



PREVENTION

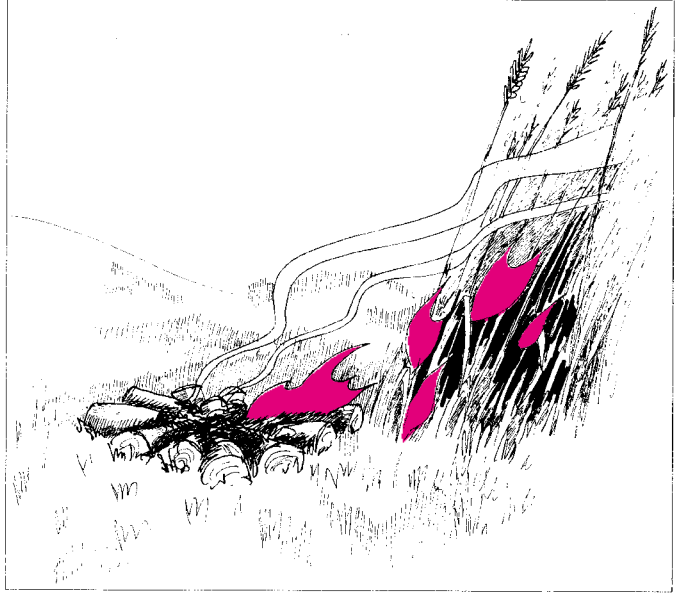
4. PREVENTION

Forest fire prevention is the means of reducing the number of unwanted, uncontrolled, or escaped wildfires.

4.1 Wildfire Prevention Activities

Wildfires may occur in any vegetation cover type when conditions are favourable for burning. Every fire requires some spark or flame to start it. At the beginning of any fire protection work it is important to investigate and establish the source of sparks or flames which under favourable conditions could start a forest fire.

Fire prevention is one of the most important functions of the fire control service. The prevention of unwanted or escaped fires is a never-ending job.



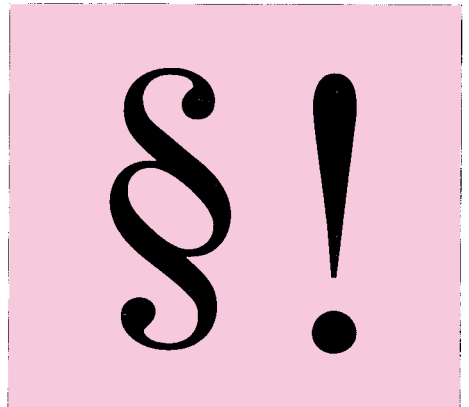
In addition, prevention activities are very often the most economical way of reducing fire damage and losses. Basically, wildfire prevention means stopping all unwanted, man-caused wildfires from starting in the first place. Fire prevention work can be started without any expensive equipment.

However, effective fire protection assumes, among other things:

- an adequately large organisation;
- knowledge of fires and their causes;
- trained firemen for fire prevention activities;
- good advanced planning for fire prevention;
- budgetary funds.

The best 'tools' that can be used for the prevention of fires are:

- education of the general public;
- elimination of the fire hazards; and
- fire enforcement laws.

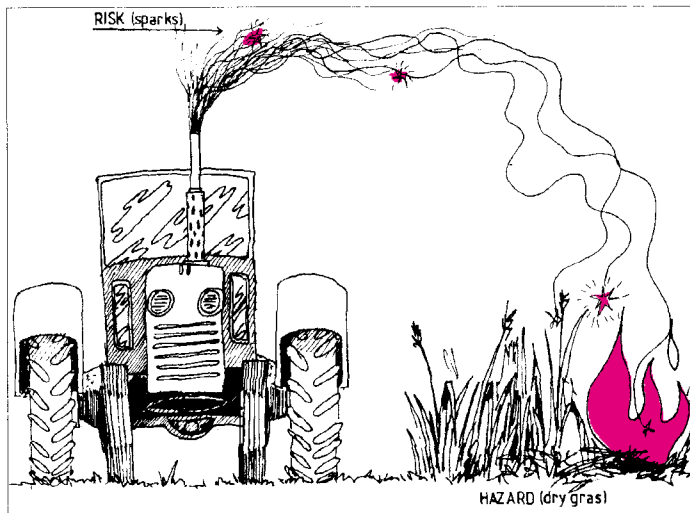


Risk

Can be defined as the chance of a fire starting from one cause or another, such as people, lightning, electricity, etc.

Hazard

Is the fuel complex by type, arrangement, volume, condition, and location that forms a special threat of ignition or difficulty in suppression. Areas covered with grass, brush, and forest fuels are examples of a hazard.



In organising wildfire prevention in a particular area one must first know what the usual causes of fire are, and the risks and hazards involved. The fire prevention efforts of any education should be effectively tailored in order to eliminate or reduce the causes, the task, and the hazards. The overall objective should be for everyone to know how to prevent wildfires, their causes, risks, and hazards, each of which may vary in different parts of the country.

4.2 Fire Prevention Planning

A fire prevention plan is needed for organising the fire prevention operations as effectively as possible. The written part of the fire prevention plan should include maps, tables, and graphs as required by the fire service. The material should be updated at least once a year.

Periods of years	Lightning		Railway carelessness		Careless use of fire		Cultivation		Re-generation		Military training		Other causes		Unknown		Alltogether	
	NF	HA	NF	HA	NF	HA	NF	HA	NF	HA	NF	HA	NF	HA	NF	HA	NF	HA
1952 - 55	32	2045	55	89	121	252	74	432	5	12	1	0.5	19	43	46	116	353	2989,5
1956 - 60	69	4356	76	303	260	1148	106	937	8	137	4	18	30	272	90	807	649	7978
1961 - 65	55	131	20	17	231	330	62	187	5	17	2	9	19	45	52	93	446	829
1966 - 70	96	233	9	8	263	590	36	72	5	63	6	12	35	140	77	760	527	1878
1971 - 75	220	339	3	3	287	202	21	16	3	19	5	8	26	93	68	174	633	854
1976 - 78	35	52	-	-	244	193	50	64	1	3	4	4	48	171	50	76	432	563
Average per cause	85	1193	27	70	234	453	58	285	5	42	4	9	30	127	64	338	507	2517

Legend: HA = burnt area (hectares) NF = average number of fires

Forest Fire Causes in Finland 1952 - 1978

The first step in planning is to collect all the basic facts and data from occurred fires. This information could be compiled, for instance, from data collected over the past five years on:

- How or why were the fires started?
- When were they started? (month, day, time of day)
- When do they occur most frequently? (weather, hazard, time)
- How many fires are started from the different causes? (number of fires listed under each cause)
- Where do they occur? (map location, forest type)

This analysis will determine the realistic and logical goals of the fire prevention plan. It will also help if, for instance, a summary of the main problems are made:

- What are the main causes of wildfires? (shifting cultivation, debris burning, etc.)
- Location of very high risk areas.
- Location of areas that should be protected.
- What are the main objectives and methods of fire protection?

