Extent of illegal fuel wood consumption from turkish state forests: economic and welfare effects

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Abstract

People living in and around the state owned forests of Turkey have traditionally and illegally been using wood as fuel wood owing to social, economic and cultural problems in Turkey. The forestry sector has little share in gross national product due mainly to the fact that the raw material is used as fuel wood instead of being used in industrial fields. The dilemma is the identification of the fuel wood consumption as well as the control of the balance between the use of fuel wood and the industrial wood with respect to the socio-economic conditions.

The main objective of this study is to analyse the economic loss and indirectly welfare gain related to illegal wood raw material consumption as fuel wood from the Maçka State Forests. In order to carry out the study, questionnaire and office studies along with forestry economic methods such as stumpage price and cutting value of growing stock were used. The results of the study indicated that, total official fuel wood and industrial wood production of Maçka State Forest Enterprise (Maçka SFE) in 1998 could only reach an amount of 9.5 % of total illegal fuel wood consumption in forest in Maçka SFE. The economic loss caused by this illegal fuel wood consumption totalled 52 billion TL ($ 208 199).

Résumé

Les populations qui habitent les forêts d'Etat en Turquie ont depuis toujours utilisé d'une manière illégale le bois de chauffage à cause des problèmes économiques, sociaux et culturels du Pays. Le secteur forestier absorbe une petite quote-part du produit national brut, surtout à cause du fait que la matière première est utilisée comme bois de chauffage plutôt que pour le secteur industriel. Il est donc nécessaire de définir la consommation du bois de chauffage et de contrôler l'équilibre entre l'utilisation du bois de chauffage et du bois pour l'industrie par rapport aux conditions socio-économiques.

L'objectif principal de cette étude est l'analyse des pertes économiques et, indirectement, du bien-être accru lié à la consommation du bois de chauffage provenant de la forêt d'état de Maçka. Pour cette étude, on a utilisé des questionnaires et des méthodes d'économie forestière telles que les prix du bois sur pied, la valeur de coupe et du volume sur pied. Les résultats de l'étude indiquent que la production totale officielle du bois de chauffage et industriel de la Maçka State Forest Enterprise (Maçka SFE) en 1998 ne pouvaient atteindre qu'une quantité égale à 9,5 % de la consommation totale de bois de chauffage de la Maçka SFE. La perte économique causée par cette consommation illégale de bois de chauffage était égale à 52 milliards de TL ($ 208 199).

1. Introduction

Raw wood fibre has been one of the oldest materials used by mankind (Fung, 1992; Bethel, 1992). Before the worldwide energy crisis, it was of little importance as a major source of energy, but, the over-increase in oil prices in 1970s suddenly increased the importance of renewable energy sources and therefore wood as an energy source (FAO, 1985).

Forests cover about 3 870 million ha, or 30 percent of the earth's land area. Estimates by FAO show that global production of total roundwood reached 3 335 million m^3 in 1999. Just over half of this was fuel wood, about 90 percent of which was produced and consumed in developing countries (FAO, 2001) .The rate of fuel wood production within the total wood production in Turkey has only been reduced to 53 (GDF, 2001) while this rate is about 14 % in Europe (Forestry Report, 2001).

Approximately 65 % of total wood consumption in the world is fuel wood. While the share of wood and other wood based fuel in the total energy consumption of the world is about 7 %, this rate reaches 15 % in the developing countries (Forestry Report, 2001). In accordance with wood supply and demand projections of the Forest Main Plan in Turkey (Forestry Main Plan, 1988), the deficit in industrial wood-supply is estimated to reach about 7 million rn^3 in 2009. In Turkey, around 35 % of energy consumption comes from wood sources for mainly heating purposes and that puts the use of fuel wood to top rank among such other energy sources as plant and animal based residues, coal, and fuel (Forestry Report, 1990). Owing to large consumption of wood as fuel wood instead of its utilization in industry, the rate of forestry sector in gross national product has been only 0.5 % (Türker and Kaygusuz, 1995; Türker, 1999). Evidently, according to Cakır (Çakır, 1984) the rate could have been around 1.76 % when the private wood production, mushroom harvesting and especially illegal fuel wood production were taken into consideration in the balance sheets.

