Country Report Turkey
Global Wildland Fire Assessment 2004

1.   Description of the fire environment, fire regimes, ecological role of fire

Turkey is a country with a land mass of 77.079 million hectares, of which 20.749 million hectares are forested, representing about 26 per cent of country's total land area. About 12 million ha of forested lands are subjected to and under the threat of forest fires. Fire has always had a pervasive influence on Turkish forests and their management, consuming thousands of hectares of forest land annually resulting in high suppression costs and causing great damages in lost timber, real estate and recreational values, and even loss of life.

Forest fire activity in the country is highly correlated with weather conditions, land use practices and vegetation associations (Canakcioglu and Ozkazanc, 1997). Most fires occur where the Mediterranean climate is predominant with high temperatures and low to nonexistent precipitation during fire season. Land-use practices over the centuries, vegetation types specific to the region and the climate have created a special fire regime across the country. But knowledge about the human impact on fire and fire regimes and about the correlation of land use and fire regimes is highly limited. Although it is generally accepted that maquis vegetation formation spread along the Aegean and Mediterranean Regions up to 250-300 m a.s.l. is sustained and maintained by mainly the presence of fires, no genuine attempt has been made to understand the role of fire in these fire-maintained and fire-tolerant ecosystems. Unofficially however, fire has been used in *Pinus brutia* stands after harvesting for seedbed creation and fuel reduction purposes.

Recent statistics indicate however that the country is experiencing an ever-increasing wildland fire problem, indicating a shift in fire regimes. Supporting this statement is the fact that the number of fires has doubled in recent years. While natural fires play an important role in many of the forest types, the increasing frequency of recent fires has transformed the fire from nature's tool to nature's threat, resulting in a dramatic decline in the quality of forests with the average fire cycle, in some localities, having been reduced to as little as 9 to 25 years (Neyişçi 1986). Given the status of the socio-economic situation and tourism in the country, it is not very difficult to conclude that the fire risk will steadily increase, resulting in more areas being affected negatively from wildfires.

1.1.   Summary Tables of natural and human influenced fire regimes

Tables 1a and 1b provide a general overview of the natural and human-influenced fire regimes present in the country. The tables are organized by different ecosystem types.

Table 1a. Summary table describing the natural and human-influenced fire regimes in different ecosystem types in Turkey.

Ecosystem Type	Name / Designation[1]	Total Area of Ecosystem in the Country (x 1000ha)	Ecosystem Sensitivity[2]	Typical Fire Frequency (yrs) [3]	Typical Fire Size (ha)[4]	Fire Origin / Cause [5]
Wildfires (including wildfires burning within prescription)						
Forest						
Forest 1: Not intensively managed and protected.						
Forest 2: Intensively managed and / or protected (major ecological or economic assets at risk)	Forest (*Pinus brutia*)	7.668[1] (4.130)	FS, FT	25-35	6.5	Mixed
Other Wooded Land						
Wooded Lands / Shrubland / Savanna 1: Not intensively managed and protected	Maquis	1.463	FT, FM	9-15	6.5	Mixed
Wooded Lands / Shrubland / Savanna 2: Intensively managed and / or protected (major ecological or economic assets at risk)	-	-	-	-	-	
Other Land						
Open Steppe / Grassland / Pastures (not included in Wooded Lands / Shrubland / Savanna) Both intensively and not intensively managed	-	-	-	-	-	
Peat / Swamp / Wetland						
Indicate biome type (e.g. peatland, peat-swamp forest, marsh)	-	-	-	-	-	
Prescribed Burning						
Forestry, Conservation						
Indicate Ecosystem Type:	Conservation Burning	3,700[2] -	-	-	-	
Agricultural / Pastoral						
Agricultural lands / Pastures (straw burning, e.g. corn, wheat, rice paddies, sugar cane; slash and burn systems; pasture maintenance burning)	Agricultural lands Burning	66.878[3] 26.174	-	-	-	Human

[1] Represents first-degree fire sensitive areas.
[2] Forested conservation areas.
[3] About 30% of all agricultural lands are subjected to residue burning.

Note: This table distinguishes between **wildfires** (uncontrolled, accidental or intentional ignition mainly not planned and in most cases unwanted; however, natural and human-caused wildfires burning within prescription are included here) and **prescribed burning** (fires intentionally set to obtain desired effects in ecosystem manipulation, land use, land-use change, etc.).

