PLANNING A TREE NURSERY

Planning a tree nursery C 20
- introduction: choosing the site

What is the most important feature of a tree nursery?

Producing environments in which young trees can thrive.

So does that mean that trees could be propagated anywhere?

Well, nursery sites do vary a great deal (C 2), but choosing a favourable spot is usually needed in order to:

(a) overcome problems and minimise losses during propagation (C 3, C 60);
(b) grow young trees with suitable root systems (C 4, C 11); ***and***
(c) produce enough good planting stock (C 34, C 47) at the right time for planting (Manual 5).

Does it matter whether the nursery is temporary or permanent?

No. The same general points apply (C 21-22), whether it is:

(1) near the house, growing small numbers of trees to plant on the farm;
(2) far from any buildings, producing enough trees to plant one area; ***or***
(3) on a main road, turning out hundreds of thousands of trees in a year.

How do I choose a good site?

Above all, the tree nursery needs to be near to an adequate supply of **water** (C 24), though not liable to **flooding;** and preferably also:

(a) not on a very steep **slope** (D 23 in Manual 4), nor completely flat land (D 12);
(b) on **soil** that is suitable (C 23), and near a supply of good topsoil (C 6);
(c) reasonably **sheltered** (C 25, C 46); ***and***
(d) **accessible** for supplies (C 24, C 51), and also to the expected planting site.

What is especially important about the water supplies?

(A) **Sufficient amounts reliably available,** even during dry weather when water use may be at its maximum;
(B) **Reasonably clean,** without having much:
(1) salt or toxic chemicals dissolved in it; ***or***
(2) fine soil particles, such as clay and silt (C 23; and D 12 in Manual 4), suspended in it; ***and***
(C) **Free or cheap,** because paying for mains water can be very expensive when large numbers of young trees are going to be watered frequently.

Supposing there is some salt in the water?

Traces of salt can sometimes be blown inland by strong winds, or left during exceptionally high tides, and it is best to avoid sites where this could happen.

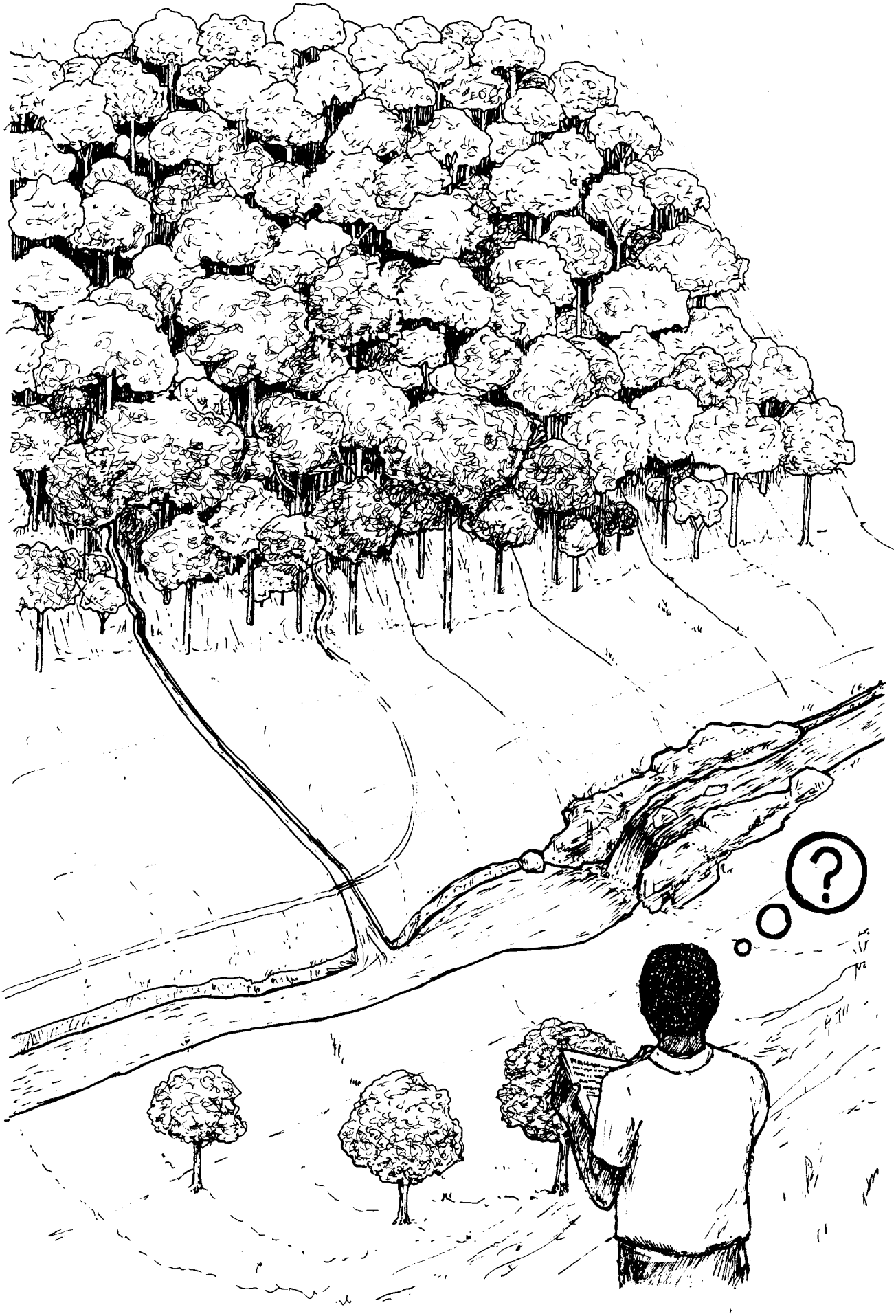
Salty water from the sea or tidal estuaries is suitable only for trees like mangroves. However, these species need nurseries only if the natural stands have been largely removed (D 26 in Manual 4), or when other genetic origins or species are to be planted.

What if all the available land is steep?

Try to find a site which:

(1) is not on loose soil or where a stream might wash some away;
(2) is well protected by surrounding trees; ***and***
(3) can be reached easily.

Successful tree nurseries can still be produced that have a series of narrow terraced beds and standing areas for containers (D 65 in Manual 4).



Supposing the whole area is a flat plain?

The chief problems could be:

(a) poor drainage, so that the soil is sometimes waterlogged; ***and***

(b) the risk of more serious damage from flooding.

However, you might try:

(1) building up the height of seed beds and standing areas for potted plants;

(2) digging drainage channels (D 65 in Manual 4); ***and***

(3) making low walls to hold back flood water.

What other soils should I avoid if possible?

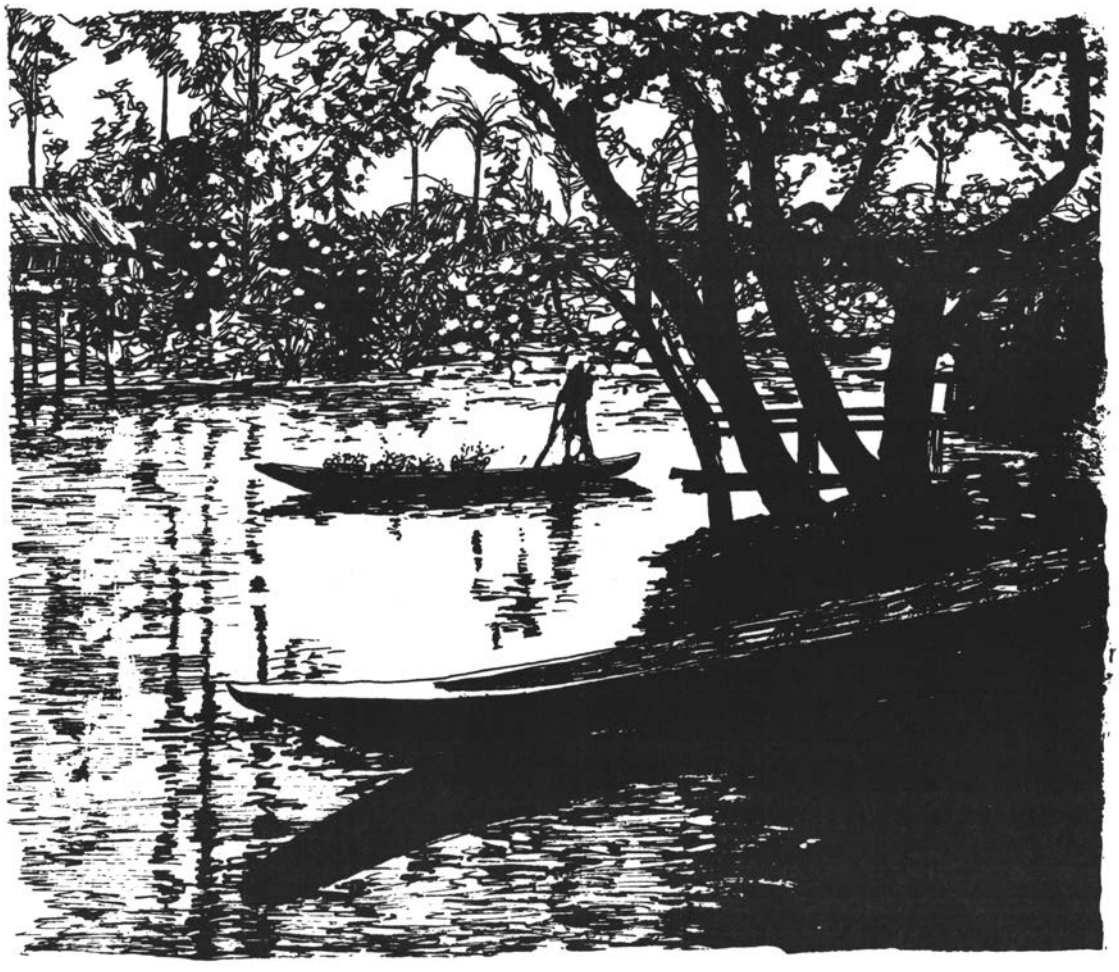
(a) **Very stony soils** (C 23), as a lot of effort would be needed to make them suitable.

