Fire monitoring from the space

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1. INTRODUCTION

Mongolia is a country located at the Central Asian highland with an area of 1565000 square kilometres, is bounded on the north by Russia and on south by China. Mongolia located deep within the interior of the Eurasian mainland far from washing it seas and oceans, is a highland country and has a marked continental climates with poor soil fertility, scanty surface water resources, in the harsh natural conditions.

Mongolian nature and geography, its economic and social specific features account for its considerable vulnerability to natural disasters. Winters are cold with zud (severe winter conditions), in springs blizzards and tornadoes, wildfires are common, in summers shower rains, floods, in autumns heavy snowfalls, frosts, blizzards often occur which means that throughout the year the country is under pressure of one of natural disasters.

Many experts from the field of disaster study to estimate how danger it is calculating number of human losses. Most of them did not include such natural hazards like heavy winter, drought and fire to the disaster if there are not so much human death. But in case of Mongolia such hazards are causing direct and indirect way much more losses in livestock beside environmental and ecological damages. Animal husbandry is one of most important field of Mongolian economy and still it is base of our living condition.That is why, for the animal husbandry based on nomadic pastoralism meteorological hazardous phenomena and wildfires, which are affecting on pasture condition, a key influences.

2. FIRE DAMAGES OF LAST 3 YEARS IN MONGOLIA

Forests and grasslands play an important role in the economy development of the country. Forest cover is 12.5 mln.ha or 8.1% mostly with larch, pine, birch, cedar, spruce and saxaul and grassland cover is 70% of all territory. In an average year occur the 50-60 forest fires and 80-100 steppe fires. During last few years Mongolia has a various natural or non natural hazards and one of most dangerous natural hazard is *a Forest and steppe fires.* They damage about 70,000 ha of forest and 700,000 ha of grassland. The economic losses exceed 10 billion tugrigs (Tugrig is Mongolian currency. 800¥ = 1$).

About 90 percent of steppe and forest fires in Mongolia are caused by human. However it is human caused, nature has a burning material. However, the forest resource is 1.3 bln cubic meter, timberland area is 300000ha, 42.1mln cubic meter wood prepared during last 37 years and 70000 ha forest area is damaged by insects every year.

Forest fire and reforestation status:

	1993	1994	1995	1996	1997	Total

Burned forest area	205282	117809	34193	2363600	2710000	5430884
Reforested area	4585.7	4934	3970.2	3211.1	5001.1	21702.1

(Areas are in hectares)

According to the statistics since 1963 we can see the frequency of forest and steppe fire and in Mongolia each ten year suffered by high number of fires (Figure 1).

The winter and spring from 1996 to 1998 were extremely dry and lack of snow in most areas. From latest of February to early of June, Mongolia was suffered from large-scale forest and steppe fire, that devastated a large part of the country. In next table we showed the some casualties of these fires.

Year	Aimag	Sum	# of fires	Area	MN¥(mln)
1996	16	120	417	10734178	371.6
1997	14	98	239	14234583	127.4
1998	15	69	132	3641672	93.9
Total			788	28610433	592.9

