

FORESTRY COMMISSION
RESEARCH BRANCH PAPER No. 20

**NOTES ON
PLOUGHING PRACTICE
IN THE
FORESTRY COMMISSION**

By

J. W. L. Zehetmayr

Divisional Officer

Duplicated for Circulation
within the Forestry Commission
25, Savile Row
London, W.1.

NOTES ON PLOUGHING PRACTICE IN THE FORESTRY COMMISSION

1. The main functions of ploughing as undertaken by the Forestry Commission may be summarised as follows:

(a) Alteration of the site as a whole to make it more suitable for tree growth, through regulation of the water regime, aeration, the mobilisation of nutrients, especially nitrogen, and the reduction of compaction. Water may be conserved by the removal of competing vegetation; drainage is effected by opening of furrows, while planting in the furrow on dry sites and on the ridges in wet sites gives the young trees more favourable moisture conditions.

Reduction of compaction and aeration is effected by the disruption of thin impervious surface peat, of compacted till, or of iron or humus pans; this may be essential to good tree growth.

Mobilisation of nutrients is effected by the decay of buried vegetation and the exposure and aeration of peat and pan.

(b) Provision of a suitable planting spot.

Desirable effects are loosened soil for easy planting, absence of vegetation from the actual spot, provision of shelter by ridge or furrow.

(c) Manipulation of this spot in a manner so as to favour the trees for as long as possible.

The maximum growth of the trees will generally be obtained if as much vegetation as possible is suppressed, and the plant is as far removed as possible from direct competition with the returning vegetation. The plant should also be placed in a relatively favourable micro site with the maximum of shelter consistent with the need for

drainage on the wetter sites. All these features should be taken into account in deciding the type of ploughing required for the site and the best method and position of planting.

2. The benefits which accrue from ploughing may be summarized as follows:-

(a) More rapid early growth, which reduces the period the crop spends in the weeding - and most frost-susceptible - phase, and ensures rapid establishment.

(b) More uniform early growth and the reduction of losses, due to the "ironing-out" of differences between planting spots, make it probable that almost every individual will enter the canopy; this in turn allows the use of wider spacings. The enormous early wastage from suppression found in close spaced plantations is thus eliminated.

(c) This uniformity of early growth makes early thinning more necessary than in the more irregular crops (of the same top height) produced by direct planting. (This may not always be an advantage if small rough material is not saleable!)

(d) Increase in the Quality Class of the crop. There is no doubt that on the poorer ground total production from a given rotation will be substantially increased by ploughing.

3. Points affecting practice arising from ploughing are -

(a) Quicker actual planting, allowing the completion of large programmes within a limited planting season.

(b) The use of smaller, cheaper planting stock. One-plus-ones against two-plus-one or two-plus-two older transplants.

(c) Reduction, and in the poorer areas, the virtual elimination of weeding (but on old agricultural land weeding may be increased through germination of weed seed after cultivation).

4. To achieve the three requirements listed in para. 1 will require different tackle on different site types. Three main site types may be distinguished and are:-

A. WET SITES, MAINLY PEAT

Here draining of the site is the most obvious requirement, but it has been conclusively demonstrated that provision of suitable conditions at the planting spot by turfing is also essential. Thus ploughing here becomes divisible into draining as such, and turf provision.

The needs of these sites are at present very well met by a number of draining and turfing ploughs, viz:

Cuthbertson Single Mould Board (Type F). Designed for cutting drains, this plough provides a turf ridge which may be planted in situ or cut up and spread. The use of the Single Mould Board at close spacing is not to be recommended save for exceptional sites where intensive preparation is required, e.g. deep peat bogs.

It should be observed that the original feature of all the Cuthbertson ploughs is that they are self-levelling, the beam being independent of the wheels when working so that the drain has a level bottom even when the wheels are crossing irregular ground. This feature is not incorporated in any other plough.

Cuthbertson Double Mould Board (Type P). provides two turf ridges but the furrow cut is not suitable as a permanent drain though it will serve for some years, and may be deepened by hand later. Its use is confined to the less steep slopes, since on steeper areas the turfs roll downhill or back into the

drain. Thus the number of Double Mould Board ploughs in use is very much less than of Single Mould Board.

A few 'Type S' Double Mould Board machines are in use, which give a deeper furrow, half-way in dimensions between the flat furrow of the 'P' and the drain of the 'F'. This machine is obsolescent.

Bogg Turfing Plough. This plough is cheaper and lighter than the above but although still widely used has been abandoned in favour of the Double Mould Board in certain conservancies, as it was found that the turf was not large enough for adequate vegetation suppression, weeding costs were high, and more than counterbalanced the saving on ploughing.

