitudes and perceptions of resin tappers after the catastrophic event, with a focus on understanding the factors that influence their willingness to continue working in the resin tapping sector. The study examines the following hypotheses:

Hypothesis 1. *There is a significant relationship between resin tappers' sociodemographic profile and their willingness to continue working in the resin tapping sector.*

Hypothesis 2. *There is a positive correlation between the availability of support policies and measures and resin tappers' willingness to continue working in the resin tapping sector.*

The study used a mixed-methods approach, including a structured questionnaire, statistical analysis, and semi-structured interviews. The results of this study can provide valuable insights for policymakers and stakeholders in the forestry sector to develop more effective policies and measures to support the sustainability of the resin tapping sector and rural employment in Northern Evia.

2. Materials and Methods

2.1. The Study Area

The island of Evia (or Euboea) stretches along the northeastern coast of mainland Greece (Figure 1). It is the second largest Greek island, after Crete, with an area of 365,400 ha. It is approximately 180 km long, oriented from northwest to southeast, and its width reaches 45 km in its central part. In terms of relief, Evia can be divided into three parts: northern, central, and southern Evia. Following the occurrence of the catastrophic wildfire, the northern part of the island holds specific significance within the scope of this study. It is characterized by hilly and flat areas interrupted by the Telethrio and the Xiron mountains, which have altitudes of 997 m and 991 m, respectively. In certain locations, steep slopes are the prevailing terrain.

The study area is managed by the Forest Service Office of Limni (FSOL), is located in northern central Evia, and extends in longitude from 23°13' to 23°40' and in latitude from 38°40' to 38°55', covering an area of 57,073 Ha [8,26].

According to the latest management plan of the FSOL, forest covers 79.5% of the total area. It consists of xerophytic and flammable species, namely, Aleppo pine with an understory of evergreen broad-leaved trees, which occupy over 75% of the total area, and fir, black pine, and oak, which account for approximately 25% of the forest; the former is particularly vulnerable to wildfires. The wildfire that occurred in Evia in 1977 is known as one of the largest and most destructive wildfires in modern Greek history [27]. The fire broke out on 24 August 1977 and raged for several days, eventually consuming an area of approximately 41,000 hectares of forest, farmland, and settlements, and resulted in the deaths of six people. The burnt areas recovered, and resin tapping resumed in the years that followed.

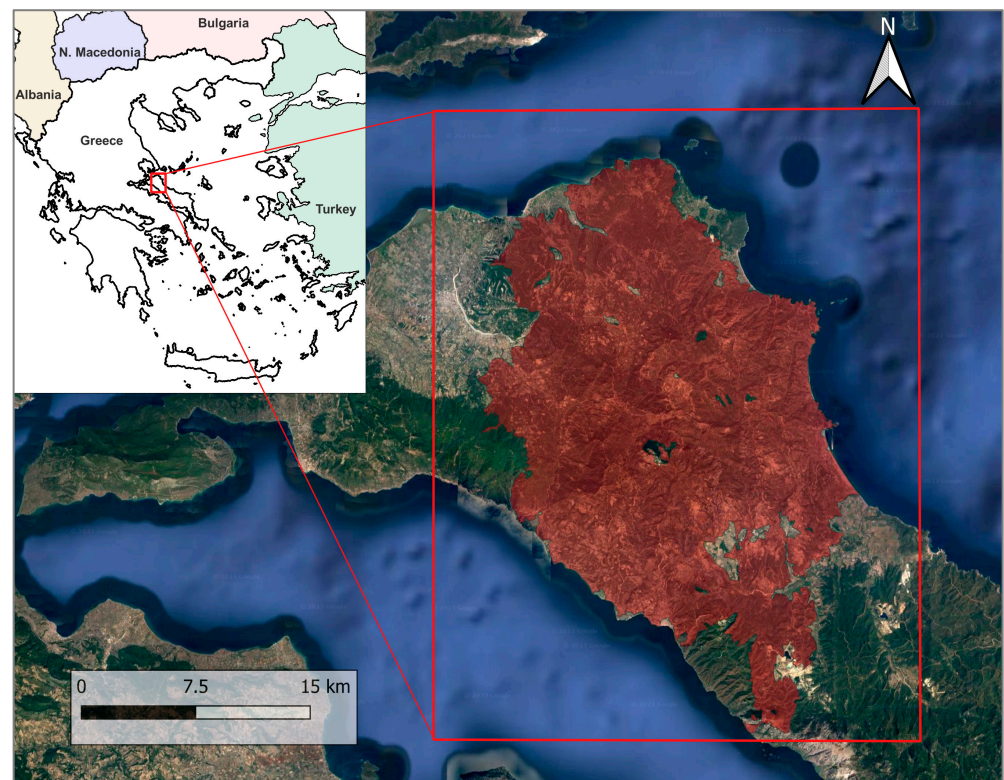


Figure 1. The location of the study area and the area burnt by the fire.