(b) **Very heavy soils,** with a lot of clay in them, which would make nursery work much more difficult;

(c) **Extremely acid** or **alkaline soils,** with very low or with high pH (D 12 in Manual 4), which would need special treatment to grow all but a few tolerant species;

(d) **Highly degraded land,** requiring a lot of soil improvement for seed beds (D 22, D 32 in Manual 4); ***and***

(e) **Very exposed sites,** needing a lot of shade and shelter (C 25, C 41, C 46), while still remaining liable to storm damage (C 3).



How important is access for a nursery?

(A) By foot or by boat, it is essential;

(B) With a wheelbarrow or head pan, it is highly desirable;

(C) By motorised vehicle capable of travelling on rough terrain, it is very useful;

(D) If connected to a metalled road, it is a helpful bonus.

For access to the planting site, see C 21; and D 61 in Manual 4.

What supplies are needed?

Besides water (C 24), the main items generally include:

(1) supplies of topsoil, sand, old sawdust and other materials for making potting mixes (C 6, C 24); and sometimes soil and roots from older trees as *inoculum* (C 30-32);
(2) containers (C 6) and basic tools (C 51);
(3) poles, shading and fencing materials (C 41, C 46).

Building and roofing materials, basic furniture and extra tools may also be needed.

But supposing I can't get all those things?

If funds are limited, your nursery is very remote or the land is degraded, concentrate on:

(a) choosing the best site you can find;
(b) obtaining the most important items for good tree growth, but using methods that do not involve costly or bulky purchases; ***and***
(c) getting the young trees to the planting site in good condition.

What else is important about the site?

(1) Protection from climatic extremes (C 3, C 40-41);
(2) Convenience for carrying out regular watering (C 43) and checks (C 40); ***and***
(3) The size needed (C 22) for the number of young trees to be grown, allowing for the possibility of future expansion; ***and***
(4) The shape of the area chosen for the nursery in relation to planning an efficient internal layout (C 22).

Are there some other guide-lines?

(A) Before deciding where to put the tree nursery, and setting it up (C 26):

(1) look for advice in other nursery manuals (C 61-A), particularly any available for your locality;
(2) make a list of possible nursery sites, together with their advantages and disadvantages (C 54); ***and***
(3) discuss the options with other relevant people (C 53).

Planning a tree nursery C 21
- temporary or permanent?

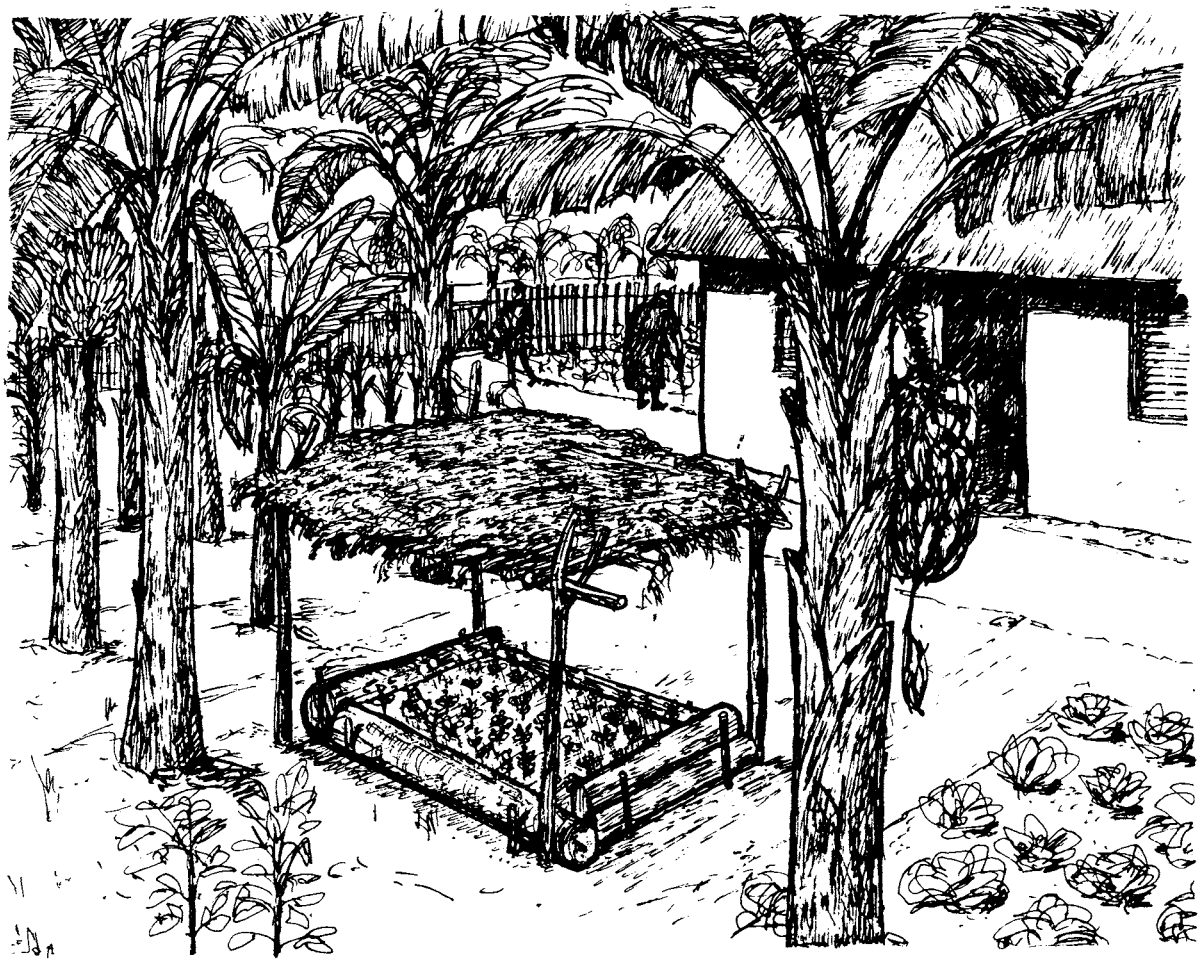
Isn't a permanent nursery always best?

No, it is often a good choice, but sometimes a temporary nursery makes more sense.

When would that be?

Provided that (given the seeds) people locally could raise good planting stock, temporary nurseries can be a good idea, for instance when:

(A) small numbers of young trees are to be grown near the house, perhaps under the shade of a short-duration crop such as bananas;
(B) plants will be wanted nearby for one or two seasons only; ***or***
(C) planting is in remote areas or difficult terrain where bringing in young trees would be very difficult.



What are the advantages of temporary nurseries?

(1) They can be set up near the planting site, so that the young trees:
(a) do not have to be carried far; ***and***
(b) can be moved just before the planting time (Manual 5); ***and so***
(c) may be subjected to considerably less stress (C 41, C 47).

(2) If the nursery is made by clearing a piece of woodland:
    (a) the soil may remain relatively fertile during the period of use (C 23);
    (b) trees may be left around the nursery, with perhaps a few scattered across it, to give protection from wind and sun (C 25).
(3) Establishing them is less dependent on the availability of substantial funds.

And what counts against temporary nurseries?

Particularly when they are remote, it may be harder to:
    (a) provide the knowledge and training (C 50, C 52) needed for small, scattered tree nurseries to succeed, utilising the skills that have been learnt in another area;
    (b) bring in the tools and materials needed (C 51); ***and***
    (c) check regularly that the work is being done properly, whether the plants are growing well and when they will be ready for planting (C 40, C 47).

Could a temporary nursery be converted into a permanent one?

Yes, this might be possible, provided that it is appropriately sited, and:
    (1) there is enough space available (C 22);
    (2) the water supply is sufficient and reliable (C 24);
    (3) access is adequate (C 20).

You could take this possibility into account when setting up a temporary nursery.

What are the advantages of permanent nurseries?