The first step should be education. The second step should be to enforce the laws and regulations which control the fires caused by agriculture and shifting cultivation.

After that the next step could be the preparation of regulations to control campfires and fires caused by hunters through education.

After this summary of responsibility for the action to be taken for the prevention of fires has been completed, the following decisions will have to be taken:

- Will any new laws be needed?
- Who will talk to the general public and when?
- Who will talk to school children and teachers?
- Who will work on the problems of fire hazard reduction?

4.3 Contents of a Wildfire Prevention Plan

The following example for a fire prevention plan and its content may not be suitable for each fire district or department, but is a general guideline.

Table of contents for a fire prevention plan:

1. Basis of the fire plan
 - 1.1 Fire occurrence map
 - 1.2 Fire statistics, graphs
 - 1.3 Fire risk area map
 - 1.4 Forestry operations map
 - 1.5 Hazard areas map
 - 1.6 Sign and warning board map
2. Fire prevention objectives
3. Summary of problems and measures to be taken
4. Resources for fire prevention operations
 - 4.1 Use of firemen, foresters, police, etc.
 - 4.2 Contact persons and co-operation with village leaders

4.3 Finance

5. Laws, regulations, rules, and restrictions for fires
6. Public education, mass media, and guidelines for tourists, campers, hunters, etc.
7. Rules and regulations for forestry, farmers, etc.
8. Reduction of the physical hazards in high risk areas
9. Signs, posters, warning boards, and other information material
10. Fire prevention training and education
11. Feedback information

For every fire prevention plan there needs to be individual information and statistics on each of the above topics. The goals and methods of fire prevention will be based on this information.

After the fire prevention plan has been prepared, any fire occurrence during the fire season must be analysed to determine what effect the plan has had.

A much better review of the problem areas and a better start for planning can be made if relevant statistics, tables, graphs, and visual maps are prepared.

These maps could be separate or all the information can be on one map, using different colours to indicate the various pieces of information recorded.

4.4 Wildfire Causes and Risk

One part of fire prevention planning is to make an analysis of the fire risk and causes. The various types of risks and hazards in the protection area should be considered in a wildfire prevention analysis.

4.4.1 Land owners, farmers, and the rural population

- (i) In most countries, agricultural burning, such as in shifting cultivation, grazing, and fires to control vermin and insects, together with the many variations of rubbish and debris burning, are major causes of wildfires.

This type of wildfire is often the result of a failure to select the proper time, place, and method of burning or in the supervision and control of the burning operation. In order to minimise the number of escaped fires caused by agricultural burning there should be local regulations which would require that:

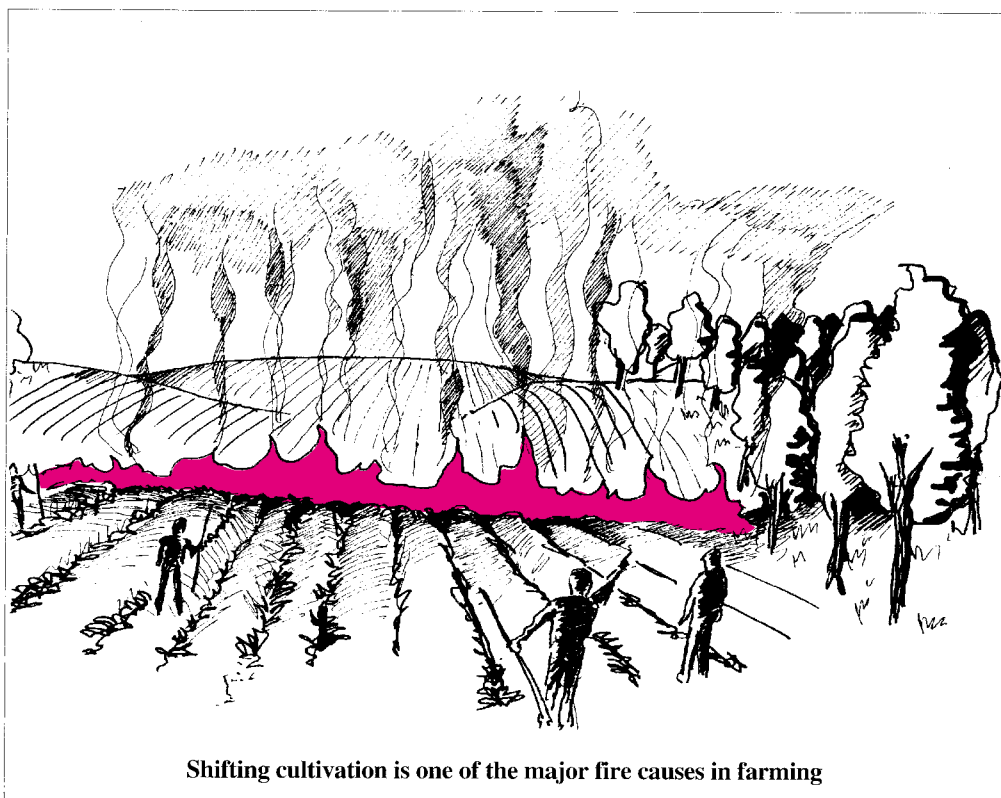
- a burning permit must be obtained;
- burning should be carried out only in designated areas; and
- burning should be carried out only in certain weather conditions.

- (ii) The best way to reduce the causes of fire is by education. First of all the public should be taught how to burn safely. Then the public should learn how to minimise all hazards safely. The public should learn how to minimise all outdoor burning during fire hazard periods. Good results have been achieved from the system whereby during fire hazard periods the local radio and television informs the public of the danger of fire when weather conditions show a high risk factor. The regulations should prohibit anybody from starting an outdoor fire during such a fire hazard period.

There is also a need for effective patrolling and fire detection during all periods of high fire risk.

The fire service should cooperate with the local people and the authorities. The objectives of this cooperation and the education of the public should be to encourage the right attitudes towards wildfires. When the public understands the value of the forests and the loss that comes from wildfires, they may be a little more careful when lighting outdoor fires.

In addition, there must be laws and regulations to forbid outdoor fires. However, before these laws and regulations are made, the living conditions, religious traditions, and the realistic needs of the rural people for outdoor fires must be taken into consideration. In some countries, cooperation with the local population is only possible through the village chief or the village elders.