Ransom Solotrac is still used on shallow peats to some extent, but is not really a plough for wet ground, being more suited for general ploughing on good heath or mineral soil areas.

The ideal combination is felt to be one Single Mould Board, to put in drains, with a second plough of one of the other types to plough between the drains for planting. Hand cutting and spreading of turfs is an alternative to the latter, particularly favoured on better but steeper ground where the Double Mould Board will not work and growth on single turfs is adequate.

Other special types of plough in limited use on peat are - Cuthbertson Deep-going Double Mould Board Draining Plough Type B). This will make main drains thirty inches deep, but may need two tractors to pull it; this tool is for special jobs only; there may be a case for deeper main drains, at present this plough is the only alternative to hand deepening.

Cuthbertson Reversible Single or Double Mould Board Plough which can be quickly modified to throw a single furrow to right or left, or a double turf on either hand. Though, theoretically, this is the ideal peat plough which should be able to tackle

any site it is rather clumsy and not many are in use. As many of the other Outhbertson ploughs have interchangeable Single Mould Board/Double Mould Boards this outfit has little advantage, except where frequent changes would be necessary.

B. HARD HEATHS

Here natural drainage is impeded by the surface peat layer, and by a pan or compacted layer lower down. The most important point is to break up the surface peat, next to reduce the general compaction, which may involve breaking the pan. This is essential only if the pan lies less than a foot from the surface, but it is desirable to break it at depths down to eighteen inches. Below eighteen inches the pan is rarely breakable without a great increase in plough weight and tractor power, and there is little evidence that its rupture would justify the increased cost.

The ploughs at present available are:-

R.L.R. Plough Obsolescent owing to high maintenance costs and lack of manoeuvrability. This plough has done excellent work and is the only one that will plough in really rank heather.

Tine Ploughs carried:-

(a) On tractor direct ('mounted tine'). Very manoeuvrable but not as robust as (b) or (c), and not as suitable for ground with soft pockets. Excellent for felled woodland and broken ground with rock outcrops and boulders.

(b) On Outhbertson carriage. An effective but unnecessarily expensive tool, as this carriage is designed for self levelling, not necessary on this type of land, and is not designed to bear the shocks consequent on tining.

(c) On Forestry Commission carriage. This new equipment is most robust and will probably become the most widely used on the heaths.

Areas ploughed with these tine ploughs may need a limited length of open drains, but not an intensive drain layout such as is necessary on the peatlands. The tine outfits can all be converted for opening drains in (a) and (c) by substituting a Begg type mould-board on the beam, and in (b) by replacing the standard Cuthbertson mould board and discs.

Only the latter will give a first-class levelled drain; with the others some bottoming by hand may be required.

The recent changeover from deep-going ploughs to tine-ploughing (equivalent to shallow ploughing + subsoiling) is fully justified by experiments on the position of planting, which show that the ridge is not a good planting site. Tining, particularly if carried out along the contour, gives free vertical drainage, and run off is minimised. On low rainfall areas (under 40 inches) water conservation, rather than drainage, is likely to be required later in the rotation, and the need for the deep-going mould-board plough (R.L.R. type) can thus be seriously questioned.

Solotracs are still used on marginal heath types but should not be used when the pan is at all hard, as they will rarely break it.

C. SITES WHERE FREEDOM FROM COMPETING VEGETATION IS MORE IMPORTANT THAN DRAINAGE OR THE RELIEF OF COMPACTION

This general head covers several types on which relatively little research has been done. On many of these sites intensive ploughing is not essential to good growth as it is on the peats and hard heaths, so that the considerations raised in section 5 have particular force. A number of main types may be distinguished.

- (i) Western grasslands without peat. In some respects this type resembles the heaths in that drainage is not a problem, while the soil is often compact, but the major difficulty is the rapid invasion of grass after grazing is removed. The Solotrac and Double Mould Board Cuthbertson have been widely used to cultivate, suppress the vegetation and provide some shelter to ridge side planting. Trials with a Forestry Commission Double Mould Board + Subsoiler and with the tine are in hand.
- (ii) East Anglian Heaths. The main features are low rainfall, light soil and frost throughout most of the year. Shallow single furrow ploughing with planting in the furrow bottom has been found satisfactory. This eliminates competition from the grass mat, gives some shelter and additional moisture, while exposing the minimum of soil to wind erosion. Light agricultural type ploughs were employed in the past. Little planting is now being done.
- (iii) Chalk Down Land. This has many features in common with the (ii); shallow soil, drought, and competition from the grass mat being the risks to be overcome. Shallow ploughing is essential to avoid bringing up the chalk, and generally this has been single furrow ploughing with agricultural type ploughs with furrow side planting to give the roots access to the double soil layer. Complete shallow ploughing with disc ploughs mounted on a half track tractor has been successful.