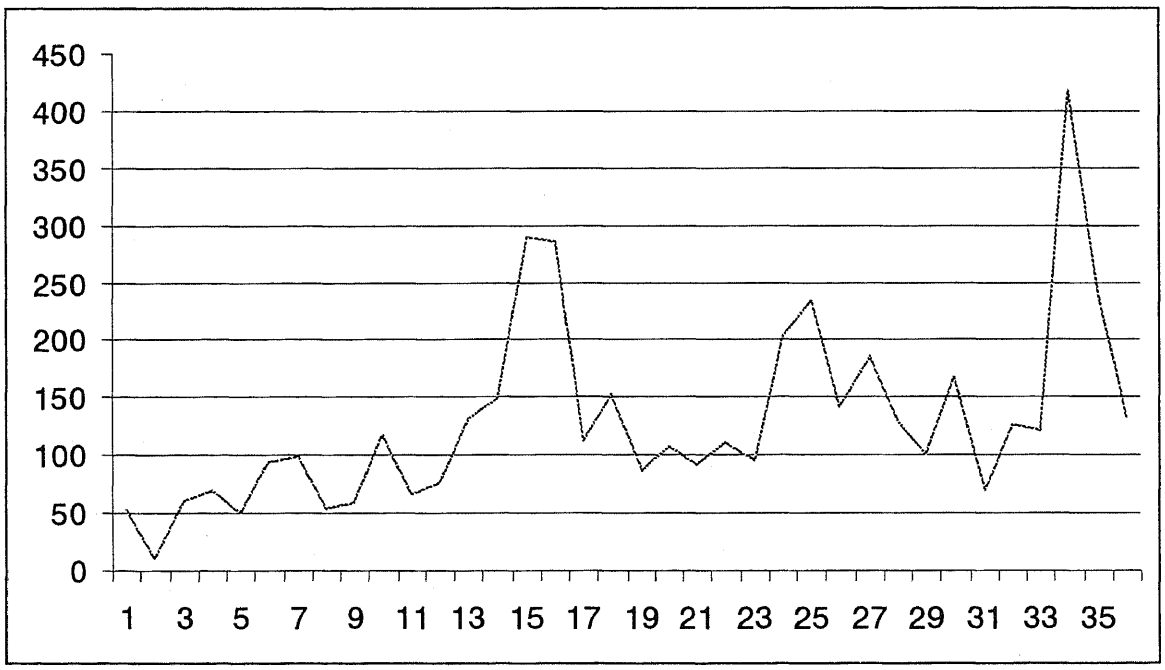
Casualties are:

29 people died, 82 people had different burn, 11700 livestock died, 218 family house, 1066 communication facilities, 750 fences, 26.3 mln.ha pasture and forest burned

Total cost of properties 820.2mln

Ecological and economical damage estimates 1bln 850.5mln

Figure 1. Fire frequency from 1963-1998*



* Data for this graph is provided by N. Erdenesaikhan, officer of the Ministry of Nature and Environment

3. CLIMATE CONDITION IN LAST 3 YEARS

The global warming is one of the reasons of fire. In mountain and steppe zone number of days with 0 and higher degrees increased from 10 to 20 and total temperature increased about 100 degrees. Last 60 years precipitation and temperature are increasing. But precipitation in spring is decreasing. Deepness of frozen soil decreased in 20-60cm. Winter in 1995-1996 was warmest in last 60 years.

4. FIRE DETECTION AND MONITORING BY SATELLITE DATA

The monitoring and establishment of effective early warning system is a key to efficient organization of fire against activities. There are few possibilities of monitroing such as local people, helicopter or airplane patrol and satellite remote sensing.

Local people

Because of low density population and huge territory it is almost impossible to know where what is happening. Distance between 2 families is about 20-30km and distance between 2 sum centres is 50-100km. But if fire location is determined, those local people are the main human resource for the fire against activity.

Helicopter or airplane patrol

Mainly due to economic difficulties it is impossible to establish permanent control using helicopter or airplane. For example for 1h flight by helicopter fuel costs 420$ or flight between Khuvsugul province and Ulaanbaatar city will cost around 2500$. It means to patrol only 4 h per day in spring fuel will cost around 150000USD. But everyday flight between capital city and provinces can used for such purposes.

Satellite remote sensing

This is a most cost effective tool to monitor fires for today. The receiving station, which established in June 1995 at the Information and Computer Centre of Ministry for Nature and Environment, daily receives the AVHRR (Advances Very High Resolution Radiometer) data from NOAA satellites and can be used to detect and monitor the forest and steppe fire. Since 1996 we developed methodology for for detection using AVHRR data and servicing by fire information Mongolian Civil Defence Organization and provicial administrative units.

By above mentioned technology using the daily NOAA satellite data we can monitor and estimate total burned area, as showed on Figures 2-3.