When outdoor fires are allowed the public should be educated to know the following:

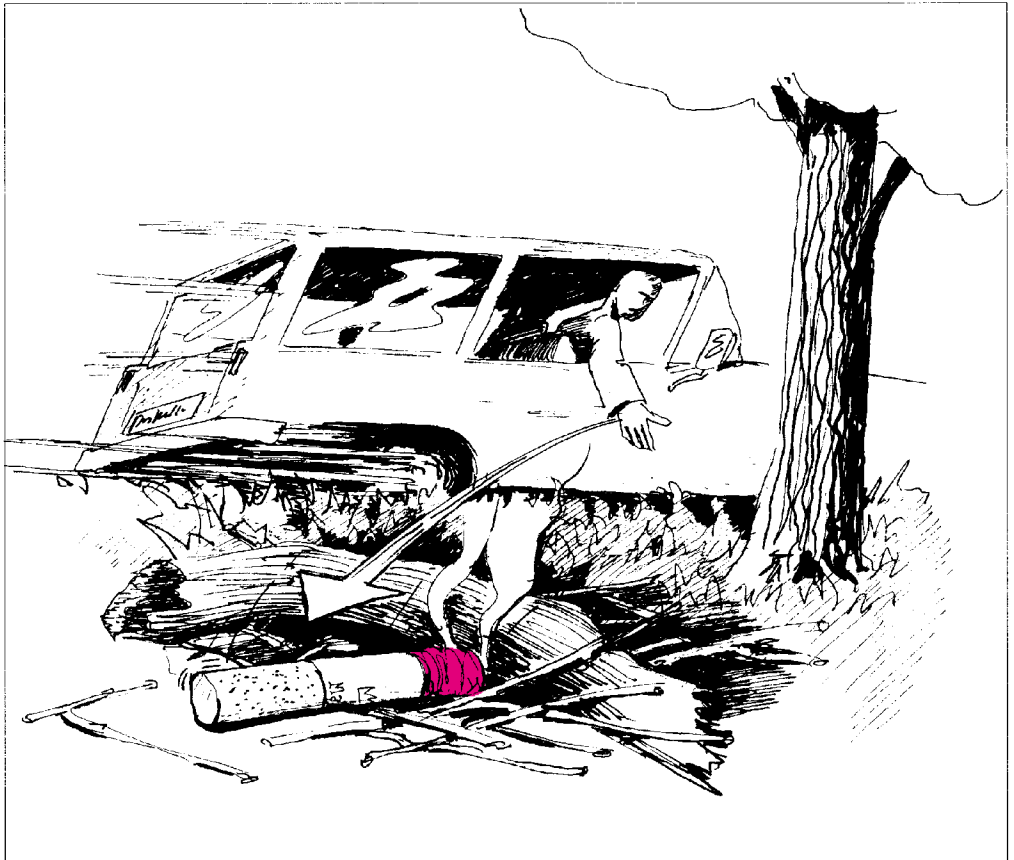
- (i) Burn only during safe conditions, for example, when there is little or no wind and after rain if possible.
- (ii) Obtain a permit from the local fire authority or forest fire headquarters.
- (iii) Start the fire in a safe place, not too close to the forest or woodland. Clear all hazardous material from around the fire area.
- (iv) Burn at a safe time and never on a windy day. Generally, the early morning or the late evening is the best time.
- (v) Before starting a large outdoor fire there must be stand-by fire suppression equipment and men available to prevent the fire from spreading.

Special burning for farmlands

Some special fire regulations will be appropriate for agricultural purposes, when burning grain fields for example. These fires can be hazardous when the fuel is dry. It is therefore important to educate the farmers to burn when the conditions are safe.

4.4.2 Cigarette smoking

One of the major causes of wildfire is the careless smoker. Picnickers, campers, hikers, fishermen, hunters, tourists, or local residents who smoke while in a forest or grassland area can, through carelessness, cause a disastrous fire. To reduce the number of wildfires caused by smoking, each smoker should be made aware of the danger and precautions to be taken.



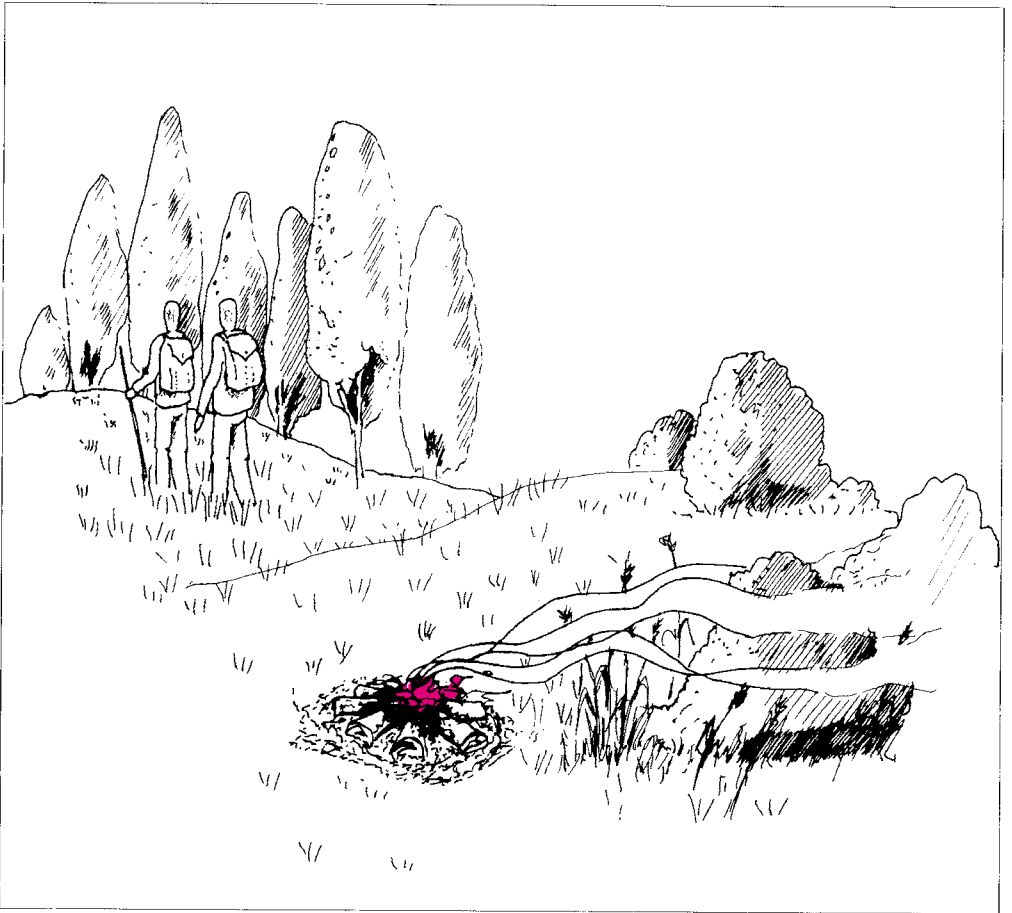
For instance, some very simple basic rules for smoking could be:

- (i) During the fire danger season, smoking while walking or working in a forest area is prohibited.
- (ii) Smoke only in designated safe places where there is no hazardous fuel. These areas could be next to a stream or lake, on sandy soil, or on a roadway.
- (iii) Crush the butt-end of the cigarette against a bare rock, or into a sandy soil.
- (iv) Use a cigarette lighter or make sure that the match is extinguished.
- (v) Use the ashtray in the vehicle.

4.4.3

Campfires

Campfires are a frequent cause of wildfires in those areas where camping, hunting, hiking, fishing, and picnicking are popular.



