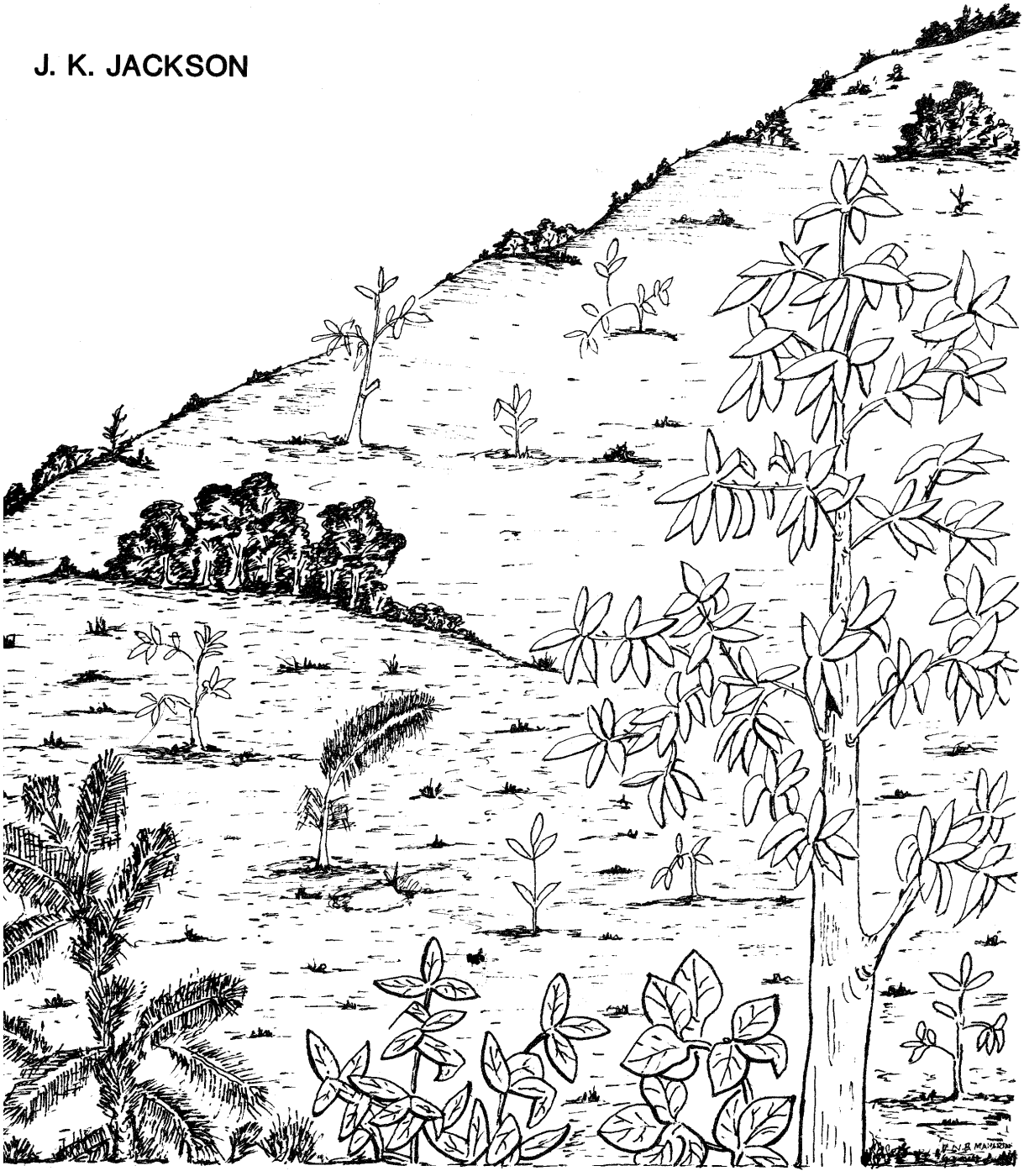
MANUAL OF AFFORESTATION IN NEPAL

J. K. JACKSON



NEPAL–UK FORESTRY RESEARCH PROJECT

MANUAL OF AFFORESTATION IN NEPAL

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Bamboos

Gramineae

by C.M.A. Stapleton

Occurrence and importance

Until recently little was known about the identity, distribution, and uses in Nepal of the different species of bamboo. The standard reference, Gamble (1896), is not at all adequate for identification purposes in Nepal, and the herbarium specimens available are not well determined. This is understandab1e as Nepal has not been adequately covered by bamboo taxonomists in the past, and also as accurate identification of bamboo specimens requires both flowers and vegetative material. As most bamboos do not flower frequently and many species drop all their leaves and culm sheaths when they do flower, these are not usually available together, so that specimens are fragmentary.

A few publications have named species from Nepal, but these have often been more guesswork than accurate identification. However, Seeland (1980) studied the names and uses of the seven bamboo species known near a village in east Nepal and successfully identified the five most important. Acharya (1975) wrote a sensible feasibility study of bamboo as the basis of cottage industry expansion in central Nepal without attempting specific identification. He used the three categories into which bamboo species are most commonly grouped in Nepali: bans, nigalo, and malingo. These three groups probably constituted a more rational taxonomy at that time than the official genera. Since 1981 the Forest Survey and Research Office has undertaken a programme of determining the distribution, local names and uses of major Nepalese species, along with their vegetative, and when available, floral features. Stapleton (1982a) and (1982b) gave preliminary identifications of the eastern species, subject to the limitations imposed by the small area which was covered and the status of taxonomy at that time. An update of these species and a preliminary identification of the central and western species are given below. Mid—western and far—western species will be covered in due course. It is recommended that until a comprehensive list of diagnoses for Nepalese species is published along with a means of field recognition, local names be used as much as possible. Different species are distinguished by those who use them and though their names may not be altogether consistent, they can be backed up by a geographical reference. This is much more useful than guessing at a name incorrectly, or calling them all Dendrocalamus strictus (as A. & J. Storrs (l984) have misleadingly labelled a description that is accompanied by illustrations of both Dendrocalamus and Bambusa species).