2.2. Selection of Participants

The population under study was made up of communities of resin tappers located in Northern Evia. The number of resin tappers between 2014 and 2018, as reported by the resin tappers' cooperative archives and FSOL, varied from 362 to 454. The selection of study participants was carried out at the community level. The cooperatives' archives of resin tappers yielded valuable information about both the cooperative production and its members, although it did not include any data on those resin tappers working as freelancers. Although it involved additional expense, the decision was made to visit all study areas in order to conduct an on-site examination of the situation. This research choice was justified by the fact that the majority of resin tappers were initially very negative with regard to participating in the study or even expressing their views on the fire. Additionally, certain resin tappers reported as registered could not be reached because they were employed in other professions in the meantime.

In addition, specific selection criteria were applied for participation. Resin tappers who met the following conditions were eligible to participate: (a) having been active in the study area for at least five years, and (b) working and residing in Northern Evia. The number of participants was determined using a proportional stratified sampling method. The work experience of the forest workers was utilized as a stratification criterion, which included four categories: 1–10 years, 11–20 years, 20–30 years, and more than 30 years.

2.3. Questionnaire and Interviews

The results in this article originate from personal interviews held with resin tappers in the study area. The data collection process involved the use of a structured questionnaire, which aimed to investigate the participants' perceptions of specific aspects of the study. The questionnaire was accompanied by a cover letter that provided information on the background and purpose of the study.

In the first part, profile information was collected from all respondents. The second part encompassed inquiries regarding the effects of the wildfire on their occupational situation and the expected timeframe for ecosystem recovery, while its last part focused on

the assessment of measures and incentives for the promotion of forest-related professions in the study area. A five-point Likert scale was used to measure the perceived level of importance (ascending scale from 1 to 5). To ensure that the questions were unbiased, clear, and comprehensive, the questionnaire was pre-tested by 21 resin tappers. This helped to identify any potential issues with the questions, such as misunderstandings, or confusion, and to verify the quality and comprehensiveness of the information obtained.

During the interview process, many resin tappers expressed a negative attitude towards the study and voiced doubts about its potential contribution. Additionally, several participants had a low level of literacy, which made personal interviews the best method for data collection. On the contrary, in a few cases participants with tertiary education degrees preferred to complete the questionnaire on their own and ask questions if needed. To ensure the validity of the findings, informal follow-up discussions were conducted.

2.4. Statistical Analysis

The responses were analyzed with SPSS software version 23. The Shapiro–Wilk test was used to assess the normality of the data, considering the relatively small sample size of 89. Additionally, the homogeneity of variance was examined using Levene’s test. Because the data did not meet the criteria for normal distribution and homogeneity of variance, non-parametric analyses were exclusively employed to investigate the comparisons between sub-groups of respondents and the relationships among variables. Because the responses were ratings rather than a continuous measure, these data are not suitable for analysis of variance [28]. When the assumptions for a repeated measures analysis of variance are not met, the non-parametric alternative is the Friedman test. This involves ranking the scores for each variable and comparing the mean ranks between the variables to determine whether there are any statistically significant differences. Additionally, the maximum likelihood χ^2 test was employed to test for statistically significant differences between the responses of different groups of participants. The Mann–Whitney U test was utilized to investigate significant differences between the medians of the examined groups. The level of significance was set to $\alpha = 0.05$ for all cases.

Categorical principal components analysis (CATPCA) was used to identify consistencies between categories of variables, specifically, the responses from the study participants. CATPCA was performed using the SPSS Categories module, which is a generalization of principal components analysis (PCA) [29]. PCA reduces variables in a dataset to a small number of principal components that represent the information in the variables as closely as possible. CATPCA uses iterative Alternating Least Squares (ALS) to optimally quantify the categorical modalities of each variable [30]. CATPCA is flexible in handling variables of different analysis levels, including nominal, ordinal, and numerical variables, and can deal with nonlinear relationships between variables. This makes it a useful exploratory technique in empirical surveys [31,32].

3. Results

3.1. Participants’ Background Information

In the period February–May 2022, a total of 89 resin tappers were interviewed, the majority of whom were male (73–82%). The average age was 45.57 years ($sd \pm 9.91$) with professional experience averaging 17.83 years ($sd \pm 9.40$). The respondents’ age range was broader in males (23–69 years) compared to females (31–60). Almost three quarters of them had completed lower secondary education (35.2%) and upper secondary education (31.8%), while fewer (19.3%) had attended primary education (sometimes incomplete). Nine out of the 89 participants had a university degree (10.2%). Moreover, most male participants (59–81.9%) and almost all female participants (15–93.75%) identified themselves as members of the local resin tappers cooperative ($\chi^2 = 0.624$, $df = 1$, $p = 0.430$).

