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The Forest Fire Situation in Mongolia

Abstract

Forests occupy about 11 percent of Mongolia's territory. Despite the low forest cover the forest ecosystems are considered a key asset of the ecological wealth and the well-being of people in the country. Diverse environmental and ecological conditions have resulted in the development of a variety of forest ecosystems. Disturbances in these sensitive ecosystems deserve detailed investigations to prevent damages to nature and society. On the background of tremendous losses of forests through fires, the forest conditions and issues of forest protection considering the role of fires, their causes, the system of monitoring and managing forest fires and measures to prevent fires are elaborated. Mongolia's government initiatives are directed to improve the situation with the forests, and their disturbances as a whole. An essential legal regulation has determined the ratio between financial means provided for the protection of the environment and income received from the use of natural resources. Some 85 percent of income from forests must be directed to forest protection and restoration.

1. Introduction

Mongolia is a country with small forest resources, but the forest's importance is seen from the fact that the country occupies tenth place by area of forestland and first place by forest area per capita in the Asia region. About 92 percent of the total original forested area of 17.5 million hectares is currently growing trees, while 8 percent is not. Management of forest resources in Mongolia suffers from several weaknesses such as unregulated use, overuse, and inadequate protection. As a result, the important causes of forest degradation and deforestation are fire, overgrazing, mining activities, improper commercial logging, illegal collection of wood for construction and for use as fuel, hay making in forest steppes, complacency in enforcement of forest rules and regulations and damage by pests and diseases. Forest fires, by far, have had the most serious impacts on the forest of Mongolia. Forest fires are mostly incendiary, caused by herders and collectors of antlers.

Wildfires constitute a major factor that determine spatial and temporal dynamics of forest ecosystems. About 4 million ha are disturbed to varying degrees, either by fire (95 percent) or by logging (5 percent). On the average, 50 to 60 large forest fires and 80 to 100 large steppe fires occur annually. The recent increase in the number of fires is related to anthropogenic causes. The most obvious consequence of frequent and intense fires is the loss of forested land. The current fire pattern is affecting 14 percent of this resource annually.

This paper characterizes the forest situation and discusses the merits and demerits of the existing fire management system in Mongolia trying to identify the most useful measures for building an efficient fire management organization.

2. Mongolian Environmental Status

2.1 Geographical Location and Land Surface

Mongolia is a land-locked country which covers an area of 1 564 118 km^2 on the southernmost fringe of the Great Siberian boreal forest and the northernmost Central Asian deserts and vast steppes bordering the Russian Federation in the north and the People's Republic of China in the east, south and west. According to size, Mongolia is the seventh largest country in Asia and among the biggest of the land-locked ones (Figure 1).

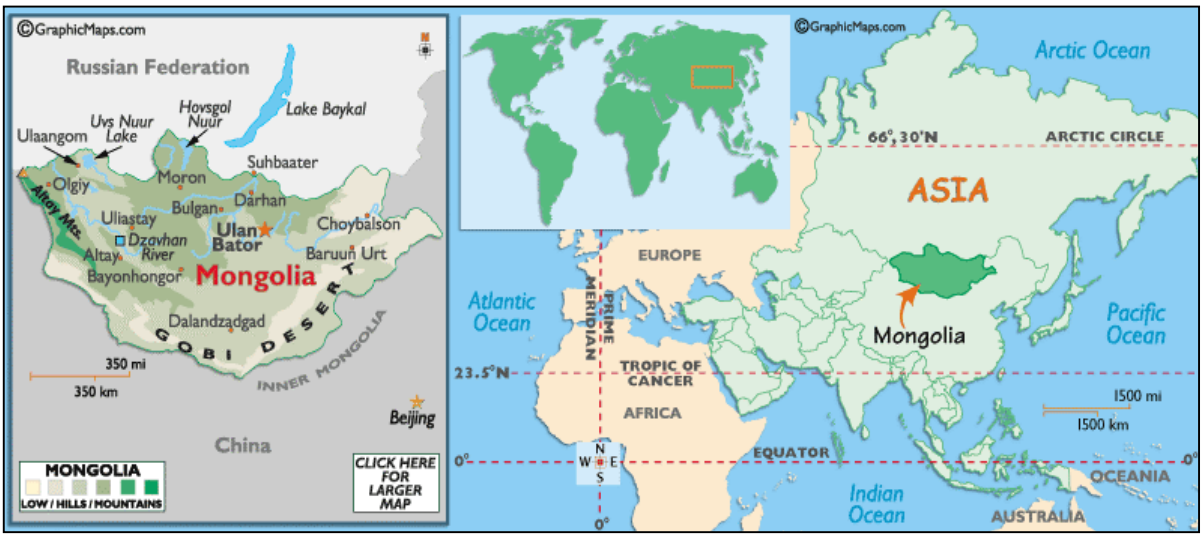

Figure 1: Geographic location of Mongolia.Source: http://worldatlas.com/webimage/countrys/asia/mn.htm)

The Mongolian environment has a large variety of features. The northern part of the country is covered by forested mountain ranges. The southern part encompasses desert, desert-steppe and steppe areas with low mountain and rolling hills characterized by sparse vegetation cover. The western part is made up of a cradle of snow-capped high mountains and glaciers, and the eastern part consists of an area of vast plains and wild heaths. About 81% of Mongolian territory is situated higher than 1000 m a.s.l., the lowest and highest points being at 532 m and 4374 m, respectively (Tsedendash, 1998). Besides, one third of Mongolian territory consists of desert steppe zones.

2.2 Basic Natural Belts and Zones

Mongolia can be divided into six natural belts and zones (UNDP, 1998): Alpine belt, Mountain Taiga, Mountain Forest Steppe belt, Arid Steppe, Desert Steppe and Desert zones. These belts and zones differ from each other on the basis of their soil quality and plant and animal species which, in turn, are adapted to different habitats and climate conditions characteristic to each of these belts or zones.

The **Alpine** belt of the Mongolian Altai, Khangai and Khentii mountainous regions, with their perpetual snow, glaciers, traces and signs of ancient ice covers, has been well preserved due to a constantly cold climate and strong winds. The area is inhabited by some endangered animal species. These are the Wild Mountain Sheep (*Ovis ammon*), Siberian Ibex (*Carpa sibirica*), Snow Leopard (*Uncia uncial*), Rock Ptarmigan (*Lagopus mutus*), and Altai Snowcock (*Tetraogallus altaicus*). The respective plant species are the Dwarf Siberian Pine (*Pinus pumila*), *Ptilagrostis mongolica*, and White Gentiana (*Gentiana algida*).

The **Mountain Taiga** belt comprises about 5 percent of the Mongolian territory in the Khuvsgul and Khentii mountain ranges in the northernmost part of the country and experiences a relatively cold and humid climate with an annual precipitation of close to 300 to 400 mm. Due to a short warm period, the growing season is not long enough for many plant species. Forests in this belt are dominated by the Siberian Pine (*Pinus sibirica*) and the Siberian Larch (*Larix sibirica*), and are inhabited by animal species registered in the Mongolian Red Book, such as the Musk Deer (*Moschus moschiferus*), Elk (*Alces alces*), Lynx (*Lynx lynx*), and the Eurasian Otter (*Lutra lutra*).

