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Analysis of the Relations Between Forestry Financial Supports and Forest Crimes

Volkan Sevinç[1]

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Abstract
Forest crimes are among the serious threats destroying forests. To prevent the forest crimes there are various solutions proposed, such as fortification of the laws, increasing the penalties, or increasing the public awareness. This article, however, suggests an alternative solution of preventing the forest crimes by investigating the relations between the individual financial supports provided to forest villagers and the levels of various forest crime types in Turkey. The study shows that, when the forest villagers are given financial supports, the levels of illegal logging, illegal transferring of forest products, illegal expansion of private lands into forests, illegal processing of trees, and illegal pasturage crimes decrease significantly. However, the financial supports do not affect the levels of illegal occupation of forestlands crime.

Keywords Forest crimes · Forestry financial supports · Illegal logging · Sustainable forestry

Introduction

Forests are economically and ecologically important natural resources. However, there are many factors damaging the forests and reducing the forest assets. Among these factors, there are human-induced factors as well as natural ones. When the human-induced factors are considered, except for arson and accidental cases like shepherd fires, hunting fires, and traffic accidents, various intentionally committed forest crimes also damage the forests. For this reason, countries take various measures and enact penal laws to prevent the forest crimes for the protection and sustainability of forests. According to a recent report, Interpol has conducted many global police operations against forest crimes over the past decade and these operations resulted in the seizure of more than one million cubic meters of illicit timber, which is worth more than 1.5 billion dollars across Africa, Asia, Europe, and the Americas (Interpol 2021).

Brantingham and Brantingham (2017) report that forest crimes generally occur in places with characteristics that favor the opportunity for their occurrence. Additionally, Kitteringham (2010) states that to reduce forest crimes structural changes in the fields of health, education, employment, and environmental management are needed. Lochner and Moretti (2004) studied the effect of education on criminal activity and their results suggested that when the increasing education level decreases the crime levels. Gunes and Elvan (2005) investigated the logging activities in Turkey and concluded that the underlying causes of logging are related to the economic, political, and cultural structures of Turkish society. Similarly, in a study by Gençay and Mercimek (2019), a survey was conducted in Kastamonu province of Turkey to investigate the impact of laws on forest crimes. The study revealed that the crime level decreased when the public had enough information about forest crimes and punishments. Thompson and Magrath (2021), however, state that forestry law enforcement, forestry management, encouraging the local communities are necessary to combat the logging problem. In another study by Setiono and Husein (2005) performed in Indonesia, they state that when logging crime is committed by organized groups, forestry law enforcement approach fails to capture the criminals. To prevent the logging crime, they suggest that the banking system should be made more active to follow and detect the money laundering transactions.

Countries may have supporting policies for their certain industrial sectors for various reasons. These supports may be in political or financial forms. According to a report prepared by Tomaselli (2006) and published by United Nations Forum

✉ Volkan Sevinç
vsevinc@mu.edu.tr

[1] Faculty of Science, Department of Statistics, Muğla Sıtkı Koçman University, 48000 Muğla, Turkey

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on Forests (UNFF), private funding has been the main source of funding investments in the forestry sector. Additionally, a recent report by the United Nations (UN) states that the COVID-19 pandemic has increased the threats on forest resources and the financial resources. Thus, forests are currently at risk of being reduced. In the report, it is also emphasized that sustainable forest management including adequate financing is the key component of efficient and resilient recovery from COVID-19 (Lang et al. 2021).

The European Parliament (EP) reports that in the European Union (EU), however, as there is not a common policy about forestry, forest policy is still a national matter. Nevertheless, many EU measures have an impact on the forests in the member countries or similar countries that are not members. Moreover, the common agricultural policy of the EU is the main source of the funds for the forests within its borders. A measure by the EU covers investment in the development of forested areas and improvement of the viability of forests. Another measure is to provide rewards for forestry, environmental and climate services, and the conservation of forests. A budget of 8.2 billion euros has been allocated for the 2015–2020 period. For reforestation, 27% of the budget was allocated. For more resilient forests and damage prevention, however, 18% of the budget was allocated for each (EP 2021). EU Forest Crime Initiative (EUFCI) in Danube-Carpathian Region covering the countries Bulgaria, Romania, Slovakia, and Ukraine, which exist in close regions to Turkey. (Schlingemann et al. 2021). The study mostly considers the logging crime and one of the results of the study is that the largest portion (64%) of the actors involved in the forest crimes are the local residents and the poor citizens. The second greatest rate (47%) belongs to the small and medium-sized enterprises, the third is the corrupt officials and businesses with a rate of (32%), the forth is the forest staff and guards (20%), the fifth is the organized crimes (18%), and the last belongs to the multinational companies with a rate of 14%. Bösch (2021) performed a quantitative cross-national analysis to investigate institutional quality, economic development, and logging by using logistic regression. The study shows that in a country, the gross domestic product per capita, economic growth, voice and accountability, rule of law, and control of corruption factors have significant effect on logging as well as the physical-geographical characteristics of the country.

It should be noted that all forest crimes, except for arson, are committed for economic gain (Koson and Dvoskin 1982). Additionally, vast majority of the studies in the literature regarding forest crimes agree that the main cause of the forest crimes is economic (Şen and Ünal 2011); (Durkaya et al. 2020); (Schlingemann et al. 2021); (Ünal et al. 2021); (Özden and Ayan 2016). Moreover, they also report that the greatest actors in the forest crimes are the local residents and the poor people who make their living mostly from forestry.

Research Gap and Motivation of the Study

There are many studies in the literature that deal with strengthening laws, increasing penalties or raising public awareness through education in the fight against forest crimes. However, it is worth investigating how forest crimes are affected if financial supports are provided to people living near forests. Turkey is a country that has been providing financial supports to its forest villagers. Thus, it will be interesting to investigate whether any improvement in the economic conditions of forest villagers through financial supports will lead to a decrease in forest crimes in Turkey. Therefore, in this article, we aim to analyze the relations between the financial supports that are provided to forest villagers by the state and various forest crime types in Turkey. In the literature, there is not a previous study analyzing such a relationship.

Another novelty of our study is that the studies in the literature about forest crimes are mostly concentrated on illegal logging crime. However, as well as the illegal logging crime, our study also involves the analyses of other forest crime types committed in Turkey, which are illegal transferring of forest products, illegal expansion of private lands into forests, illegal occupation of forestlands, illegal processing of trees, and illegal pasturage crimes.

The plan of the article has been shaped as information about the study area, the data, the variables, the forest crimes, the forestry financial supports in Turkey, and information about correlation analysis are provided in Section “Study Area and Data”. Afterwards, the correlation analyses and the findings of the study with the corresponding discussions are presented in Section “Results and Discussion”. Finally, the conclusions related to the overall study are provided in Section “Conclusions”.