[1] Name or designation of plant association / ecosystem (if there are several corresponding to one sub-category, you may add extra lines)
[2] indicate whether the ecosystem is fire-sensitive, fire-maintained or fire-tolerant. Use the following suffix letters to indicate: **FS** (fire sensitive ecosystem: fire has a detrimental effect on these ecosystems in terms of ecological and/or economic damage), **FM** (fire maintained ecosystem: fires are needed to maintain these ecosystems in terms of ecological and/or economic benefits; **FT** (fire tolerant ecosystem: fires have a minor impact on these ecosystems in terms of ecological and/or economic aspects)
[3] approximate fire return interval in years, average number of years between fires
[4] approximate mean or typical area affected by a single wildfire or prescribed burning fire in hectares
[5] specify if either natural, human-caused, or mixed

Table 1b. Summary table describing the distribution of natural and human-influenced fires in Turkey throughout the year.

Ecosystem Type	Wildfire Occurrence / Use of prescribed burning by Month and Percentage											
	J	F	M	A	M	J	J	A	S	O	N	D
Wildfires (including wildfires burning within prescription)												
Forest												
Forest 1: Not intensively managed and protected (upper: % of number of fires; lower: % of area burned)	1.0	1.4	4.0	3.9	4.4	10.6	21.0	21.6	16.6	9.6	4.7	1.2
	0.5	0.5	1.9	1.1	1.0	6.4	32.6	27.8	11.4	3.7	2.3	0.8
Forest 2: Intensively managed and / or protected (major ecological or economic assets at risk)	-	-	-	-	-	-	-	-	-	-	-	-
Other Wooded Land												
Wooded Lands / Shrubland / Savanna 1: Not intensively managed and protected (major ecological or economic assets at risk)	-	-	-	-	-	-	-	-	-	-	-	-
Wooded Lands / Shrubland / Savanna 2: Intensively managed and / or protected	-	-	-	-	-	-	-	-	-	-	-	-
Other Land												
Open Steppe / Grassland / Pastures (not included in Wooded Lands / Shrubland / Savanna) Both intensively and not intensively managed	-	-	-	-	-	-	-	-	-	-	-	-
Peat / Swamp / Wetland												
Indicate biome type (e.g. peat-swamp forest, moorland, marsh)	-	-	-	-	-	-	-	-	-	-	-	-
Prescribed Burning												
Forestry, Conservation												
Indicate Ecosystem Type:	-	-	-	-	-	-	-	-	-	-	-	-
Agricultural / Pastoral												
Agricultural lands / Pastures (straw burning, e.g. corn, wheat, rice paddies, sugar cane; slash and burn systems; pasture maintenance burning)	-	-	-	-	-	-	-	-	-	-	-	-

[1] Values are for percentage of number of all fires regardless of ecosystem type (numbers in parentheses represent monthly percent values of area burned). These data will assist to evaluate regional to global fire patterns that are important for environmental assessments or decision-making. The percentage (%) of vegetation affected by fire by month (totalling 100% for each line) is indicated.

1.2   Narrative of influences on the fire regimes of the country

Forest fire is a recurring phenomenon in and has a major impact on the sustainability of Turkish forests. Fires are an integral part of many forest ecosystems and of complex social, economic, ecological and environmental origin. However, Fire has always been treated marginally and attitudes toward fire have evolved around an effective fire protection policy with a strong emphasis on fire control with little or no regard given to the ecological effects or the underlying causes of fires, and fire research concentrated mainly on the prediction and the immediate effects of fires on flora, fauna and soil. As a result, in terms of fire control, success has been quite satisfactory. However, the policy of fire control or total fire exclusion has changed ecosystem structures in large areas such that fire danger determined by fuel conditions has been exacerbated.

The damage incurred by fires is assessed on the basis of area and stand type within which fires occur. Assessments are mostly made in economic terms, i.e., wood burned, money spent for suppression and planting etc. No scheme is available for assessing the ecological and social aspects of fires.

Along with the population increase in the country, demographic movements and other social and economical issues play an important role in overall forest fire problem. These involve communication and transportation networks, power lines, wildland/urban interface, recreation/tourism, and land ownership (cadastral) problems.