The following information should be made known to people who go camping:

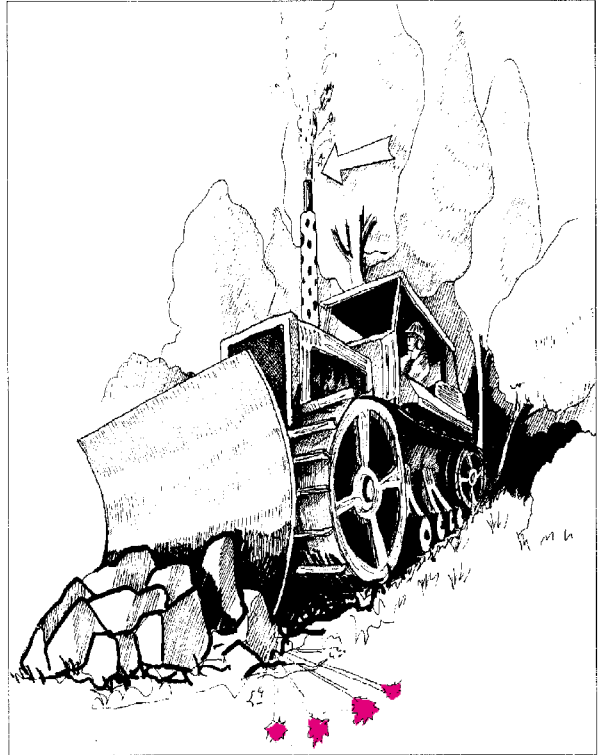
- (i) The campfire should be contained in a specially constructed fireplace which should be well away from overhead and surrounding hazardous fuels.
- (ii) The campfire should be kept small.
- (iii) The campfire should never be left unattended, as a wind could spread the fire into nearby fuels.
- (iv) Make sure that the fire is properly out before leaving the site. This can be done by pouring water or sand over the fire and stirring the embers with a stick. By feeling with your hand, check that no burning material remains.

To reduce the damage caused by campfires the public should be educated and informed about fire prevention methods. Signs and warning notice boards should be erected and information on how to prepare a safe camp site should be available at all public camping sites.

4.4.4 Logging and other forest operations

Very often, logging and other forestry operations cause wildfires. Careless employees and the use of different machines, such as power saws, tractors, and bulldozers in hazardous areas during the fire danger season can be the cause of fires.

When in the forest the use of approved spark arresters in tractors and other power driven equipment is one way to reduce the risk of fire. Welding operations should be restricted to designated safe areas and some of the more dangerous forestry operations should be restricted by local regulations. While working in the forest the employees should be trained in the use of, and have nearby, fire suppression equipment, such as fire extinguishers, shovels, and backpack pumps.



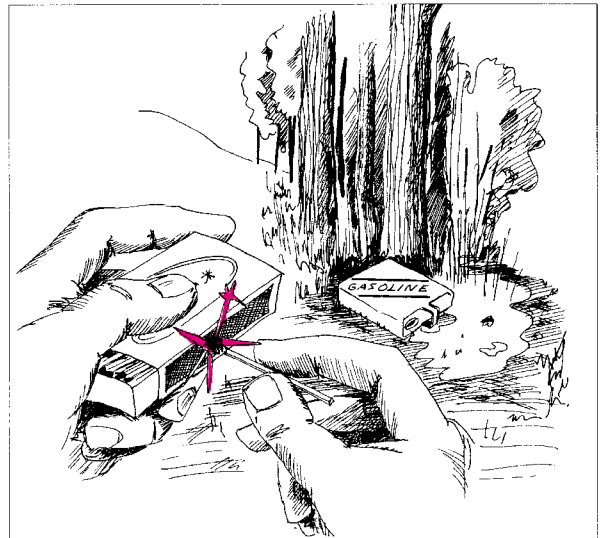
4.4.5 Arsonists

During the last few years arson has taken the top place in the causes of wildfires.

In many countries during this time the number of wildfires started by arsonists has increased at an alarming pace. It is difficult to prevent this new development.

Law enforcement is a general deterrent to arson.

It is very problematic to control and prevent arson.

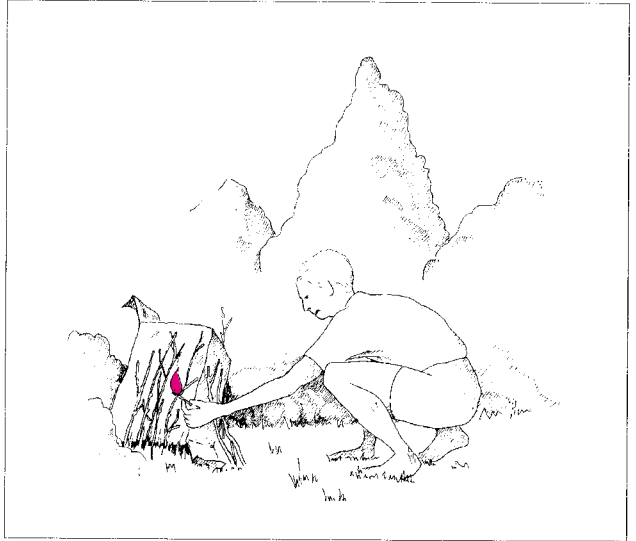


4.4.6 Children

Children playing with matches or with other sources of fire are causing an increasing number of wildfires each year.

Children are often too young to understand what is dangerous playing.

Training, relevant education, and proper parental supervision are necessary to prevent this cause of wildfires.



4.4.7 Lightning

Lightning is one cause of wildfire that is not preventable. Usually lightning is accompanied by rain, but occasionally a 'dry' lightning will start many fires. Fires started by lightning strikes may smoulder for days before conditions become favourable for the spread of the fires.

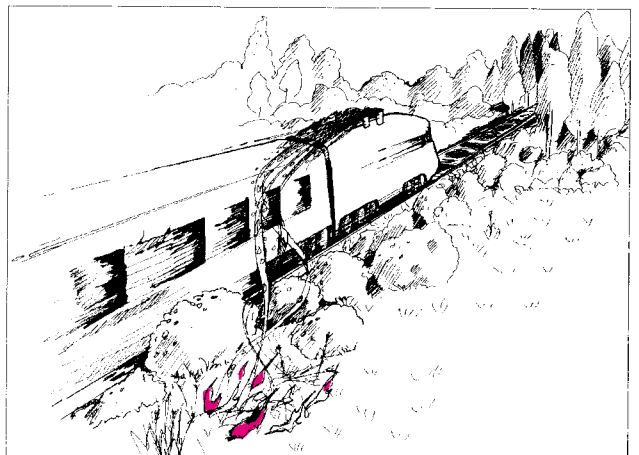
Constant detection is required to locate these dormant or sleeping fires. Lightning storms usually follow a definite path across the terrain. A map which shows the fires caused by lightning over a period of ten years will usually show the lightning fire pattern. Prompt detection is the best defence against fires caused by lightning.