Study Area and Data

The report published by EUFCI regarding the countries in Danube-Carpathian Region indicates that the local residents and the poor people living around the forest areas are the main actors of the forest crimes in the region (Schlingemann et al. 2021). Similarly, Şen and Ünal (2011) reports that the main causes of the forest crimes in Turkey are the people living in rural areas or villages near forests. Additionally, they state that the most important reason for forest crimes in Turkey is the economic reason. In another study performed in Ilgaz province of Turkey, Ünal et al. (2021) report that the forest crimes are directly correlated with low levels of income, lack of awareness of laws, low penalties, and low education levels. Moreover, in a study performed in Black Sea region of Turkey, Durkaya et al. (2020) found that the income and education levels of the people living in the forest villages had a direct effect on the forest crimes committed.

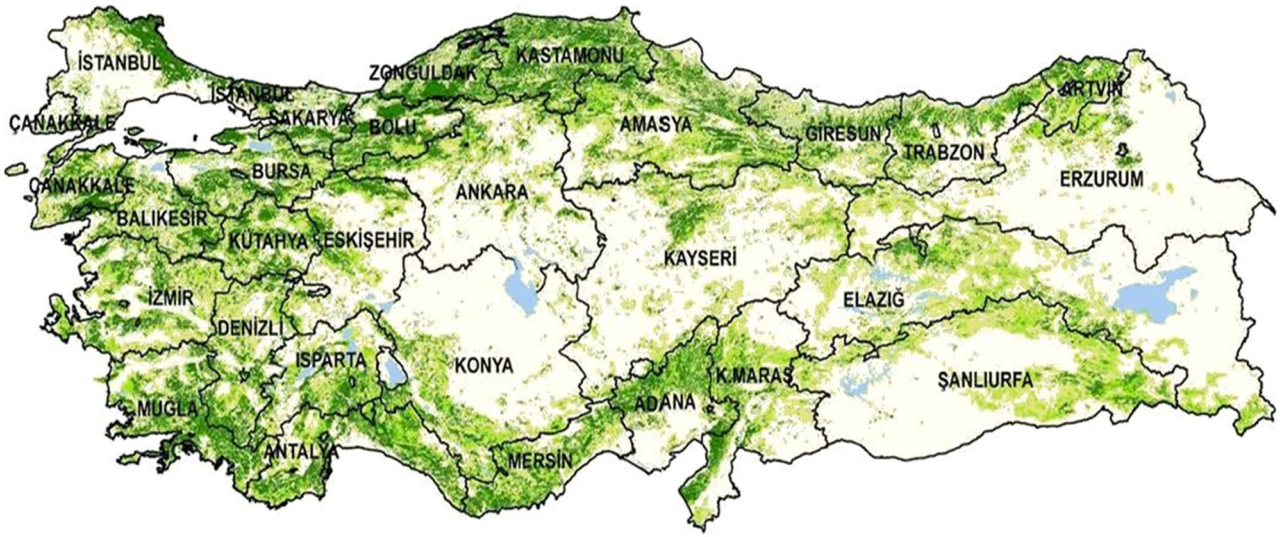

Fig. 1 Forest assets map of Turkey as of 2020

The studies show that one of the main causes of the forest crimes in Turkey is the low level of incomes of the people living in the villages near the forest areas. In Turkey, the state supports the forest villagers in forms of financial supports and cooperative credits. Thus, to investigate the relations between the financial supports provided to forest villagers and forest crimes, Turkey is an appropriate area of study.

Turkish forests are under the control of the General Directorate of Forestry (GDF), which is a state agency. Turkey has a forest area of 22,993,000 ha as of 2020 and the forest areas cover 29.4% of the country area. There are also private forests, which are less than two thousandths of the whole forest area (GDF 2021a). The map of the forest assets of Turkey for the year 2020 is demonstrated in Fig. 1 (GDF 2021b).

As seen in Fig. 1 the GDF was divided in 28 regional directorates of forestry in Turkey as of 2020. However, Hatay and Sinop were established as regional directorates in 2021. Thus, as of 2021, the GDF is divided into 30 regional directorates, which are Adana, Amasya, Ankara, Antalya, Artvin, Balıkesir, Bolu, Bursa, Çanakkale, Denizli, Elazığ, Erzurum, Eskişehir, Giresun, Hatay, Isparta, İstanbul, İzmir, Kahramanmaraş, Kastamonu, Kayseri, Konya, Kütahya, Mersin, Muğla, Sakarya, Sinop, Şanlıurfa, Trabzon, and Zonguldak directorates. The distribution of the forest assets with respect to the regional directorates of forestry in Turkey are demonstrated in Fig. 2, which is based on the data published by GDF (2021a) for the year 2021.

Figure 2 shows that, in Turkey, Amasya, Elazığ, Şanlıurfa, Antalya, Muğla, and İzmir are the first six regions having the largest forest areas, which are more than one million ha. On the other hand, Çanakkale, Artvin, Sinop, Hatay, and Sakarya are the last five regions having the least forest areas, which are less than 600,000 ha. The most common tree species observed in Turkish forests are oak (*Quercus*) (29.42%), Turkish pine (*Pinus brutia*) (22.74%), and black pine (*Pinus nigra*) (18.31%). The annual amounts of wood in the rough production (m^3) in Turkey between the years 2010 and 2021 are given in Table 1 (GDF 2021d).

When Table 1 is examined, it is seen that the amounts of coniferous and non-coniferous log productions in 2021 are almost twice the amounts in 2010. The fuel wood production, on the other hand, mostly has a decreasing trend, except for the slight increases in 2019 and 2021.

In Turkey, the Gross Domestic Product (GDP) grew by 4.5% and the industrial sector by 6.2% in the first quarter of 2020. However, due to the negative effects of the Covid-19 pandemic, the GDP contracted by 9.9% and the industrial sector by 16.5% in the second quarter of 2020. The GDP of Turkey as of 2020 is $719.955 billion (World Bank 2020). Although 29.4% of Turkey is covered by forests, income from the forest products has 3% contribution to the state treasure. (GDF 2021d). According to the data published by Social Security Institution (SSI) of Turkey, there are 34,579 workers employed in forest-based industries in 2020 (SSI 2021).