The **Mountain Forest Steppe** belts extend through the Mongolian Altai, Khangai, Khuvsgul mountain massifs and borders on the Mongolian Taiga belt which is in the southernmost fringe of the Great Eastern Siberian Taiga. One specific feature of the Mountain Forest Steppe is that the back slopes of the mountains facing the north, northeast and northwest are covered with different species of forest and woody plants whereas their front slopes facing the east, south and southwest are densely covered

by the steppe plants almost up to the sharp ridges of the mountains, giving an impression of sharp boundaries of habitats of the mountain forest and steppe species. The Mountain Forest Steppe belt encompasses 25% of Mongolian territory and is inhabited by such globally endangered animal species as the Manul (*Felus manul*) and the Black Grouse (*Lyrurus tetrix*), and plants threatened by extinction such as the Mongolian Pheasant's Eye (*Adonis mongolica*) and *Saussurea involuctur*.

The **Arid Steppe** zone with an area of approximately 20% of the country's territory comprises the entire Eastern and Central Mongolian flat plain extending as a tapering zone thousands of kilometres westwards to the northwestern fringe of the Khangai mountain range called Khankhokhii. The Mongolian steppe is part of the great plain which starts from the Danube river in Hungary and includes the Puszta, sweeping towards the east up to the Manchurian steppe in Eastern Asia. The vegetation of the Mongolian steppe is dominated by Xerophyta, several species of *Caragana*, *Artemisia frigida* and many forms of feather grass. Mongolian Gazelles (*Procapra gutturosa*), roaming and grazing in herds of several thousands, can also be spotted in this area.

The **Desert Steppe** zone includes the Depression of the Great Lakes, the Valley of Lakes and the Middle and Eastern Gobi Lowlands. This area belongs to the semi-arid zone which has an annual precipitation of 100 to 200 mm, loose soil and fewer species of animals and plants compared to the zones, northwards. The Desert Steppe is a habitat for such animal and plant species like the Asiatic Wild Ass (*Equus hemionus*), Saiga Antelope (*Saga tatarica*), Black-tailed Gazelle (*Gazella subgutturosa*), Houbara Bustard (*Chlamydotic undulate*), and *Caragana bungei*.

The **Desert** zone is located in the southern and southwestern parts of Mongolia and has a severe climate with annual precipitation of less than 100 mm and high diurnal temperature fluctuation. The Desert zone is an area of extremely unique physical formations of changing contrasts like hills, hillocks, rolling heaths and sand dunes. It contains deposits of ancient flora, fauna and mineral resources, and provides a habitat for threatened animal species such as the Wild Camel (*Camelus ferus bactrianus*), Gobi Bear (*Ursus arctos gobiensis*), and Mongolian Agama (*Stellio stoliczkamus*). Plant species found in such habitats include *Populus diversifolia*, Potanin's Trumpet Flower (*Incarvillea potaninii*), *Ammopiptanthus mongolicus*, *Halimodendron halodendron*, etc.

2.3 Climate and Climate Change

The main characteristic of the climate of Mongolia are sunny days, long and cold winters, low precipitation and large annual, seasonal, monthly and diurnal fluctuations in air temperature. The average mean temperature recorded in January is -34°C in the plateau and depressions but extreme temperatures have been recorded between -50°C and -56°C. In the northern mountains the average mean temperature in the warmest month is between +15°C and +20°C but again, extreme temperatures have been recorded of +35°C to +41°C, depending on the area. The total annual precipitation in mountainous regions averages to about 400 mm, in the steppe from 150 to 250 mm and in the desert steppe less than 100 mm. About 75 to 85 percent of the precipitation falls during the three summer months.

The Mongolian territory is demarcated along the mountains in the north and down through the plateau semi-desert where it reaches a drop in elevation in the southernmost part of the Gobi desert. Accordingly, there is more precipitation in the north and less in the south, as well as, drier, warmer and more windy weather in the south. Although, Mongolia has many warm and sunny days in autumn, the air temperature starts to fall in September. In the north, the mean daily temperature falls below 10°C in the first week of September. But in the desert the mean daily temperature falls below 10°C around the end of September. The mean daily temperature reaches 0°C in the north during the first week of October, and in the south, at the end of October.

Climate change is expected to have significant effects on the re-growth and productivity of forests. Climate scenarios indicate that the forest area might decrease due to expansion of the steppe and desert zones. The high mountains, tundra and taiga regions are expected to decrease by 0.1 to 5% in 2020 and 4 to 14 % in 2050. The area of the forest steppe may decrease by as much as 3 percent in the first quarter and 7 percent in the second quarter of the 21st Century (MAP-21 1998). The forest gap model (FORET) was used to estimate future changes in the species composition and productivity of specific sites. Biomass dynamics of the main species in northern forests, larch, cedar, pine and birch, were calculated according to the GCM climate change scenarios, in which carbon dioxide would be

doubled. The result shows that the total biomass might decrease by 27.2 percent for larch, 5.1 percent for birch, 35.3 percent for Siberian pine, and 4.2 percent for Scotch pine (Batsukh 2004).

2.4 Soils

The harsh continental climate, rugged mountains, Central Asian steppes and deserts have created specific conditions for the formation and distribution of a variety of soil types in Mongolia. The lower latitude steppe, desert-steppe and desert zones extending throughout the southeastern, southern and southwestern parts are characterized by an extremely dry climate and sparse vegetation and contain the arid-steppe's brown, the desert-steppe's grey brown and the real desert's grey brown soils. The northern high regions with sufficient moisture supply contain grey soils of the mountain and mountain forest steppes, or the brown soil of the mountain steppes, and the mountain taiga's cinder-like soil. Soil formation and distribution are affected by a variety of conditions like climate, landscape forms (including slope steepness) and exposition.

Mongolian soil is divided into two soil-bio-climate regions: northern and southern, belonging to special regions of Central Asia. The northern mountainous region is generally characterized by dark brown and brown soils. Because the quality of the soil is good, this region harbours twice or three times the number of species as comparatively found in the Gobi desert region. The southern, southwestern and western parts of the country contain light chestnut, light grey and grey steppe soils (UNDP 1998).

2.5 Water

Mongolia has comparatively high levels of surface and ground water resources. The rivers of Mongolia belong to the inland drainage basins of the Arctic Ocean, the Pacific Ocean and Central Asia. The higher and middle Selenge, the biggest river in the country, and parts of the Yenissei River which start from Mongolia belong to the Arctic Ocean drainage basin. In the northern and western mountainous part of Mongolia, the water network is of high density. The southern, central and southeastern parts of the country have few rivers and other water resources and they are usually situated in depressions without any outflows. Mongolia has 3 811 rivers and streams with a total length of 67 000 km, over 3 000 big and small lakes with a total volume of 500 cubic kilometres, about 6 900 springs with steady flows, over 190 glaciers with a total size of about 540 square kilometres and over 250 mineral water springs which form specific water ecosystems.

