

Nature Management in the Netherlands and its Financial Consequences, with Special Attention to the Role of Fire¹

J. A. VAN DER VEN
*Research Institute for
Nature Management,
Leersum, Netherlands*

INTRODUCTION

INTEREST in the scarce nature areas in the Netherlands began about a hundred years ago, and the first nature reserve was protected at the beginning of this century. The interest became more general, however, a few years ago when more people realized that misuse of the environment might be disastrous if functions and values of nature were not incorporated in the decisions.

People were not aware that they were breathing until they smelled something unusual. People did not realize that they liked silence until the noise of aeroplanes prevented them from sleeping. Perhaps one even took life for granted until birds were found dead in the gardens and fish dead in the rivers.

From this moment it was realised that there was not only an

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environmental problem, but also the need for an environmental policy which would take into account the wishes of the people. It became clear that the weighing of thoughts and wishes involved economics. This science then became concerned with the adaptation of scarce resources to the needs of the people. Economists do not say what should be, but they try to explain or to understand what already exists and to formulate ideas about the necessity of the various needs. For each individual, making choices is a recurring problem; for an economist it is a daily routine.

As far as the wishes of the consumer are concerned, the presence of free nature plays a special role in the same way as free economic goods which must be used collectively. To use as well as preserve nature over a long period is a problem in itself. Only nature as such will be dealt with further.

In this paper extensive consideration cannot be given to the biological consequences of different choices which are made in nature management. There is already a great deal published about this in relation to other subjects. Consideration will be given here to the making of choices in nature management with special reference to the management of heath areas. The financial aspect of the choices will also be further developed. Since extra attention will be given to the use of fire as a tool for management, this method in general will be dealt with further. Before proceeding to the main subject, it is necessary to include several facts concerning the natural environment, the population and influence of man and the aims and results of nature conservation in specific relation to the Netherlands. These facts are characteristic and must be known in order to understand the management itself.

DETAILS OF THE NATURAL ENVIRONMENT

Holland is a small country; half of it is protected from the water by dunes and dikes. If man did not maintain the dikes the western and northern parts of the country would be flooded. The size is nearly 16,000 square miles which is about one third the size of the state of New York. There are about 13 million people living in this

area, and it is to be expected that in the year 2000 there will be 15 million. Several years ago the future population was estimated to be about 20 million but, because of a changing attitude toward birth control, the lower figure may be more correct. For the aims of nature conservation this point is very important! It means that there is an average of 380 people per square kilometer (about 950 per square mile). This creates special problems for nature conservation which will be discussed later. The North Sea has a strong influence on the Netherlands. The climate is mild and snow and ice may be expected in December, January and February. The lowest temperature experienced is approximately -15°C (5°F). In January the average daily minimum temperature is approximately -1°C (30°F).

Summers are not very warm and the highest temperature is approximately 30°C (86°F). The average daily maximum temperature in July is approximately 20°C (68°F). The rainfall averages 765 mm and never exceeds 1000 mm (40 inches) per year. Seasonal rainfall may be more important (see Fig. 1). Note that the driest period is from March to June. This is important when considering the use of fire in nature management.

Some comments should be made about the occurrence of thunderstorms. There are approximately 100 days per year when thunder is heard. Most of these occur from April to September (9–16 days per month). From October to March there are only 3–8 days when thunder is heard. There are 500–1000 occurrences of lightning reported each year, but only 10 percent result in fire. The usual "victims" of these fires are houses, farms and hay-stacks. A special register is being prepared for the Netherlands by the Meteorological Institute but figures are not yet available. Wildfires in woods and nature areas occur usually in the dry periods. In 1970 there were about 300 fires affecting 650 ha (see Fig. 2). From year to year these figures can vary considerably. Statistics show that most fires are caused by carelessness or arson. Although lightning is not specifically mentioned in the reports, it seems to be of minor importance. This may be due to lack of information but it seems unlikely that fires would break out during such periods because of the drenching rainfall which usually accompanies thunderstorms. This means that in