Fire regimes are highly affected and gradually changing as a result of excessive and increasing human activities. Of the activities of man, tourism is becoming the most important risk factor ever to change the fire regimes. Given the status of the socio-economic situation and tourism in the country, it is not very difficult to conclude that the fire risk will steadily increase, resulting in more areas being negatively affected from wildfires. Statistics indicate that the number of fires has doubled in recent years, indicating an alarming increase in the frequency of fires and thus a dramatic decline in the quality of forests with an average fire cycle, in some localities, having been reduced to as little as 9 to 25 years (Neyişçi 1986, Alexandrian and Esnault 1997). The increase in the incidence of fires, however, is not the only factor that changes the fire regime. The increased and effective use of technology in transportation, communication and fire suppression has contributed considerably to decreasing the average area burned to as low as 6 ha per fire or the total are burned to 4000 to 5000 ha per year.
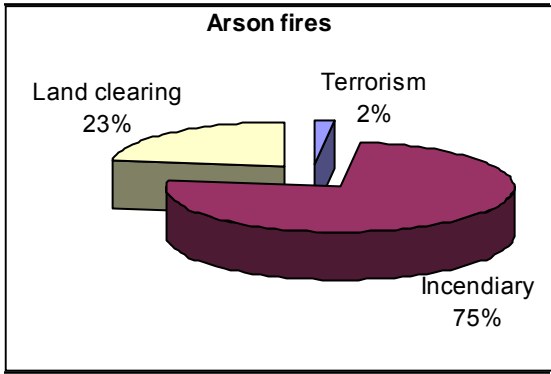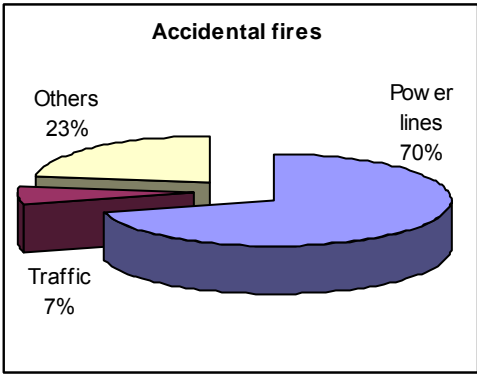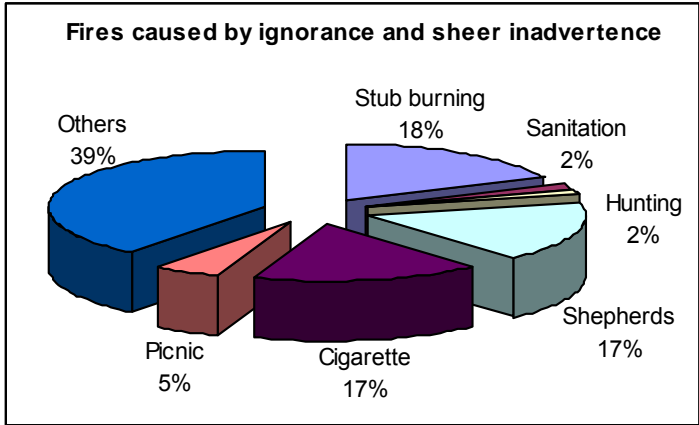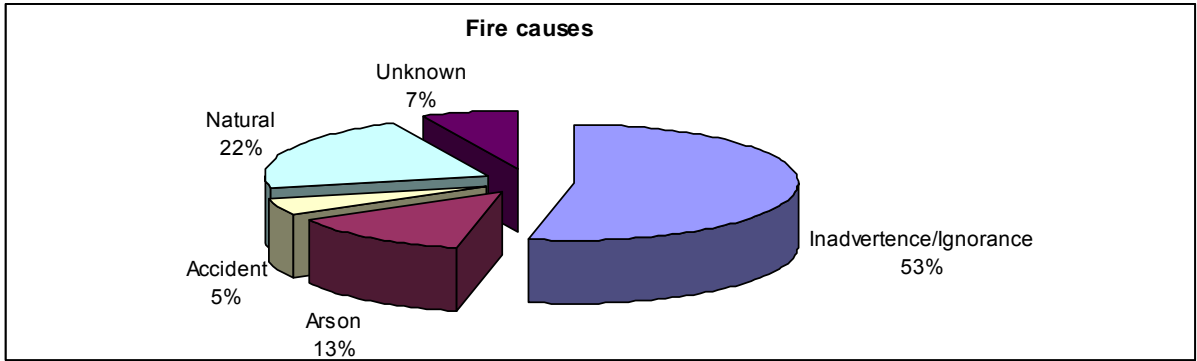
Fire seasons seem to be correlated well with fire weather and fuel conditions. No significant change and/or shift have been observed over the last several decades. Shifts are due mainly to fire hazard conditions (i.e., fuel conditions and weather).