Rain, ground water, snow and glaciers are the main water sources of rivers. It is common that in the north-south and east-west directions, rain is the more important source for the rivers, while the amount of snow water flow decreases. The ground water resources in the country are spread unevenly and from north to south the chemical components of the water change and mineralization increases. It is caused by the changes in climate, as a decrease in precipitation from north to south, increases the air temperature and evaporation. Therefore, southern parts of the country have sparse vegetation and fewer species of animals (Munkhzorig, 2002).

3. Characterization of the Forests and their Governance

3.1 Distribution of Forests and Abundance of Forest Species

The forests are mainly located in the northern parts of the country, basically within the Khangai and Khentii ranges and Khobsogol region. Mongolian forests are located on the very brink between the Siberian taiga (Trans-Baikal forest area) and the Central Asian steppe zones, functioning as a separator of taiga and steppe. They play an important role in the maintenance of naturally balanced water conditions in rivers and streams, in the prevention of soil deterioration, in the amelioration of the climate as well as in the preservation of the permafrost in its ecologically important form. Due to their Central Asia hard continental origin forests in Mongolia have low capacity of natural regeneration and they are very sensitive to forest fire, insects and human forest use. Non-forest lands of almost 1.4 million hectares consist of southern mountain slope sites, pasture and grass haying sites, sub-alpine areas, etc. Figure 2 provides an overview of the structure by land cover types of the forest lands.

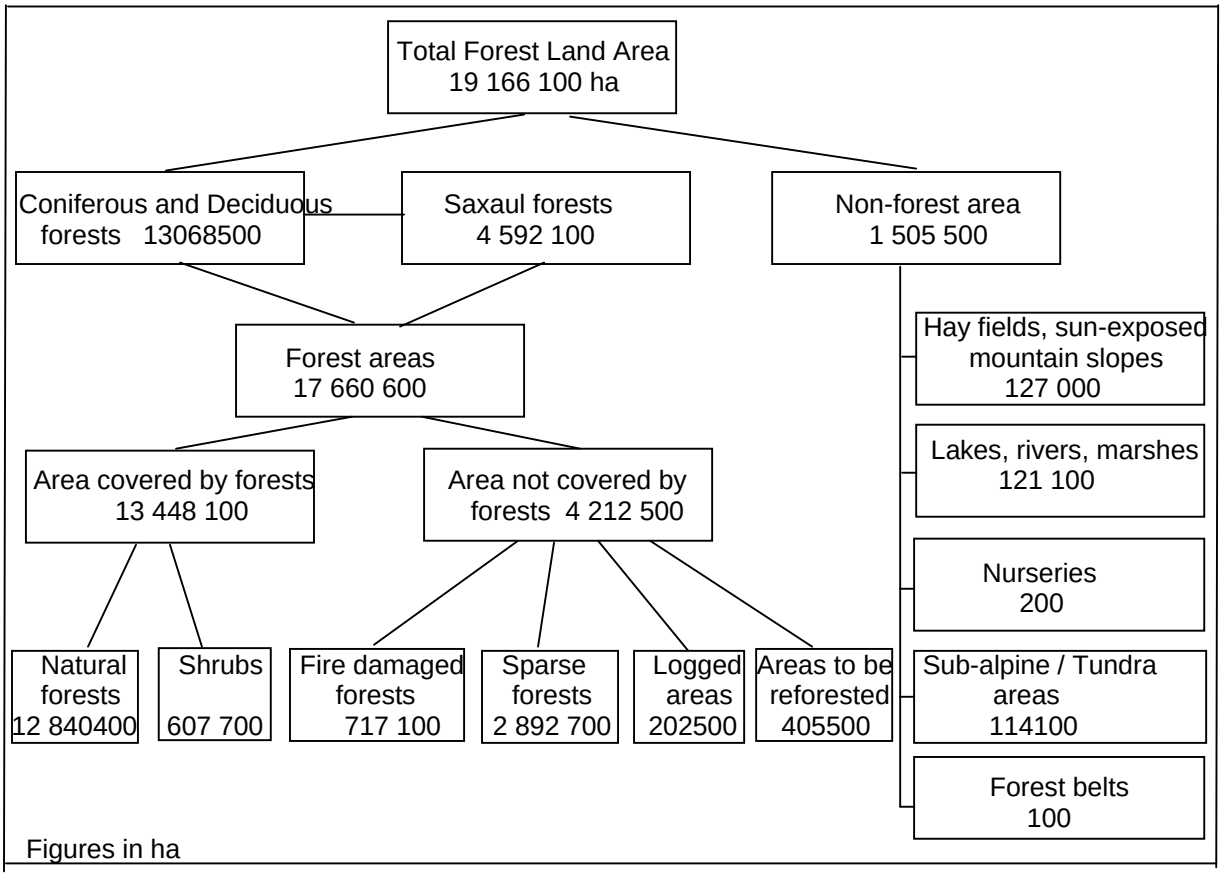

Figure 2: The forest structure of Mongolia. Source: Water and Forest Resource Center 2007

Besides biophysical attributes of land cover the forests of Mongolia have been structured by functional categories, which can be characterized as follows:

1. **Strictly Protected Forest Zones** include the strictly protected sub-alpine forests and those parts of the protected highland areas which have already been included in the network of the established Protected Areas. Forests in the Strictly Protected zone are to be managed to maintain their ''natural features" and their "ecological balance" though, inexplicably, the law allows protection and suppression measures against fire and pests, both of which are important natural influences in the renewal and regeneration of boreal forest. These forests cover up to 48.2% of the country's total forested area.
2. **Protected Forest Zones** include natural forest and woody plant reserves in the green sub-zones, forest in Buffer zones, all saxaul (*Haloxylon ammodendron*) forests, forest in oases and on mountain slopes steeper than 30 degrees. Forests in this category cover 45% of the total forested area.
3. **Utilization Forest Zones** include all other forests, excluding those mentioned in the other two categories; these zones consist of forests where selective timber cutting and logging are allowed. These forests make up over 6.8% of Mongolian forests.

Mongolian forests contain about 140 species of trees, shrubs and woody plants. The most important coniferous and broadleaved species are listed in Table 1.