3.2. Changes as a Result of the Fire

Despite describing themselves as resin tappers, 34 male respondents (46.6%) and one female respondent (6.3%) were forced to work in other professions in the period that followed the fire ($\chi^2 = 11.555$, $df = 1$, $p = 0.001$). These professions were in the majority related to other forest professions, most notably forest work (62.9%), other agricultural work (11.4%), or manual labor (22.8%) (Table 1). It is worth noting that all these professions were exercised in close proximity to participants' place of residence.

Table 1. Employment of study participants in other professions in the period that followed the fire.

Profession	Male	Female	Total
Forest worker	21 (60.0%)	1 (2.9%)	22 (62.9%)
Farmer	4 (11.4%)	—	4 (11.4%)
Construction worker	4 (11.4%)	—	4 (11.4%)
Entrepreneur	1 (2.9%)	—	1 (2.9%)
Manual worker	4 (11.4%)	—	4 (11.4%)
Total	34 (97.1%)	1 (2.9%)	35 (100%)

The study revealed that both male and female participants exhibit a considerable degree of optimism towards the restoration of the burnt ecosystems, with 84.9% and 91.1% of them, respectively, expressing their belief that the recovery would span from “fair” to “complete” (Figure 2). Both respondent groups share the belief that the burnt areas will recover within a period of 30.3 ± 8.97 years on average ($F = 0.481$, $df = 1$, $p = 0.490$), and further agree that it will take an additional decade (40.05 ± 11.22 years after the fire) to reactivate resin production ($F = 0.319$, $df = 1$, $p = 0.574$).

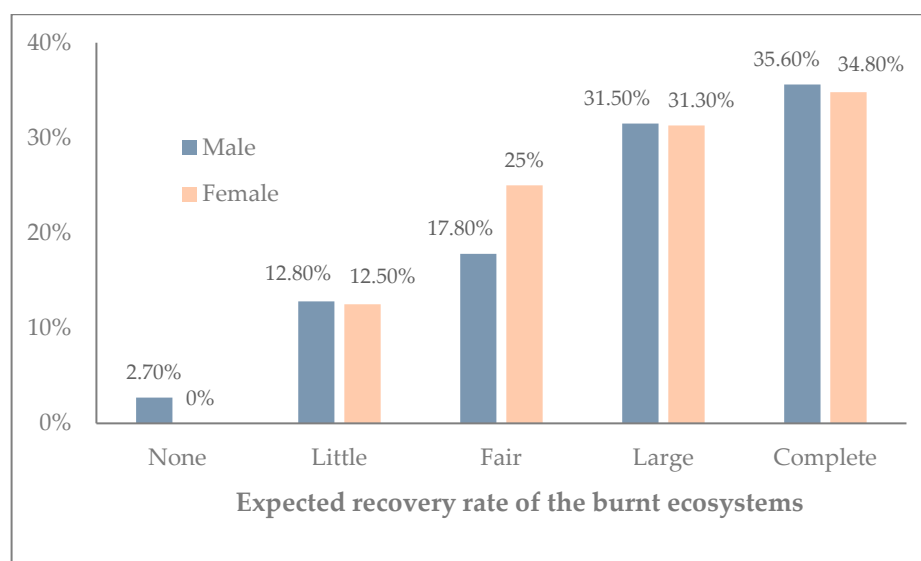


Figure 2. Expected recovery rate of the burnt ecosystems according to the study participants.

Reforestation (53.9%), soil erosion mitigation measures (52.8%), and salvage logging in the burnt areas (51.7%) are perceived as necessary actions to facilitate the recovery process of the impacted ecosystems. It is noteworthy that the respondents emphasize the need for a comprehensive long-term forest management and protection strategy in the coming years (e.g., thinning, protection from grazing animals) to optimize the attainment of the restoration objectives.

3.3. Satisfaction with State Measures

The majority of the respondents (61.8%) received financial assistance in the aftermath of the incident intended, which was aimed at covering their immediate expenses. Moreover,

compensation for loss of income was provided to 79.8% of the respondents (Table 2). Regardless of whether they received any form of assistance, the respondents expressed extremely low satisfaction levels (median = 1) towards the fire management and initial mitigation actions carried out by the state authorities. Notably, the financial aid recipient group exhibited significant differences in their responses ($U = 558.5, p < 0.001$), unlike the income loss support recipients ($U = 851.5, p = 0.795$). Among all groups, the prevailing proportion, 63.6–90.9% of the respondents, reported being ‘very poorly’ or ‘poorly’ satisfied.

Table 2. Breakdown of respondents’ satisfaction level with the fire management and initial mitigation actions undertaken by State authorities according to the type of support received.