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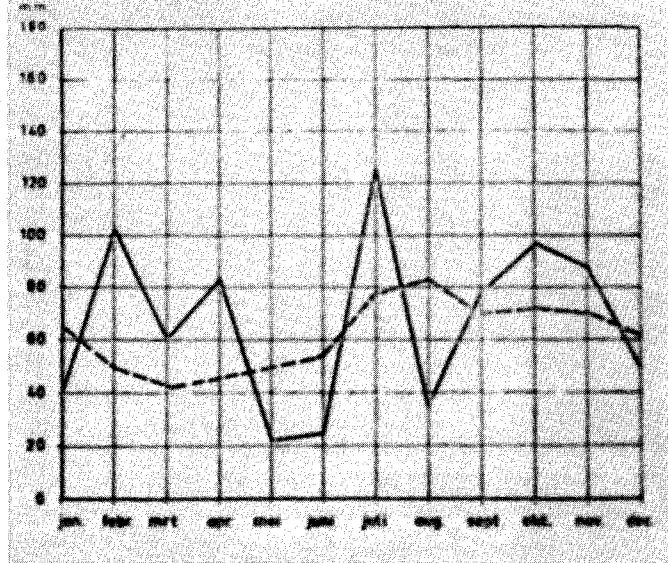


FIG. 1. Rainfall in the Netherlands. Unbroken line gives the rainfall in mm in the year 1970. Broken line gives the average rainfall.

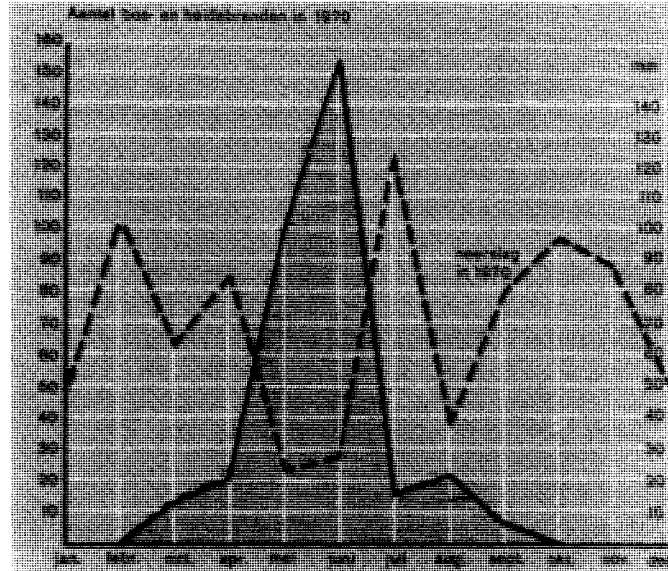


FIG. 2. Wildfires and rainfall in the Netherlands in 1970. Unbroken line gives the number of forests and heath fires. Broken line gives the rainfall in mm.

this country as far as can be seen lightning plays a very unimportant role in the natural rejuvenation of woods, etc.

POPULATION AND THE INFLUENCE OF MAN

Originally the natural landscape of the Netherlands had to be radically changed to make the country habitable. Dikes were constructed to hold back the water, marshes were reclaimed, shallow lakes were pumped dry to make polders, higher land was deforested and the waterlevel was continually lowered. In fact all the land has been influenced by man in one way or another, and it is therefore not possible to speak of "wild nature."

Cultivated land is often of great biological value. A large part of it consists of pastures which are also very important nature areas. Many of these are situated below sea level and are therefore protected by dikes. The control of waterlevels is used for both agricultural purposes and for nature conservation (e.g. to inundate some pastures temporarily for wintering geese). The high density of birds in such areas is strongly related to their agricultural uses. Modern methods of managing such areas will have a bad effect on the original wealth of the land. The birds of meadows (lapwing, ruff, godwitt) and the wintering geese are completely tied to these areas biologically.

Table 1 shows how the use of the soil in Holland has changed over the last century. The increase in cultivated land has come to a standstill; deforestation has made room for reforestation. The extent of nature areas was decreasing for a long time, but this process has also come to a standstill. The built up area (houses, roads) is slowly increasing. Nearly all town-building takes place at the expense of cultivated land.