Table 1: Distribution of forest stock by leading tree species in Mongolia. Source: Tsogtbaatar (2002)

Tree Species		Standing Stock (m^3)
Coniferous		
Siberian larch	*Larix sibirica*	1 026 860 600
Scotch pine	*Pinus sylvestris*	92 606 000
Siberian pine	*Pinus sibirica*	163 960 400
Spruce	*Picea obovata*	3 688 100
Fir	*Abies sibirica*	375 700
Broadleaved		
Birch	*Betula platyphylla*	86 162 900
Poplar	*Populus* sp.	2 120 600
Aspen	*Populus tremula*	1 390 200
Willow	*Salix* sp.	544 700
Total		**1 379 181 700**

The standing volume averages to over 100 m^3 ha^{-1} ranging from 19 m^3 ha^{-1} for willow, 65 m^3 ha^{-1} for birch to about 140 m^3 ha^{-1} for Siberian larch and pine, respectively. Mean age by tree species has been estimated at about 40 years for the broadleaved species and over 120 years for the coniferous tree species. The crown coverage is about 0.53 on the average (Tsogtbaatar 2002).

3.2 Legal and policy framework

Rules on forestry in Mongolia were first adopted in 1925, which then became the Forest Law in the 1930s. Since 1995, the Mongolian parliament has adopted about 25 environmental laws, covering various aspects of land use, environmental protection, air, plants, animals, forests, toxic substances, environmental impact assessment, wildlife protection, and protected areas, etc. (Government of Mongolia, 2002).

The Forest law, enacted in 1995 and amended in 2007, provides the basic framework for the protection, proper use and regeneration of Mongolia's forests. According to this law the state owned forest land and forest resources are subject to leasing or allocation to economic units, organizations and to groups of citizens. The law regulates the roles and responsibilities of government agencies and as well as citizens. Mongolia is also signatory of international treaties with important implications for forest management.

A National Forest Policy was prepared in 1998. It focused on forest utilization, forestry resources conservation and social welfare concerns. The forest policy was revised through the National Program on Forestry (Non Timber Forest Products) in 2001 and the National "Green Wall" Program in 2005. These policy documents clearly represent state policy to shift its priorities away from utilization of forest resources towards conservation, protection and reforestation. The National Program on Forestry priorities are institutional restructuring, forest fire and pest management, reforestation and enhancing the quality and efficiency of timber processing. The National "Green wall" priorities are building totally 3 000 km long green zones between desert and steppe eco-zones from western to eastern regions of Mongolia with the aim to combat desertification and sand movement (Ykhanbai, 2004).

Structure and Powers of the Government Agency in Charge of Forestry

The new legal provisions laid down in the Forest Law of 2007 are regulating the establishment and tasks of a Forestry Agency.

- A government agency responsible for forestry (referred to as "Government Agency" hereinafter) and forestry units within the Aimags and in the capital city will be established within the departments responsible for nature and environment. They shall operate under the jurisdiction of the Member of Government in charge of nature and environment.
- If so required, inter-Soum or Soum forestry boards, or forestry officers at some Soum Governor Offices may be installed to provide technical and methodological support in the implementation of national forest protection, utilization and reproduction policy at the local

level, and in organizing the transfer of forest parcels to partnerships, economic entities and organizations for possession on a contractual basis.

- The Government Agency shall have the following powers:
    - based on forest resources available, prepare proposals on annual harvest resources for approval by the Central Government Authority;
    - organize the implementation of the decisions of relevant state and government bodies on forest utilization, protection and reproduction;
    - approve Soum and Duureg management plans and organize implementation thereof;
    - organize works at central and local levels to reforest logging areas, burns, infested and diseased tracts, to forest semi-desert, desert and steppe areas, and to establish forest belts;
    - plan forest ecology-economic evaluations and have them approved;
    - provide nationwide technical guidance and coordination to the work of establishing tree and shrub seed banks and forest nurseries, and growing seedlings and saplings;
    - provide technical guidance to local forest partnerships, economic entities and organizations;
    - distribute the budget allocations for forest protection and reproduction, monitor and report use of funds;
    - develop and have approved the methodologies, norms and standards for forest protection, rational utilization and reproduction;
    - monitor changes in forest resources, maintain the forest databank and supply information;
    - provide all-round support and assistance to the participation of domestic and foreign organizations in forest protection and reproduction activities;
    - develop model programmes and management plans for use by Partnerships, economic entities and organizations in their forest protection, utilization, and reproduction activities, approve guidelines and manuals for their formulation (Law of Mongolia on Forest 2007 Article 13)

Fire Prevention and Control

- Aimag, capital city, Soum and Duureg governors shall formulate fire prevention and control programmes and take measures to secure the requisite allocations in the local annual budgets.
- Partnerships, economic entities and organizations shall self-finance the fire protection activities in their tenure forests.
- A working group decreed by Aimag, capital city, Soum or Duureg governor, or the government fire fighting authority shall determine the cause of the fire, damages inflicted and expenses incurred to control the fire.
- Citizens, partnerships, economic entities and organizations shall abide by the following requirements for fire prevention and control:
    - refrain from starting fire in the open air and ensure that such fire, if unavoidable, and its ashes as well as matches and cigarettes are completely extinguished in the fire seasons from 20 March to 10 June and from 20 September to 10 November;
    - in the fire danger periods, notify the respective environmental ranger and provide him/her with fire prevention warranty for logging, extraction of non-timber resources, trekking, outings and other activities;
    - strictly fulfil the provisions of Article 7 of the Law on Forest and Steppe Fire Prevention[1].
- Governors of all levels shall use their legitimate powers to mobilize the requisite human and technological resources and promptly take fire control measures while citizens, partnerships, economic entities and organizations shall comply with the rulings of the governors (Law of Mongolia on Forest 2007 Article 23).

3.3 Recent Changes of Mongolian Forests

Socio-economics: According to a survey of human impact on ecosystem in Mongolia during the last 100 years, it is seen that some 40% of all forests in Mongolia have been impacted at some level or

[1] Law on Forest and Steppe Fire Prevention, published in Issue No. 11 of 1996 of the State Bulletin.

another; 684 000 ha have not regenerated after fire damage and 250 000 ha after clear cutting; 1 737 000 ha of coniferous forests have been replaced by birch and poplar, 159 000 ha by steppe and sand / stones, and 1 230 000 ha by low-quality coniferous forests. Cold-resistant taiga forest has been shrinking; and 16 percent of forest ecosystems have been replaced by non-forest ecosystems. Reports indicate that between 1974 and 2000 forest cover of an area of about 1.6 million ha was lost (Krasnoshekov et al., 1992).

The annual volume of logging, which was about 2.2 million m^3 in the mid 1980s, fell to about 0.86 million m^3 in 1992 and the harvest in the year 2000 was only 0.5 million m^3. This fall is partly due to the influence of institutional and policy changes involving privatization of production enterprises and decentralization of decision-making power. But partly it is also due to the supply constraint caused by the reduction in the area of designated utilization forest from about 5.8 million ha in 1985 to 2.4 million ha in 1990, and further to 1.19 million ha in 1996. This is due to re-classification of some of the utilization forests as protected areas. Also, the Forest Law of Mongolia prohibited clear cutting of natural forests and prescribed selective cutting as of 1995 (Tsogtbaatar, 2002).