Satisfaction	Financial Assistance		Income Loss Compensation	
	Yes	No	Yes	No
Excellent	3 (5.5%)	0 (0.0%)	3 (4.2%)	0 (0%)
Good	12 (9.1%)	1 (6.1%)	12 (16.9%)	1 (5.6%)
Fair	5 (21.8%)	2 (3.0%)	4 (5.6%)	3 (16.7%)
Poor	7 (12.7%)	1 (3.0%)	7 (9.9%)	1 (5.6%)
Very poor	28 (50.9%)	29 (87.9%)	45 (63.4%)	13 (72.2%)
Median	1 ^a	1 ^b	1 ^a	1 ^a
Mean rank	50.85	33.92	43.48	44.89

Different letters denote statistical differences at $\alpha = 0.05$ level between the recipients and non-recipients of state support types according to Mann–Whitney U tests.

Table 3 reveals that the respondents expressed higher levels of satisfaction towards the effectiveness of the implemented recovery measures. The majority of both groups of financial assistance recipients rated their satisfaction as being from “poor” to “fair”, and shared a median value of 3 ($U = 565.0, p = 0.373$). Conversely, the recipients of income loss compensation exhibited lower levels of satisfaction (median = 3) compared to those who did not receive it (median = 4), as evidenced by the significant difference in their responses ($U = 432.0, p = 0.034$).

Table 3. Respondents’ satisfaction with regard to the handling of the fire and initial mitigation actions.

Satisfaction	Financial Assistance		Income Loss Compensation	
	Yes	No	Yes	No
Excellent	5 (9.1%)	4 (12.5%)	5 (7.1%)	4 (22.2%)
Good	16 (29.1%)	8 (25.0%)	17 (24.3%)	7 (38.9%)
Fair	16 (29.1%)	11 (34.4%)	25 (35.7%)	3 (16.7%)
Poor	15 (27.3%)	7 (21.9%)	18 (25.7%)	4 (22.2%)
Very poor	3 (5.5%)	2 (6.3%)	5 (7.1%)	0 (0.0%)
Median	3 ^a	3 ^a	3 ^a	4 ^b
Mean rank	46.04	40.89	41.67	55.50

Different letters denote statistical differences at $\alpha = 0.05$ level between the recipients and non-recipients of state support types according to Mann–Whitney U tests.

Nearly 70% of the respondents reported being satisfied with the announced employment program. While a higher proportion of female respondents expressed satisfaction (87.5%) compared to their male counterparts (65.8%), the observed difference was not statistically significant ($\chi^2 = 3.353, df = 1, p = 0.067$).

The majority of the respondents believed that there will be a need for forest workers (50.6%) in the future (Table 4). On the contrary, the outlook for resin tapping was not encouraging, with only 19.1% of the interviewees expressing optimism. Similarly, the perspectives for construction workers (20.2%), forest operation supervisors (14.6%), and forest machine operators (12.4%) were not optimistic.

Table 4. Respondents' satisfaction in relation to the announced seven-year employment program.

Sex	Satisfaction	
	Yes	No
Male	48 (65.8%)	25 (34.2%)
Female	14 (87.5%)	2 (12.5%)
Total	62 (69.7%)	27 (30.3%)

Of the 89 respondents, 41 (46.6%) were willing to work as forest workers and 25 (28.4%) were willing to work as resin tappers in the future. Additionally, twelve respondents expressed their willingness to work in the employment program (13.5%). This suggests that, in total, 71 of the 89 respondents (79.8%) are willing to be employed in a forestry-related profession in the future.

3.4. Measures for Promoting Employment in Forest-Related Professions

Incentives (77.1%) represented the best option for improving the attractiveness of the resin tapping profession. Better promotion of the forestry sector through the vocational guidance system was next with 27.3%, followed by social media with 19.3% and traditional media with 11.4%, respectively.

Finally, the respondents were asked to assess the importance of different types of incentives (Table 5). They rated, in order of magnitude: reduced taxation, equipment subsidies, incentive payments, and earlier retirement, with mean ranks ranging from 2.39 to 2.75. However, there were no statistically significant differences between their rankings ($F = 5.824$, $df = 3$, $p = 0.120$).

Table 5. Importance of various incentive types.

	Mean Rank
Reduced taxation	2.75
Equipment subsidies	2.44
Incentive payments	2.41
Earlier retirement	2.39

3.5. CATPCA Results

Ten variables were used in total for the application of the CATPCA method, with four of these measured on the ordinal scale and six on the nominal scale. The variables used were the following: age group ("Age group": ordinal, 1–5), annual resin production ("Resin production": ordinal, 1–5), membership at a resin tappers' cooperative ("Cooperative member": binary, 1–2), work experience ("Work experience", ordinal, 1–4), job difficulty ("Job difficulty": ordinal, 1–5), participant's sex ("Sex": binary, 1–2), willingness of young people to be employed in resin tapping ("Young people": binary, 1–2), income loss compensation ("Income loss compensation", binary, 1–2), intention to work as a forest worker in the future ("Forest worker": binary, 1–2), and intention to work as a resin tapper in the future ("Resin tapper": binary, 1–2).