In 1900, 1650 square meters of woods and nature areas were available per inhabitant of the Netherlands. Nowadays there are only 300 square meters per person remaining. This means that at a time when more nature is needed because of changes in housing facilities, leisure time, etc, less is available. At the moment more people need more open space. This means that recreation in these areas must be organized very carefully in order to preserve the

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TABLE 1. USE MADE OF THE SOIL IN THREE DIFFERENT YEARS AS A PERCENTAGE OF THE AREA OF HOLLAND.

	1833	1930	1968
Cultivated land	58	70	70
Wood	5	8	8
Nature areas	28	13	6
Water	4	3	8*
Buildings, roads, etc.	5	6	8

*In 1968 there was no more open water than in former times, but a larger part of the open water was included in the statistics.

wealth of nature. It is therefore essential that nature areas be managed from a different point of view. Biologically, the Netherlands is very rich and complex. The early influence of the various ice-ages, the ever present influence of the North Sea, the partly diked big rivers, such as the Rhine, and the long human occupation have all resulted in a varied landscape needing many different ways of management. Many of these are closely related to old agricultural methods.

Table 2 gives a summary of the types of nature areas in the Netherlands. It appears that almost half is made up of heath, which does not however imply that only one type of nature area is involved. As explained below, there are a number of different types of heath areas, each with its own wealth and management problems.

The dunes form the second largest group of nature areas. There is again great diversity here from very dry dunes to dune slacks. The moist areas belong to the most valuable nature areas in Europe. The greatest management problems in the dunes arise from extremely busy recreation activities and from the large scale withdrawal of drinking water.

It can be seen from the table that there are few marsh areas remaining. They harbour rare breeding birds such as spoonbill and purple heron as well as important plant life. Since marsh areas have the tendency to become quickly overgrown, management is usually concentrated on keeping as much terrain as possible open. Mowing, and may be also burning in the future (see below), are the most important methods of management. A total of approximately 200,000 ha of nature area are involved, more than half of which is owned

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by the state or nature conservation organizations. There are also 260,000 ha of woods, one third of which is in the hands of the State Forestry. (It should be mentioned that the salt marshes in the north are not included in Table 2.)

TABLE 2. NATURE AREAS IN THE NETHERLANDS

Heath	61,000 ha	45%
Dunes/beach	38,000 ha	28%
Sanddrifts	5,000 ha	4%
Moor	14,000 ha	10%
Marshes/reed	18,000 ha	13%
	136,000 ha	

In the Netherlands there are approximately 160 species of breeding birds, and together with many migrants, 387 species can normally be observed. The wild flora of the Netherlands includes about 1300 species. Some years ago Dr. Westhoff gave an idea of the problems associated with the botanical wealth of the country. About half of the species are threatened and many have already disappeared or are found in only one place, which is usually a nature reserve. This natural wealth is the result of an age-long influence by man working with primitive methods. A mosaic of small, connected, cultivated areas and nature areas has resulted. As long as farming of the cultivated land was restricted, the wealth of the nature areas was certainly not disturbed. The influence of modern agricultural methods, however, extends much further than the cultivated land. The present-day tendency to integrate small meadows into large fields has led to radical changes. But there is no longer cultivation of nature areas and an increased care for nature and landscape can be noticed.

AIMS AND RESULTS OF NATURE CONSERVATION

As explained above a large part of the nature areas is safeguarded. To preserve the natural wealth is one of the most important tasks for both private and government organised nature conservation. Besides ownership, a very important way to protect valuable nature areas and woods is by protection of the "Town and Country Planning Act." By means of this law it is possible to make plans for the

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use of the land in one area. Apart from the ownership the land can be allotted for use as a building site or nature area etc. The law can also determine which work must, or may not, be carried out. Expropriation, compensation or contributions to the costs are the logical consequence. Nevertheless ownership of nature areas by an organization with interests in nature, offers the best protection.

Concentrated use of the environment by traffic, factories and buildings also influences the protected nature areas. We cannot stop such activities as soon as an area is purchased, but we must ensure that our interests are not threatened by these activities. The various environmental laws give further protection, not only for the nature reserves but for man himself. Research concerning areas and good management of these areas on such a small scale is of great importance. As already seen, there is a great diversity of nature reserves with a long history of management. This management was related to agricultural or hunting purposes rather than to nature conservation. A great deal of the natural wealth has arisen unintentionally from a way of management in the past. One of the big problems for nature conservation is to preserve this wealth.