Figure 2. Active fire and burned area

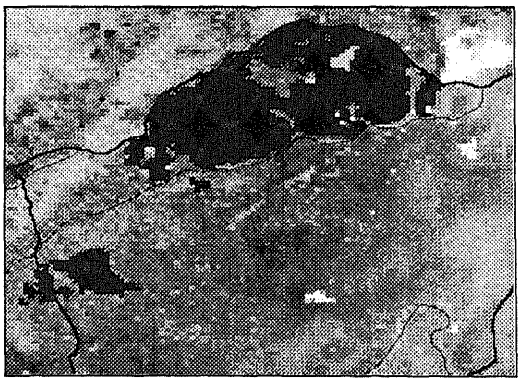
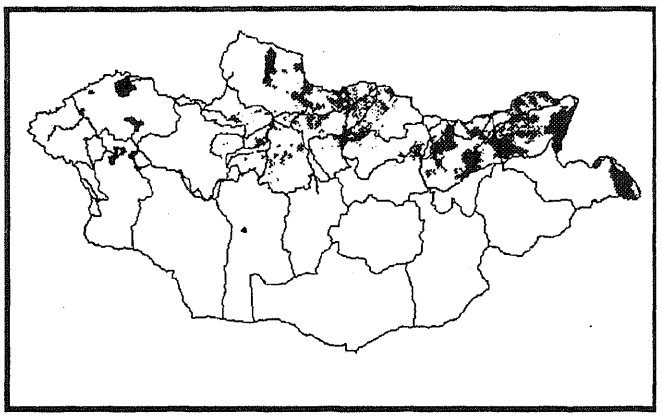
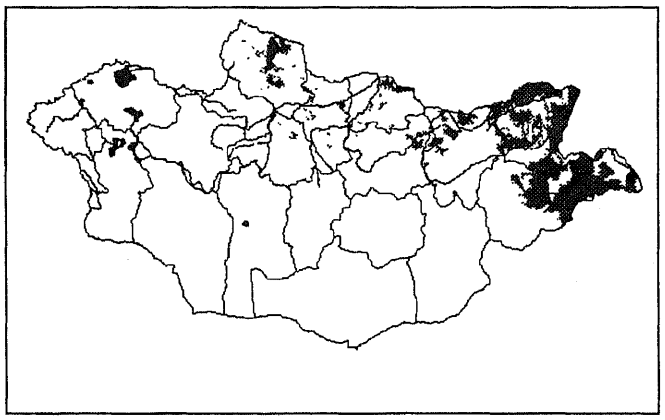


Figure 3. Burned area

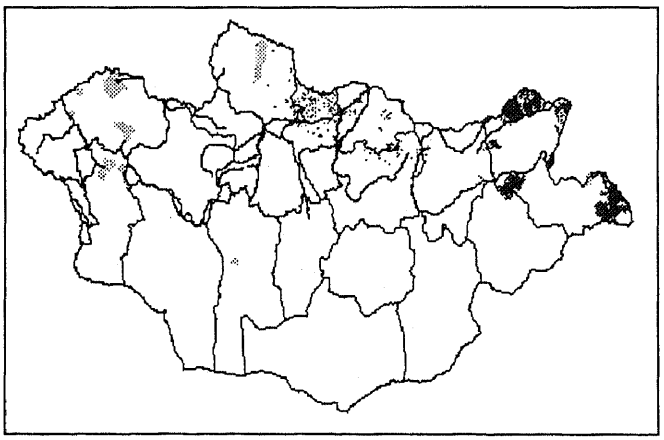
Figure 4-6 are showing the summarized burnt area forest and steppe fire over territory of Mongolia, of spring 1996 - 1998 respectively. The total burnt areas calculated as 10734.2, 14234.6 and 3641.7 thousand hectares of forest and steppe respectively.



1996,
Total burned area: 10734178ha



1997
Total burned area: 14234583ha



1998
Total burned area: 3641672ha

Figure 4-6. Total burned area maps of 1996, 1997 and 1998

5. CONCLUSION

The remote sensing system is a efficient tool for permanent control for detection and monitoring wildfires. But there are also several difficulties for establishment of early warning mechanism in order to organize effectively fire agains activities. One of them is communication system in Mongolia. Current meteorological and environmental information network reaches all the provincial centres (aimag). It means after receiving and processing of satellite data, producing fire information within 30minuts data can be disseminated to all centres at the aimags and information from the aimag centres to the local places, where is fire, takes many hours. Wild fires, specially in steppe area, are expanding very fast and in many cases information will be useless.

Another problem is a data resolution. NOAA AVHRR data has 1.1km resolution and it is impossible to detect small fires. Specially steppe fires are expanding so quick, and when information reaches the local places, where are fires, it is too late.