The convergence criterion value of 0.00001 was met after seventeen iterations. The two-dimensional solution resulted in eigenvalues of $\lambda_1 = 1.81$ for the first principal component (PC1) and $\lambda_2 = 1.49$ for the second principal component (PC2), both of which satisfy the acceptance value of 1 [33,34]. This two-dimensional solution explains 63% of the total variance.

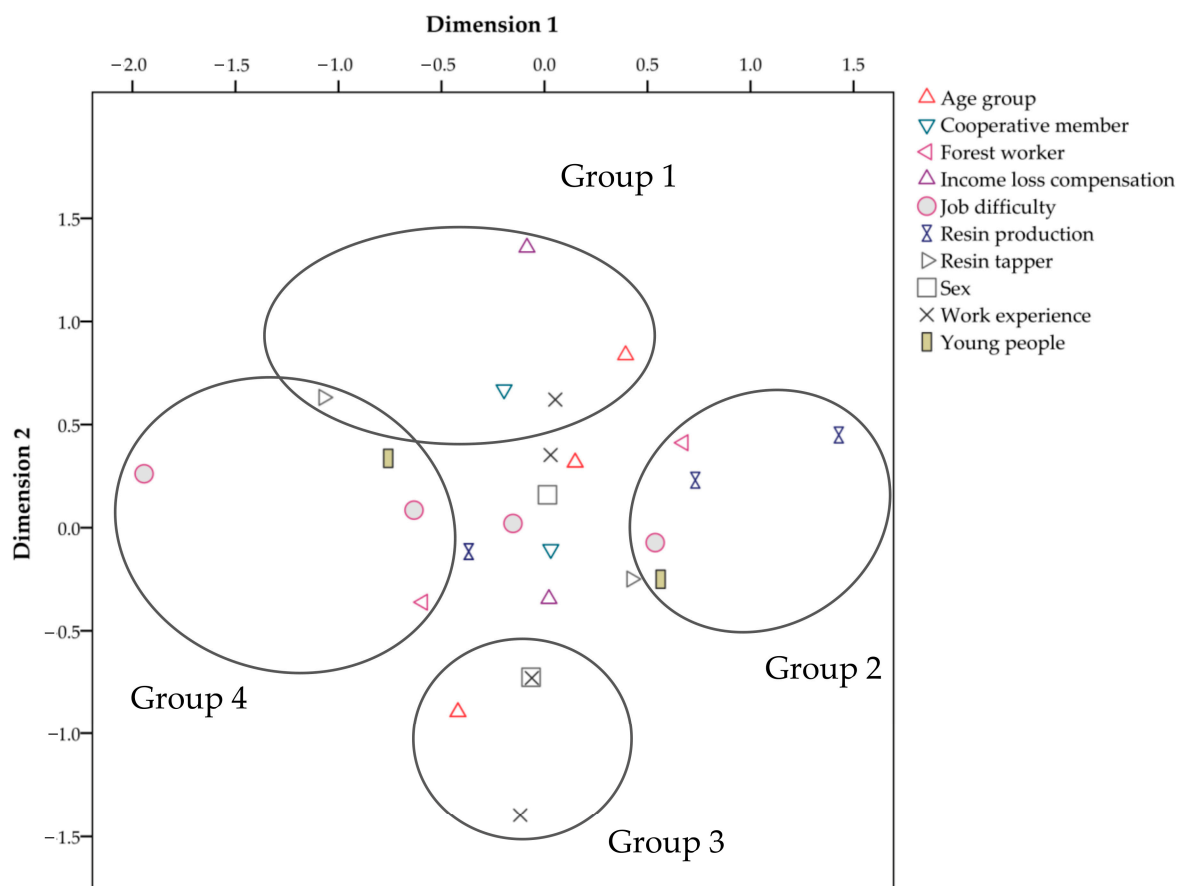
The values of the variable loadings for the two principal components are described in Table 6. The variables "Intention to work as a resin tapper", "Willingness of young people to be employed in resin tapping", and "Job difficulty" present the highest positive loadings in relation to PC1 and form a group that could be interpreted as "Perceptions of the resin tapper profession". The variable "Intention to work as a forest worker" presents the highest negative loadings in relation to PC1.

Table 6. Component loadings of the variables used in the CATPCA analysis.