4.4.8 Railroads

The railway system of a country can also cause forest fires, especially where coal - burning engines are in use.

The engine driver should be made aware of the dangers and fire guards along the line are essential.



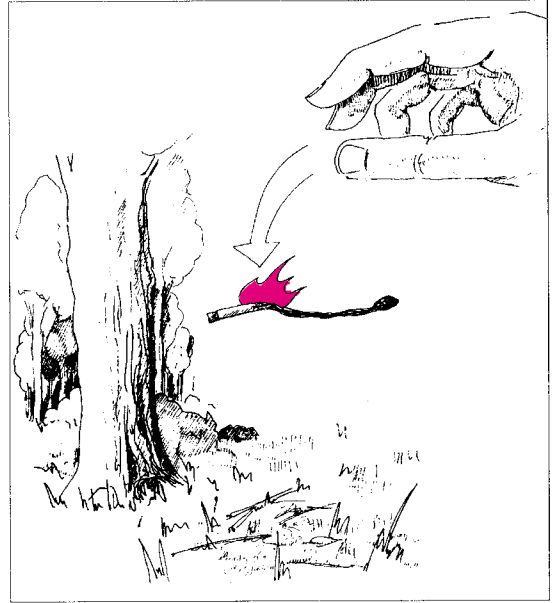
4.4.9 Secondary causes of wildfire

Carelessness of people is a major cause in most countries.

Secondary causes of wildfire include all the other causes that have not been previously listed. There may be many other causes, such as broken power lines, army training operations, negligent people, etc.

It is important to analyse these fires over a long period of time.

The wildfire prevention effort of the fire service must consider every possible type of fire that occurs in the protection area.



4.5 Prevention Methods

There are many different methods used to prevent wildfires; some need a lot of manpower, and some need much money. If satisfactory results are to be expected from the fire protection objectives some of these methods should be used in combination.

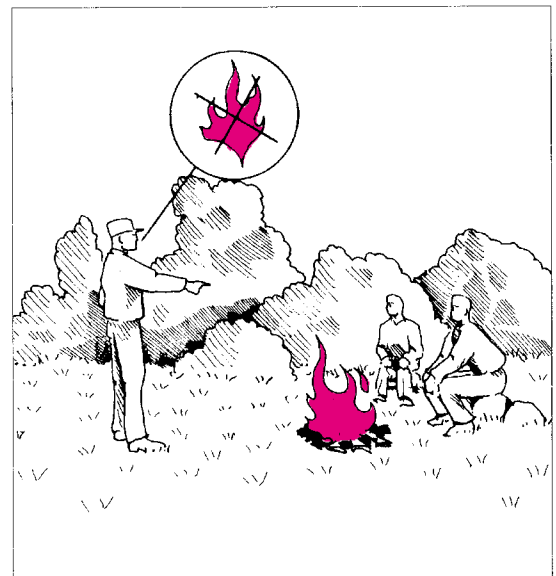
Therefore it is important that there is a fire prevention plan which estimates both the monetary resources and manpower requirements.

It is a normal situation that the results of the fire prevention activities are seen only after a long period of time. Fire prevention requires intensive and patient work from year to year.

4.5.1 Personal contact

Personal contact is probably the most effective method of fire prevention, if it is done correctly. The best place to demonstrate fire prevention techniques is at the site of a potential fire.

Here it can be demonstrated how to build a safe campfire, how to smoke cigarettes and tobacco carefully, and how to prevent the different types of fire from starting. The most far reaching results will be gained through public understanding and cooperation which will, in turn, depend on the awareness, interest, attitude, opinion, and beliefs of the individual person.



4.5.2 Associations and groups

In the work of fire prevention, useful co-operation could be gained from associations and special groups of people. These groups could be, for instance:

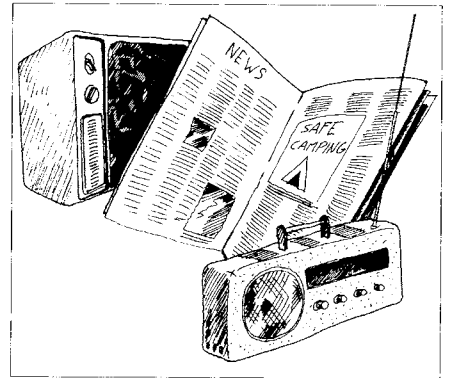
- wildlife clubs;
- environmental groups;
- Boy Scouts and Girl Guides;
- camping associations;
- holiday home owners; and
- caravan and motoring associations.

All these groups, and many others, can assist in the detection and prevention of fires. The more people you have on your side, the more effective will be the elimination of wildfires caused by human carelessness.

4.5.3 Mass media

Mass media includes radio, television, newspapers, and various other publications designed to reach the general public or specific groups.

The use of the mass media is one of the best means of public education in the prevention of wildfires. However, it must be sure that the method used is reaching the target audience. How many people can read and how many own a radio or a television set must be known.

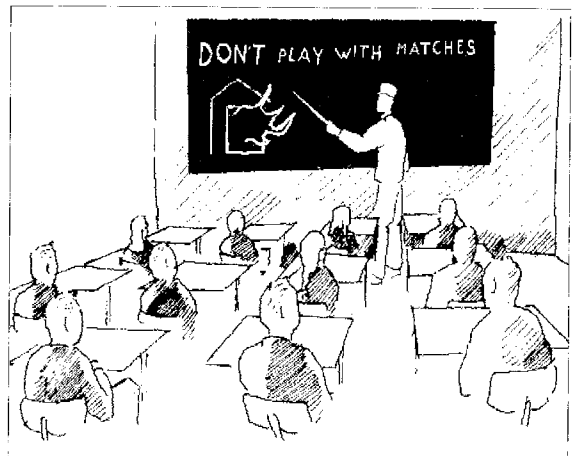


Provision for advertising over the radio, on television, and in the newspapers during the high and extreme fire danger periods for advising against any burning activity, will help to keep down the numbers of escaped fires. These warnings to the public should be arranged through the local weather forecasting service.

4.5.4 Schools

Fire prevention training in schools and colleges is an important part of any prevention effort. How to introduce the material will depend on the particular school or college system. The best approach is to first contact the Principal and find out the most suitable type of presentation.

Teachers can be involved by providing information and furnishing relevant material to them. The main benefit from school contacts is that not only the students are reached but also the parents through the message the students carry home.



