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A Critical Approach to the Calculation Method of Economic Value of Forest Fire Damages in Turkish Forestry: A Case of Forest Enterprise From Mediterranean Region

Abstract

The paper presents an approach to calculate fire damage in a forest area from the forest economics standpoint. The damage calculated using the approach presented here and the one determined by the State Forest Enterprise were compared for a burned area in Kumluca State Forest Enterprise, Antalya. When the land revenue from area, the general administration costs and the alternative costs of the labour used for extinguishing the fire (out of SFE's staff) are taken in to consideration, it seems that about 26.6 billion Turkish Liras (TL) (= $US 42,980) have been ignored. This is approximately 12 % of the compensation value calculated by SFE.

Keywords: Sustainable forestry, Turkish forestry, Forest fires, Economic value of forest fire damages.

1. Introduction

Today, the rapid population increase and technological developments increase the importance of effective, productive and most importantly sustainable use of forest resources. At this point, sustainable forestry plays a key role in attaining the goal of sustainable development. However, there are some biotic and abiotic factors affecting the sustainable forestry (Türker et al., 2001a).

Turkish forests are under the threat of many factors such as forest fires, insect, fungus, storm, snow, pollution and illegal uses. As in all other countries of the Mediterranean basin, forest fires are one of the most important destruction factors both environmentally and economically. In Turkey, 58% of forests have sensitive characteristics regarding the forest fire (GDF, 2002).

In Turkey, the calculation method of fire damage is quite inadequate in its current application. Because the General Directorate of Forestry (GDF) is only taking into consideration the market value of products burned and the suppression and reforestation costs. So, there are some criticisms from the interest groups, especially Non-Government Organisations (Türker et al., 2002).

The purpose of this paper is to propose an approach to calculate fire damage.

2. Materials and Methods

Along with the relevant literature on forest fires and statistical information in Turkish forestry, the management records of an area burned in 2000 in Kumluca State Forest Enterprise, Antalya were also used as a research material in this study.

In the study, firstly some basic theoretical information is given about the determination of approximate value of forest fire damage from a forest economics standpoint, and then the economic value of forest fire damage is determined. Lastly, to evaluate the current method in Turkish forestry, economic value of the forest fire damage calculated for a sample area has been re-calculated by also taking into consideration some of additional cost items that should be calculated and the result has been compared with previous result.

3. Findings

3.1 Determination Methods of Forest Fire Damages

3.1.1 Determination of Approximate Damage Value in a Forest Fire from Forest Economics Perspective

The types of damage can be classified as below (Firat 1971; Acun 1976; Firat and Miraboğlu 1977):

- Damage arisen from cutting the stands in the fire area earlier
- The loss of revenue obtained from the land during the years when it is unplanted
- The share of the burned land in administrative expenditures during the years when it is unplanted
- The level of damage caused by fire to the surrounding forests
- The loss from problems in management plans and decreases in non-wood forest products
- The cost for changing or redesigning the management plans
- The damages to the wildlife
- The decrease socio-cultural services of forests
- Damage caused by fire in environmental values
- Damage caused by fire in recreational services
- Damage caused by fire in watershed
- Reforestation costs
- Damages occurred out of forest

3.1.2 Currently used Method of Forest Fire Damages in Turkish Forestry

The damage value at the end of forest fires is calculated as follows (Türker, 1997; Anonymous, 2002; GDF, 2000; Türker et al., 2001a; Türker et al., 2002):

- After fire, a technical person on site prepares a Fire Damage Report. The damage level of seedlings, growing stock damaged by fire, the necessity of reforestation and also level of reforestation, the percentage of non-valuable part of growing stock burned by fire and the feeding expenditures made for people who work in forest fire are calculated based on the values in this report.
- The growing stock obtained after fire and not valued in market is classified as timber, mine pole etc. and its volume is determined in terms of volume according to current values in the management plan.
- The market value of growing stock damage is calculated by multiplying these volume values with the unit price determined by the relevant SFE according to Forest Law No: 6831 and article 112, by extracting the harvesting, transportation and stacking costs from the average value of auction sales in the relevant year.
- Then, the reforestation costs are calculated by multiplying the amount of the area which must be reforested after fire with the unit cost of reforestation determined by the relevant SFE according to Forest Law No: 6831 and article 114.
- On the other hand, costs of fire suppression (costs for machine use and food for workers) are calculated according to the Fire Damage Report.

In brief, the total damage cost arisen from a forest fire for a forest enterprise is the sum of market value of output burned by fire, reforestation cost, suppression cost and expenditures for the workers including the expenses of petrol and oil etc. necessary for cars. The decreases in the economic, environmental and social values due to burning is not taken into consideration in the calculations.

3.2 Economic Evaluations of Forest Fire Damages in Turkish Forestry: Kumluca SFE Example

3.2.1 Calculation of Forest Fire Damages with Current Application: Kumluca SFE Example

Here, a 417 ha forested area burned in 2000 is used as an example. The types of damage and values calculated by the relevant SFE are shown in Table 1 (Anonymous, 2000).