Between 1940 and 2002, a total of 45.8 million m^3 of round wood was harvested from more than 320 000 ha, and annually about 395 500 ha were affected by forest fire and 101 100 ha of forest area damaged by insects and pests since 1980. Between 1996 and 1997 alone, 5.0 million ha were affected by forest fires, and within them nearly 500 000 ha forests were completely burnt and lost their ecological function.

In the period from 1995 to 2000, besides the Law on Forests the Mongolian Parliament adopted the Law on Fees for Timber and Fuelwood Harvesting, the Law on Forest Fire Prevention, and the Law on Quotas of Export Custom Tax on certain goods. But, relevant laws and regulations have not succeeded due to a lack of appropriate institutional restructuring and privatization of the forestry sector during the period of economic transition. In the past few years, silvicultural thinning has been reduced. Its annual rate reached less than 500 ha. Clearcuts covered about 1 000 ha annually. The salvaged trees have been used for sawn timber and fuelwood for local citizens (Forest Policy Statement 2001).

Since 1971, reforestation activities have been regulated by the State Central Plan and Directive. Reforestation activities totalling 100 300 ha cover only 30% of all logged area in the country. For example, reforestation and afforestation activity implemented annually covered about 3 900 ha in 1980-2000, 4 600 ha in 1996-1999, and 8 200 ha in 2002 (Tsogtbaatar, 2002). Due to financial constraints, activities on combating desertification and soil erosion and raising of seedlings have not met present needs.

The logged timber supplies domestic demand for wood and timber products. An assortment of woody products were once exported in small quantities, but forest enterprises, timber-harvesting companies, and wood-processing factories are at a standstill due to old, outdated machinery, equipment, and inappropriate industrial processing technology. This is reflected in the fact that in 1989, products of the forestry sector amounted to about 4.7 percent of the gross domestic product (GDP); by 1998 this rate had declined to 0.25 percent (Tsogtbaatar, 2002).

Faced with the problem of dwindling forests and its ecological consequence, the government has given emphasis to forest conservation in recent 10 to 15 years, with the objectives of conserving bio-diversity, maintaining ecological balance, protecting wildlife, enhancing beneficial influence of forest, and controlling desertification. Some 17.1 million ha, about 10.9 percent of the Mongolian territory, have been declared as protected areas. Of this, some 8.4 million ha are designated forest lands (The World Bank 2003).

Illegal logging: Today the government of Mongolia established quotas for sawn timber and fuelwood on the level of 0.04 and 0.6 million m^3 correspondingly. This approximately is a half of wood used in the country, the rest is accounted for by the illegal cutting (Kondrashov, 2005). The government approved the law on the import of wood trying to balance demand and supply. Currently about 65 percent of logged wood is used by the poorest and economically disadvantaged groups of the Mongolian population in agricultural and urban regions for heating and cooking, for which there is no alternative. The result of this is the acceleration of the forest destruction. If there will be no other source of energy, then under today's level of deforestation the serious shortage of the fuelwood will be felt by the end of this decade.

Constant monitoring, maintenance of law and order in forestry is the responsibility of environment inspectors and foresters in Aimags (provinces) and Soums (districts). All inspectors are supervised by the State Inspection Bureau. Overcoming illegal logging is the main task of these authorities.

The government introduced some measures to decrease the illegal wood turnover including:

1. Certification code for transportation of commercial timber and fuelwood between the Aimags and cities;
2. Revised license to cut commercial and fuelwood;
3. Revised law articles connected with planning and allowable cut volumes;
4. Established sector inspection of illegal cuttings;
5. Involved NGOs and citizens in logging monitoring;
6. Government support to community based forest management approaches

The government tries to combine the efforts with the activities of the civil society beginning to understand that the forests and their sustainable development is one of the main economic pillars of the country.

In recent years, illegal logging in the forest, associated trade and corruption attracts a lot of attention of the worldwide, therefore “Forest Law Enforcement and Governance” (FLEG) action started to implement.

FLEG - At the national and international level participating countries assumed the role of strengthen coordinating actions to combat illegal logging and transboundary illegal trade, and associated corruption for sharing information and experience and for reporting progress on implementation, including e.g. through a peer review mechanism.

At the Ministerial Conference on Forest Law Enforcement and Governance in St. Petersburg, Russia, representatives of the Governments from Europe and North Asia (ENA region countries) and from other participating countries as well as the European Commission considered sustainable managing their forests and enforcing their forest laws and that good governance and law enforcement are prerequisites of sustainable forest management and further underlining that, while taking into account their international obligations, all countries have the sovereign right to manage and utilize their forest resources to meet their national policy objectives, recognizing that forest law enforcement and governance issues have local, national, transboundary, regional and global implications and then all these countries accepted and approved the St. Petersburg Declaration on 25 November 2005.

The Mongolian Government acceded to the St. Petersburg Declaration on 25 November 2005 therefore now Mongolia is responsible for developing its national Forest Law, resolution and policy on the Forestry and consisting with International conventions and negotiations.

For implementing St. Petersburg Declaration:

A. Nationally, within the ENA region
1. Policy framework
2. Legislation system
3. Institutions and Capacity Building
4. Sustainable Forest Management
5. Rural Development, Livelihoods and Poverty Alleviation
6. Trade and Customs framework

B. International level
1. Implementing Forest-related Policies
2. Trade and Customs
3. Research
4. Collaborative Implementation Actions. Strengthen coordinating actions to combat illegal logging and transboundary illegal trade, for sharing information and experience and for reporting progress on implementation, including e.g. through a peer review mechanism, of the St. Petersburg Declaration and indicative list of actions.

For the implementation of the St. Petersburg Declaration, support of Donors and multilateral cooperation is very important. Participating countries at the Ministerial meeting are starting to implement the provisions of the Declaration.

The Mongolian Parliament approved the new version of the Forestry Law in May 2007 and started actions as implementing new law and to advertise on the right way to governmental and nongovernmental organizations, local citizen and all current organizations. Also we organized the advance FLEG workshop on illegal logging, its reason, associated trade and corruption and opportunities to overcome obstacles in the local level.

The GTZ program on the “Conservation and sustainable management of natural resources” organized five “Forest Law Enforcement and Governance” workshops.

4. Forest Fire Situation in Mongolia

4.1 Fire Environment, Fire Regimes and Ecological Role of Fire

Occurrence of forest fires depends on forest type, precipitation distribution, and availability of fire sources. Forest fire statistics for the period 1963 to 1997 reveal that the majority of fires burned within the central and eastern parts of the forested area. This can be attributed to the predominance of highly fire susceptible (highly flammable) pine *Pinus sylvestris* and larch *Larix sibirica* stands. Annual precipitation ranges from (200) 250 to 350 mm. Air temperature fluctuations can amount to 90°C, with the summer maximum being +40°C. Snow cover is usually not more than 10-15 cm deep. Summer is the season of the lowest precipitation that usually occurs as heavy showers. Moreover, economic activities are much higher here as compared to other parts of the region.