The importance of bamboos in the rural economy of Nepal can hardly be overemphasized. They are in great demand by farmers both for fodder and for the many other uses to which they can be put, and in many parts of the country practically every farm will have several clumps of bamboo. They are planted near buildings and on small areas of land which are for various reasons unsuitable for agriculture, such as gulleys, steep slopes and rocky sites. So far they have been planted mainly by individual farmers on their own land, but there is no reason why they should not be used on a larger scale in community forestry plantations. Once established they will produce an annual crop for many years.

Uses

Bamboos have very many uses and it is impossible to enumerate them all in a short space. In all except the driest and highest regions of the country bamboo products are an integral part of rural life and it is extremely difficult to imagine the rural economy without them.

The culms can be used entire, split into sections, crushed into panels, or split and then woven. The culms of Bambusa and Dendrocalamus species are used entire for strong rafters, pillars and fence posts. After splitting they are used for roof lattices, floors, ceilings and walls. Some Dendrocalamus species (especially D. hamiltonii) are used for weaving. Bambusa species and other Dendrocalamus species are less flexible and so not as good for this purpose. Culms of Drepanostachyum and Arundinaria species are more important for weaving as the outer layers produce more flexible and durable material than can be obtained from Dendrocalamus or Bambusa species. Woven products include baskets, mats and trays used for collecting, sorting, transporting and storing

agricultural products. Baskets are the principal medium of transportation for most goods beyond the road heads in the hills. Culm sections are now finding a modern use reinforcing concrete, especially in small works such as water tanks and toilet slabs.

Bamboo leaves are well known to be very nutritious and palatable as animal fodder. ~4egi (1977) and Negi, Pal, and Ehrich (1979) have shown the chemical composition and taste of some Bambusa and Dendrocalamus species to be among the best available from fodder trees. Dendrocalamus hamiltonii in particular has been highlighted as one of the most important sources of fodder in neighbouring Himachal Pradesh.

Branches and waste culm material are readily used as firewood. In areas with a great deal of bamboo it can constitute as much as 50% of firewood used, although it is far from ideal for this purpose.