Forest Crimes and Forestry Financial Supports in Turkey

Forest crimes, in general, can be defined as any action harming forest assets or their future and prohibited by laws to protect forests. A report by World Bank (2006) describes the forest crimes as illicit activities such as illegal logging illegal occupation of forestlands, woodlands arson, wildlife poaching, and encroachment on forests (both on public and private ones). The report also states that the corruption caused by forest crimes all over the world is particularly troubling in developing countries. Although the report

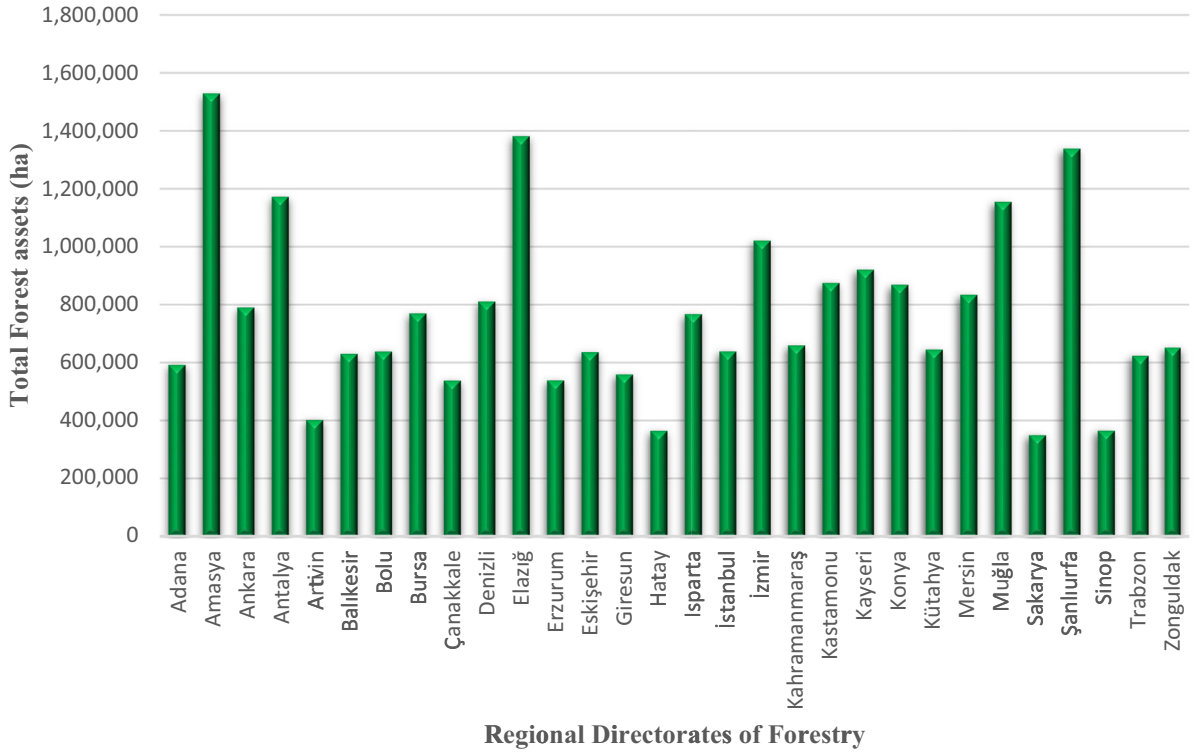

Fig. 2 Distribution of the forest assets (ha) of Turkey as of 2021, with respect to the regional directorates of forestry

Table 1 Yearly wood production of Turkey in 2010–2021

Years	Logs of Coniferous Wood (m^3)	Logs of Non-Coniferous Wood (m^3) (except tropical wood)	Fuel Wood (m^3)
2010	9,501,980	3,066,539	5,395,779
2011	10,440,865	3,141,597	5,083,576
2012	10,744,778	3,679,587	4,824,506
2013	10,848,147	2,819,840	4,486,277
2014	11,307,865	3,615,344	3,943,496
2015	12,807,215	3,830,383	3,767,240
2016	12,715,352	4,294,646	3,657,801
2017	11,486,044	4,035,579	3,269,735
2018	13,918,115	5,162,022	3,667,841
2019	16,252,761	5,860,487	4,192,349
2020	18,087,054	6,664,012	4,047,510
2021	20,917,243	6,818,025	4,115,526

addresses the weak governance and subsequent poor law enforcement as the main cause of the forest crimes in the world, it also suggests that poverty reduction approaches targeted at forest-dependent populations committing forest crimes are also needed. In another study by Kishor and Belle (2004), which also supports the improved governance solution to reduce forest crimes, international trade in protected species, logging outside concession boundaries or in protected areas, underrating and misclassifying species, timber smuggling, transfer pricing in timber trade, and timber processing without a license are also considered as forest crimes. Contreras-Hermosilla (2002) provides a detailed list and descriptions of various forest crime types.

In Turkey, forest crimes and the corresponding punishments are defined and regulated by Turkish Forestry Law (1956) numbered 6831, which was published in the Official Gazette in Turkey on September 8, 1956. According to Turkish Forestry Law (1956), Article 4, there are three types of accepted forest ownership as state forest, forest belonging to public legal entities, and private forest. State forests are owned and controlled by the GDF as well as processing and manufacturing of all kinds of forest products, as mentioned in Article 89 of Turkish Forestry Law (1956). However, Article 6 states that all forest owned by the other parties than the state are still subject to the control of GDF.

Turkish Forestry Law (1956) provides detailed descriptions of many kinds of forest crimes with the corresponding prohibitions, punishments, and fines. In this study, there are

six types of forest crimes, which were taken into consideration. These crimes are illegal logging of trees, illegally transferring of the forest products, illegally expanding the lands into the forests, illegal occupation of the forestlands, illegal processing of trees, and illegal pasturages in the state forests.

The term illegal logging was used in this study in the context of harvesting timber in contravention of the related laws and regulations. Turkish Forestry Law (1956) defines the illegal logging crime in Article 14 as

A. "To cut or uproot grown or planted seedlings to damage plantation areas, to choke or wound trees, to cut their branches and tops or to get produce wooden tiles from the trees."
B. "To cut old or young trees or to uproot them or to get tar or bark or resinous wood from them, to cut leaning or overthrown trees or to take or uproot them on produce coal from them."

The crime of illegally transferring of the forest products is described in Article 108 as "anyone who transports, saws, works, accepts, sells, buys, or keeps illegally harvested or collected forest products is punished". The term forest product refers to all timber and non-timber products that can be obtained from forests. Additionally, Article 42 states "transportations within the forest are realized in routes determined by the forest management. The transportation permits should always be carried and exposed to related personnel when requested." Thus, according to Article 100, "transporters of any products without marking on them or without transportation permit document (against Article 41) are punished according to Article 108."

The crime of illegally expanding lands refers to the crime of encroachment on both public and private forests as described by World Bank (2006). This type of crime is committed by expanding private lands (usually farming lands) into the forests by either burning or cutting down the trees, trespassing the forest border line. The illegal occupation crime, however, refers to any kind of building or establishment built on forestland by burning or making use the empty places through invasion, as described in Article 17 of Turkish Forestry Law (1956), which brings regulations for both of illegal expanding and illegal occupation crimes.