The average fire season usually has two peaks. One peak is during spring from March to mid June and accounts for 80 percent of all fires. Fires start in late March and early April, immediately after snow melt when forest fuels are drying rapidly on southern- and western-facing slopes. Intensive solar radiation removes water from the topsoil by evaporation, and the remaining water flows from elevated sites downhill and accumulates in depressions because it cannot penetrate deeply into frozen soils. Spring fires are thus most common in stands on these elevated dry landscape elements and in those where herbs and small shrubs form a loosely compacted living ground cover layer. The other fire peak falls within a short period in autumn from September to October and accounts for 5 to 8 percent of all fires.

Steppe fires often invade the adjacent forest-steppe and sub-taiga zones. High fire danger is largely due to the prevalence of light-needled conifers in stands adjacent to steppe areas. These are mainly pine stands with mixed herbaceous ground cover, which are characterized by high fire danger in spring and autumn. In the mountain forest belt, especially in the high elevations, lightning fires are most common. Lightning storm activity increases considerably at the end of May and in early June. However, lightning fires are more rare in larch and Siberian pine stands of the mountain taiga (Chuluunbaatar, 2001).

Wildfires constitute a major factor that determine spatial and temporal dynamics of forest ecosystems. Out of the total of ca. 17.5 million ha of forest land, 4 million ha are disturbed to varying degrees either by fire (95 percent) or by logging (5 percent). In one of the most sparsely populated countries in the world, it is difficult to get accurate data on fire causes (Goldammer, 2002). It is known, however, that during the main fire seasons no natural fire causes exist. The recent increase in the number of fires per year is related to the opening of markets once highly controlled or restricted. The vast majority of fires are not deliberately set to clear land; rather, it is a function of carelessness.

Fires start for three reasons:

1. Antler collection starts in the bitter cold of February when fire is simply a survival tool;
2. Sparks from vehicle exhaust pipes in remote forests;
3. Tracer bullets left by the Russian military have entered the game hunting market and are used to hunt elk for the blood antlers.

Figure 3: Forest in Northeast Mongolia degraded by illegal logging and fire. Photograph 2007: GFMC.

Figure 4: Forest patterns in Northeast Mongolia are also shaped by past logging activities involving large-scale clearcuts and fire. Former pine-dominated stands are replaced by pioneers species such as birches and poplars. Photograph 2003: GFMC.

Figure 5: The presence of remnant mature trees and regeneration is indicating that the denuded, grass-dominated mountain lands of Nothern Mongolia are potential forest sites. The regeneration is killed by recurrent grass fires. Photograph 2003: GFMC.

Figure 6: Open pine forests with limited impacts of illegal logging are quite resilient to frequent surface fires. The recurrent surface fires reduce the fuel loads and leave behind a forest in which the risk of high-intensity and high-severity is reduced. Photograph 2003: GFMC.

The current fire pattern is affecting 14 percent of this resource annually. The short growing season and low growth capacity of the trees means that these damaged forests may take 200 years or more to regenerate and develop to a state comparable to the situation before the outbreak of fire. In addition to their commercial value, the forests are a precious ecological resource. They contain the sources of virtually all rivers in the country including the inflow to Lake Baikal (Russia), the largest fresh water lake in the world. They protect soil, rangelands, provide habitat for wildlife and serve as windbreaks. Figure 3 shows the area damaged by fires in Mongolia for the previous 25 years.

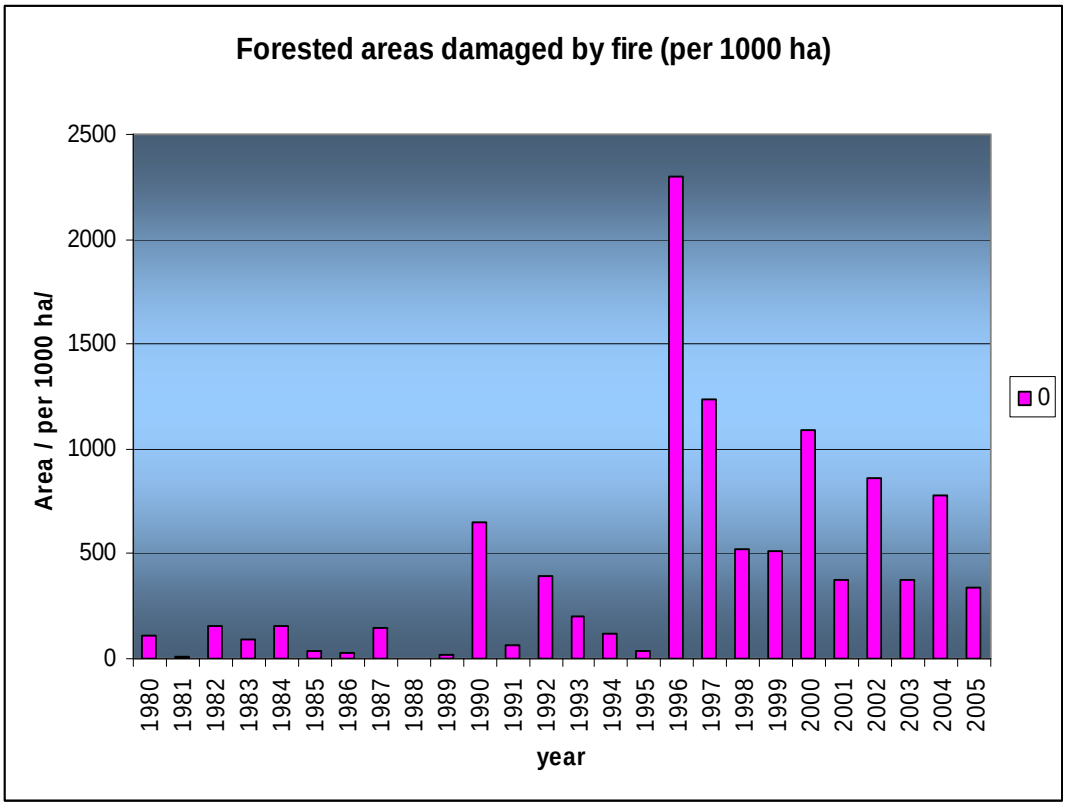

Figure 7: Forested areas damaged by fire from 1980 to 2005. Source: GFMC database; Bayartaa (2006)

It becomes clear that after 1995 when the transition restructuring of economy was at the full swing and management abilities of the government were weakened, the area damaged by fires had increased. In addition, winters and springs from 1996 to 1998 were extremely dry and were lacking snow in most areas of the country. From late February to early June of these years, Mongolia suffered from large-scale forest and steppe fires that devastated large parts of the country. During these fire episodes 29 people died, 82 people were injured and 11 700 livestock were killed. Also, 218 family houses, 1 066 communication facilities, 750 fences and 26.3 million ha of pasture and forest burned. The total costs of property losses amounted to 820.2 million MN¥ (Mongolian Tughrik). Ecological and economical damage were estimated as 1 850.5 million MN¥ (December 1999 value: ca. $US 1.8 million). Despite new laws and regulations since then, the average data on damage by forest fires has been far greater over that in the earlier decades.