Table1. Types and Values of Damages caused by Forest Fire according to SFE

Damage Types	Damage Values	
	(x 1000 TL)	$US [1]
Timber Damage	80 352 000	129 991
Reforestation Cost	118 932 570	192 405
Extinguishing Cost [2]	27 981 695	45 268
Total Damage Value	227 266 265	367 664

[1] 1 $US = ~620,000 TL (as of time of writing the manuscript)
[2] Extinguishing costs include food, fuel, and premium for workers and helicopter costs etc.

The damage types taken into account were timber damage, reforestation cost and extinguishing cost. Since there were no seedlings in the burned area, any damage calculation related to the seedlings was not made.

3.2.2 Damage Types Added to Damage Calculations

As a result of comparing the method currently applied by GDF in Turkish forestry to determine the economic value of damage occurred after fire with a new method developed from a forest economics standpoint, it is possible to state the following evaluations (Firat, 1971; Acun, 1976; Ünal, 1990; Türker, 1997; Türker et al., 2001a; Türker et al., 2002).

3.2.2.1 Deprived Revenues While Forestland Unplanted Following the Fire

In the current application, after fire, the loss of revenue, which the SFE will be left without revenues from the forestland during the years that might be unplanted, is not included in the damage value. In another word, after a fire, if the forest area burned by fire cannot be replanted by SFE for any reason, the revenue from forest area for the years the land remain unplanted should be included in the damage calculation.

This is calculated by using the following formula (Firat and Miraboğlu 1977; Miraboğlu 1979):

$$K_0 = \frac{B(1.0P^n - 1)}{1.0P^n}$$

Where; K_0 is the revenue from the land for empty years, B land value, n period that the forest area remained empty after fire, p interest rate.

Here, B land value is a value used by GDF to use for land allocations and calculated as equivalent of the loss arisen from destruction of forest area and the decrease in the performance capacity of site. This value was calculated for the year of 2000 as 400 million TL/ha. Research area remained empty for 2 years (n) and P interest rate is taken as 3 %. According to these data, the revenue from the land for empty years can be calculated as follows:

$$K_0 = \frac{400000000(1.03^2 - 1)}{1.03^2} = 22{,}961{,}636 \text{ TL / ha}$$

As the forest area burned by fire is 417 ha, the total revenue from the land is as follows:

417 x 22,961,636 = 9,575,002,212 TL (= $US 15,490)

3.2.2.2 General Administration Costs While Forestland Unplanted Following the Fire

In the current application, the share of the forest area in general administration cost is not reflected in fire damage costs. After forest fires, if it is impossible that the forest areas burned by fire are replanted by SFE, the share of forest area in the general administration expenditures which the SFE must spend every year should also be reflected in fire damage costs. But, these items have also been ignored in the calculation of fire damage value.

It is also possible to calculate the share of the forest area burned by fire in the general administration expenditures for empty years as follows:

$$K_0 = \frac{v(1.0P^n - 1)}{0.0P \times 1.0P^n}$$

Where, K_0 is the capital value of the general administration expenditures spend during empty years after fire, v annual general administration expenditure per ha and p forestry interest rate.

The general administration cost has been calculated as 4,587,707 TL/ha for Kumluca SFE in 2000 (Anonymous, 2000). As the area has been remained 2 years as unplanted and interest rate is accepted as 3%, the administration cost per ha is

$$K_0 = \frac{4587707(1.03^2 - 1)}{0.03 \times 1.03^2} = 8{,}778{,}427 \text{ TL / ha}$$

Then, as total area is about 417 ha, the share of the forest area in the general administration costs is

8,778,427 x 417 = 3,660,604,059 TL (= $US 5,922)

3.2.2.3 Alternative Labour Costs

In current application of Forest Damage Report, the expenditures done for work machines used for fire suppression and food costs for suppression workers have been calculated. Thus, the damage value is under its real value. Furthermore, the alternative costs of labour force, motor/less vehicles, helicopter, chemicals etc. used in extinguishing the forest fires should be calculated.

Tens, some times, hundreds of people, soldiers, obliged person and the other citizens, work night and day to extinguish forest fires. To determine the reel cost of forest fire suppressions, the alternative costs of this labour force must be included in the calculation of forest damage value.

179 people including soldiers, forest villagers, and dweller in surrounding places, worked in example forest fire. The alternative labour costs of these persons can be determined by the formula (Türker et al., 2001a):

$$ALC = P \times W \times T \times D$$

Where; *ALC* is alternative labour cost, *P* the number of person worked in forest fire, *W* average wage per hour, *T* average working time in a day, *D* the number of working day.