In the Turkish Republic Government's Development Plans, the use of wood in industry rather than as fuel wood has been proposed as a policy, and it has been suggested that alternative energy sources be looked for to re-

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place wood with electric energy, wind and solar energy. But, due to the failure of proposed plans in these sectors producing alternative energy sources, illegal cuttings[1] by forest villagers have been continuously taking place.

Turkey covers 20,7 million hectares forest of which 26,6% of the total land area. The growing stock of the forests is about 57,8 m^3/ha and its mean annual increment is 1,7 m^3/ha. Compared with the officially determined amount of annual harvest level, the amount of uncontrolled illegal cutting constitutes a great share in Turkey (Yazıcı, 1990). For instance, a study by

The General Directorate of Forestry (GDF) (GDF, 1986) shows that an amount of 17 110 231 m^3 fuel wood from state forests is consumed every year, and when compared with an amount of 8 406 300 m^3 fuel wood sold by SFE to forest villagers, an amount of 8 703 931 m^3 illegal wood consumption is evidently seen, which constitutes 103 % of fuel wood sold by SFE to forest villagers every year.

In this study, the villages in the area of Maçka SFE were chosen as research area. The main objectives of this study are to identify the extent of illegal fuel wood consumption from Maçka SFE forests and to analyse the economic loss relating to the local welfare as a result of the amount of this illegal cuttings.

2. The Study Area

There are 39597 ha forest area in Macka SFE, which contain 70 villages subject to the research. 92 ha of this forest area are high forest and the remaining area (8%) is coppice. The enterprise's growing stock is about 151,8 m3/ha and annual increment is 147 470 m3.

The study area is located in the town Macka of Trabzon in the Black Sea region of Turkey, between 41 N lat. and 40 E long. The climate is mild. The year is divisible into three seasons; winter (December - Mid-April), summer (June - August) and autumn (September - November). The predominant weather over the year is rainy. The mean annual rainfall is 807 mm, of which 65 % occurs during the rainiest months (from September to February).

The social, economic and geographic features of the 70 villages in the research area can be summarized as follows:

Altitudes of the villages vary from 250 to 1850 m. Macka is the largest town of Trabzon with an area of 1000 km2.

Six villages are related to municipality villages and the others are forest villages.

All villages have electricity and water equipment.

The cultivation area of these villages contains grass (5.0%), pasture (27.5%), forest (47.6%), shrubbery (9.0%), nut grove (3.2%) and agricultural field (7.7%).

Main agricultural products are barley, wheat, corn, tobacco, potato and hazelnut. Tobacco and hazelnut are produced for the market and the others are consumed for domestic requirements.

Forestry, agricultural and stockbreeding activities are made by primitive technology. Because of the fact that there are no industry and service sectors, the gross income per person from agriculture, forestry and cattle-breeding according to the current producers is only $312 (Türker, 1992).

3. Material and Method

3.1. Material

Two different questionnaires originally conducted by Türker (Türker, 1992) that cover 70 forest villages in Macka region of Trabzon Province were used in this study. The first questionnaire includes questions regarding social, economic, geographic and demographic factors for each village, while the second form includes questions in order to interview randomly selected 30 households within each village.

Furthermore, in the second questionnaire, people, mainly women, were asked some other questions concerning other energy sources used as well as fuel wood consumption level in the villages.

Apart from these two questionnaire forms, forest management plans prepared for Macka Region, accounting records, annual work plans, records of fuel wood and timber granted for individual houses, road network plans, cover type maps, and village inventory were also used.

3.2. Method

3.2.1. Questionnaire Design and Application

The research was conducted in 70 villages with 6 345 households. Thirty households for each village were selected as a sample size independently from each other (Kalıpsız, 1976). Thus, sampling rate of 33 % was reached (Türker, 1992). This rate is well above the requirements of a generally acceptable sampling rate of 10 percent for a socio-economic research to be conducted in villages (Brokensa et al., 1983).