(A) Larger numbers of young trees can be grown, sometimes at a lower cost per plant;
(B) Planning and supervision of the work may be easier (C 40, C 50), reducing the risks of damage to the young trees (C 3, C 41);
(C) More tools and materials can be held (C 51), immediately available for use;
(D) It is easier to build up the experience and skills of a team of staff and workers (C 50, C 52), and to continue to benefit from the training received;
(E) Fences and buildings can be put up, and hedges and shade trees grown, which improve:
    (1) the growing environments for the young trees (C 4, C 10-15, C 25);
    (2) their protection from damage (C 3, C 25, C 46, C 60);
    (3) the smooth day-to-day running of the nursery (C 54); ***and***
(F) Special facilities for research (C 15) or for valuable collections can be handled.

Do they have some disadvantages?

Yes. For instance, a permanent nursery:
    (1) usually costs more to set up and run;
    (2) may lose the fertility of its nursery soil (C 23) after some time; ***and***
    (3) could run out of local supplies of components for making up good potting mixes (C 6, C 24).

If all the planting stock is grown in a single large nursery, an extra risk is that it might all be lost in a major incident, accident or attack by pests or disease (C 3, C 45).

So when should I choose a permanent nursery?

(a) If a suitable site is available not too far from the likely planting areas;
(b) When you expect an ongoing need for planting stock which temporary nurseries could not meet;
(c) If the nursery is to have a training function for the district;
(d) When research is to be carried out, or where careful supervision is needed for a particular tree species to be grown successfully; ***or***
(e) If a stockplant area is to be established nearby, to produce regular supplies of shoots to be rooted as cuttings (Manual 1).

Planning a tree nursery C 22
- size, shape and layout

How do I decide on a suitable size for the tree nursery?

This depends firstly on how many young trees are going to be grown (C 63-A), and by what methods (C 2). For instance, when:

(A) **cuttings are to be rooted,** space would be needed for poly-propagators for rooting and for 'weaning' (Manual 1);

(B) **seeds are to be sown,** this might be done in:

(1) *seed trays* under cover;

(2) *seed beds* on the ground; ***or***

(3) directly in *containers*.

Except for (B 3), space will also be needed for growing on the young trees when they are potted up or transplanted (C 63-B).

Does the type of planting stock make a difference?

Yes, it does. The amount of space needed will vary quite a lot, depending on the set of species being grown, and whether the young trees will be planted as:

(a) container-grown plants;

(b) root-pruned soil blocks;

(c) striplings or stumps; ***or***

(d) bare-rooted plants.

Suppose I am planning a very small nursery?

If just a few container plants are to be grown in a temporary nursery, the size of its growing area can be simply determined by the space needed for each pot, multiplied by the number of pots.

What about a larger, permanent nursery?

For the growing areas themselves, there are six main points to consider:

(1) how many young trees are needed each year;

(2) the type of planting stock to be produced;

(3) what are the likely wastage levels from seeds and cuttings that fail to produce successful plants;

(4) roughly how long the trees will need to stay in the nursery before planting;

(5) whether their growth habits are slender or bushy, and so how much space each plant will take up; ***and***

(6) if planting can be done:

(a) only during one (or two) short periods of the year; ***or***

(b) for extended periods, or continuously.

Will space be needed for anything else?

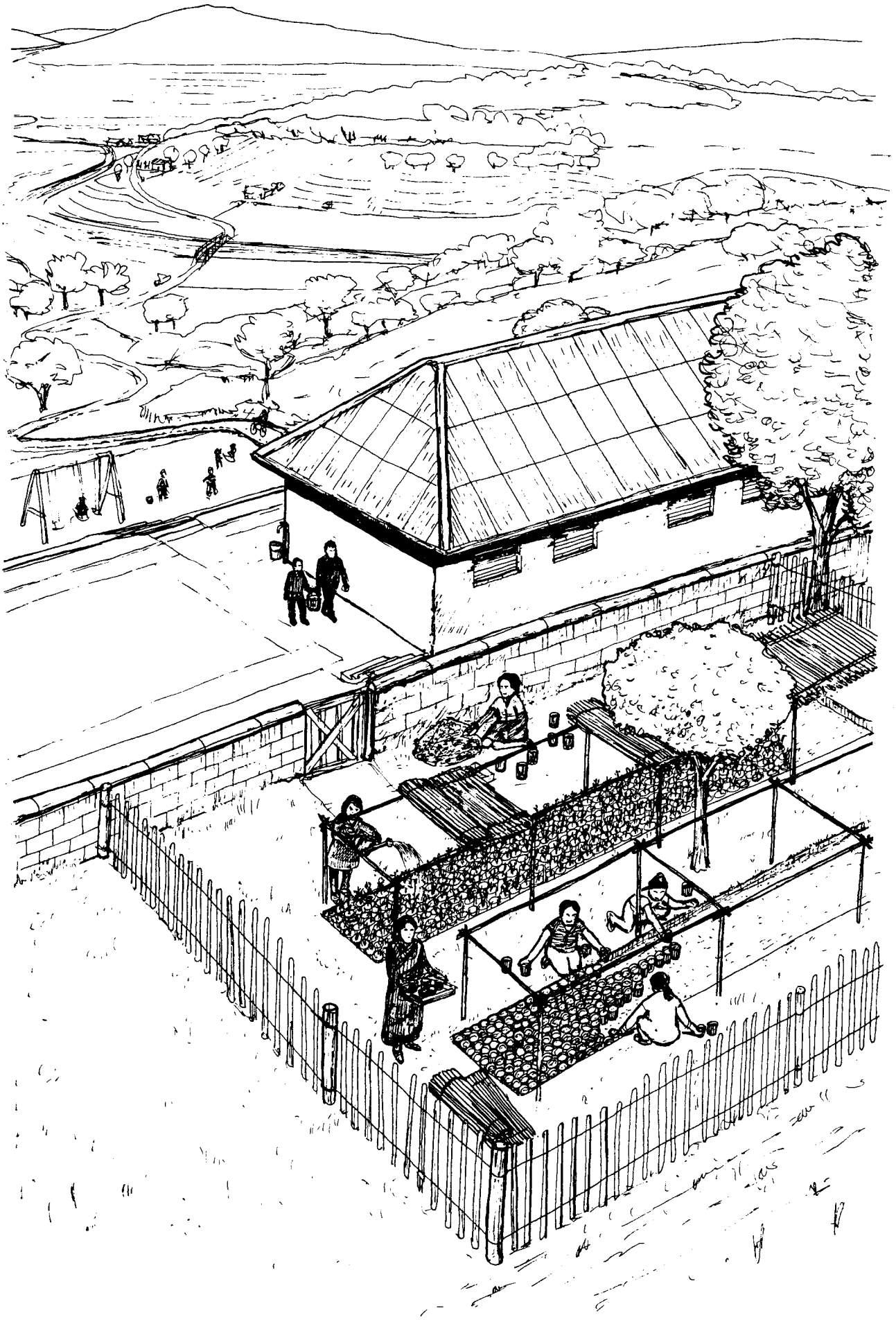
Yes; it is also important to allow room (C 63-C) for:

(a) access paths amongst the beds of seedlings, transplants and potted plants;

(b) access roads, including turning, loading and parking places;

(c) buildings, sheds, a covered working place and storage areas for materials (C 24);

(d) hedges, shelter belts and shade trees (C 23, C 46).



What about future expansion?

Yes, this is an important point. Needs could include:

(A) growing unexpected extra batches of trees;
(B) putting up an additional building; ***or***
(C) being in a position to expand the nursery output later on, if required.

In any case, it is usually sensible to allow 25% more than the minimum calculated, so that one is not cramped for space to work in.

But isn't it a pity to make the nursery too big?

Yes, if:

(1) information is lacking on how many trees will really be needed;
(2) space is urgently needed for other permanent land-uses; ***or***
(3) costs of land are very high; ***but***

No, in most other circumstances, because it would be a pity if space had previously been available, but now was not, and yet:

(a) the nursery is proving successful and needs to expand; ***or***
(b) more flexibility is desirable in order to improve the internal layout.

How can I get a rough idea of the total area needed?

See sheet C 63-C for this.

Does the shape of the nursery matter much?

Not nearly as much as finding a suitable piece of ground (C 20). However, try and avoid:

(A) a long, narrow piece of land, which might mean a lot of extra carrying, and possible 'bottlenecks' that restrict working and access; ***and***
(B) a very wavy margin, which could give problems in laying out the beds, and lead to extra expense for fencing (C 25, C 46).

What is the best shape?

A piece of ground that:

(1) will allow east-west alignment of the beds, to allow more even light to the young trees, but is not more than three times as long as it is broad;
(2) has more or less straight margins; ***and***
(3) will allow entry at a convenient point in the internal layout.

Is the layout particularly important?