2.   Fire statistical database: Wildfire and prescribed burning statistics for the period of 1988-2004

In accordance with the format of the Global Wildland Fire Assessment 2004 statistical data for the years 1988 to 2002 (including the two 5-yr periods 1988-92 and 1998-2002 that are of interest for the FAO Global Forest Resources Assessment 2005 [FRA-2005]) are provided in Table 2. Detailed analysis of fire causes in the period 1997-2004 is provided in Tables 1 to 4.

Table 2. Wildfire database 1988-2004 for Turkey. Data of the two 5-yr periods 1988-92 and 1998-2002 are highlighted because these periods are of key interest for FRA-2005.

Year	Total No. of Fires on Forest, Other Wooded Land, & Other Land No.	Total Area Burned on Forest, Other Wooded Land, & Other Land ha	Area of Forest Burned ha	Thereof area of "Forest 2" ha	Area of Other Wooded Land Burned ha	Thereof area of "Wooded Lands / Shrubland / Savanna 1" ha	Human Causes % of No.	Natural Causes % of No.	Unknown Causes % of No.
1988	1372	18210	18210						
1989	1633	13099	13099						
1990	1750	13742	13742						
1991	1481	8081	8081				52	2.3	46
1992	2117	12232	12232				40	2.6	57
1993	2545	15393	15393				50	1.5	48
1994	3239	38128	38128				36	4	60
1995	7676	7676	7676				48	7	45
1996	1645	14922	14922				55	3	42
1997	1339	6316	5803	5714	89	558	66	6	28
1998	1932	6764	5717	5444	273	1047	73	3	24
1999	2075	5804	3979	3843	136	825	69	10	21
2000	2353	26352	24580	22607	1973	1773	73	6	18
2001	2631	7394	5990	5682	308	1404	69	7	21
2002	1471	8413	6100	6020	80	915	76	12	18
2003	2177	6644	6644	5662	715	268	73.35	21.14	5.51
2004	1762	4876	4876	3623	466	45	72.34	7.26	20.4
Average	2306	12591	12069	7324	505	854	61	7	32

Figures 1-4. Supplement information to Table 2: Fire causes for the period 1997-2004.

3. Narrative summary of major wildfire impacts on people, property, and natural resources between 1988 up to 2004

Since there is not yet an international standard in place to define economic and ecological damages caused by fire, Tables 1a and 2a are not asking for such information. However, in Turkey some figures are available at national level, including individual fires resulting in extraordinary damages that have been recorded.

Since 1988, 58 people have lost their lives in 40 different forest fires. Of those, one was the Regional Director, 2 were district managers, 2 district officers, 2 forest engineers, 1 division director, 3 forest rangers, 5 pilots, 3 bulldozer operators, 4 drivers, 2 soldiers, 1 villager, and 32 fire workers.

There have been occasions where fires threatened several villages and their inhabitants. As a precautionary measure some villages were evacuated temporarily. Fires burned some houses and destroyed some animals.

Table 3 provides an overview of large fires in Turkey between 1988 and 2002.

Table 3. Large fires since 1988.