Where the soil is somewhat deeper the Forestry Commission Double Mould Board + Subsoiler has been used, followed by furrow planting; this also is mounted on a half track.

5. Considerations which should determine the decision to plough an area and the tackle to be employed.

- (a) There is a tendency on the part of the younger foresters and officers to plough everything in sight,

using the handiest equipment, and of their seniors to question the need for it. This should be decided by economic considerations, weighing the cost against the benefits to be obtained from ploughing, which may be a long term improvement in growth or merely those which occur in the early years of the life of the plantations, namely, ease of planting, reduction of weeding, conservation of labour, and quicker establishment. Where the latter is the case, i.e. no long term benefit is expected, the main point for consideration is the availability of labour for maintenance, and the cost of ploughing. To use or bring in heavy equipment for small areas may involve heavy expenditure beyond the cost of ploughing, and the latter itself is a large item if any tracked tractor is used, while on the other hand if labour is scarce use of the plough may enable programmes to be carried out that could not be done by hand, but it should be recognised that the final cost may be greater.

(b) It is often easy to use heavier tools than are really necessary, merely because they are available. This may or may not be justified by the fact that extra cost would be involved in providing an additional lighter range of tools for a varying proportion of the planting area. There have been cases of successful use of light equipment in forests where easier ground predominates, but the heavier equipment may still be required for the difficult remainder. This question is largely economic. Does the area justify two outfits, one lighter and one heavier? Could the majority be done with a lighter gear leaving over a proportion till another year?

(c) It is also possible that in some areas the saving in ploughing costs will justify the omission of a proportion of the land which offers special difficulties to the equipment, unploughable areas even of some size could be left unplanted and smaller areas hand planted with a 'safe' species. There is possibly a category of ground

'plantable if ploughable', particularly on sites with rock outcrops and boulders. Here, however, it is improved tractor design rather than improved ploughs that are required, the wear and tear on tracks being the limiting factor at the present time.

6. The main possible criticisms and questions arising on the present ploughing practice are --

(a) Ploughing methods in vogue are all designed to produce ridges of turf or soil or bands of loosened soil. This may increase liability to windblow by the creation of zones of weakness, as with furrows spaced at five feet, or by the orientation of the main roots along the ridges as has been shown to be the case on heaths. It is for these reasons that recently an attempt has been made to put complete ploughing - an old experimental method - on a practical basis by the use of a large disc plough. A similar plough might be desirable on peat for full ploughing between the main drains but no satisfactory tool is available. (The Prairie Buster was the nearest approach). On the better peats, where turfs will suffice, their production by hand from Single Mould Board ridges may prove more satisfactory than use of the Double Mould Board Turfing Plough, which will tend to orientate the roots.

(b) The question of extraction over ridge ploughing may also be important but has not yet arisen; the clayey heaths where erosion of the ridges will be slow are the most likely sites for this difficulty to arise. The tine plough is the least susceptible to this criticism.

(c) Burning. If it will facilitate the work, one more burning will not seriously harm the general run of hill ground. There is in fact some evidence that early growth is stimulated by the release of nutrients following burning. Burning certainly delays the onset of competition from the re-invading vegetation.

(d) Vegetation Suppression. There is a school of thought which holds that this is the main aim in all ploughing. Often it has been followed by the planting of spruce on what may become heather ground. It would appear better in this case to save on ploughing and plant a safer, even if slower, species. On the more fertile areas it is probably true that vegetation suppression or removal is the main aim, since here drainage and removal of compaction are not as important as on the poorer types of land.

(e) Downhill Ploughing. This is a source of some argument. One opinion is that except on very light or free soils, downhill ploughing can do little harm since the water is divided between so many channels, and that cross draining by hand will deal with the odd pockets of erosion which may occur before the tree cover becomes effective. Downhill ploughing should in all cases be confined to those slopes which are too steep to be ploughed on the contour.

(f) There is a tendency among all supervisory staff dealing with ploughs to try to go one better, by ploughing more difficult ground to ever greater depths. (This may be counteracted by the piecework driver's desire to make his wage and thus to avoid trouble!) It is suggested that for normal work, drains to eighteen inches, tining to eighteen inches and turfing to nine inches are the maximum depths that are required and that the present tools with 40-50 horse power tractors will achieve these depths under most conditions encountered. For small areas of more difficult ground these standards might be reduced somewhat if ploughing would be greatly facilitated thereby. While by no means suggesting that improvements in gear, alteration of settings, etc. will not be made, it is hard to imagine how the Cuthbertson Draining Plough, for instance, could be improved on.