Variable	PC1	PC2
Age group	−0.276	−0.586
Annual resin production	0.593	0.187
Cooperative member	−0.083	0.282
Work experience	−0.057	−0.678
Job difficulty	0.649	−0.087
Participant's sex	−0.031	−0.340
Willingness of young people to be employed in resin tapping	0.651	−0.289
Income loss compensation	−0.043	0.684
Intention to work as a forest worker in the future	−0.627	−0.384
Intention to work as a resin tapper in the future	0.670	−0.395

Similarly, the variables “Income loss compensation” and “Cooperative member” present the highest positive loadings in relation to PC2. This group could be interpreted as “Personal attributes”. Finally, the variables “Work experience”, “Age group”, and “Participant's sex” present the highest negative loadings in relation to PC2.

The CATPCA program generates scores for variable categories, which are then used to create a dispersion diagram. Figure 3 shows the coordinates for each variable category along each dimension. Several variable categories exhibit consistency in their scores (Table 6). With regard to the first dimension, there is consistency (value of the variable categories below −0.5 or above 0.5 in both dimensions) between the following categories: “Resin production: 10.1–15 t and more than 15 t”, “Job difficulty: Very difficult”, “Young people: No”, and “Forest worker: Yes” (Group 2) on the one hand and “Young people: Yes”, “Forest worker: No”, “Job difficulty: medium and low”, and “Resin tapper: Yes” (Group 4) on the other.

**Figure 3.** Joint plot of the variable categories used in the CATPCA analysis.

Two additional groups are formed based on the second dimension. Group 1 consists of the categories “Work experience: 1–10 years”, “Cooperative member: No”, “Age group: < 30”, and “Resin tapper: Yes”, while Group 3 consists of the categories “Work experience: 21–30 and 30+ years”, “Age group: 51–60 and 60+”, and “Sex: Female”.

4. Discussion

4.1. Demographic Data

The large majority of the study respondents were male. This finding is in line with previous studies that have found all forestry-related professions to be male-dominated [35]. Furthermore, the average respondent age was 45.57 years, a value very close to those found in similar studies (e.g., 44.4 years in Tsioras [20]), an indication of an aging working population that has been reported elsewhere as well [36,37]. Notably, the current study found that educational attainment levels were much improved. Whereas in 2004, according to a study carried out in Greece [20], 66% of the participating forest workers had attended “primary education” and 22% of them the “lower secondary education” (22%), now only 19.3% quit school after “primary education”. The largest group was “lower secondary education” (35.2%), followed by “upper secondary education” (31.8%), and a considerable proportion (10.2%) of resin tappers reported having a “university degree” level of education. This may suggest that younger individuals are returning to their communities after studying in larger cities. This fact might be partially attributed to the fact that a specific area was examined, and not the whole country as in previous research. Nevertheless, the trend of higher educational attainment levels is obvious in rural Greece, where most younger people complete compulsory upper secondary education before starting to work. This is a very promising finding, as educational attainment has shown to be related to vocational competency levels [38]. Furthermore, education can be beneficial in many ways by facilitating the implementation of vocational training programs [39].

Among resin tappers, only 18% were not members of a local cooperative, indicating that cooperative membership may be advantageous for pursuing professional interests. This is valid for pine resin tappers in non-European contexts as well, such as in Indonesia [40] and Honduras [41].

Following the catastrophic fire, 35 of 89 respondents reported being compelled to pursue alternative professions. These alternate occupations were largely in the fields of forest agriculture and manual labor, and were found to be located near the respondents’ communities. These findings align with other studies showing that Greek forestry professionals feel connected with their communities and want to continue living and working there despite the problems they face [8,19,20].

4.2. Ecosystem Recovery

The role of resin tappers is very important in ecosystems threatened by fires in the Mediterranean region [13], especially in the coming years, when fire risk is expected to increase [42,43]. Conversely, fire is a very important agent of vegetation change [43] and is an intrinsic part of the landscape [44–46]. The extent and time of recovery of the burnt ecosystems is unknown, as it depends on multiple factors [47,48]. The study participants are quite confident that the burnt ecosystems will recover completely within a timespan of roughly 30 years, and estimate that it will take ten more years to restart tapping in the areas that are currently totally burnt. Their estimation is in agreement with Zagas [49], who supported the view that the Aleppo pine forests can be fully restored in 30 years under the precondition that there is no recurrence of fire. The respondents’ belief is consistent with previous knowledge from the area, which was burnt in 1977 and subsequently completely recovered, allowing tapping to be resumed. However, caution should be exercised, as we cannot predict future climatic conditions or unfortunate natural events, and it would be unwise to take the respondents’ perception for granted. In Southern Europe, the trend of *P. halepensis* populations being converted to shrubland after recurrent wildfires has been

reported [43,50]. Thus, possible evolution of the study area ecosystems to alternative states would mean they would no longer be connected to resin production in the future.