Regional Directorate	Date	Area burned (ha)	Fire Cause
Çanakkale	25.07.1994	4049	Stubble burning
Muğla	27.07.1996	1438	Unknown
Muğla	27.07.1996	7090	Negligence
Antalya	21.07.1997	1715	Negligence
Muğla	11.08.1997	1385	Negligence
Adana	30.09.1999	1200	Arson
Bursa	05.04.2000	1970	Negligence
Balıkesir	05.04.2000	1267	Power lines
Adana	03.08.2000	3138	Negligence
Denizli	13.07.2000	1459	Negligence
Antalya	03.08.2000	2102	Arson
Çanakkale	01.09.2000	1689	Negligence
Balıkesir	12.08.2002	3573	Unknown
Muğla	15.08.2002	1776	Power lines

4. Application of prescribed burning in the region to achieve management objectives (purposes, extent, results)

Although there is an increasing awareness as to the use of fires to meet some management objectives such as seedbed preparation and slash removal, fires have never been incorporated into overall fire management planning. Except for the (illegal) burning of agricultural fields after harvest, slash burning of pruned trees on roadsides is perhaps the only activity that involves fire. New developments in fire studies, changing attitudes toward fire and appreciation of the role of fires in our ecosystems make one believe, however, that it will not be too long before fire is employed in overall land/fire management planning.

5. Operational fire management system(s) and organization(s) present in the country or region

Fire management in Turkey is a federal responsibility. Duties are carried out by the state forest enterprises functioning under regional directorates. Fire control policies have been developed around a strong emphasis on total fire control as a response to destructive fires. Regardless of the high costs involved, it is the forest service department's responsibility and policy that all the required activities are planned and implemented immediately. In no time, however, have the beneficial use and ecological

role of fire been incorporated in fire management planning process. So, fire management deals mainly with fire prevention and control activities.

Risk is associated with ignition, and risk abatement involves raising the level of awareness of general public and various responsibility groups to the dangers of ignition and subsequent forest fires through education and enforcement. It is of the opinion of the forestry service that a strongly favourable public opinion is a vital necessity in any effort to reduce the number of people-caused fires. All the available communication avenues have increasingly been utilized for this purpose. These involve the utilization of the mass media and local media outlets of radio, television, newspaper and magazines, education programs in the schools, military bases, service clubs, signs, and personal contacts. Also, fire law enforcement has been a potentially valuable technique for forest fire prevention since the laws have a potential to educate the public as well as deter the negligent or malicious from destructive behaviour.

Non-governmental organizations help raise the level of awareness of general public and various responsibility groups to the dangers of ignition and subsequent forest fires through education and conducting/supporting relevant activities. These activities involve seminars, TV and radio programmes, practical field work, and suggestions brought to the attention of policy makers.

Local people are responsible by law to immediately to respond to a fire situation when and if requested. The response of the local people and communities to a fire has risen considerably in recent years. This has mostly been a result of the changing attitudes towards forest resources and of the success of the public awareness campaigns.

Academia has a very important role in all aspects of fire management. However, their effectiveness has been fairly limited. Only in recent years, however, have the scientific studies been increasingly conducted and the results obtained put into practice. The most important step in this regard has been taken for the establishment of a National Fire Danger Rating System.

Organizational systems or procedures used in large fire situations and the collaboration on different levels (local, national, international)

Since 1997, there have been substantial improvements in the handling of forest fires. A Fire Command Center (FCC) established in 1997 under the General Directorate of Forestry (GDF), Forest Protection Unit is responsible for all fire management issues, ranging from prevention activities to fire suppression and other related issues. As part of the activities of FCC, a more comprehensive national database on forest fires is being created containing information on all aspects of forest fires. Information gathered on the location and cause of fires is used to develop fire prevention techniques and prevention planning. Important/large fire situations requiring inter-regional cooperation are handled with the help of the FCC. The Forest Protection Unit of the GDF with the help of the FCC handles all inter-agency or international agreements/procedures.

6.   **Sustainable land-use practices employed in the country aimed at reducing wildfire hazards and wildfire risks**

Despite the high cost involved in the construction and maintenance, firebreaks and fuel breaks have been widely used to break the continuity of forest fuels. Fuel breaks have been constructed along and around the high fire risk and hazard areas such as camp grounds, disposal sites, settlements, major highways, railroads and in and around plantations and productive forests. Although very labour-intensive, the practice of clearing and burning surface fuels within 15-20 m on each side of forest stands along major highways is a usual one. As a general rule, fire breaks constructed in plantations and naturally regenerated areas are supported by some fire resistant species (especially *Cupressus sempervirens* var. *pyramidalis*). These species are planted along the firebreaks with up to five rows. In areas close to settlements or critical areas, such species as stone pine (*Pinus pinea*) have been heavily utilized (planted) in place of other species. The local people look after these areas by pruning the trees and cleaning underneath and harvest their cones. Not only this practice help maintain an important fire resistant zone but also provide for the local people an opportunity to make a living. One other activity worth mentioning concerning fuel modifications is the charcoal production using some bush species that would not normally be harvested or utilized (Serez et. al., 1997). Those who produce charcoal purchase the wood they cut for a very low price (about 1/10 of what they sell charcoal for). Again, this benefits both forests and people.