As well as the illegal logging crime, the crime of illegal processing of the trees is also regarded as a crime by Article 14, which refers to using any kinds of products made from illegally obtained timber from forests, for any purpose like producing wooden tiles or coal. Moreover, Article 108 states, "Anyone who transports, saws, works, accepts, sells, buys, or keeps illegally harvested or collected forest products is punished."

The crime of illegal pasturing is defined by Article 19 as "the access of any kind of domestic animal to forest is prohibited. The forest administration only allows grazing for animals suffering from malnutrition in drought regions." Additionally, it also states, "this permission can be given under the terms and conditions of a given period, for the defined animal species and areas, and with the condition that no damage should be given to the forest." Similarly, Article 21 states, "the grazing of herds on the state forestlands should be done according to the plans and permission of the forest administration."

Logging from forests depends on strict regulations in Turkey. Turkish Forestry Law (1956) gives some rights to the Turkish citizens that are eligible to be defined as forest villagers. Forest villager documents are given to people who have been residing in a forest village in Turkey for at least one year. The list of the forest villages is determined by Ministry of Agriculture and Forestry (MAF). Forest villagers are permitted to obtain timber and non-timber products from forests condition to necessary permissions. Article 37 states "except logs, poles, mine props, industrial wood, paper wood, fuel wood, fiber wood, stick resin, resinous wood, boxwood, storax included in the annual production program of the state, all other kinds of forest products and residues are allowed to be utilized in determined locations and periods, giving priority to forest villages, development cooperatives, or to neighboring villagers or workers as with the payment of tariff prices." While getting these permissions, forest villagers have priority in using the forests next to their villages as mentioned in Article 40. It is also necessary to get permission for hunting in forests in Turkey according to Article 80 of Turkish forestry Law (1956). The article states, "the forest officers are authorized to detain the hunted animals and vehicles of individuals hunting in forests, forest lakes and ponds without hunting license and permission obtained from forest administration." Elvan (2014) provides a detailed examination and explanation of the forest crime types in Turkey within the framework of criminal law.

Turkey provides monetary aids to its forest villagers in forms of individual financial support credits or cooperative credits. To benefit from these loans, it is required to be a registered forest villager. The financial supports are provided to the forest villager families within the frame of the law on Supporting the Development of the Forest Villagers numbered 2924.

Financial supports are given in two categories as economic and social credits, which are interest-free loans with a maturity of 3–7 years. Only 1 person from each family is given credit for matters other than microcredit projects for housewives. Re-credit can be given to those who pay the entire debt without delay. The social credits are provided for the purposes of roof covering, exterior sheathing, solar

Table 2 The numbers of the families given financial support credits and the total amounts (TL) provided in 1997–2021

	The Numbers of the Families Given Financial Support Credits	Total Amounts Provided (TL)
1997	1812	28,979,731
1998	575	23,138,049
1999	1584	64,569,314
2000	2307	74,235,939
2001	1408	42,892,645
2002	2066	62,920,505
2003	2530	102,705,644
2004	3708	152,271,904
2005	5334	185,533,864
2006	9264	173,625,055
2007	17,629	142,211,630
2008	22,912	133,992,247
2009	22,681	137,177,372
2010	27,232	163,601,434
2011	21,577	180,446,865
2012	17,875	165,980,567
2013	21,081	339,912,316
2014	12,538	251,063,581
2015	10,421	253,167,294
2016	12,309	305,343,475
2017	10,303	258,591,460
2018	8519	216,693,262
2019	9341	238,963,158
2020	9248	270,516,678
2021	11,127	346,912,639

water-heating system installation, solid-fuel heating system installation, internal electrical installation for village houses, buying pellet stove, and pellet central heating system installation. The economic credits, on the other hand, are provided for buffalo breeding, sheep breeding, beekeeping, mushroom cultivation, medical and aromatic plant cultivation, greenhouse, viticulture, and fruit growing. In addition, the economic credits are provided also as micro-credits for housewives and limited contributions for purchasing tractors.

The financial credits provided to the forest villagers are not given in the form of grants in equal amounts, but in the form of interest-free repayment loans having certain upper limits that families can use based on their demands, which is the most important advance of these credits. While benefiting from the interest-free financial loans distributed in the specified areas, families are requested to document their expenditures in the relevant areas.

The numbers of the families, who are forest villagers, given financial support credits and the total amounts provided to them in 1997–2021 are presented in Table 2 and graphed in Fig. 3. The financial support amounts (in Turkish lira – TL) in Table 2, are adjusted values with respect to the deflator coefficient for the year 2021.

In Fig. 3, due to the scale differences of the numbers in the two data sets, the logarithms of the scores in the data set were taken.

When Fig. 3 is examined it is seen that the financial supports (TL) provided to the forest villager families have an increasing pattern between 1997 and 2021. On the other hand, it is observed that the number of families benefiting from these resources increased until 2010, but after this year, a general downward trend continued until 2020, with slight increases in 2013 and 2016.

There exist some ground truthing studies, which were performed to investigate the effectiveness of the forestry financial supports in the selected forest villages, such as Önal and Bekiroğlu (2011) performing a study to determine the socioeconomic results of the financial supports provided to the forest villagers in Turkey between the years 1999–2008. They chose the study area as Şile town of İstanbul province, and they interviewed the forest villagers residing in this area and conducted surveys. They applied the surveys to a group of 117 villagers who were randomly selected from the 30 forest villages in this area. The results of the study suggest that the financial forestry supports (provided under the title ORKÖY project) are useful in sustainable management of forest resources in the study area. In other words, the financial supports provided increased the welfare levels of the forest villagers and decreased their dependency on the forests. In another study concerning the ground truthing about the financial supports provided to the forest villagers, Çiray and Ünal (2021) evaluated the results of these projects in the years 2000–2019. They carried out the study in Kütahya province of Turkey by visiting 179 forest villagers, who were provided financial supports, from 32 forest villages located in this area. They used face-to-face survey and in-depth interview methods. They report that 43.6% of the participants stated that they were partially satisfied from such financial supports, 44.7 of them declared that they had no idea. However, 94% of the participants stated that the milk, fattening, and solar energy projects, which were realized by means of the financial supports, were the right (i.e. useful) choices. Similarly, Albayrak (2021) performed a field study among the forest villagers in Artvin, Turkey. The study, which covers Yusufeli, Şavşat, and Ardanuç towns of Artvin province, was carried out between April 2002 and September 2021 by interviewing 12 people forestry villagers, who had migrated to the big cities but later returned to their villages because of the Covid-19 pandemic. The forestry villagers stated that, in the past, they had met their fuel and roofing needs with the help of the provided forestry financial supports and they wanted the supports to be