It is necessary to study whether it is possible to use methods in management which approximate the past situation as far as possible. The old management methods can be studied as well as modern possibilities. When considering old management methods it must be remembered that the use of the land surrounding the nature area concerned, is completely different from the earlier use. This use can have a great influence on the nature area (e.g. withdrawal of water, fertilizer, air pollution). With modern management methods the question is usually whether the heavy machines affect the land or not. It must also be considered whether a similar method in the small scale nature area will be too harsh. This will be developed further in the section on heath management.

MANAGING HEATH AREAS

Heath is made up of dominant communities of *Calluna vulgaris*, *Erica tetralix* and/or *Empetrum nigrum*. In this sense it is confined



FIG. 3. "Nature reserve; do not damage or disturb." Controlled burning in a nature reserve.

to Western Europe. Some heath appeared spontaneously in the course of succession (natural heath) e.g. the dune heaths of the Westfrisian islands. Most heaths however are semi-natural landscape relics of an ancient agrarian phase, originating from woodland. After the agrarian "green revolution", large heath areas were withdrawn from sheep production. Large parts were reforested or taken, after fertilization, into agrarian production. The remaining heath areas are now important nature areas worth preserving as natural and cultural phenomena. To maintain these areas a certain kind of management is necessary. The tendency for regeneration into forests

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depends on several circumstances (e.g. the proximity of other trees and the wetness of the soil). The various kinds of management depend on the heath type: e.g. dry heath on loamy soil, dry heath on poor sandy soil, damp moorland, moist *Erica* moorland etc.

Another very important factor is the surface area of the land to be managed. A small area will be easily affected by the way in which the surrounding grounds are used. An area of several 100 hectares will only be affected at the borders, and inside the reserve a pure kind of management will be possible. It is not possible to analyze all kinds of heath here. Three principal groups of heath are therefore considered together: poor, rich and moorland.

The general aims in managing heath as a nature area will be: maintaining the area as it is or improving the area; maintaining the characteristic birds and plants in their landscape; permitting recreation in such a way that the biological value of the heath will not be damaged. Management of the three different types of heath will now be considered on the basis of six different methods of management.

1. NON-INTERFERENCE

As explained above much heathland is the result of human interference in the past. Since it is a semi-natural landscape a certain continuation of interference is required. However, it is possible to leave poor heathlands alone and let natural succession take its course. In this case seedlings should be removed on a limited scale, particularly if small areas are involved. In dunelands e.g. on the Westfrisian islands, human interference is unnecessary. In some highly peaty areas with high waterlevels this non-interference as a way of management may also be applied.

2. TREE (SEEDLING) REMOVAL

Pulling out seedlings or cutting down young trees is an additional way of management. In small areas this must be done occasionally if there is no regular way of management. Using this method one does not eliminate the problem of overgrowth; within a year there are three birches to replace the one removed. Fir trees can be cut down, but birches grow again after felling. This regrowth can be prevented



FIG. 4. Two males of the black grouse on their territories (lek in heath area).

by placing the cut heath over the stubs. Casual use of 2.4.5-T-ester is hardly limited; systematic use in a reserve to remove the overgrowth is simply to be condemned. Small heath areas bordered by birch forest can hardly be maintained. If there are no extremely important reasons for maintenance of such a terrain, it may be better to consider a more natural forest than a heath area. In other cases the open character can be preserved by conversion to a fodder field.

3. SOD REMOVAL

This method is no longer really practicable nowadays, although in the past it was obviously one of the factors contributing to the nature of the heath area. The sod was previously used in sheep barns and then together with the manure, spread on the fields. Thus the upper layer of the heath was removed periodically so that the heath could rejuvenate itself on the sand. This is still sometimes done, but obviously as an artificial form of management. Plans are being made to use sod in azalea cultivation, which may give this form of management a better future.

4. BURNING

Burning was used in the past together with sheep-grazing. The heath was burned for rejuvenation every 9–15 years. Usually sheep could graze again on the heath the same year. Burning is now used as a method of selective rejuvenation of the heath for which it is very suitable.