4.3. Typologies of Study Participants

The CATPCA analysis provided a number of interesting typologies of the interviewed individuals. Group 1 consists of young individuals with rather limited work experience who are not members of a cooperative but who are willing to work as resin tappers. This group represents a potential labor force that could be targeted by policies aiming to promote and support the resin tapping profession. This is the case for Group 4 as well, which consists of individuals who are willing to work in resin tapping and perceive the profession positively but who are not currently involved in the industry due to job difficulty and who believe that young people are not willing to work in resin tapping. The forest industry is experiencing challenges in attracting new professionals, as noted by Egan and Taggart [51]. To ensure sustainable rural development, it is crucial to encourage younger generations to engage in forest operations [52]. With an aging and diminishing population in rural areas, failure to address this issue could have significant implications for the forest industry, resulting in a widening gap between the demand for and the availability of forest workforces [52].

Having identified these two groups of potential resin workers, policymakers could develop programs to provide training for young people interested in forestry professions, create incentives for cooperatives to recruit and support new members, and establish regulations that ensure fair working conditions and adequate compensation for resin tappers. Such measures are necessary in order to secure the sustainability of the resin tapping industry, as well as to ensure better working conditions.

Group 2 consists of resin tappers who perceive the profession positively, are willing to continue working as resin tappers, find the job difficult, and are older than those belonging to Group 1. This group may represent experienced and committed resin tappers who are important for the continuity and sustainability of the resin tapping profession, as indicated by their large annual resin production (>10 t).

In the case of Group 2, it may be useful to consider measures that address the difficulties faced by resin tappers, such as improving working conditions and increasing the financial compensation for their work. Access to additional forest resources for tapping could be another approach [41], as could incentives to work in other areas where the resin tapping potential is underutilized [53]. This is valid for the study area, where resin is tapped only from specific trees characterized by their large resin production value (>2.5 kg year⁻¹) [8]. Thus, additional tapping resources could be found in the form of trees with medium resin production or in areas not previously tapped due to their steeper terrain.

Finally, Group 3 consists of female resin tappers, who according to the CATPCA results are typically older (aged 51–60 or 60+), have large work experience (21–30 years), and likely face unique challenges related to their gender. To better understand this group, we should consider their narrower age range (31–60 years) compared to that of their male colleagues (23–69 years), as well as their statements that their work tasks were of “auxiliary nature”. Such duties usually exclude the use of chainsaws, but are of equal importance during resin tapping or forest tending operations. To support this group, policymakers could consider implementing targeted initiatives to address gender-based issues in the forestry sector [54], such as providing training and education opportunities that are specifically tailored to the needs of female workers [55]. Additionally, policymakers could work to promote gender diversity in the forestry sector by encouraging women to pursue careers in resin tapping and other forestry-related professions in times when the workforce is in decline [56].

4.4. Employment Perspectives and Future Directions

The results of this study suggest that, despite the challenges facing the forestry sector, there is potential for it to provide stable and sustainable employment opportunities for rural communities. Most of the respondents believe that forest workers will continue to

be needed in the future, and a high percentage of them are willing to work in forestry-related professions. However, the study found that resin tapping is perceived as a less attractive option compared to other forestry-related jobs. This highlights the need to address the attractiveness of different forestry professions to ensure a sustainable workforce and promote rural employment. Furthermore, in the present context, the professions of forest operations supervisor or forest machine operator are currently absent from Greek forest operations, and are recommended as part of efforts to reorganize and enhance the forest operations sector.

According to Blombäck et al. (2003) [57], there is a positive trend for well-trained forest workers who have stable employment conditions, while there is a negative trend for poorly trained occasional woodcutters, such as farmers. To make use of the development potential that forestry can offer [58,59], investments in the form of proper tending and cultivation of forest areas are needed. In Efthymiou's estimation [60], a workload of 12 h per hectare of forest land in Greece could potentially generate employment for 50,000 to 52,000 professional forest workers, each working for approximately 200 days per year. This projection could result in a substantial rise in rural employment in the country's mountainous regions. In fact, Northern Evia, where the seven-year long community support program will take place, could be considered as a pilot area. It comes as no surprise that this program involves high expectations on the part of the study participants; however, this program alone will not serve as a solution to all problems. It will be beneficial to resin tappers, especially to those who are close to their retirement age, though not as much to younger workers. Therefore, it is suggested that the program should be evaluated, especially in term of its restoration goals, to ensure that the maximum benefits are accrued and its continuation is secured.