4.2 Mongolian Fire Management Organization

In 1969 the Mongolian Fire Protection and Aerial Patrol Service was established to provide early detection and rapid initial attack on fires, based on a Soviet-style aerial detection and airborne firefighting program. The Service was staffed by 200 to 300 smokejumpers and helicopter rappellers, including a fleet of helicopters for helitack and tactical aerial support. The aerial forces operated out of seven bases distributed throughout the fire-prone regions of northern Mongolia. Smokejumpers on routine aerial patrols detected a high percentage of the fires and handled approximately 90 percent of the suppression workload. In the early 1990s, when the communist government and Soviet financial

support abruptly disappeared, the Mongolian aerial program sharply declined. At present, the country cannot afford to maintain and fly their aerial patrol aircraft. The decline of the aerial program through the mid-1990s resulted in a “fire suppression void” and greatly contributed to the horrendous losses experienced in the 1996 and 1997 fires.

Immediately following the 1996 fires, Mongolia received assistance from international organizations. The German government initiated an Emergency Fire Aid project in the northern and eastern parts of the country between October and December 1996. In February of 1998, the German and Mongolian governments signed an agreement to start an Integrated Fire Management (IFM) project to be implemented over three years (1998-2000). A primary task of the project was the establishment of a fire management plan compatible with the protected area goals and the responsibilities of the local communities (Goldammer, 2002).

The Mongolian government has since been working to find long-term solutions to improve fire management. In a first step, the parliament passed a law designed to organize and improve firefighting efforts at all levels. The Law on Forest Fire Prevention and Control of 1996 provides detailed requirements for the setting up of forest fire prevention and control organizations at local and central levels. In support of the state’s responsibilities in the area of forest fire prevention and control, the owners / managers of forest and other land have the following responsibilities:

- They are required to provide professional technicians or forest rangers to patrol and protect forests
- They must control the use of fire within their areas
- They must undertake fire prevention measures as required

The law shall also regulate civil and criminal penalties for violation of provisions in the law, or causing fires, or creating a risk of fires. These provisions and their efficient implementation are very important to the conservation of the forest environment.

Emergency Response Organization: The State Emergency Commission is chaired by the Deputy Prime Minister and has overall responsibility for dealing with a fire emergency situation. This commission consists of representatives from all the ministries. The Chief of the Civil Defence Committee is the Deputy Chair of the State Emergency Commission. The mission of the Civil Defence Committee is to protect human lives and properties from natural disasters. In a wildfire emergency situation, the Civil Defence Committee is responsible for all operational aspects of fire suppression efforts.

The provincial branches of the Civil Defence Committee do not have full-time employee staff. Civil Defence representatives are in a reservist status and are activated in a civil defence capacity only in the event of an emergency incident. The Civil Defence organization includes approximately 200 smokejumpers based in seven northern provinces. It also includes approximately 100 specialized rescue personnel who are trained firefighters.

In response to an emergency fire situation, the State Emergency Commission must declare a state of emergency. Special coordination groups will be established in local areas impacted by the fire situation to direct suppression efforts and provide humanitarian relief as needed. During the fire emergency in last 40 years the military and police forces were mobilized to fight the fires as numerous local people. Border troops near Russia were also mobilized. All available resources were mobilized in the fire suppression effort, which on a daily basis ranged from 3,000 to 10,000 firefighting personnel and from 1,000 to 3,000 vehicles. Local individuals were conscripted to fight fire and were organized in crews under the leadership of military personnel or other officials.

Figure 8: Northern Mongolian “moonscape” – a result of accelerating illegal exploitation and fire. Photograph 2007: GFMC.

Figure 9: Investigation of a truckload of illegally cut timber. Photograph 2007: GFMC.

Figure 10: The local economy of many Soums in Mongolia's North is dependent on illegal logging and sawn timber production – economies that are fragile and not sustainable. Photograph 2007: GFMC.

Fire-Station of National Emergency Management Agency

Action Direction of the Fire-station: It directed to implement the Law on the fire fighting and emergency, keeping the safely situation of the population, State, organizations and enterprises and to sustain the economical development of the State.

Monitoring department on the fire fighting and prevent: Nowadays, department of the fire analysis of the Fire-station under the State Emergency reaching to the hot point of the fire and detecting the reason of the it in the centre or local place as soon as possible. It analyzes the sample materials from the fired place. They research all the fire criminals, its reason and situation in the State for each month, season and year. Also they work on chemical, electric and heating analyses of substance and materials, which send by citizen, organizations and enterprises.

When there will be fire the heating transition reacts with water and it secretes poisonous substances to human health. Now they are working on the research of poisonous substance and materials.

Prioritization Criteria for Resource Commitments: Priority fires for the limited suppression resources were determined based on the fire's proximity to population centres and threat to National Parks and Strictly Protected Areas. Due to the limited resources available and the number and magnitude of active fires, it was determined that some remote fires would have no suppression activity.

Intelligence Gathering: The Ministry of Nature and Environment maintains a very modern Information and Computer Centre that compiles environmental data. This includes meteorological, water quality and pollution data.

Among a number of earth observation sensors the National Ocean and Atmospheric Administration (NOAA) series satellites are used. They are used for monitoring the development of natural disasters,

such as wildfires, floods, as well as meteorological phenomena, etc. There are four major advantages of using NOAA series satellites for fire detection and fuel mapping (early warning) (Erdenesaikhan, 1999):

1. Spectral Resolution. The Advanced Very High-Resolution Radiometer (AVHRR) sensor on board of NOAA satellite acquires data in 5 spectral channels. The Spectral location of Channel 3 (3.55-3.93 μ) coincides with the radiation of maximum intensity from a black body with a temperature 780 to 800K, and is therefore well suited to the detection of elevated heat sources, which indicate the presence of active fires. Channels 4 and 5 (near-infrared channels) are located in the thermal infrared part of electromagnetic spectrum where all radiation is emitted by the earth surface according to its temperature and radiation and used for estimation of cloudiness, cold surface of the earth. Channels 1 and 2 are in visible and near-infrared parts of the electromagnetic spectrum where all radiation is reflected sunlight and widely used for estimation of vegetation cover.
2. Spatial Resolution. Resolution of AVHRR data is 1.1 km^2. Although the resolution is rather low, due to very high sensitivity of the channel-3 to the hot sources, even 50 m long fire fronts can be detected in the steppe. Full (1.1 km) and lower resolution (4 km) data can be recorded and transmitted directly from the satellite in the High Resolution Picture Transmission (HRPT) for selected areas of the world within a radius of 2 500 km from a receiving station.
3. Frequent temporal coverage. Currently, there are 2 NOAA satellites in complementary near-polar orbits, NOAA-12 and NOAA-14, one crossing over Mongolia at local solar times of approximately 07:30 and 19:30, and the other at 02:30 and 14:30. The orbital characteristics are such that with two satellites in operation, the possibility exits for twice daily and twice nightly coverage at any point in Mongolia.
4. Overpass time. The current afternoon, approximately 14:30 overpass time of NOAA-14 is the best available in terms of fire detection and monitoring in Mongolia

Large fires were detected by the Information and Computer Center (ICC) on 23 April 2006 on the base of satellite data (classification by the NOAA AVHRR) (http://www.fire.uni-freiburg.de/GlobalNetworks/CentralAsia/CentralAsia.html). The images in Figure 4 show a time series of fires burning in 2006 in the foothills of the mountains that separate Russia (north) from Mongolia (south).