The aim of management is to obtain heath in various stages of growth in one area. The map in Figure 5 shows an area of 400 hectares divided into several parts which are burned in different years. Some other parts are mowed or non-interferenced at all. Naturally it would be possible to manage this heath as one large area, but this would result in a monotonous heath which would be biologically uninteresting. The same impression is obtained when this method of management is considered in relation to one species of bird (the black grouse). Black grouse research is the most important that has been carried out in the Netherlands in relationship to fire, and should therefore be considered further here. The main research on this subject has been conducted by Eygenraam from this institute.

The black grouse has long been related to heath. With the introduction of reclamation it was thought to be impossible to preserve this species. Later it was found that the black grouse obtains food mainly from outside the heath and thus reclamation actually had a favourable effect on its density. Nevertheless the bird disappeared from many places. But the main reason for this was the lack of heath management at the beginning of this century. For a good population three stages of heath are necessary. For roosting the birds need short and not too dense vegetation. Because they do not roost for a long time in one place, they must have enough variety to make a choice. Secondly they need medium tall heath for the long rest between the morning and afternoon feeding times. It is also important that these places should not be disturbed by sheep or recreation. The third type of heath they need is tall and bushy, old heath for breeding. The map in Figure 5 shows a good black grouse habitat. From these data it has been concluded that no more than 10 percent of an area of 100 ha should be burned yearly. This is only a guide line and can of course be adapted to the actual situation.

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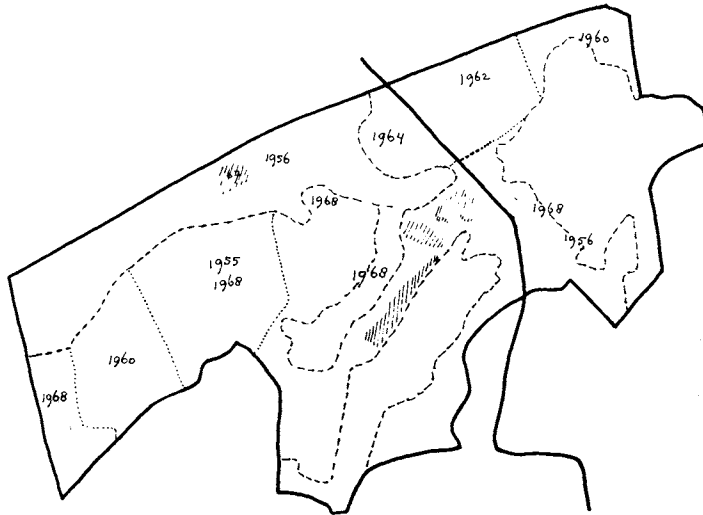


FIG. 5. Area in Drenthe, Netherlands of 400 hectare (heather and partly woods). The dates give the years in which the part concerned is burned. Some parts on the border are never burned. On the shaded parts the old heather is mown and removed.

As a result of burning as a way of management there was an increase in the black grouse population within a few years. This increase was as much as five-fold depending on external factors. We particularly wish to maintain this bird on the heath as an interesting, biological phenomenon. As you can imagine this research meant a complete new reintroduction of fire in the heath management of the Netherlands.

One problem with burning is that small areas situated near forest are difficult to burn because of fire danger. Otherwise it is a question of experience, since it is considered possible to burn even small areas, although more trouble and cost is involved. Another problem is the presence of *Juniperus communis* on the heath. In such places it is almost impossible to use fire since this tree burns very easily. Burning

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now plays an important role in the total management of heath. The light fertilization which results from burning is also of great importance for the heath on poor soil.

5. MOWING

Several methods of mowing are available. Hand mowing is too expensive and has no special biological advantages. Heavy machines usually damage the heath and are preferably not used. Mowing *without* transport of the cut heather generally gives poor results. Young heath has no chance due to the mulching effect of the cut heather and as a consequence other species are inclined to replace the *Calluna*. Mowing *with* removal of the cut material is possible but, in contrast to burning, it impoverishes the heath. The heath is already rather poor, and therefore intensive cutting with transport will not give good results.