Yes, for all but the smallest nurseries, because a well-planned arrangement of the different parts helps to achieve a smooth 'flow' of materials into, work done in, and young trees going out of the nursery. So, having worked out how much space is needed for each part, you could:

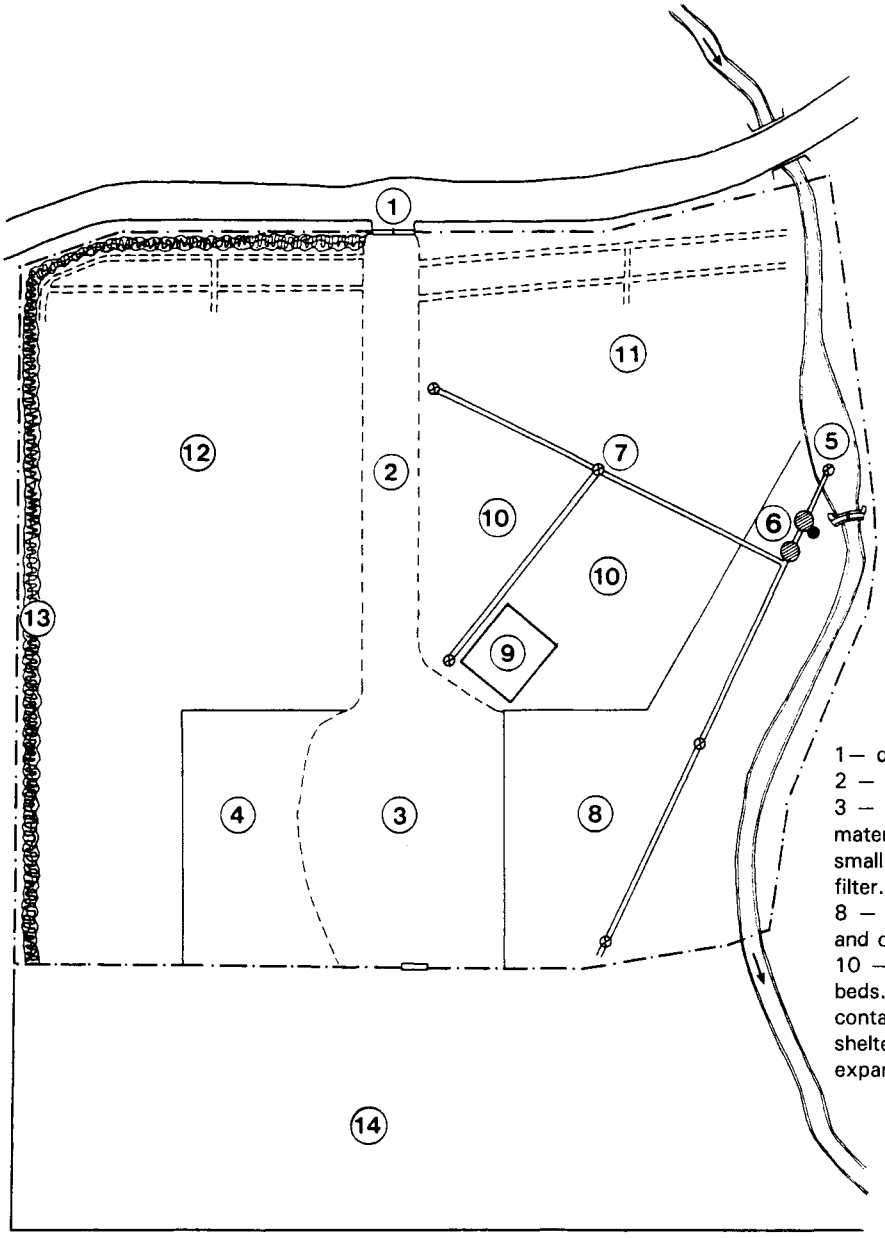
(1) think about the ***order*** in which the various jobs will be done;
(2) make some rough sketches of possible layouts that would permit a good 'flow';
(3) walk the ground, make some rough measurements, and see whether some fit in better with the terrain, points of access and existing shade and shelter; ***and***
(4) choose the one that looks likely to:
    (a) provide enough working space and avoid blocks to easy moving of materials;
    (b) minimise unnecessary walking and carrying (C 20).

So a good layout can save time?

Yes it can. For example, good planning will save you nearly an hour if a job takes:

only one minute less for each plant, and there are 50 of them; ***or***
just 5 seconds less per plant, and there are 700 plants.

With jobs that are done frequently (C 54), the time saved by an efficient nursery layout can amount to a substantial amount each week.



1— double gate and fence. 2 — nursery road, with paths off it. 3 — turning area. 4 — storage of materials. 5 — water source and small dam. 6 — water pump and filter. 7 — pipes and taps. 8 — covered working area, store and office. 9 — shade house. 10 — seed beds. 11 — transplant beds. 12 — standing area for container plants. 13 — hedge for shelter. 14 — space for later expansion.

Are there any other advantages of planning the internal layout?

Yes, there can be several, for example:

(A) the growing areas could be better protected (C 25);

(B) parts with better soil or drainage (C 23) could be used for beds rather than for roads or buildings; ***and***

(C) less damage to the young trees is likely to occur if there is room to walk between them, and if any taps for hoses are carefully positioned.

Is it easier to get it right if the nursery is new?

Yes in some ways, for there may be the opportunity to:

(a) learn from visiting other nurseries; ***and***

(b) do some planning before choosing the site, nursery size or internal layout.

However, in a new nursery there may be less experience amongst staff, and fewer skilled workers (C 53). One possibility would be to:

(1) start off in a small way with temporary, movable structures;

(2) modify the layout as experience is gained; ***and***

(3) build a more permanent facility after a year or two of experience.

How should the actual laying out of the nursery be done?

See sheet C 26.

Planning a tree nursery C 23
- *nursery soils*

Can a tree nursery be made on any soil?

One might be able to manage where it is unsuitable, but it is much better if you can choose a site with a favourable soil.

Supposing all the plants will be grown in seed trays and containers?

Provided you can make up good soil mixes (C 6), then you could still achieve satisfactory tree growth and suitable root systems for planting even with a poor nursery soil. Indeed, access to a plentiful supply of components for making up good seed and potting mixes (C 24) can be more important than the type of nursery soil. However, the smooth running of the nursery (C 50-54) can be hampered if the ground:

(A) gets very sticky after rain, or is liable to flooding;
(B) blows about and covers everything with dust in the dry season; ***or***
(C) is so hard or rocky that it is difficult to make the beds and paths, or to put in poles to support shading.

So a good nursery soil is preferable?

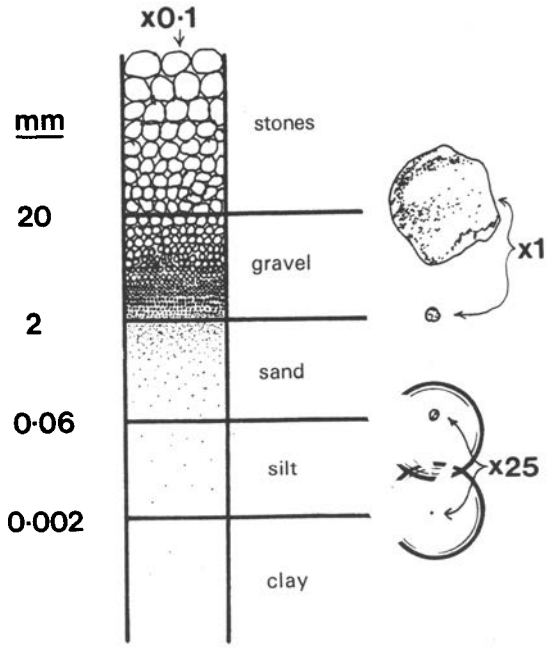
Yes it is. In particular, it keeps open the option of using nursery beds of various kinds (C 22, C 26).

What are the features of a good nursery soil?

The main points are to have:

(1) a favourable soil *texture,* depending especially on the proportions in it of soil particles of different sizes;
(2) sufficient organic matter and nutrients, and an appropriate acidity; ***and***
(3) adequate depth, aeration and drainage.

It can also be an advantage if the nursery soil already contains micro-organisms which form close associations with tree roots that are beneficial or essential for good tree growth (C 30-32).



Which kinds of soil particles make the texture unsuitable?

If possible the nursery soil should not:

(a) have a lot of large stones in it;
(b) contain a lot of clay; ***or***
(c) consist mainly of a single size of particle.

A light, moderately sandy loam is often most suitable (D 12 in Manual 4).

But what if I can't find a place with a favourable soil texture?

If the only available sites are on:

(A) ***soils rich in silt or clay,*** you could:
(1) dig some coarse sand into the topsoil of seed and transplant beds;
(2) put a thin layer of grit or fine gravel on the soil surface after sowing seeds, to discourage damping-off disease (C 45); ***and***
(3) cover paths with a thick layer of coarse gravel.

(B) ***soils that are very sandy,*** one could:
(1) dig organic matter into the topsoil of the beds, such as composted plant and animal wastes or sieved 'black soil' (C 33); ***and perhaps also***
(2) add some fine silt.

(C) ***stony sites,*** you might:
(1) dig stones out of the topsoil; ***and***
(2) use them for foundations for buildings, laying concrete, making drains or putting in the bottom of poly-propagators (A 31 in Manual 1).

Wouldn't this be too much work?

Not if it makes it possible for the tree nursery to produce good planting stock! Anyway, most of the work is not on the entire nursery, but just the top 10-15 cm of the growing areas.

Will such improvements also add to soil fertility?