The amount of wood consumption in 1990 was calculated in stere by measuring the wood piled in front of the houses with a steel tape with an assumption that some social, economic, cultural, demographic and geographic factors that affect the amount of fuel wood consumption are stable and never change, and that the amount of fuel wood obtained in 1990 can be extended to 1998. This will help both to find out the economic loss in 1998 as a result of illegal fuel wood consumption and also to identify the relationship between this economic loss and the physical and socio-economic variables of Macka SFE.

3.2.2. Calculation of Stumpage Price

Stumpage price can be defined as the estimated value of the growing stock per cubic meter. It is the value of stan-

[1] The necessary consumption of the villagers for their basic needs not for trade.

ding wood excluding the cost of felling, transportation and skidding (Fırat, 1971). This is in fact, the differential value of the growing stock.

In this study, calculation of the economic loss caused by illegal fuel wood consumption is based upon multiplication of stumpage price for each product such as logs, mine pole, industrial wood and fuel wood as explained earlier by the amount of production obtained for each product mentioned above assuming that illegal wood material consumed by villagers is utilised by SFE.

Currently, the General Directorate of Forestry in Turkey calculates the stumpage prices in terms of tree species and product types as to be valid for all Forestry Enterprises in Turkey. In the formula used to calculate stumpage price for the market, expenses related to the procedures until the product is in the market and margin of profit are subtracted from the estimated market price of that product.

The following formula is used to calculate stumpage price:

$$S_f = (t + h_g + n_g + S_g + t_g)\ 1.0M$$

$$t = (S_f / 1{,}0M) - (h_g + n_g + S_g + t_g)$$

where,
S_f: Selling price, h_g: Harvesting cost, n_g: Transportation cost, S_g: Sale cost, t_g:Distribution cost,
% M: Profit rate of forest resource owner as a percentage value, t: Stumpage price.

3.2.3. Calculating Cutting Value for Growing Stock

The cutting value of growing stock is calculated by subtracting the complete range of expenses from the market value of the growing stock in a whole stand (Mirabo_lu, 1978). Three basic steps are followed when calculating the cutting value for growing stock. First, the standing volume of each stand for which a cutting value is calculated is determined. Next, the amount of wood products in all diameter classes in this stand volume is identified. Finally, the total cutting value of the growing stock is obtained through multiplying the amount of each wood product by its stumpage price and summing them across the product type ranges (Mirabo_lu, 1958).

In this study, in Macka SFE, based upon the distribution of diameter classes of growing stock in terms of tree species (see Table 1), the volume rates of product types for different tree species were calculated (see Table 2), by which stumpage prices were multiplied (see Table 3), and accordingly the cutting value of growing stock for 1998 was determined (see Table 4).

A similar method was applied for the amount of illegal fuel wood consumption, and the financial value of this illegal consumption was determined (see Table 5).

Distribution of Tree Species and Diameter Classification for Growing Stock in Maçka State Forest Enterprise (m^3).

Table 1. *Distribution of Tree Species and Diameter Classification for Growing Stock in Maçka State Forest Enterprise (m^3).*

Tree Species	Growing Stock Distribution in terms of Diameter Classification				
	I. Diameter Class	II. Diameter Class	III. Diameter Class	IV. Diameter Class	TOTAL
Fir	2 057	14 079	19 237	10 462	45 835
Spruce	598 099	2 295 547	1 220 636	535 085	4 849 367
Beech	62 045	190 027	136 414	161 793	550 279
Hornbeam	43 852	71 421	22 071	23 468	160 812
Alder	39 278	146 663	63 490	7 886	257 317
Other B.leaved	3 095	2 204	945	1 354	7 598
Scotch pine	13 332	34 848	5 523	372	54 075
Oak	743	1 287	109	-	2 139
Chestnut	13 039	10 280	3 307	343	26 969
Fir	2 057	14 079	19 237	10 462	45 835
Spruce	598 099	2 295 547	1 220 636	535 085	4849 367
Scotch pine	13 332	34 848	5 523	372	54 075
Beech*	162 052	421 882	226 336	194 844	1 005 114
Total	775 540	2 766 356	167 132	740 763	5 954 391
%	13	46	28	13	100

Source: Maçka State Forest Enterprise Management Plans (1984-2003)
Note: Beech* = Hornbeam+Alder+Oak+Chestnut+other broad leaved tree.