6. GRAZING BY SHEEP

Grazing possibilities are closely related to uses of grazing in the past. Although this appears to be the most popular way of management this is debatable because of the changing use of the surrounding land. Sheep grazing was previously related to the entire agrarian system but now it is only an expensive way of management with poorer results than burning. The poor results are partly due to the influence of the sheep which are always "scratching" on the heath. A second disadvantage is that the public may find the herds a big attraction and may follow them on the heath. For several kinds of birds (black grouse and herrier) this would be disastrous. Only if an area had already been chosen for recreation would a herd of sheep give good results. A flock must consist of 400 animals which need about 400 hectares of heath and about 20 hectares of grassland.

There are several other types of grazing such as grazing without a shepherd, or grazing at a stake etc. These will not be treated here. A flock of sheep could be used on heath of several hundred hectares area on rich soil. Burning will usually be necessary in addition for rejuvenation of the heath.

Heath on poor soil will generally not have enough food for a

flock of sheep. The heath on moorland is only partly available since many parts are absolutely unsuitable for grazing. The financial consequences of a flock of sheep are not even very encouraging, as explained below.

7. COMBINATIONS

Several types of management must be combined to obtain good results. Such combinations give the best results for the given purposes. It is impossible to suggest that all heath should be managed in the future by only one of the above methods. In fact the best combination for management purposes should be established for each terrain.

FINANCIAL CONSEQUENCES OF SEVERAL TYPES OF MANAGEMENT

In Table 3 the financial consequences of each of the above mentioned management methods are shown. The costs per year for management of 100 ha of heath are given for each method. However, as explained above, a maximum of one tenth of a 100 ha terrain is burned or mown. Thus for most management methods the costs given apply to 10 ha. A terrain of 100 ha is therefore managed over a 10 year period by always working another part of the area. At the end of such a cycle one begins again. The only exception is in the fact grazing. A flock of sheep is only reasonable if more than 400 ha are available. For the sake of comparison, the costs for an area of 100 ha are taken as a quarter of the costs for 400 ha. The costs are not entirely comparable since, for example, burning of a large surface area is much cheaper than the same method in a small area. In the

TABLE 3. YEARLY COSTS OF HEATH MANAGEMENT OVER 100 HA (IN DFL.)

	Costs	Investments
1. Non-interference	0	0
2. Tree removal	900.—	0
3. Sod removal	p.m.—	p.m.—
4. Burning	1000.—	500.—
5. Mowing	2500.—	p.m.—
6. Grazing	7000.—	50000.—

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case of mowing, however, management of an area twice as large costs twice as much as the figure given here.

Naturally, non-interference (method 1) costs nothing, but in nature management it can be seen that the cheapest is almost never the most desirable. Considering the wealth which must be preserved in a reserve some costs must be expected. As already mentioned, management methods for extensive heath on poor soil are occasionally extremely limited.

Pulling out or cutting down overgrowth (2) is a means of maintaining the open character of the heath rather than a method of rejuvenation. This is therefore only a supplementary measure. Starting with 100 ha of heath one can suppose that if such a terrain had been mown or burned 5 or 6 years ago, then the overgrowth would have to be removed from a maximum of 10 ha. This measure is therefore considered to be supplementary to management methods (4) and (5). The most important cost contributing to the given assessment is wages. In a number of cases the extracted birches are sold as plants. In such cases either a small profit is made or the costs for the treatment of the area at least covered.

With respect to sod removal (3) there have been no special calculations made in view of the fact that there is no real application of this in management.

For burning (4) as a management method the low yearly costs are noticeable. In fact only the costs of wages are of importance. Investments are extremely low and a drip-torch is in fact the only implement required. If one wishes to burn small plots in a very combustible area a small fire-engine is to be recommended. Although there are various methods of mowing (5), the method chosen for assessments was that which included transport. In many cases there are no costs associated with this and a profit can actually be made since the cut heather can be used for dike building and the broom industry. Continual application of this management method leads however to an impoverishing of the heath which is not biologically desirable. Various other methods of mowing can sometimes give good results when used as a supplementary measure in difficult to burn parts of small reserves. The costs concerned regard those

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which have to be made, when the measure has to be carried out at owner's expense.