Young shoots of several species are commonly used as a vegetable, although this use is not as extensive in Nepal as in other Asian countries.

Paper is made from bamboos in many countries; they are the principle source of pulp in India and Bangladesh.

Table Bl (from Stapleton, l982b) summarizes the qualities of Bambusa and Dendrocalamus species needed for different purposes in eastern Nepal. Seeland (1980) gave a comprehensive list of uses in a Rai village there.

From the point of view of utilization the important bamboos can be broadly divided into four categories: large construction species; large multipurpose species; small low-quality weaving species which can easily be cultivated; and small high-quality weaving species which cannot be cultivated outside the temperate forests:

> The first category is typified by Bambusa nutans. The culm walls are thick and strong, but inflexible and brittle so of less use for weaving. Poles are used for carrying the dead and shoots are never eaten.
>
> The second category is typified by Dendrocalamus hamiltonii. The culm walls are thin and flexible and good for weaving, but not strong or rigid enough for many constructional purposes. The large leaves however make good fodder and the new shoots are very palatable for human consumption. Both first and second categories are called types of ‘bans’ in Nepal.
>
> The third category is typified by Drepanostachyum intermedium. The small culms have no constructional value, but are superior to those of the larger genera for weaving. While they are not the highest quality bamboos they can readily be cultivated at lower altitudes and represent a good compromise between quality and availability. The shoots are not palatable. They are known as types of ‘nigalo’.
>
> The fourth category includes several other more exacting Drepanostachyum species and Arundinaria maling. They produce the highest quality weaving material and also palatable shoots. The Drepanostachyum species are commonly known as ‘malingo’ or more properly ‘malinge nigalo’ while A. ‘maling’ is always known as ‘malingo’.

In the middle hills people often have access to all four categories. The first three are planted on their own land and the fourth is collected from the forest periodically to supplement their own supply of weaving material. In the higher hills and some western areas the first two categories will not grow and thus bamboo has little constructional function. In the lower hills and terai the last two categories will not grow so that weaving is of a much lower standard and not so important.

In addition to the more mundane uses of bamboos they are also used on many festive or religious occasions. They support symbols of the deities and prayer flags on mountain passes and summits and around houses. They are used to make swings, especially at dasai. At weddings four small poles may be placed as a guard around the centre of activities and the bride may be carried in a bamboo sedan chair or cage. Corpses are carried to cremation on a single pole of certain species.

Table B1 - List of principal uses (In order of diameter)

Use	Desirable dimensions and qualities
Container	Diameter of cavity more than 12 cm.
Pillar for shelter or drying rack.	Outside diameter more than 15 cm, wall more than 3 cm.
Roof beam or truss.	Diameter 10-15 cm, wall more than 2 cm, straightness.
Thatch supporting lattice.	Wall less than 3 cm, diameter 7—15 cm, straightness.
Fence post.	Diameter more than 10 cm, durability.
Fencing rail (split)	Wall less than 2 cm, splitting ability.
Flooring/ceiling (split)	As for thatch lattice.
Wall panelling (split)	As for thatch lattice.
Split arid woven mats and panelling.	Wall thickness 1—2.5 cm, straightness, minimum nodal swelling, long internode.
Split and woven baskets and trays.	Wall 1—2.5 cm, flexibility, minimal nodal swelling, straight—ness, long internode.
Crushed and woven panelling.	Wall less than 1 cm, flexibility.
Split bands for tying (choya)	Flexibility, strength, splitting ability.
Fodder.	Heavy branching.
Firewood.	Bent, thin—walled, no other use.