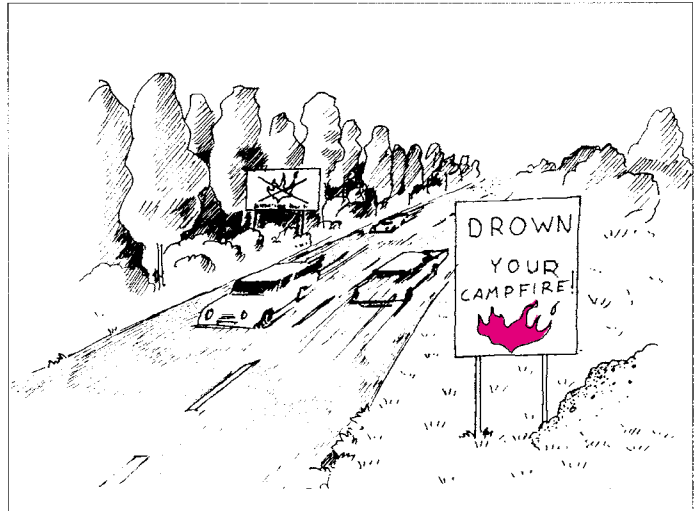
4.5.5 Signs and warning notice boards

Fire prevention signs can be used to inform the public of fire regulations, restrictions, and procedures to reduce fire. Signs should be erected in carefully selected places, where they will be most effective:

- along roadsides;
- at camping grounds;
- at petrol stations; and
- anywhere people congregate.

Timing is very important. A sign warning of extreme danger should be removed as soon as the danger has passed.

Place the sign so that it will be clearly seen. It should be neat, and not in conflict with other notices.



4.5.6 Posters

Posters can also be used in places where the public assemble, such as market places, bus and railway stations, public offices, and schools.

4.5.7 Other methods of fire prevention

There are a number of other different methods that have not been mentioned. One of them is a **Smokey Bear** programme as in Indonesia.

This means that a national animal is taken as a symbol for teaching fire prevention. The animal gives good advice and instructions on the proper way to use a fire in the forest.

This kind of programme is very effective, especially for children, when used in films, on television, in posters, cartoons, and in advertising.



Fire control logos

Thailand



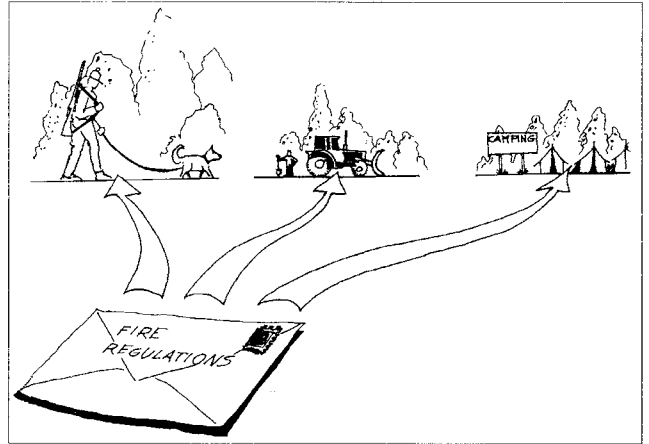
Namibia



Prevention letters

A well prepared letter aimed at a specific aspect of fire prevention and sent out with a personal message to a group is very effective.

For instance, a letter sent to local hunting associations just before the hunting season could produce favourable results.



Fire danger forecast

The national weather forecasting service should be able to send out a fire danger rating daily throughout the fire danger season.

Arrangements can be made with radio and television stations to include in their regular weather forecasts some fire danger warning, particularly when the rating is high or extreme. This is a very useful service both for fire prevention and for fire suppression. It is also a good means to make the general public more aware of the dangers of wildfires.

Firebreaks and fuelbreaks

Firebreaks or firelines may be either natural barriers, such as a road or a stream, or specially constructed barriers to limit the spread of fires and to provide an established control line in the case of a fire starting.

The usual firebreak is a strip of land that has been cleared of all trees and scrub growth.

The width of the strip will depend on the type of fuel, location, the topography of the land, and weather conditions. Usually, the width of the clearing will not be less than one half the height of the tallest tree which supplies the fuel.

A fuelbreak is a wide strip or block of land on which the natural vegetation has been permanently modified so that when a fire burns into it, it can be more readily extinguished with relative safety for the fire fighters. It may or may not have firelines built into it.

Fuelbreaks are generally placed strategically along ridges and in valleys. They also include any access roads.

Firebreaks and fuelbreaks should also be constructed to prevent wildfires from spreading from one area into another area.

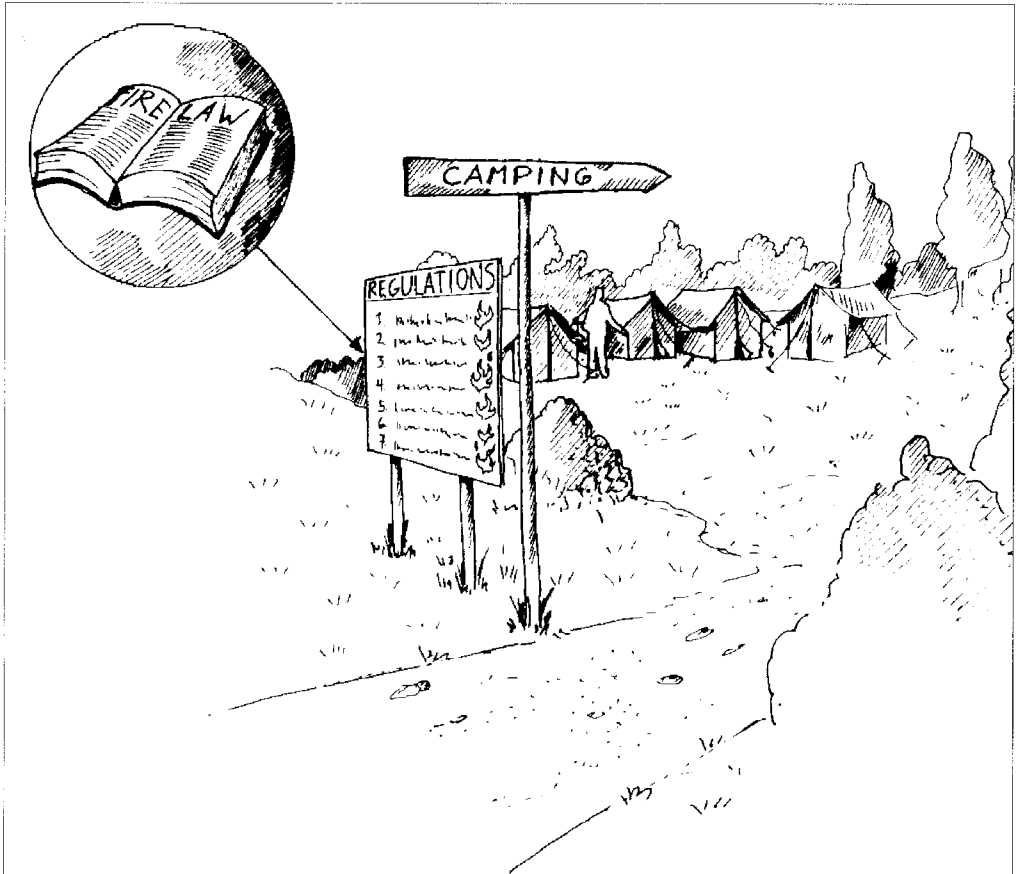
A greenbelt

A greenbelt is an adaptation of a fuelbreak in which the vegetation is kept green and living by irrigation.