The recent fire danger situation in forest and steppe zones challenged staff of the National Remote Sensing Centre to test and improve their operational technology to quickly process and transfer fire locations and other data to disaster related and administrative organizations. Fire events are grouped in forest as well as other wooded and other land. During the wildfire emergency, fires are mapped daily using computerized satellite imagery. The fires are then numbered and listed by province and county with the latitude and longitude indicated for each. The map and list are sent daily to the Civil Defence Commission and the Ministry of Nature and Environment. Another service that the computer center provides are meteorological data for the Mongolian Hydrometeorological Service, Weather Modification Centre "Khuryn Shim".

Other fire situation intelligence data are gathered through information from the field. Generally, this information is two days old by the time it is received in Ulaanbaatar. There is no radio communication from the fires to the local command centres. Information from the fires is carried by people on horseback or vehicles to local command centres and then transmitted by telephone to Ulaanbaatar.

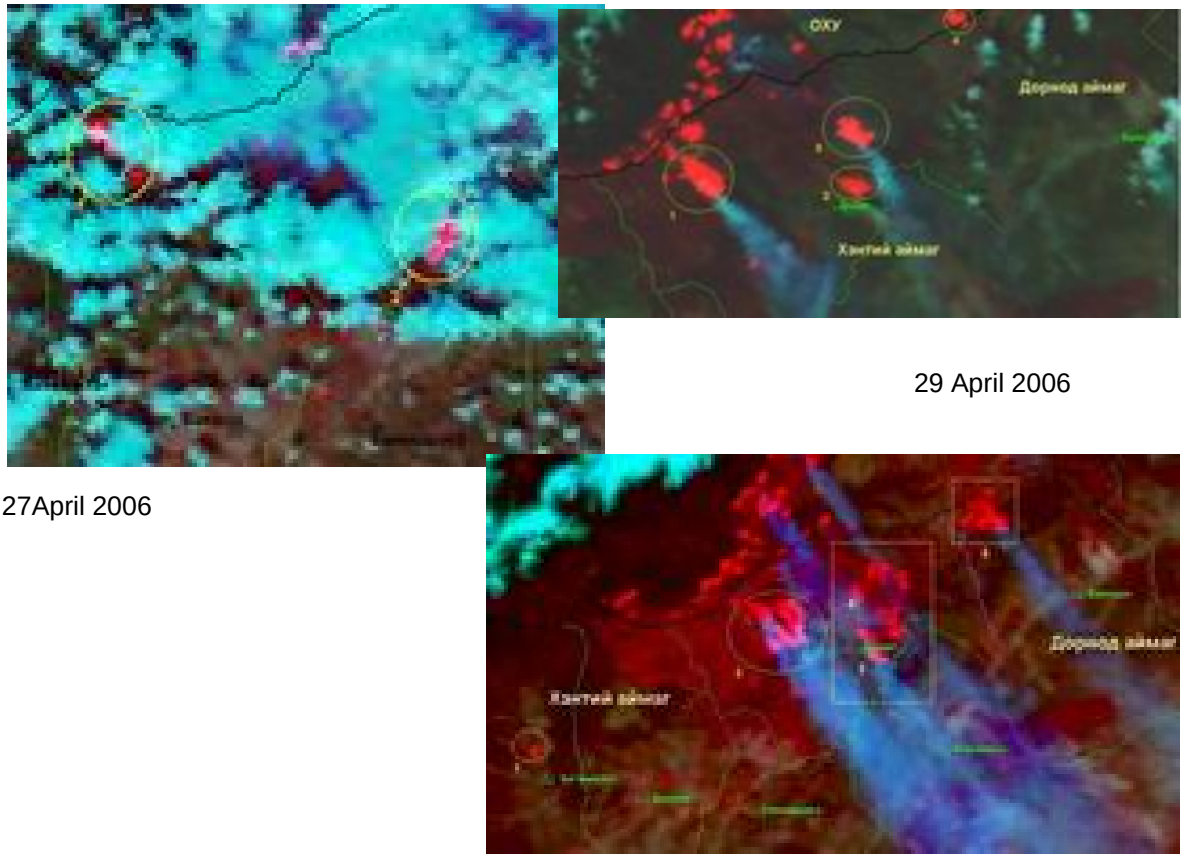

Figure 11: Time series of fires from 27-30 April 2006. Source: Information and Computer Center Mongolia (2006)

5. Conclusions

This paper intended to highlight the overall situation of forest fires in Mongolia integrated in the biophysical and predominating forest-related socioeconomic conditions of the country. The current situation and prospects of fire management have been discussed. The following conclusions can be drawn:

1) For studying the relations of humans and wildland fires it is necessary to take into account the co-existence of nature and human society. There is a need to take into consideration the authority of traditions which were formed during centuries and not interfered by external factors for a long time. This, first of all, is attributed to agricultural use of fires, prescribed burnings, and the role of domestic animals in impacting on the landscapes. However, in combination of the existing customs with additional new knowledge it is possible to establish a functioning system of fire management.

2) For an institutional setting of fire management it is very important to understand that the solution of forest fires problems belongs not only to the government but to the civil society as a whole. It is very significant that forest fire protection becomes a vital necessity of every member of the society.

3) Various countries have developed policies, legislation and location specific strategies in wildland fire management and gained experience in implementation and enforcement. This experience should be shared with Mongolia. So, Mongolia could elaborate standardized protocols, agreements, command systems and methods for delivering to, or receiving assistance from other countries to suppress catastrophic fires. Besides clearly defined bilateral or multilateral agreements it will be important to utilize the Incident Command System (ICS) as a unified standard procedure for multinational

cooperation in wildfire incidents. Methods and dissemination of information on early warning of fire risk, and fire danger have also been developed in various countries and could be applied to Mongolia.

4) Guidelines are needed for the various user levels, ranging from practical guidelines for local fire managers to guidelines for land-use planning and policy development. Guidelines must consider the specific natural (ecological) conditions of wildland fire, as well as the social, cultural, economic and political environment.

These activities would help steps forward to train a new generation of highly qualified specialists able to contribute their own ideas and practices to create a more advanced management system in the field of natural resources management to provide for the sustainable development of the resources. A basis would be established to change the human behaviour, the attitude of authorities to urgent needs in the field of fire management to improve the ecological situation in Mongolia.

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