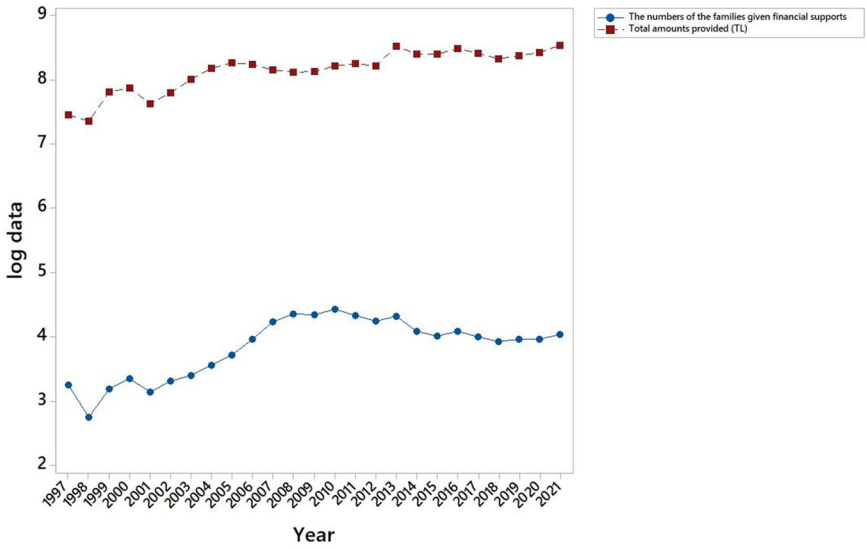

Fig. 3 Time serios plot of the logarithms of the numbers of the families given financial support credits and the logarithms of the total amounts (TL) they receive in 1997–2021

Table 3 The variables used in the study

	Variables	Definitions
The Dependent Variables (Forest Crimes)	Illegal logging	The annual number of illegal logging crime cases.
	Illegal transferring of forest products	The annual number of the crime cases of illegal transferring of wood products.
	Illegal expansion of private lands into forests	The annual number of the crime cases of illegally expanding private lands into forests through encroachment.
	Illegal occupation of forestlands	The annual number of the crime cases of illegal occupation of lands in forests by building structures for settlement or business.
	Illegal processing of trees	The annual number of the crime cases of illegal processing of trees by producing every kind of wooden items.
	Illegal pasturages	The annual number of the detected illegal pasturage cases.
The Independent Variable	Financial supports	The annual number of the forest villager families that are provided individual financial support credits by the Turkish State.

continued. Moreover, Coşgun (2021) performed an analysis of the solar power plant supports in the forest villages in the western Mediterranean region of Turkey, which covers Antalya, Burdur, and Isparta provinces. The aim of the solar power plant implementations is to reduce firewood consumption. The study was carried out on 629 forest villagers living in 100 randomly selected villages from a total of 152 villages and benefiting from solar power plant supports. The findings of the analysis suggest that the solar power plants installed reduces the firewood consumption of the forest villagers.

Data and Variables

The data consist of the numbers of the crime cases belonging to the dependent variables illegal logging, illegal transferring of forest products, illegal expansion of private lands into forests, illegal occupation of forestlands, illegal processing of trees, illegal pasturages, and the independent variable financial supports provided to forest villager families in 1997–2021. The data were recorded and published by the GDF (2021c). The crime records are based on the number of the forest crime cases caught by forest protection guards employed by the GDF. The definitions and explanations regarding the variables used in the study are provided in Table 3.

It would be useful to draw the time series plots of the variables to observe their behaviors in the years 1997–2021. Thus, the numbers of the forest villager families that were provided financial support credits by the state and the numbers of the illegal logging, illegal transferring of forest products, illegal expansion of private lands into forests, illegal occupation of forestlands, illegal processing of trees, and illegal pasturage crime cases recorded in Turkey in 1997–2021 are presented in Table 4 and graphed in Fig. 4.

When Fig. 4 is examined, in general, it can be said that the number of the families being provided individual financial supports follows an increasing pattern until 2010

Table 4 The data set used in the study

Years	Financial Supports	Illegal Logging	Illegal Transferring of Forest Products	Illegal Expansion of Private Lands into Forests	Illegal Occupation of Forestlands	Illegal Processing of Trees	Illegal Pasturages
1997	1812	16,184	5741	5130	2340	2310	7131
1998	575	15,044	5911	5429	2375	2140	6385
1999	1584	12,138	4085	5384	3038	1746	3771
2000	2307	11,357	3666	4529	3773	1405	5250
2001	1408	10,963	3529	5258	5080	1554	3281
2002	2066	10,222	4378	5008	3987	1084	3051
2003	2530	10,771	4436	3886	3248	1747	2726
2004	3708	8472	3246	3573	2830	697	3720
2005	5334	7332	2767	3981	3484	624	3758
2006	9264	5956	2052	2837	2446	399	3035
2007	17,629	6028	1900	2836	2292	288	3356
2008	22,912	5020	1651	2393	2185	313	2733
2009	22,681	4946	1692	2283	2437	299	2066
2010	27,232	4114	1339	3019	4089	300	1952
2011	21,577	3742	841	2337	2947	213	1448
2012	17,875	4149	1017	2013	2963	178	1711
2013	21,081	3620	892	1930	2623	169	1684
2014	12,538	3519	689	2209	2628	133	1571
2015	10,421	2944	708	1971	2103	82	1005
2016	12,309	2891	658	2332	2996	68	1032
2017	10,303	2993	802	2473	2241	68	1067
2018	8519	2880	670	3465	3221	58	818
2019	9341	3356	706	3550	3549	96	834
2020	9248	4532	786	5096	4642	92	962
2021	11,127	4047	548	6043	5987	88	802

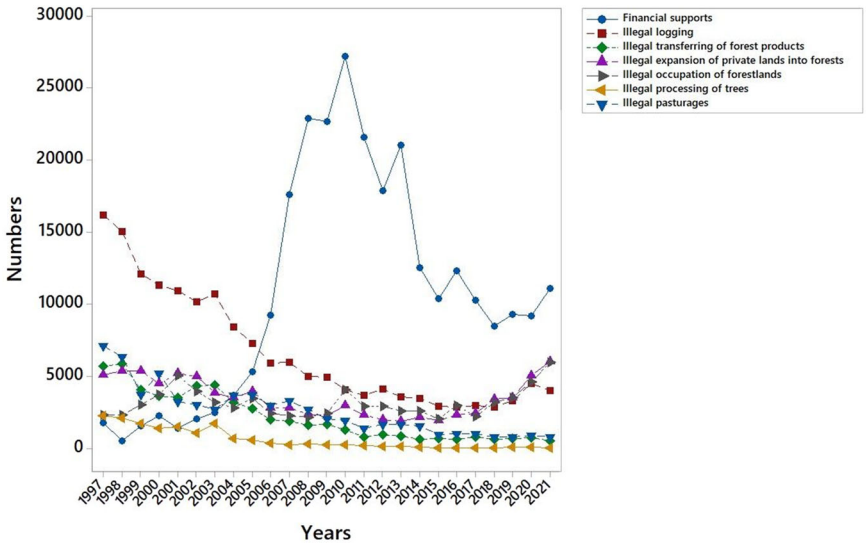

Fig. 4 The numbers of the families receiving financial supports and the numbers of the forest crime cases in Turkey for the years 1997–2021

except some decreases in certain years such as 1998, 2001, 2009. After 2010, however, the number of the families receiving financial supports has a decreasing trend with slight increases in 2013 and 2016 until the year 2018. The numbers of the families seem to have an increasing trend again after 2018. The probable reasons for the sharp