4. Findings

4.1. The Total Amount of Fuel Wood Consumption in the Villages

As a result of the questionnaire study in the research area, for each village the average amount of consumed fuel wood by each household was determined for the year 1990, and given the reasons specified in the methods section, this amount was assumed to be at the same level as for the year 1998.

Then, the calculated amount of fuel wood consumption per household was multiplied by the number of total households in that villa-

ge and hence total fuel wood consumption of each village was determined.

When this was done for 70 villages, the amount of annual fuel wood consumption was found to be 228 495 stere; being one stere equal to 0,75 m^3, the total amount of fuel wood consumption of the study villages was 171 371 m^3.

4.2. Total Amount of Fuel Wood Allocations to Villages

Related statistics as to the amount of fuel wood allocated to each forest village in 1990 by Macka SFE under the Forestry Law, items 31 and 32 was taken from the files kept for the specific purpose of recording fuel wood allocation for each village, fuel wood allocated to 70 villages by Maçka SFE for the year 1998 was 7 758 m^3 (Anonymous, 1998).

4.3. Total Amount of Illegal Fuel Wood Consumption in Villages

When the total fuel wood allocation made to villages by Macka SFE was deducted from the total fuel wood consumption in 70 villages of Macka in 1998, total amount of illegal fuel wood in all the vil1ages was calculated at 163 613 m^3.

4.4. Total Amount of Economic Loss Caused by Illegal Fuel Wood Consumption

In order to calculate the economic loss that occurred as a result of illegal fuel wood consumption, firstly the amount of various product types in Macka SFE Forests was identified; then multiplying this amount by stumpage price determined for each product, the cutting value of growing stock in Forest Enterprises was calculated.

The volume rate of product types of tree species in Macka SFE by diameter classification was calculated by using the table titled "Table for Volume Rate of Product Types that Main Tree Species have (barked standing tree)" (Anonymous, 1984). However, the table does not include volume rates of species such as Alder, Hornbeam, Chestnut and Oak. Based on the assumption that the volume rates of such species are equal to those of Beech, the product amount of each tree species in Maçka SFE was calculated (Türker, 1992) and displayed in Table 2 below.

Having calculated the amount of product types contained in tree species, the growing stock cutting value of Macka SFE was calculated to be approximately 1 870 billion TL ($ 7 459 331) in 1998 by multiplying

Table 2. *Amount of Product Types Contained in Tree Species in Macka SFE (m3) logs and fuel wood*

Tree Species	Product Type			
	Log	Mine pole	Industrial Wood	Fuel wood
Spruce	1 867 461	1 054 214	619 972	586 452
Fir	20 392	4 808	6 548	6 527
Scotch pine	10 961	16 434	4 814	11 932
Beech*	309 992	301 474	118 151	134 000
Total	2 208 797	1 380 530	749 285	738 911

Source: Maçka State Forest Enterprise Management Plans (1984-2003)
Note : Beech* = Hornbeam + Alder + Oak + Chestnut + other broadleaved tree.

Table 3. *Stumpage Price List*

Year	Product Type	GDF Stumpage Price	
		(000 TL/m^3)	($/$m^3$)
1998	Log	570	2,29
	Mine pole	280	1,12
	Industrial Wood	200	0,8
	Fuel Wood	133	0,53

Sources 1) Maçka SFE Archives - 1998
2) GDF Stumpage Price and Distribution Cost Schedules

Table 4. *Growing Stock value in Maçka SFE*

Year	Currency	Product Types				
		Log	Mine pole	Industrial wood	Fuel wood	TOTAL
1998	000 000 TL	1 259 130	386 680	149 800	73 900	1 869 510
	$	5 058 145	1 546 194	559 428	295 564	7 459 331

Source: Table 2 and Table 3

the amount of that product type by stumpage prices determined by the GDF, given in Table 3, and also detailed under Method (Table 4).