A weakness of Greek forestry is the lack of a well-organized vocational training system [19,20]. A new development is the introduction of training seminars for new forest workers [61]; however, a more systematic approach would be advisable [19,20]. Vocational guidance has been recognized as an important factor in improving labor performance and human resources development (ILO 2007), and is regarded as a precondition for every modern forestry industry. Multiple benefits can be derived from a specialized vocational training system, including higher productivity as well as better organization and management of the cooperatives [62]. Major improvements can be derived from the improvement of safety and health conditions during resin tapping, which is a difficult and dangerous profession [63,64]. Both Greek forestry professionals [20] and the study participants in the discussions that followed have expressed very positive attitudes towards the introduction of vocational training for young incoming colleagues as well as more experienced workers.

Cubbage et al. [65] discussed various policy instruments aimed at improving multi-functional forest management. A well-designed payment system is considered essential for recruiting forest personnel and reducing work-related accidents and illnesses, as noted by Toupin et al. [66]. However, changes on the national scale might take considerable time, suggesting that the use of incentives is necessary. According to the study results, reduced taxation is ranked first, which, according to their statements "would be fair" for rural populations. Equipment subsidies can be very beneficial to resin tappers. Equipment, which need not necessarily be expensive when combined with the right techniques, may contribute as well [63]. Furthermore, equipment subsidies can facilitate the expected move from resin tapping to wood harvesting by providing the capital for modern equipment requested under the new circumstances (e.g., skidders, forestry tractors). Nevertheless, to ensure optimal selection and utilization of new equipment and safeguard the investment cost, it is imperative to establish specific criteria for equipment purchase or replacement [19]. The use of incentive payments is another measure proposed, and is an expected outcome, as the respondents most probably identify incentive payments with the amount of subsidy they receive per kilogram of resin collected. Finally, earlier retirement could be used in order to increase the attractiveness of forestry professions, considering their strenu-

ous nature [35,67–70], occupational illnesses [71–75], and high frequency and severity of accidents [36,76–78].

4.5. Strengths and Limitations of This Study

The current study is, to the best of our knowledge, the only one examining the views and attitudes of resin tappers on their employment perspectives in the aftermath of a catastrophic fire. The importance of the research is highlighted by the fact that it deals with a traditional profession that is currently extinct in many countries, some of which are trying to revive it [9]. As a result, the findings of this study could be of interest to a wider international audience, despite the differences in social, economic, and forest management contexts.

However, the study has limitations that need to be acknowledged. The most crucial limitation is the relatively small sample size, which resulted from the reluctance of resin tappers to take part in the research during a stressful and unpleasant period for them and their families. Furthermore, there is a rather limited amount of literature on resin tappers' attitudes due to the profession's extinction in most developed countries. To address this limitation, the present study relied in part on the literature from other relevant forest professions, which was supported by the fact that a number of study participants were employed in both resin tapping and wood harvesting in previous years.

5. Conclusions

The traditional profession of resin tapping is closely linked to important social, cultural, and economic ecosystem services. It is currently extinct in many developed countries, though efforts are being made to revive it. Although pine tapping activity in Greece has remained active for thousands of years, after the fire of August 2021 the future of the profession in northern Evia, the larger contributor to national resin production, remains largely insecure.

Resin tappers are willing to make a professional shift to forest operations, a finding that could serve as a basis for developing policies and support measures to retain existing human resources and attract younger people to forestry-related professions. However, until the burnt areas recover satisfactorily the outlook for resin tapping is not encouraging. Therefore, policymakers and forest managers may need to focus on promoting other forestry-related professions and expanding the working territory of resin tappers to other areas suitable for tapping, such as those with steeper terrain or tree varieties with lower resin production. Additionally, gender issues should be examined to increase female employment in forestry professions.

Further research is needed in order to define concrete environmental, social, and economic objectives and to provide welfare to the local communities. Valuation of the facilitated ecosystem services could help policymakers in these efforts.

The introduction of a training system for forest workers will undoubtedly upgrade the professional capacity of resin tappers and increase their professional flexibility in the coming years. Likewise, prioritizing financial incentives could assist those communities affected by the fire by providing access to necessary forestry equipment. Thus far, the seven-year-old employment program is the sole element of job security for these rural populations, and there is no assurance of its continuation; thus, state authorities will play a pivotal role in the attainment of this objective. In conclusion, efforts should be made to ensure that continuous employment is guaranteed, otherwise valuable human capital will quit the forestry sector and invaluable ecosystem services will be threatened.

Author Contributions: Conceptualization, P.A.T. and C.G.; methodology, P.A.T. and C.G.; validation, P.A.T. and C.G.; formal analysis, P.A.T. and C.G.; investigation, C.G.; data curation, P.A.T. and C.G.; writing—original draft preparation, P.A.T. and C.G.; writing—review and editing, P.A.T., C.G., M.T. and A.S.; visualization, P.A.T. and C.G.; supervision, P.A.T., M.T. and A.S.; project administration, P.A.T. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Acknowledgments: The authors wish to express their gratitude to Spyros Zigiris, Head of the Limni Forest Office for his help during data collection.

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

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