Of 513 people who worked in the fire, just 334 persons are employees of the SFE, the remaining (A) 179 are not (Anonymous, 2000). According to the data provided by State Institute of Statistic, the average wage per hour for December of 1999 was 1 330 000 TL (SPO, 2000). And also, (C) 8 hours is accepted as the average working time in a day. Since the fire was put out in 7 days, the number of working day is accepted (D) 7 days. Using these data, the alternative labour cost is calculated as:

ALC = 179 x 1,330,000 x 8 x 7 = 13,331,920,000 TL (= $US 21,568)

3.2.2.4 Some Other Damage Types

When the damage value concerning the growing stock is calculated in Fire Damage Reports prepared by the SFEs, only cutting value of growing stock is taken into account. This value may indicate true results for mature stands. But it will not be appropriate for other stands that are midway through the developmental stages. Because the growing cost value stock calculated for young stands or the growing stock expectation value for the stands at the middle ages will be more than the calculated growing stock cutting value.

In our example, the cutting age for the stand in management plan is 60 year and burned stand age is about 40 or 50 years. Thus, cutting value of growing stock found in Fire Damage Reports prepared by the SFEs can be substituted for the damage value for growing stock after fire. Similarly, the costs of

physical and moral damages incurred during the fire should be added to the fire suppression costs. In addition, the every kind of health expenditures must also be added. The cost of every kind of protective measures to be taken and staff and equipments to be appointed should be subjected to the calculations. If the backfire technique is used to prevent the current forest fire, the damages arisen from second fire should also be added to the compensation. Such items were not added to the calculations in this study, as simply these were not present.

One other deficiency in the Fire Damage Reports prepared by the SFEs is that the loss of non-wood forest products is not reflected to the calculation of fire damage compensation. To eliminate this deficiency, firstly, the inventories of national forests' secondary products or non-wood forest products should be completed and according to the type of annual or periodic utilisation from these resources, the revenue deprived by the SFE should be subjected to the compensation. As there is no available inventory of non-wood forest products for the forest area burned by fire as well as for all over the country, such a calculation couldn't be realised.

3.2.3 Comparison of Current Calculation with that of the proposed Calculation

When the land revenue from area, the general administration costs and the alternative costs of the labour used for extinguishing the fire (out of SFE's staff) are taken in to consideration, it seems that about 26.6 billion TL ($US 42,980) have been ignored. This is approximately 12 % of the compensation value calculated by SFE. When the other items mentioned above are added to the damage value in future, it is obvious that the reel damage value would reach greater values. Adding the suggested damage types to the damage calculation caused damage value per ha to increase from $US 882 to $US 985.

Table 2. Comparison of Current Calculation with Suggested Calculation

Damage Types		Damage Values		
		(000 TL)	$	$/ha
Current Application	Damage Value Calculated by Kumluca SFE	227 266 265	367 664	882
Added Damages	Deprived Land Revenues	9 575 002	15 490	37
	General Administration Costs	3 660 604	5 922	14
	Alternative Labour Costs	13 331 920	21 568	51
	Total Added Damage Values	26 567 56	42 980	103
Total Damage Value		253 833 791	410644	985

4. Conclusion and Recommendations

There is some negativity such as clearing for agricultural purposes, illegal cuttings, grazing, forest fires etc. obstructing the management of forest resources according to the multiple use and sustainability principles in Turkey. The forest fire is one of the negativities occurred in Turkish forestry (Türker et al., 2001).

The cost of damage occurred as a result of forest fires was calculated as US$ 9,604,402 for the whole country in 2002 in Turkey (GDF, 2002). However, this amount indicates only minimum damage because of the reasons mentioned above.

In Turkey, people are a main factor causing the forest fires. In this case, it is important that human being must be taken into consideration for the protection of forests from fires. Especially, the training of a part of society related to the forests is required. Also it is necessary to determine the economic aspect of fire damage (Türker et al., 2001a).

It is seen that the damage value reaches to 26.6 billion TL (US $ 42,980). This is about 12 % of the damage value (227.3 billion TL = $US 367,664) calculated by using current application for the sample forest area. This is just a result of adding the three items to the damage value calculation. However, as

the other items that cannot be added to the calculation because of various reasons are taken into account, the damage value in question will reach to greater figures.

On the other hand, the forest fires are also a negative externality for forest resources and forest management activities. In this case, the compensation value calculated according to this approach will indicate the minimum compensation value, although all cost items are taken into account. Because, that a forest area is destroyed by fires, it means that it will be deprived of many positive externalities such as erosion prevention, regulation of water regime, carbon storage etc. provided by that forest area (Türker et al., 2001b). Consequently, considering the positive externalities deprived as a result of forest fire, it is seen that the calculation of real compensation value is very difficult and the amount calculated shows only minimum value of compensation.

In the calculation of current fire damage compensation in Turkish forest management, in the short run, a few items might be added to the calculation by using available inventories. In the middle and long run, other cost items can also be added to the calculation when transforming into intensive forest management practices. To reflect this damage calculation approach into current application, related legal framework should be revised.

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