Yes, because improving the soil texture generally means that:

(a) earthworms and other important decomposers (D 10, D 13 in Manual 4) are more likely to be recycling nutrients and improving soil texture;
(b) the roots of the young trees can grow, branch and collect water and nutrients better (C 11, C 13-14); ***and***
(c) there is less likely to be a need to add fertilisers (C 33).

How else could I have a fertile nursery soil?

(1) The most fertile sites tend to be those on volcanic soil, but good sites can often be found where richer soil has been deposited near the bottom of valleys (D 12 in Manual 4).
(2) Nitrogen-fixing species (C 32) can be planted as a cover crop when beds are not in use, as hedges (C 46) or as shade trees (C 41; and D 41 in Manual 4).
(3) Green manure or appropriate fertilisers could be added (C 33).

Does the acidity of the soil matter?

Somewhat acid soils are generally best for a tree nursery, with a pH between about 4.5 and 6.5 (D 12).
Very acid, or **alkaline** soils may make it difficult to produce good trees, except for local species that are adapted to growing on them.

Can one alter the pH?

To a limited extent one could modify the topsoil of seed beds, by working in some:

(a) crushed limestone or other calcareous rock, lime, basic slag or acid-reducing fertilisers such as sodium or calcium nitrate to **very acid** soils; ***or***
(b) urea or acid-forming fertilisers such as ammonium sulphate or nitrate to **alkaline** soils.

It is somewhat easier to change the pH of seed and potting mixtures (C 6).

How deep should a nursery soil be?

The deeper the better in most circumstances, with a minimum of 8-10 cm, except where all the young trees are in raised beds or containers.

And what about soil aeration and drainage?

Uncompacted, freely-drained soils, with plenty of air spaces in them, are most suitable for nurseries, because:

(1) the root systems of the young trees are unlikely to become waterlogged (C 11) after watering or during rainy weather; ***and***

(2) the paths and access roads are less likely to be cut up if they have to be used soon after rain.

Soils with *impeded* drainage will be less suitable on both these counts, while excessively freely-drained soils may dry out very rapidly.

Type of soil:	Sandy gravel	Sandy loam	Silty clay
Texture:	loose	good	hard when dry, sticky when wet
Air supply to roots:	excessive	plentiful	restricted
Drainage:	excessive	free	impeded
Water retention:	poor	good	very good, but soil cracks when dry

How can drainage be improved?

(A) Choose a slightly sloping site for the nursery (C 20), and align the paths and beds downhill.

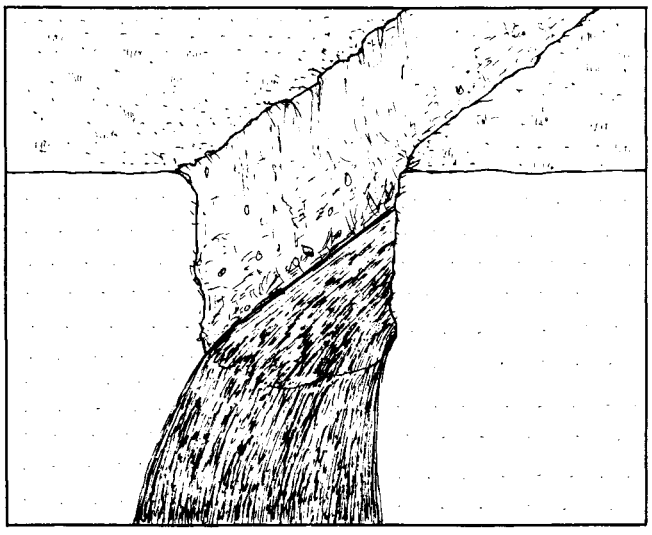
(B) If necessary, put in some drains. These could be:

(1) **open ditches,** preferably with only a slight gradient, and with barriers at intervals (D 65 in Manual 4) and perhaps a layer of stones on the bottom, to reduce erosion and also retain useful water;

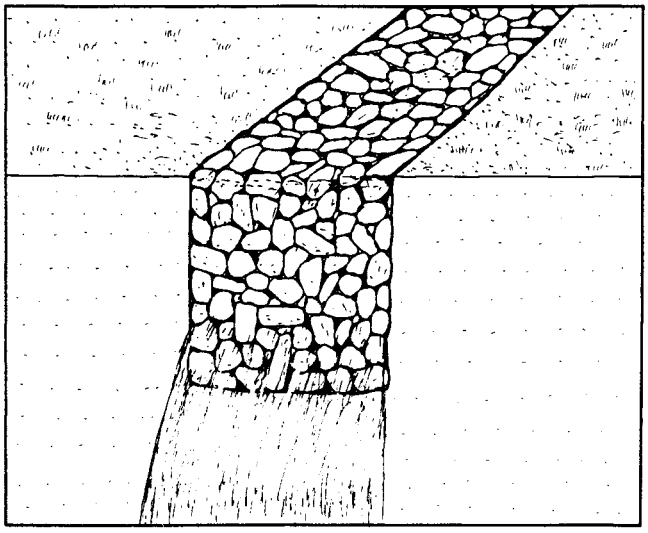
(2) **'blind' drains,** (trenches filled back in with stones, between which the water can run), which could form some of the nursery paths; ***or***

(3) **plastic pipes with perforations,** which can be buried beneath the beds or paths.

(C) Add some fine gravel, grit or coarse sand to the nursery beds, and consider raising them above the level of the paths. Put plenty of gravel on these.



Open drain.



Blind drain.

What can I do if drainage is excessive?

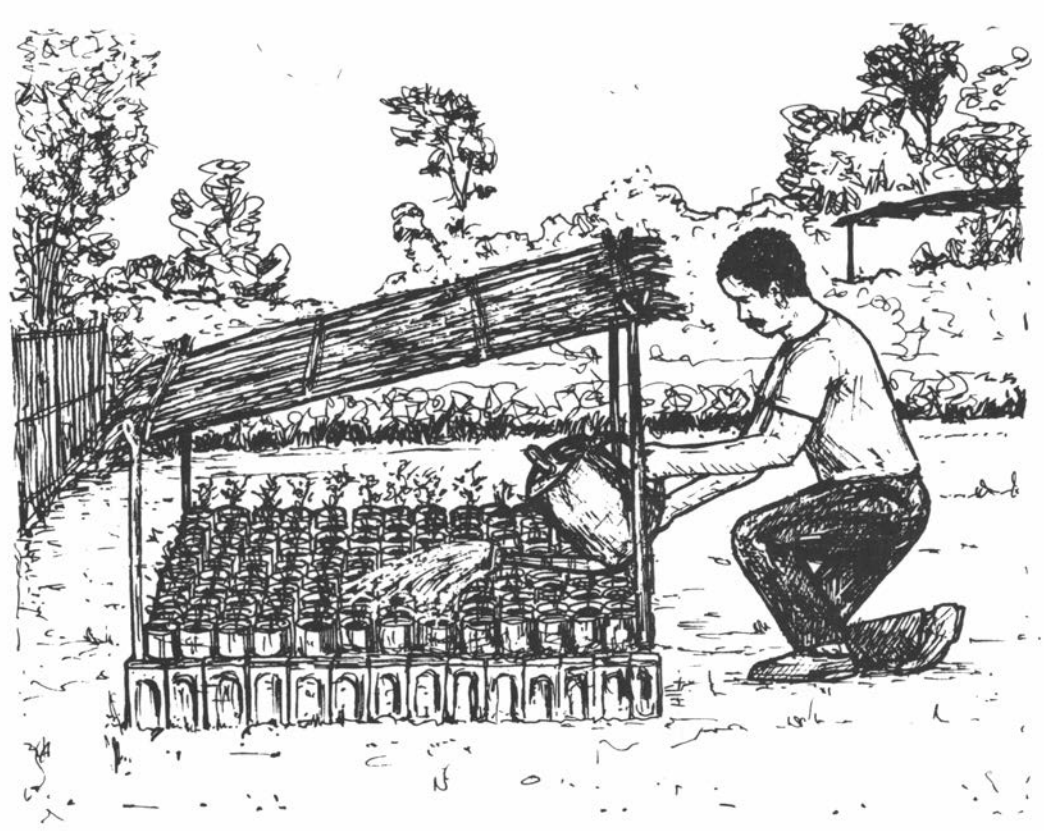
(a) Align the beds and paths along the contour;
(b) Plant hedges to trap soil and slow run-off;
(c) Add organic matter or some silt to the beds.

On a steep site, you could consider making a terraced nursery (C 20; and D 65 in Manual 4).

Is there anything else to consider?

Try and avoid sites that are:

(A) very windy and without existing trees (C 25);
(B) close to the high tide level, in case salt is washed or blown in during exceptional weather (C 20);
(C) near to a place where toxic wastes have been or are being dumped; ***or***
(D) containing persistent weeds, or near a source of their seeds (C 44).



Planning a tree nursery C 24
- supplies of water and soil mixes

Isn't water supply the most important thing about the site?

Yes, that's right. There are very few places where one can rely on rainfall always watering the trees in the nursery adequately. Having a nursery water supply is essential for:

(A) rooting cuttings in poly-propagators or other systems (Manual 1);
(B) germinating small seedlings in a protected environment (Manual 2); ***and***
(C) watering the young trees during rainless weather, so that they survive and grow well (C 13, C 43).