Although illegal in forested areas, especially in plantations and naturally regenerated areas, grazing is another land use practices that reduce fire hazard in many localities. Providing it is kept in predetermined or known areas, grazing is allowed by the officials as a precautionary measure. Tensions between the officials and shepherds and between shepherds themselves have been the cause of many fire incidences over the years.

7.   Fire management / suppression technologies, training standards and facilities

Technologies and systems

Fire management relies on early detection, fast initial attack and powerful suppression. Each region has been provided with sufficient resources and man-power to combat forest fires.   Available resources include:

- 135 fire trucks
- 12 helicopters
- 11 fixed-wing airplanes
- 882 fire lookout towers
- 8472 radios
- 650 initial attack crews (of 12-15 men), and
- 120 standby forces (of 40-50 men)

As needed new resources are being added and new technologies adopted. These forces are allocated to each district based on fire danger levels and area in question.

Fire monitoring is made through 882 fire lookout towers scattered across fire-prone areas. At times of high fire risk, motorized ground troops and sometimes helicopters are used for fire monitoring purposes and for deterring the mischief-maker. Public reports have also become one of the most important information sources for fire incidences. This is mainly ascribable to the promotion and the general acceptance of emergency telephone number 177 by the public as the number to call in case of a forest fire.

Except for utilizing the daily temperature and relative humidity to rate fire danger, no system is in place for fire danger rating. However, Some initial steps have been recently taken to establish a fire weather index system in one of the fire sensitive regions. A network of automated weather stations will be established soon for the system. The system will generate current fire danger levels based on past and present fire weather conditions, and fire danger levels for the future based on forecast weather conditions.

Information dissemination will also be made on the internet once the information system has been completed.

National wildland fire management planning, preparedness

Fire management involves fire prevention and pre-suppression activities. Every State Forest Enterprise has a fire management plan in which all maps of the area in question; resources available and activities to be done are listed for the plan period. State Forest Enterprise is responsible to carry out all activities according to the plan.

Wildland fire management training

Fire workers and technical personnel are trained every year for up to two months. There are two training centres for fire workers where they take theoretical courses and attend seminars given by lecturers and fire experts. The main load of the training lies on the practical field work. Workers are trained to efficiently use the equipment they have. This involves wireless radio communication, chainsaw, hand tools and hose operations, water and retardant use, fire truck/engine and bulldozer operations etc.

8.   Public policies concerning fire

A political decision might influence fire regimes in a way that can scarcely be foreseen when released. Unfortunately, fire has always been treated marginally, based on the simple assumption that it is always bad. Thus, the policy of *total fire control* or *fire exclusion* has been adopted for several decades with no regards to the ecological effects of fire on forest ecosystems. As a result, in terms of fire control, success has been quite satisfactory. However, the policy of fire control or total fire exclusion has changed ecosystem structures in large areas such that fire danger determined by fuel conditions has been exacerbated.

Land ownership boundaries or borders separating public and private lands are not completely delineated in Turkey. So, there are always ownership disputes and conflicts in and around forests and protected areas.

Tourism is becoming one of the fastest growing sectors in the economy. However, government incentives for tourism have been creating new problems for the sustainability of forest and other natural resources. The relative increase in the number of fires in recent years is clearly an indication of this situation.

Parallel to these, demographic movements and other relevant social and economic issues also play an important role in overall forest fire problem.

About 8.8 million people live in 17,445 villages in or near forests (Anonymous 1991). Socio-economic life standards of most of these people are well below the national average. People with low income and low life standards see the forests as an earning ground for their sustenance. So, people set fire in the forest to create jobs that will earn them some provision or manipulate vegetation to improve and produce useful plants for their animals to feed on.