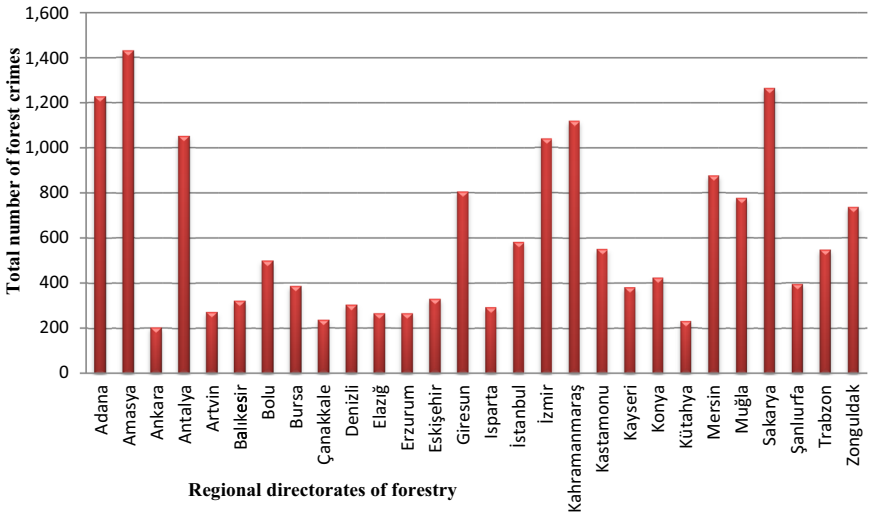

Fig. 5 The total numbers of the forest crimes seen in the regional directorates of forest in Turkey as of 2020

decreases in the financial supports provided by the state in the years 2001, 2008, 2014, and 2018 are the economic crises experienced in Turkey during these years. In fact, the 2018 crisis was a global economic crisis that also affected Turkey. In 2014, however there was a dramatic loss in the exchange rate of the Turkish lira (TL) against the United States Dollar (USD), which caused a serious decrease in the purchasing power of the TL. Thus, less amount of money was put into circulation, to prevent the TL from losing its value more.

In general, the crime of illegal logging displays a decreasing pattern between 1997 and 2018 except for the little increases in 2003, 2007, 2012, and 2014. The most important reason for the extraordinary increase in 2014 is that there was a considerable decrease in the value of the TL against the USD in 2014, which is followed by a sharp increase in the interest rates. This situation caused a serious decrease in the purchasing power of Turkish citizens. After 2018, however, there is an extraordinary increase in the illegally logging crime level reaching its peak in 2020. Afterwards, the crime levels seem to have a decreasing trend. Meanwhile the increase in the year of 2020 is notable. This increase can be explained by the conditions due to the Covid-19 pandemic, which started in this year. One possible condition for this extraordinary increase can be given as the curfews, which prevented people from working and caused a dramatic decrease in incomes. In addition, the curfews also caused less security controls in the forests, which caused criminals to act more freely than usual (Lang et al 2021); (GDF 2021d). It can also be seen that the crime case numbers of illegal transferring of forest products have some little peak points in the years of 1998, 2003, and 2017. However, the case numbers visibly fluctuate between the years 1997 and 2007. On the other hand, they remain almost linear with a slightly decreasing trend afterwards. Moreover, it is also possible to see that the case numbers belonging to the crime of illegal expansion of private lands into forests fluctuate in a slightly decreasing way with small peaks and troughs between 1997 and 2012. The case numbers remain almost steady between 2012 and 2017. However, they quickly increase afterwards, reaching its peak in 2021. Meanwhile, the sharp increase in 2020, the beginning of the Covid-19 pandemic, is also noticeable for this type of crime. When the crime graph of illegal occupation of forest lands is analyzed, a rapid upward trend is observed from 1997 to 2001. Afterwards, with a slight increase in 2005, there is a decreasing trend until 2008. In the following years, there is not much fluctuation until 2017, except for the small increase in 2016. However, after 2017, a sharp increase occurred for this type of crime and reached its peak in 2021. As for the crime of illegal processing of trees, although the numbers of cases of this type of crime fluctuated slightly, creating two small peaks in 1997 and 2003, it is seen that they decreased after 2003 and remained almost at the same level until 2021. When it comes to the number of illegal pasturage numbers crime, it is observed that they experienced a rapid decline from 1997 to 1999. However, they increased rapidly afterwards and peaked in 2000. Afterwards, they decrease rapidly until 2003. After this year, with two peaks observed in 2004 and 2005, they show a decreasing trend until 2021 with an approximately flat pattern. The total numbers of the cases for all forest crime types, which were encountered in the regional directorates of forestry and reported by GDF (2021d) for the year 2020, are presented in Fig. 5.

Figure 5 shows that the highest numbers of forest crimes are seen in Amasya, Sakarya, Adana, Kahramanmaraş, Antalya, and İzmir regions, which have forest crime cases over one thousand. However, the crime levels are seen the least in Çanakkale, Kütahya, and Ankara regions, which have cases less than 250. It can be expected that the level of crimes will be higher in the regions having larger forest

Table 5 Normality test results of the variables ($\alpha = 0.05$)

Variables	Kolmogorov–Smirnov Statistic	*P*-value	Normally Distributed
Illegal logging	0.221	0.010	No
Illegal transferring of forest products	0.194	0.022	No
Illegal expansion of private lands into forests	0.154	0.126	Yes
Illegal occupation of forestlands	0.158	0.105	Yes
Illegal processing of trees	0.276	0.010	No
Illegal pasturages	0.148	0.150	Yes
Financial supports	0.125	0.150	Yes

Table 6 Outlier analysis results of the variables

Variables	N	Q1	Q3	Interquartile-Range	Outlier – Year
Illegal logging	25	3569.5	10496.5	6927	None
Illegal transferring of forest products	25	747	3597.5	2850.5	None
Illegal expansion of private lands into forests	25	2334.5	5052	2717.5	None
Illegal occupation of forestlands	25	2406	3661	1255	5987 – (2021)
Illegal processing of trees	25	94	1244.5	1150.5	None
Illegal pasturages	25	1049.5	3538	2488.5	None
Financial supports	25	2418.5	17752	15333.5	None

areas. However, when Fig. 2 and Fig. 5 are examined together, this expectation appears to be not realistic. For example, although Amasya directorate has the largest forest area and the highest level of crimes, Elazığ, for example, has the second largest forest area but considerably low level of crimes. Similarly, Sakarya has a smaller forest area compared to the other directorates, but the level of the forest crimes is remarkably high in this directorate. A more realistic explanation for the differences observed in the distribution of these crimes by region is that, as stated in the 2021 activity prepared by the GDF, the number of protection officers has been increased in the regions where forest assets and forest crimes are intense, and a more intense observation activity has been carried out in cooperation with the headmen in the forest villages (GDF 2021e).