Water is also needed when preparing potting soils (C 6) and for cleaning tools (C 45, C 51).

What about a small, temporary nursery near a house?

This could be supplied mainly from waste water from the home or a school, provided that:

(a) there will be enough of it every day;
(b) it does not contain very large amounts of detergent or soap, or smaller amounts of substances harmful to young trees; ***and***
(c) clean water is used for poly-propagators, seeds and germinating seedlings.

How much water will be needed in a larger tree nursery?

Young trees in containers may need watering at intervals from twice a day to twice a week, depending on the species, the container size, the potting mix and the weather. Each seed tray or pot might take between about 10 millilitres (ml) and a litre each time, and there is bound to be some waste.

Young trees in beds also need watering, usually a little less frequently. You could estimate the quantity at 10-20 litres per m^2 of growing area.

So a nursery with 20 m^2 of beds and 1000 young potted trees might sometimes require as much as a thousand litres a day.

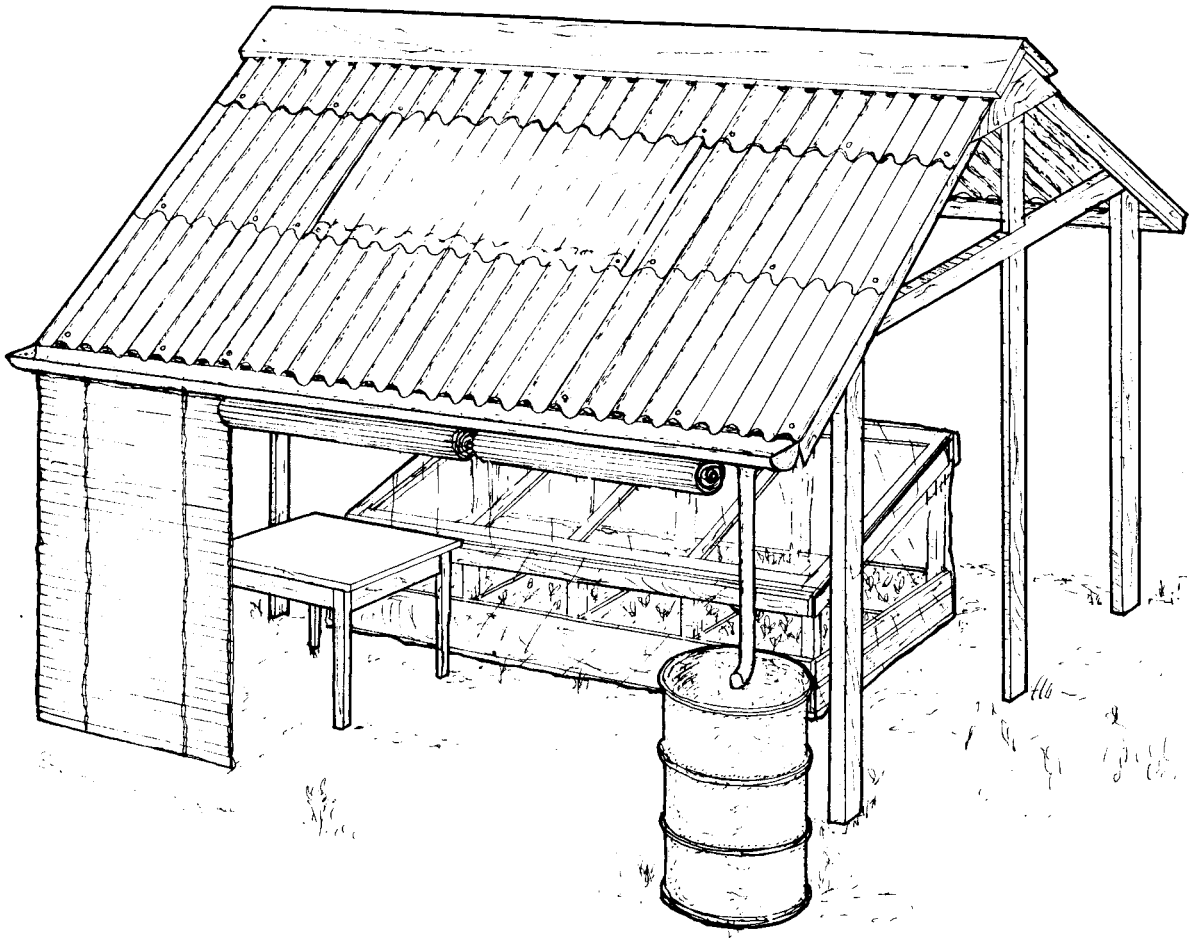
Can I do anything to reduce waste of water?

Yes, several things can be done, including:

(1) storing water when plenty is available for times when it is scarce and demand is greatest;
(2) channelling rainwater to help keep the deeper levels of soil moist, or using polythene sheeting to direct excess water into a collection pond;
(3) using sunken transplant beds (provided that they will not become waterlogged):
(4) avoiding over-watering the young trees (C 11, C 42);
(5) choosing less wasteful ways of watering; ***and***
(6) training people to avoid pouring water on paths, and to look out for and mend leaks promptly (C 50, C 52).

Which kinds of water are suitable?

(a) A stream or river;
(b) A freshwater lake;
(c) A pond or small reservoir created by building a dam;
(d) Rainwater, collected from the roofs of buildings or with polythene sheeting, and stored in large barrels or tanks;
(e) A well or borehole; ***or***
(f) Mains water, though this can be very expensive (C 20).



What are the key points about the water supply?

(A) **Sufficient quantity:** enough water is needed to be able to:

(1) water every potted plant twice a day;
(2) water all the seed trays, seed beds and transplant beds once a day;
(3) store some water as a reserve;
(4) allow for the washing of people and vehicles; ***and***
(5) build in a safety margin (for example of 50% extra).

(B) **Reliability:** great problems involving emergency supplies will result if the water runs low or stops completely during very dry weather, and the young trees might still be damaged or even die.

(C) **Reasonable cleanness:** the water needs to be free of:

(1) a lot of silt, clay, dust or other fine particles suspended in it;
(2) dissolved pollutants, salt, oil or other chemicals that are toxic to most plants.

Can't some of these things be cleaned out?

(1) **Suspended particles:** most of these can be fairly easily removed by:

(a) arranging for the water to be taken from a sheltered part of the water supply;
(b) leaving the water to stand before using it; ***or***
(c) passing it through a simple filter (for example, gravel followed by coarse sand) and the regularly and frequently cleaning this out.

(2) **Dissolved substances:** although extracting them is usually possible, it is often too expensive for a tree nursery. It would be better to try and arrange things so that less of these enter the water supply.

However, the supply does not need to be up to the standard of pure drinking water.
Note: staff and workers should be clearly informed about this (C 52).

Couldn't standing water give some problems?

Yes, you might find a build-up of:

(a) **mosquito larvae,** unless suitable fish are present, or a few drops of paraffin (kerosene) are added to water containers;
(b) **algae** or an excess of other small micro-organisms in the water, which can usually be checked if water containers can be covered;
(c) **water weeds,** which can be removed periodically with a hooked stick or a net;
(d) **dead leaves,** which can be excluded or removed if there is a tendency for the water to become foul-smelling.

Should the water supply be inside the nursery?

For all nurseries, it is a big advantage if the site is chosen so that the water supply is **within or close to the nursery,** provided that it will not cause flooding.
For small nurseries, you could have some buckets handy to catch waste water.
For large nurseries, if the water supply is below the nursery, think about pumping water to a high point, where it could flow by gravity to supply a series of taps throughout the nursery.
On some dry or steep sites, it might be necessary to carry or pipe in the water from a distance.

Hydraulic rams do not require an external energy source, since they use water pressure to pump a little water to a higher level.

And it matters how the watering is done?

Yes, watering is a skilled job, though it can be done in various ways (C 43).

What supplies of materials are needed for making soil mixes?

A variety of components, described in sheet C 6, that when mixed together provide:

(a) a suitable mixture of particle sizes for the roots to branch into (C 4, C 11);
(b) good drainage and aeration with adequate water retention (C 23);
(c) enough organic matter and nutrients.

How important are soil mixtures?

They are usually vital to the growing of good planting stock. Their most important uses are to:

(1) mix up good potting soils for trees grown in containers (C 6);
(2) make a suitable germination medium for plants raised in seed trays (Manual 2);
(3) prepare a good rooting medium for cuttings (A 35 in Manual 1); ***and***
(4) improve the condition of the nursery topsoil in beds of various kinds (C 23).

How much of each will be needed?

Surprisingly large amounts. For instance, about 1 m^3 of a component forming only 25% of a potting mix would be needed to pot up 1000 cylindrical pots, 14 cm wide and 18 cm tall (C 63-C).