4.6 Laws and Regulations

The basis for forest fire prevention will stem from the local laws and regulations against wildfires, and from knowing how to behave with outdoor fires.

National and local laws and regulations for smoking, campfires, and debris burning are important for forest fire prevention.



Laws and regulations should be impartial and aggressively enforced. Collection of the fire suppression costs from those who cause a fire is a good method of prevention. Cooperation with the police would be required in this activity.

4.7 Fire Investigation

Unknown fires comprise a too significant proportion of the wildfire statistics in many countries. As mentioned earlier, one basis for prevention is good statistics of fire causes. This needs reliable knowledge of how and by whom the fire had been caused at its starting place.

In every wildfire, immediate investigation of possible causes and protection of evidence at the fire site is necessary.

The first fireman arriving at the scene should be responsible for preservation the evidence. It is important that the scene be preserved in its original condition.

On the way to the fire and around the fire, the fire fighter should:

- (i) make notes of anyone or anything that could relate to the starting of the fire;
- (ii) observe vehicles, motorbikes and cars, and so on near the fire area and those moving away from it; and
- (iii) record licence plate numbers, descriptions of vehicles, numbers of people, personal descriptions, and the location or moving direction of the fire.

4.8 Fire Hazard and Hazard Reduction

Fire hazard (fuel) is one factor which can contribute to the starting of wild fires. There are both natural and man-made fire hazards. There are many types of fuels that create hazards, amongst others:

- fuels from brush, fields, and right-of-way clearings;
- slash accumulations in timber cutting;
- dryden grass and debris accumulation in fields, along fence rows, around buildings, and near roads and railroads;
- large accumulation in forests of flammable leaves, dead trees, dry bushes, etc;
- exceptionally dry fuels due to a prolonged dry spell;
- rubbish accumulations in or around residences, storage areas, and other buildings; and
- improper storage of inflammable gases and liquids in or near warehouse buildings and storage areas.

All potentially hazardous areas adjacent to the boundary of protected forest or plantation areas must be the prevention objective of the Fire Service. The only way to prevent fires starting in fire hazardous areas is to eliminate the hazard or the causes.

Total elimination is very seldom possible. That is why hazards should be reduced as much as possible, such as by:

- cleaning up litter and rubbish accumulations;
- storing inflammable gases and liquids in safety (in locked stores);
- cleaning up slashed timber, cutting or breaking it into smaller pieces;
- preventing large fire hazard areas by construction of fire-breaks or fuel-breaks;
- replacing some vegetative fuel hazards with less hazardous or more fire-resistant vegetation; and
- closing hazardous areas to use during periods of extreme fire weather conditions, which may be the only solution in some areas.

In summary, it can be said that the fewer hazardous areas there are in protected forest areas the smaller is the possibility for fires to start.

In plantation areas, a dense plantation is not so hazardous because these areas are normally also grass-free areas. Less dense plantation areas normally include a lot of grass, and are therefore very problematic to protect.

4.9

Controlled Burning of Fire Hazard Areas

The most effective fire hazard reduction is to eliminate most of the fuel from hazardous areas.

This can be done easily by burning off all hazardous fuel, which is called controlled burning (or prescribed burning). For instance, dryden grass along roads and railroad rights-of-way forms very hazardous fire risk areas. It is normal in many countries to burn off all hazardous grass along roads and railroads before fire seasons. In some countries, the Forest Service uses controlled burning of slash in areas after timber cutting, which reduces the hazard on these areas.

The technique of controlled burning needs knowledge and experience from the person doing it, otherwise the fire will escape very easily.

On the other hand, controlled burnings are useful for understanding fire behaviour and it is good training in the use of handtools and equipment. Also, it gives good practice for men to work with hot flames and inside smoke. Controlled burnings are usually done just before the fire season. Fuel in the control burning area should be dry enough for burning, but not too dry, because the fire will then escape easily.

Before controlled burning there should be consideration to the following points:

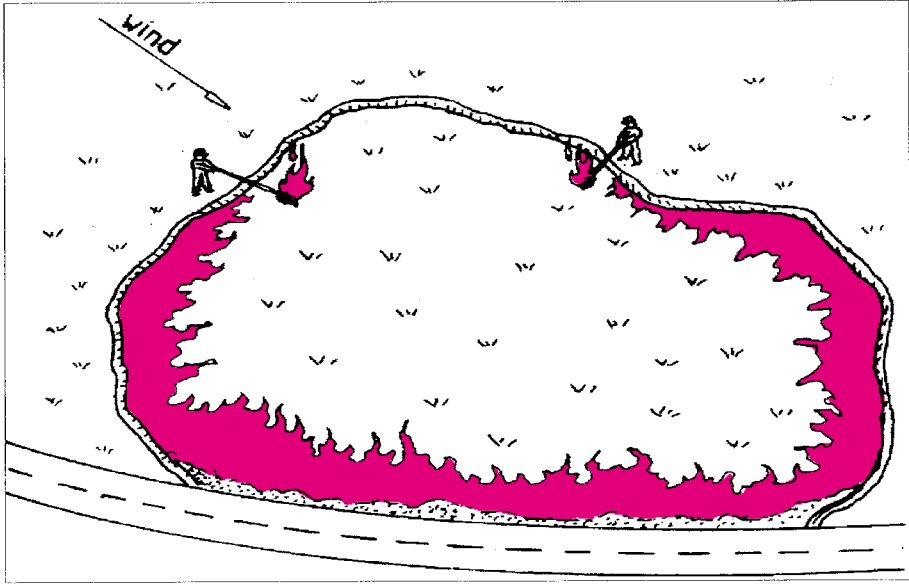
- (i) The fuel is dry enough, but not extremely dry. Relative humidity should be between 40-60 %. Below 30 % humidity, fire could become dangerous as the risk of spot fires grows.
- (ii) The weather conditions are favourable and safe for burning. Slow wind is good and its velocity is not allowed to be too much, because the risk of escaping fire and spot fires becomes too high.
- (iii) Before setting a fire the burning area must be surrounded by a wide enough fire-line. Safe width depends on the height and volume of fuel.
- (iv) There must be a sufficient amount of extinguishing equipment on the site, like swatters, backup-pumps, shovels, hooks, rakes, etc. Also, there should be enough fire men for patrolling and controlling the fire. If possible, there should be enough water for backpack pumps and / or fire pumps.
- (v) There must be only one fire boss as the leader of the controlled burning, who should have enough knowledge and experience of the controlled burning-technique.
- (vi) Before starting, the fire boss must report the plan of the burning to the local fire chief and / or fire headquarters, village chief, and neighbours.
- (vii) The best time to start firing is afternoon, because humidity is at its lowest by day and the wind is stable.

Before controlled burning can be started it must be checked that the fuel moisture and conditions are favourable for burning. This can be done by using small test fires.

The firing technique in control burning, for dry and humid fuels, is basically as follows.