As far as the reliability of the data is concerned, apparently, the GDF provides data about various forest crimes including illegal logging in Turkey, which are provided in Section "Forest crimes and forestry financial supports in Turkey". Thus, it is evident that there is a certain amount of illegal logging in Turkey. However, in some international studies, such as Li et al. (2008), it is reported that the estimated share of the illegally logged industrial round wood in Turkey is 0% as of 2004. Additionally, a report by the United Nations Economic Commission for Europe (UNECE) published in 2006 notes that Turkish forest law enforcement, governess, guarding and controlling system against forest crimes are strong and strict for long time, thus, illegal logging and associated forest crimes are not at high levels. Additionally, it also reports the rates of illegal logging for commercial use is quite low and not a significant issue to international trade (UNECE 2006).

Correlation Coefficient

Correlation coefficient measures the degree and the direction of the linear relation between two variables. A significant correlation coefficient also indicates a dependency relation between the variables for which it is calculated. There are various measures to calculate correlation coefficient such as Pearson and Spearman correlation coefficients. Pearson correlation coefficient is a parametric method, while Spearman correlation coefficient is a nonparametric measure of correlation. Pearson correlation coefficient requires some assumptions before it is calculated. These assumptions are linearity, continuous-level variables, homoscedasticity, normality, absence of outliers and independence.

To test whether the normality assumption required by Pearson correlation coefficient holds for the variables employed in the study, Table 5 presents the variables having a normal distribution, and the ones not normally distributed.

It is apparent in Table 5 that not every variable has a normal distribution, such as the variables illegal logging, illegal transferring of forest products, and illegal processing of trees. To check another assumption of Pearson correlation coefficient of absence of outliers, Table 6 demonstrates

Table 7 Homoscedasticity test results of the variables ($\alpha = 0.05$)

Dependent Variables	Independent Variable	Bonett's Statistic	*P*-value	Homoscedasticity
Illegal logging	Financial supports	9.98	0.002	No
Illegal transferring of forest products		35.25	0	No
Illegal expansion of private lands into forests		45.74	0	No
Illegal occupation of forestlands		60.58	0	No
Illegal processing of trees		77.38	0	No
Illegal pasturages		34.62	0	No

the outlier analysis results of the data. The outlier analysis was performed based on a nonparametric approach, which is interquartile range, as a common measure for all the variables; as it has already been shown that there are variables in the data set having non-normal distributions.

Table 6 shows that the variable named illegal occupation of forestlands has an outlier value as 5987 belonging to the year of 2021. Additionally, to check the homoscedasticity assumption before using Pearson correlation coefficient, Table 7 presents the homoscedasticity test results between the independent variable financial supports and the dependent variables.

When Table 7 is examined, it is seen that there is no homoscedasticity between the independent variable financial supports and any dependent variable.

It is evident that, the assumptions of normality and absence of outliers failed for some variables. Moreover, homoscedasticity assumption failed for all the variables. Furthermore, when a correlation coefficient is to be calculated between two time series, Pearson correlation coefficient cannot be used directly, as it is appropriate for independent data. However, time series data is usually dependent on time. Thus, these results indicate that Pearson correlation coefficient is not an appropriate measure to use for the variables employed in the study.

Spearman correlation coefficient, however, is a nonparametric method, which does not require any normal distribution or the other assumptions required by Pearson correlation coefficient except the linearity assumption. Thus, it can be an alternative to Pearson correlation coefficient, when its assumptions are not met. Therefore, in this study, Spearman correlation coefficient was adopted to analyze the relations between forestry financial supports and the forest crimes listed in Table 3. While calculating Spearman correlation (r_s) for two variables X and Y, firstly they are converted to ranks as $R(X)$ and $R(Y)$. Then, Pearson correlation (ρ) formula is used to calculate the correlation between the ranked variables. Spearman correlation coefficient is calculated as follows.

$$r_s = \rho_{R(X)R(Y)} = \frac{Cov[R(X), R(Y)]}{\sigma_{R(X)}\sigma_{R(Y)}} \quad (1)$$

where r_s denotes Spearman correlation coefficient, $Cov[R(X), R(Y)]$ is the covariance of the ranked variables, $\sigma_{R(X)}$ and $\sigma_{R(Y)}$ are the standard deviations of the ranked variables $R(X)$ and $R(Y)$ respectively. Just like Pearson correlation coefficient, Spearman correlation coefficient also varies between -1 and $+1$.

Results and Discussion

Spearman correlation coefficient gives the degree and the direction of the linear relation between two variables, for which it is calculated. To see the pattern of the relations between the dependent variables illegal logging, illegal transferring of forest products, illegal expansion of private lands into forests, illegal occupation of forestlands, illegal processing of trees, illegal pasturages and the independent variable financial supports, the corresponding scatterplot diagrams are presented in Fig. 6.

When Fig. 6 is examined, it is seen that the pattern of the relation between each dependent variable and the independent variable is roughly linear with a decreasing tendency except the dependent variable named illegal occupation of forestlands. Moreover, it is apparent that illegal occupation of forestlands variable has an outlier value, which is reported also by the test results presented in Table 6. However, as Spearman correlation coefficient is robust to the possible outliers, the detected outlier was not removed from the data set. Thus, the correlation analysis results between the independent variable financial supports and the dependent variables under consideration are presented in Table 8 depending on Spearman correlation coefficient.