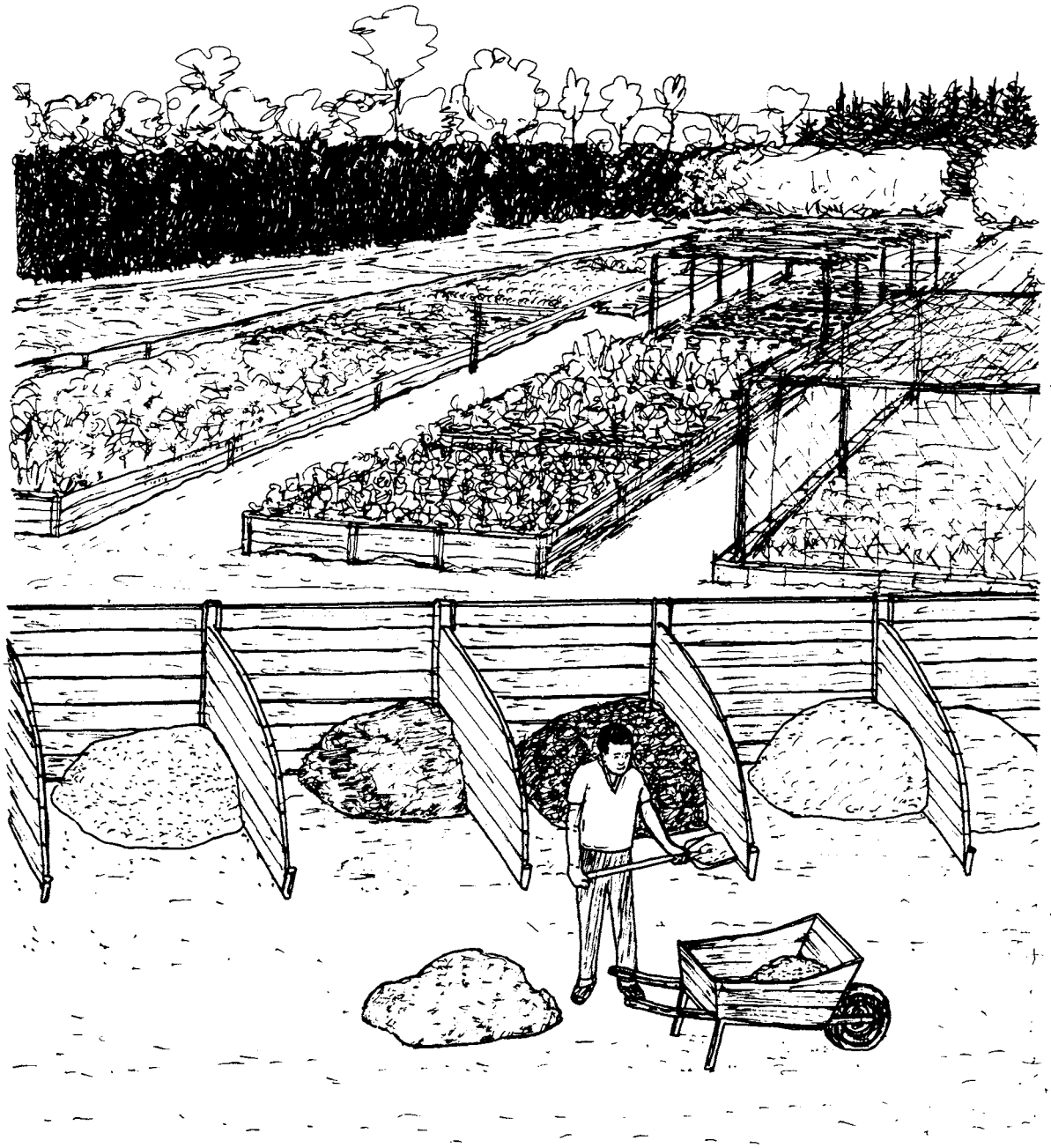
Where should I put all these components?

Since you could be handling a lot of heavy materials, it is well worth:

(a) choosing a place where they would be most convenient for use (C 20, C 22);
(b) building a set of simple wooden or cement block partitions to keep each component separate;
(c) getting in a large supply of those commonly used; ***and***
(d) planning ahead (C 54) to continue getting reliable supplies.

What other things might I need?

Other materials, tools, record sheets and notebooks (C 51, C 54, C 64-67).



Planning a tree nursery C 25
- protecting the whole nursery

What does the nursery need protection from?

At an early stage in planning, think about what can be done to minimise the risks of:

(A) flooding;
(B) strong winds;
(C) fire;
(D) browsing animals; ***and***
(E) thieves and vandals.

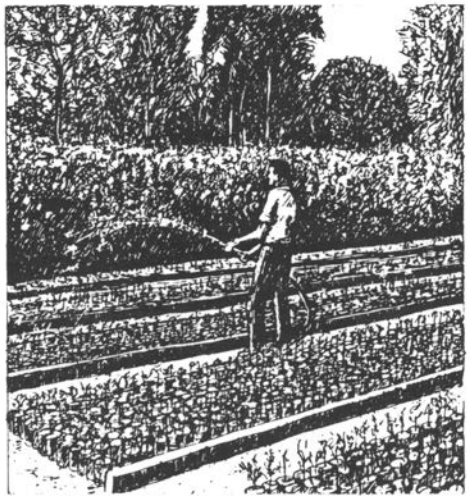
How can I protect against flooding?

In several ways, including:

(1) careful choice of the nursery site (C 20), avoiding:
  (a) very flat, low-lying or swampy land;
  (b) a place very close to a river that might rise to that height; ***or***
  (c) areas, near to the coast or tidal estuaries, which might be flooded when an unusually high tide occurs; ***or if necessary***
(2) building a protective wall of mud, bricks or concrete blocks; ***and***
(3) keeping a watch when the flood risk is high.

What kinds of damage can flooding cause?

(a) Driving out the air from the spaces between the soil particles, depriving the root systems of oxygen (C 11, C 23); ***and***
(b) Depositing clay, silt or sand all over the nursery; ***and perhaps also***
(c) Bringing salt into the nursery soil (C 24); ***and***
(d) Breaking or washing away of the young trees, if the current is strong.



Can anything be done about strong winds?

Powerful storms are always likely to do some damage, but the extent can often be reduced, and damage from lesser winds more or less eliminated, by:

(1) choosing terrain (C 20; and D 12 in Manual 4) that provides natural shelter;
(2) retaining trees near the nursery that will check the force of the wind;
(3) planting shelterbelts around and hedges within the nursery (C 46); ***and***
(4) if possible, growing tree species that are less liable to damage from wind.

Added protection can be provided by putting up a covered area for working under while it is raining (C 22), and for germinating very small seedlings (Manual 2), building poly-propagators for rooting cuttings (Manual 1), and putting up shade houses or greenhouses for research plants (C 15, C 48).

Which species would be most suitable?

(A) Those that will act as a good windbreak or give light shade, and not produce heavy branches that might break off;
(B) Some of the species to be grown in the nursery, which might later act as a handy source of inoculum for mycorrhizas or root nodules (C 30-32).

What might be most at risk from fire?

The young nursery trees and any buildings or vehicles, especially:

(a) in dry forest, savanna and grassland areas;
(b) if planted trees nearby are of species that assist the spread of fire;
(c) when fire protection lines have not been maintained;
(d) where the nursery is temporary (C 21), or when no-one is around for most of the time;
(e) when local communities are unaware of or opposed to the tree-planting.

For fire protection, see C 3; and also D 11, D 16 and D 66 in Manual 4.

Note: **Staff may also be at risk in certain situations!**

How about animals?

The three most important ways of protecting against browsing animals are:

(1) putting up fences (or even walls), or planting thick, spiny hedges (C 46);
(2) tethering or guarding domesticated animals; ***and***
(3) exchanging information about the need to protect young trees, and the kinds of domesticated and wild animals that pose the greatest risk (C 53).

What might thieves want to steal?

Items liable to be stolen might include:

(A) vehicles, equipment and tools;
(B) containers, fertilisers and other useful materials; ***and***
(C) young trees.

Occasionally vandals can cause mindless damage without stealing anything.

Is there anything that can be done?

You might consider the need for:

(a) always putting away tools and smaller items in a locked shed;
(b) keeping vehicles and larger equipment in a locked garage or near someone's house;
(c) employing a watchman at night, and over weekend and holiday periods;
(d) trying to involve the local community in the tree-planting project (D 5 in Manual 4); ***or***
(e) building a high fence with lockable gates (C 46).

Are there other things that might harm my young trees?

Yes, they could be damaged for various reasons (C 3, C 60), for example by:

(1) sudden exposure to bright sun or drying winds (C 13, C 41-42, C 47);
(2) poor watering or unsuitable regimes (C 43);
(3) competition from weeds (C 44);
(4) attack by diseases and pests (C 45);
(5) contamination of the water or soil supplies (C 24) with toxic substances; ***or***
(6) other kinds of accidents (see D 66 in Manual 4).

These risks can be greatly reduced by regular checking (C 40).

Planning a tree nursery C 26
- setting it up

What do I need to do before actually setting up a tree nursery?