For grazing (6) there are also various possibilities. At a stake the flock grazes independently throughout the whole area. With reasonable occupation the undergrowth will be nearly all eaten. Such terrains are rather poor biologically. It is extremely difficult to find a good degree of occupation for an area. A shepherd can control where the flocks graze. However, sheep show a preference for grass, followed by young heather, young seedlings and finally older heather. Thus many animals are needed before management as a whole can be taken over adequately by sheep. A great deal of knowledge is needed in order to apply this method as such successfully.

A summary of the financial consequences of a flock of sheep grazing on 400 ha in the Netherlands is given in Table 4 in order to give an idea how the figure for 100 ha in Table 3 is calculated. From the figures in Table 4 it appears that the sale of ice cream and souvenirs is a more important source of income than the actual sheep products.

TABLE 4. FINANCIAL CONSEQUENCES OF A FLOCK OF SHEEP GRAZING ON 400 HECTARE IN THE NETHERLANDS IN 1970 IN DFL.

Debit		Credit	
Provender etc.	5000.—	Sale of sheep and lambs	6000.—
Wages	15000.—		
Depreciation bldgs	700.—	Sale of wool	400.—
Maintenance	700.—	Profits on souvenirs and ice cream	7000.—
Interest	700.—		
Sundries	5400.—	Sundries	1000.—
Surplus	900.—	Grants and gifts	14000.—
	<u>28400.—</u>		<u>28400.—</u>

In summary, (7) it can be concluded that a minimal figure of f 200.- per year per hectare must be taken into account. This applies actually to small areas. Larger areas can be managed for less than f 100.- (\$30) per hectare per year. Economizing on this figure will nearly always result in a decline in biological value of the reserve.

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COMMENTS ON THE USE OF FIRE IN GENERAL

As already mentioned research concerning the black grouse has contributed to an important degree to the reevaluation of burning in nature areas. Although the public often cannot really appreciate the measure, this is the consequence of too little education. It would be worth analysing whether there are less wildfires in the summer months in areas which are regularly burned in the early spring. It is quite possible that, because controlled burning has decreased the amount of combustible material, less bad wildfires will occur in a fire-dangerous period.

The period when fire as a tool for management is used is very important. Fire must not be used after the end of March, and even sometimes earlier, because of the birds which may already be breeding. Moreover the period of growing would be shortened when burning later than March, as a consequence of which the vegetation would not be able to develop to an optimum. This applies not only for the heath areas but for all areas in which fire is used as a method of management.

In the Netherlands burning at times concerns, besides heath areas, also reed fields and often verges. Reed fields are generally still in production. In winter they are mown and the reed is used for various purposes (e.g. roof covering). Parts which are not within reach, or are not mown for any other reason, are in many cases burned in the early spring. Now that mowing is less frequently used, this type of burning is performed to an increasing degree.

Burning of reed fields has found yet another application. With the development of new polders in the former Zuiderzee, reed (*Phragmites communis*) is sown (with the help of planes) as soon as the soil is gradually being reclaimed. Pumping away the water coincides with the growth of the reed. Instead of a slow succession of diverse phases of marsh vegetation, the reed is strongly favoured. This speeds up the process by which the soil becomes suitable for cultivation, provided at least that the reed can be quickly removed after 1 or 2 years. Burning can be used for this, and parts of the new polder are burned yearly; these parts will be cultivated in the same year.

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Burning on such a large scale was a new development and led at first to many protests. So much experience has now been gained that burning can be carried out with the correct wind direction such that inhabitants of the cities are not troubled by the fire. As far as possible burning is carried out early in the year. This is not always possible because of bad weather conditions. Shortly after burning the plot is ploughed; the ash is the first (natural) fertilizer to enter the soil.

In cultivated areas with hedgerows, burning must definitely be avoided. These small refuges are not suited to burning. There is less objection to the burning of roadsides and the sides of ditches. As far as nature conservation is concerned this type of burning is not even very interesting. One advantage, however, is that litter is burned together with old vegetation; the Dutch are not as clean as one is sometimes led to believe!

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