In this part, product types that can be obtained from the amount of illegal fuel wood already calculated as 163 613 m^3 will be identified. 5 954 391 m^3 is the total growing stock in Macka SFE Forests. When such rates used to obtain Table 2 as log of 37 %, mine pole of 23 %, industrial wood of 13 % and fuel wood of 12 % are applied to 163 613 m^3, the following data are obtained as log of 60 537 m^3, mine pole of 37 631 m^3, industrial wood of 21 270 m^3 and fuel wood of 19 634 m^3 consumed as illegal fuel wood.

When the amount of each product type identified was multiplied by stumpage prices given in Table 3, the consumption of illegal wood raw material as fuel wood in 1998 amounts to around 52 billion TL ($ 208 199) (Table 5).

Table 5. *The Financial Value of Illegally Consumed Wood Raw Material in the Research Villages*

Year	Currency	Product Types				
		Log	Mine pole	Industrial wood	Fuel wood	TOTAL
1998	000 000 TL	34 506	10 537	4 254	2 611	51 908
	$	138 630	42 147	17 016	10 406	208 199

5. Discussion and Conclusion

Total amount of fuel wood allocation (7,758 m^3) by Macka SFE to villages in 1998 could only meet 5 % of the total fuel wood (171,371 m^3) consumed by the villagers in that year. The main reasons for using wood raw material as illegal fuel wood in State Forests do not meet the fuel wood needs of villagers legally due to decreasing profit level of the forests and the lack of alternative fuel sources such as coal and electricity because of the poor economic conditions of villagers.

Fuel wood allocated to villages by the Forest Enterprise in 1998 (7,758 m^3) is equal to 50 % of the legal wood production of the Enterprise (15,561 m^3). In other words, substantial portion of Macka SFE official product was widely used as fuel wood instead of utilising it in industry. This result is quite interesting. When the official fuel wood consumption and illegal fuel consumption are combined, 90 % constitutes fuel wood and 10 % industrial wood, which make it difficult to balance between supply and demand in terms of industrial wood material. While the community sustainability as well as welfare are to be taken into consideration as indicated in Kyoto Protocol, the sustainability of the forest production as a whole is much more important. We, therefore, call for alternative energy sources such as electric energy, lignite coal, fuel briquette, and for the establishment of energy forests to meet the community needs.

In addition to the aforementioned threats, when factors such as the growing stock of Macka SFE, its increase, the production of official wood raw material, and the amount of illegal fuel wood consumption by forest villagers are considered, the growing stock of Macka SFE will inevitably face extinction.

The total amount of round and fuel wood production by Macka SFE in 1998 is equivalent to only 9,5 % of 163 613 m^3 that is the total amount of fuel wood consumed illegally in Macka SFE villages.

Financial loss of the SFE caused by the consumption of wood raw material as illegal fuel wood in the villages of Macka County (52 billion TL, around $ 208 199) makes up about 3 % of growing stock in the Enterprise's Forests which is about 1 870 billion TL ($ 7 459 331). Using wood raw material as illegal fuel wood, opportunity cost substantially increases. The amount is, however, at minimum level since it is calculated multiplying stumpage price by the amount. On one hand, this process reduces the amount of SFE production for industrial purposes, on the other, the product quality decreases, and this causes difficulties in the market, and accordingly the SFE income decreases. Although the opportunity cost can be interpreted as a financial or value transfer from the forest resources to the villagers at the forest policy level, the lost or transferred amount does not appear in SFE's balance sheet nor does it appear in the forest sector records. Therefore, it is a direct economic loss of the forestry sector. Besides, three percent is not a small amount since amount of illegal utilization of forest products may, in fact, cause serious difficulties in implementing forest management plans overtime and thus jeopardizing sustainability the most important feature of forestry sector.

Furthermore, it is also hard to forecast the "real" amount of value "transferred" to the villagers as the illegal utilization is conducted haphazardly. The opportunity cost from otherwise planned use of the forest resources would be much lower.

Income obtained by Macka SFE (375 billion TL ($ 1 506 024)) out of the sale of forestry products reaches 7.2 times of the loss caused by illegal fuel wood consumption. When considering the fact that revenue obtained by SFE is calculated according to sale price and the economic loss caused by illegal fuel wood consumption according to cost price, SFE and national income will substantially increase with the transfer of wood raw material consumed as illegal fuel wood to the production of industrial products.

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