Dry fuel - the fire starts and spreads easily:

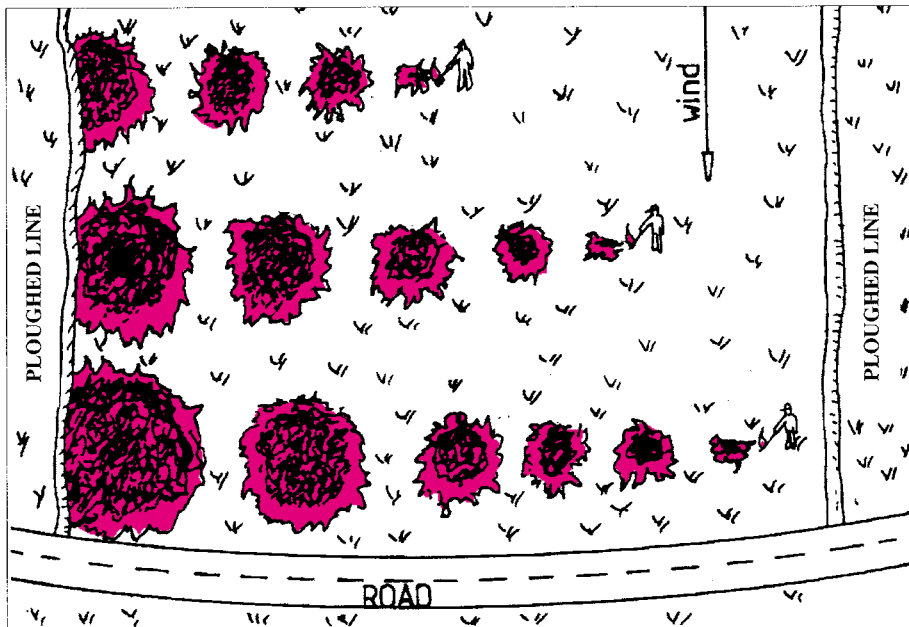
- (i) The fire is started beside the control / fireline, from the downwind side to the upwind side. The control line surrounds the area (on flat land).
- (ii) On slopes, fire starts from the upslope and spreads to the downslope.
- (iii) Firing should continue on both sides from the starting place, so that the fire's edge becomes like a horse shoe.



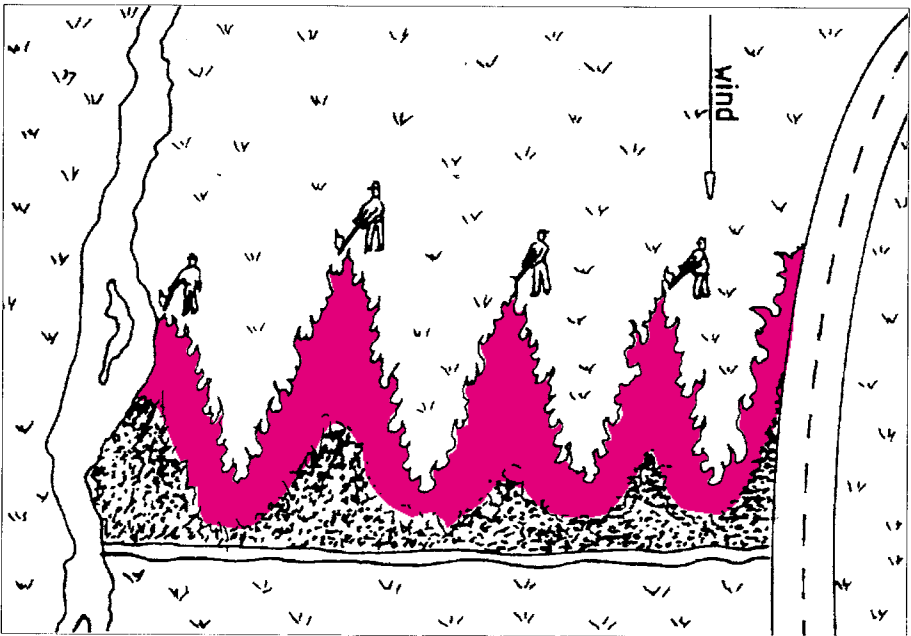
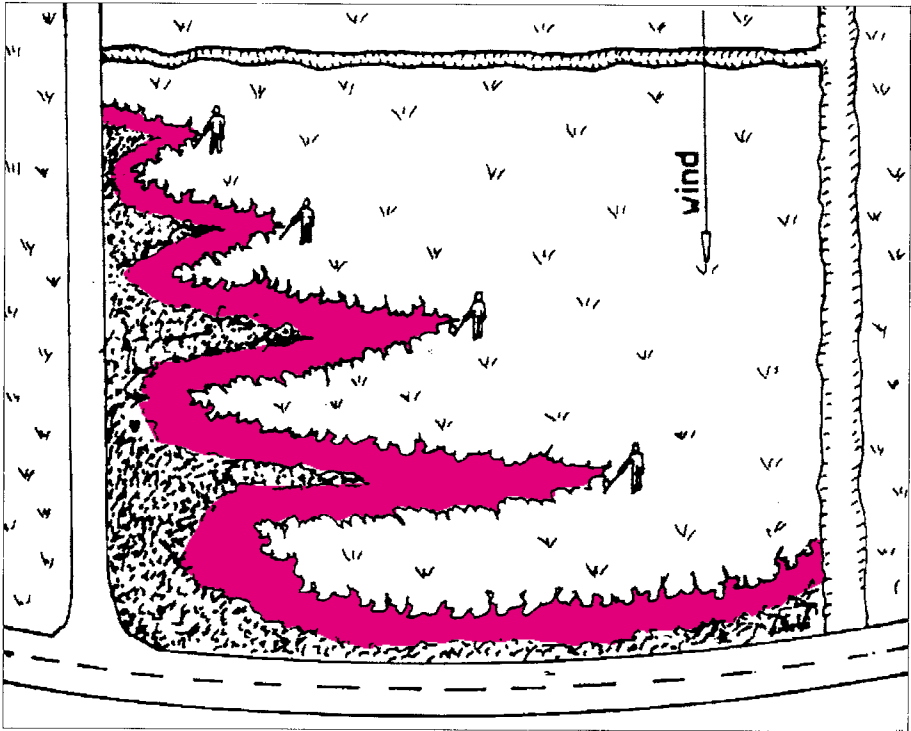
- (iv) Later on, spotfires can be made inside the area, which creates suction to the central direction and all flames move towards the centre.
- (v) After more than half of the area has been burnt, firing can be started on the upwind side of the area's edge (backfiring).
- (vi) The fire's own suction helps to keep flames inside the area. When the main fire and backfiring meet in the centre of the area they become a torch.

Humid fuel - fires will not start and spread easily:

- (i) Firing can be started from the upwind side to the downwind side (on flat land).
- (ii) For effective burning, spotfiring should be used inside the area.



(iii) For effective burning, fingers should be used inside the area.



(iv) On slopes, firing can be started from the downslope to the upslope.