As seen in Table 8, Spearman correlation coefficient between the numbers of illegal logging cases and the numbers of the families receiving financial supports was calculated as -0.631 with a p-value of 0.001, which is less than $\alpha = 0.05$. Thus, the calculated correlation coefficient indicates a moderate level of significant negative correlation between the variables under consideration. Therefore, it can be concluded that the financial supports provided to the forest villager families seem to help reducing the illegal logging crime levels. One of the possible reasons to explain this situation

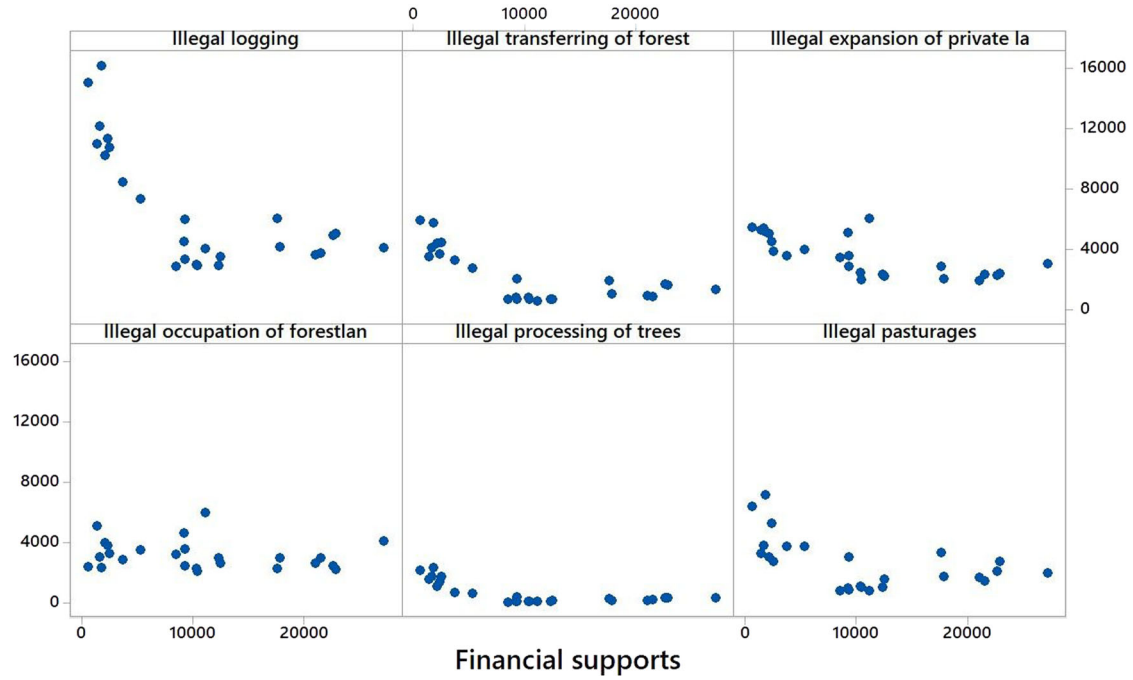

Fig. 6 Scatterplot diagrams between the dependent variables and the independent variable provided in Table 3

Table 8 Correlation analysis results of the variables ($\alpha = 0.05$)

Dependent Variables	Independent Variable	Spearman Correlation Coefficient	*P*-value	Significance
Illegal logging	Financial supports	−0.631	0.001	Yes
Illegal transferring of forest products		−0.6	0.002	Yes
Illegal expansion of private lands into forests		−0.762	0	Yes
Illegal occupation of forestlands		−0.256	0.216	No
Illegal processing of trees		−0.563	0.003	Yes
Illegal pasturages		−0.504	0.01	Yes

may be the fact that the financial supports provided to the forest villager families also cover the monetary aids given for heating and cooking facilities using coal, gas, electric (including solar), or legally purchased wood. The finding that financial supports helps reducing the illegal logging activity is supported by many studies, such as Gençay and Mercimek (2019), who suggest that the best way of preventing forest crimes are to increase the income of the people and reduce their need for forests and forest resources. Similarly, Alemagi and Kozak (2010) count poverty among the causes of the illegal logging activities in Cambodia. They also report that some employment was provided to villagers to curb illegal logging. On the other hand, in a study performed by Daşdemir and Köse (2021), which examined the effects of financial supports and informational and training-consulting services in İstanbul region, they suggest that these activities decreased the levels of legal and illegal logging cases; however, they did not have any effects on forest growing and other forest crimes.

As far as the crime of illegal transferring of forest products and the financial supports are considered, Spearman correlation coefficient was calculated as −0.6 for these variables with a *p*-value of 0.002. The calculated *p*-value is less than $\alpha = 0.05$, which means the calculated negative correlation coefficient is significant. Thus, it turns out that the financial supports provided reduce the crime of illegal transferring of forest products as well as the crime of illegal logging.

When it comes to the variables of illegal expansion of private lands into forests and financial supports, Spearman correlation coefficient was calculated as −0.762 with a *p*-value of 0. As the p-value is quite smaller than $\alpha = 0.05$, there seems to be a strong significant negative correlation between the number of the financial supports provided and the number of the crime cases of illegal expansion of private lands into forests. In addition, it turned out that the financial supports provided were most beneficial in reducing the number of cases belonging to this type of forest crime.

Speaking of the variables of illegal occupation of forestlands and financial supports, Spearman correlation coefficient was calculated as -0.256 with a p-value of 0.216, which is quite greater than $\alpha = 0.05$. Therefore, it appears that, there is not a significant correlation between financial supports and illegal occupation of forestlands variables.

When the variables illegal processing of trees and financial supports are concerned, Spearman correlation coefficient was calculated as -0.563 with a p-value of 0.003. Therefore, it can be said that there is a significant and moderately strong negative correlation between financial supports and illegal processing of trees variables.

For illegal pasturages and financial supports variables, the calculated Spearman correlation coefficient is -0.504 with a p-value of 0.01, which implies a significant negative correlation and a moderate dependency between these variables. Thus, it is again possible to comment that the provided financial supports significantly reduce the number of illegal pasturages.

Conclusions

In conclusion, the overall results of our study suggest that except for the crime of illegal occupation of forestlands, the financial supports provided to the forest villager families in Turkey significantly reduce the levels of illegal logging, illegal transferring of forest products, illegal expansion of private lands into forests, illegal processing of trees, and illegal pasturage crimes. Therefore, it is possible to conclude that the financial support provided has not been successful in stopping the crime of occupation of forest areas, which is a relatively "more profitable" type of crime. Since, when the criminals commit this crime, they acquire lands or buildings in forest areas without paying any price. This study can be repeated in other countries, where the same or different types of financial supports are provided to people living in the settlements near forests, to observe whether they change the levels of the forest crimes committed. Thus, it would also be possible to make comparisons among the behaviors of the criminals in different countries.

Data availability

The data used in this study is provided in a tabular form within the article.

Author Contributions The sole author of this manuscript is solely responsible for all the contributions made in the manuscript.

Compliance with Ethical Standards

Conflict of Interest The author declares no competing interests.

Consent to Participate The sole author of this manuscript consents to participate.

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