(A) If possible, visit local nurseries and talk to the people running them (C 53);
(B) Read sheets C 2, C 4, C 6 and C 20-25, and other information about nurseries (C 61);
(C) Estimate the approximate numbers of young trees you will be growing, and the areas needed (C 63 A-C);
(D) Look at several possible sites and finally choose the best (C 20);
(E) Make the necessary arrangements for using, leasing or owning the land;
(F) Think about how to have adequate supplies of water and components for making up soil mixes (C 24, C 63-D), and sources of seeds and shoots for cuttings (C 5); ***and***
(G) Consider who is going to do the work (C 52), and where any money will be found (C 2).

How should the work start?

The first thing to do is to choose the most effective internal layout for your nursery (C 22).

And what comes next?

(1) Felling unsuitable trees and clearing unwanted existing vegetation, while keeping other trees and shrubs that could provide useful shade (C 41), protection (C 25) and temporary cover crops over parts of the nursery that will not be used at once (C 22);
(2) Doing any major earth movements for roads, drainage or terracing that may be needed (C 20, C 23);
(3) Arranging the water supply (C 24), including any ponds, water tanks, pumps or piping;
(4) Planting hedges and additional trees for shelter, shade or protection, and fencing the nursery if this will be needed (C 25, C 46).

Should I now start marking out the different parts of the nursery?

Yes. This could be done by:

(a) pacing out on the ground to see if the planned layout (C 22) still fits, or whether it needs modifying;
(b) measuring accurately, and marking out the different parts with pegs or poles;
(c) making minor adjustments as necessary.

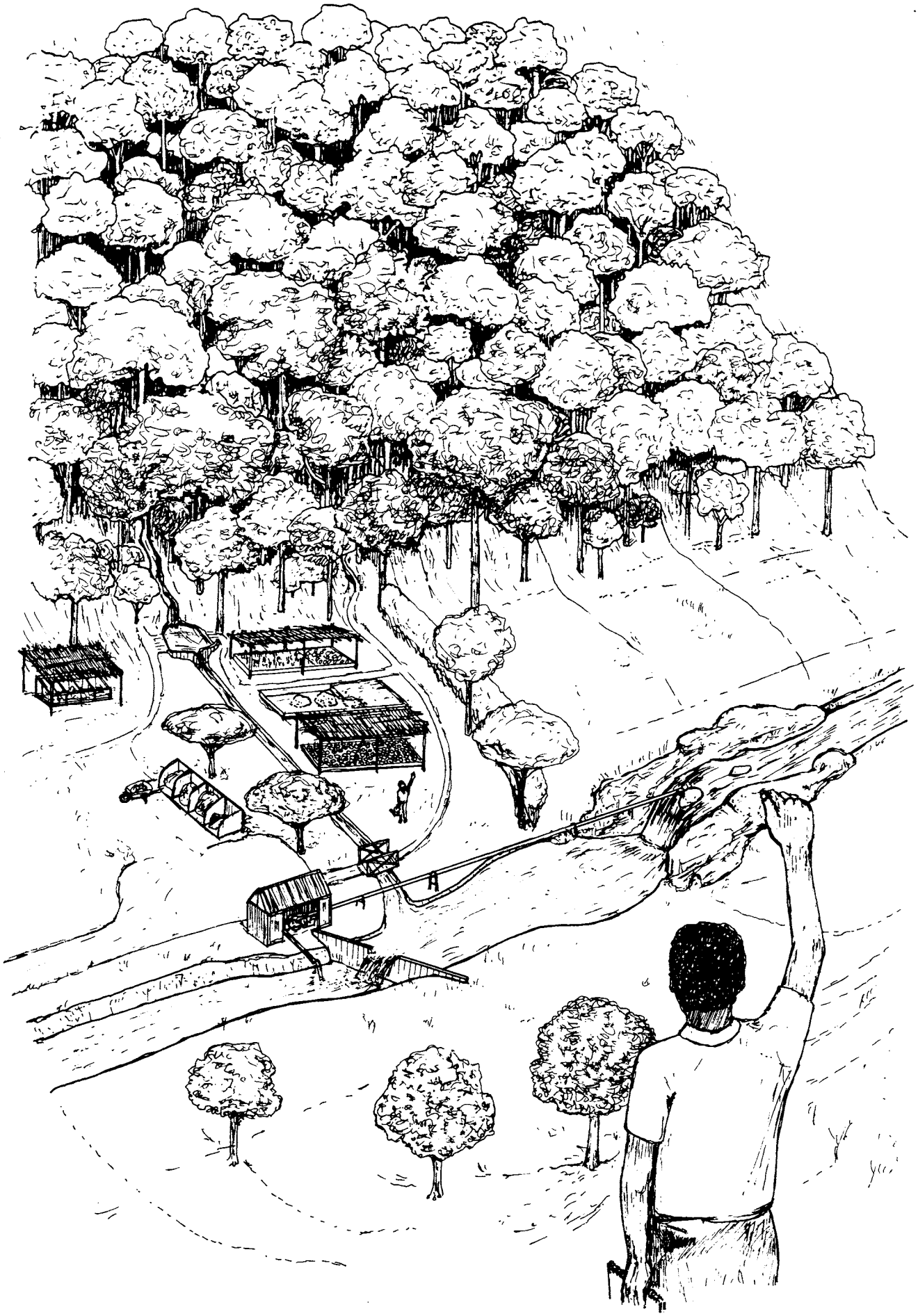
What different parts could the nursery have?

In a small, temporary nursery (C 21-22), there might only be growing areas and paths.
In a larger, permanent nursery, there could be:

(1) the growing areas themselves;
(2) paths, drains, hedges and shade trees;
(3) a covered working area, storage shed, office and washroom;
(4) storage space for stocks of materials; ***and***
(5) an access road, together with turning, loading and parking space.

Which sort of growing areas could there be?

(A) Shaded poly-propagators for rooting and weaning cuttings (Manual 1);
(B) Shaded seed beds and a covered area for germinating seeds (Manual 2);
(C) Transplant beds with removable shading for growing root-pruned soil blocks, striplings, stumps or bare-rooted planting stock (C 22);
(D) Standing ground for containers, also with removable shade; ***and perhaps***
(E) Stockplant areas, for producing plenty of suitable shoots for vegetative propagation;
(F) A shade house or greenhouse to provide special environments for research (C 48).



The remainder of the nursery area consists of spare ground in case of extra demand, and for later expansion (C 22).

How big should the beds and standing ground be?

The **width** should generally be between about 0.8 and 1.2 m, so that weeding, watering, checking and moving plants can be easily done from the two sides;
The **length** should not exceed 15 m, or access may become difficult.

See sheet C 63-B for calculating the total areas needed.

What about setting up the growing areas?

Preparation will vary according to the types of growing area chosen. For instance:

(A) *Poly-propagators* need to be in a sheltered place where they can be checked frequently (C 40; and A 31 in Manual 1);
(B) *Seed beds* might need to be raised 10-20 cm above the level of the paths to give good drainage. They could be started with gravel, continued with a suitable ordinary soil mixed with coarse sand and topped off with a fine seed germination mixture (Manual 2). Covered germination areas could be part of the sheltered working area, or in any convenient sheltered spot;
(C) *Transplant beds* could be made similarly, but topped off with a thicker layer of a less fine mixture. Alternatively, the nursery topsoil could be used as it is, if suitable (C 23). Sunken beds are sometimes used in dry areas, to conserve moisture (C 24), but be careful that the plants do not become waterlogged;
(D) *Standing ground* for pots might be put on a part with poorer soil;
(E) *Stockplant areas* are best as lines, far enough apart to allow harvesting of cuttings, pruning and weeding, and perhaps interplanted with a soil-improving shrub (A 32);
(F) *A shade house or a greenhouse* needs to be carefully planned, with adequate drainage and good shading, and with some tables or staging for smaller plants (C 48).
For studies of effects of the environment on tree growth (C 15), the ability to control ventilation and perhaps soil temperature might be useful, while for trees with chronic insect problems (C 45) the house may need to be constructed with mosquito netting.

How about setting up the shading?

(a) Decide whether to put up plastic shadecloth over part of the nursery, such as the seed and cutting propagation section and the working area, or to use leaves or mats (C 41);
(b) In the second case, choose between high or low shading; ***and***
(c) Allow for the supporting poles when calculating the width of paths and beds.

What else do I need to think about before growing the first plants?

(1) Confirming that the water supply is reliable (C 24);
(2) Getting in a supply of materials and enough tools (C 24, C 51);
(3) Starting to build a nursery team by beginning to train any staff and workers in how to carry out the various jobs reliably and well (C 52);
(4) Making up a seed germination mixture (C 6) and rooting medium (A 35 in Manual 1);
(5) Obtaining suitable seed (C 5) and arranging where to collect the first shoots for cuttings;
(6) Beginning the keeping of records (C 54) about:
   (a) where the young trees originated (C 64);
   (b) when particular batches of plants were started (C 65); ***and***
   (c) daily and weekly propagation checks (C 50, C 66).

Which species should I grow first?

It is a good idea to try out the beds and the running of the nursery with some well-known soil-improving crop plants first, such as beans or groundnuts. This is likely to:

(A) increase soil fertility, while giving useful produce to the nursery team (C 52);
(B) show up any problems with the growing environments or techniques (C 3); ***and***
(C) act as a training session before starting to grow the trees (C 50).