Because of the socio-economic constraints and relatively high rate of population increase, many people leave their villages or towns for larger cities with a hope of finding better jobs. Depopulation of these areas naturally results in a population increase and eventually overpopulation of larger urban areas. The lack of the necessary infrastructure and jobs results in an abnormal growth of such urban areas. This results in ill-developed residential areas at the wildland/urban interface. Unfortunately, laws concerning these areas and policies adopted in the past have even worsened the situation. The change of the definition of "forest" or amendments made to it has not helped to solve the problem, either.

The instability in the government and fast change of leadership at the government level, and the expectation of the public from the new leadership an amnesty after every national election, have exacerbated the already bad situation and perhaps encouraged them.

In addition to all these, policies concerning communication and transportation networks, and power lines passing through forested areas also create problems.

To help solve these problems, the following measures are suggested:

- Demographic and political analyses should be carried out,
- Inquiries in behaviour of individuals and societies made,
- Inventories of urbanisation completed,
- Plans of development formulated, and
- A broad cooperation of social scientists and geographers realized.

9.   Wildland Fire Research

Fire is one of the areas that has received the least attention in Turkey. There have been very few studies concerning fire behaviour, fire ecology or the role of fire in Turkish forest ecosystems (Bilgili and Saglam 2003; Bilgili et al. 2003; Neyişçi 1989a,b; Neyişçi and Cengiz 1985). Recently, however, attempts have been made to establish a national fire danger rating system. Initial work has been completed and weather measurements started. Based on the litter moisture and weather measurements in a standard fuel type (red pine, *Pinus brutia*), Turkish Fire Weather Index System will

be developed. Fire behaviour experiments have been conducted in several fuel types. Results of the experiments will constitute the first steps towards achieving the goal of the development of fire behaviour prediction system. Also, the use of Geographical Information Systems (GIS) in fire management is being increasingly utilized. But, all these attempts have been very limited for the reasons that there has been a lack of cooperation between universities and research institutions within the forestry sector, and a lack of mechanisms to support research projects undertaken by other units. But despite the lack of the necessary means to conduct fire research, these recent developments have been the result of genuine cooperation between Karadeniz Technical University, Faculty of Forestry and the General Directorate of Forestry.

Gaps / deficits that need to be addressed in the country for better wildland fire research

Almost all areas of fire research should have a priority. But the lack of research facilities and researchers makes it almost impossible. Except for a few studies, forest research institutions have never conducted a fire related study. There is no fire research laboratory in the country.

10.   Needs and Limitations

Forest fires are a recurring phenomenon in and have a major impact on the sustainability of Turkish forests with complex social, economical, ecological and environmental aspects. Yet, fire policies were formulated in such a way as to exclude fire on the assumption that it is always bad. Currently practiced total fire control policy has been followed by some successes with prospects. But it may not be as proper and appealing as it is thought, considering the large fires of recent history have been a result of the policy of total fire exclusion in those areas. In addition, pressures brought about by certain realities of ecology and economics, and our increased demands for multiple resources require the development of new policies and attitudes toward fire. At the same time, increasing complexity and sustainable forestry will require a deeper understanding of fire and development of more effective management systems. Effective management systems will not prove successful in any place unless they include the demands and acknowledge the role of the fire and society on forests. In this regard following points may be worth mentioning:

- The formulation of national and regional policies should address forest fires as an integral component of ecosystems and land-use.
- Flexibility in policy implementation, and clear and measurable policy objectives are needed to minimize the adverse effects of uncontrolled fires and maximize the benefits from fire prevention or from the controlled use of fires.
- Involvement of all stakeholders in policy development is a must. Especially in the case of fires when almost all fires are started by humans.
- Favourable policies must be adopted for all aspects of fire management (prevention, suppression and fire use) based on local conditions.
- Land-use policies should promote fire prevention and not contribute to deforestation or the degradation of forest resources
- Personnel policies should be realistic and fire research should have a priority.

11.   Date of Report and address of rapporteur and key contacts

10 March 2005

Prof. Dr. Ertugrul Bilgili
KTU Orman Fakultesi
61080, Trabzon
Turkey

Tel: +90-462-377-2845
e-mail: bilgili@ktu.edu.tr