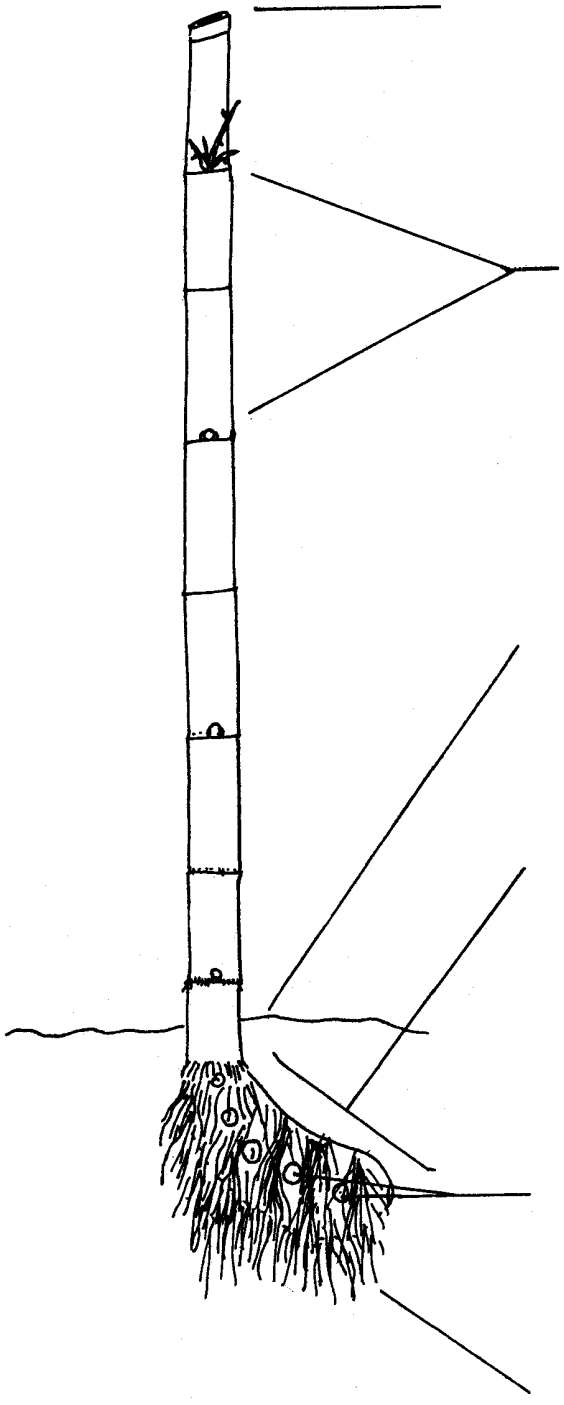
Silvicultural characteristics

Bamboos are perennial grasses, with woody culms from rhizomes. The rhizomes may be short and thick, (‘pachymorph’) and clustered together, in which case they produce bamboos in well-defined clumps; this type of rhizome is found in all the larger Nepalese bamboos (‘bans’, Bambusa spp. and Dendrocalamus spp.) and in most of the smaller Nepalese ones, Drepanostachyum and Thamnocalamus spp. Species of Arundinaria have long thin (‘leptomorph’) rhizomes which run parallel to the ground and produce isolated shoots at intervals up to 3 m. Pachymorph bamboos may have a long neck between the main sections of the rhizome giving a very open clump. Extension of this neck may be facultative in some species.

Mature bamboo clumps produce new shoots every year, throughout the rainy season. These shoots develop rapidly, and within two or three months reach their full height and diameter; the current year’s culms are however much softer and less woody than older culms. The culms persist in the clumps if not cut for about 7— 12 years, depending upon the species, dying slowly and being replaced by new culms. If older culms are not removed they restrict the development of the rhizome system and new shoots. Much greater productivity is obtained by thinning out the poles regularly. Species vary in the distance between poles. Those which naturally produce a more open clump are much easier to manage and thus more productive.

Bamboos vary greatly in their flowering habits. Some species flower only at long regular intervals of up to 120 years or more. It is a popular misconception that this applies to all bamboos. However, most bamboos flower at shorter more irregular intervals and sporadic flowering very frequently occurs with a single clump or a few clumps flowering. Such sporadic flowerings have been seen in all the seven Nepalese Bambusa and Dendrocalamus species. Another popular misconception is that clumps of all species always die after flowering.

Figure B1



Cut above head height at 2-2.5 m, just above a node.

Do not damage branch buds or young branch shoots.

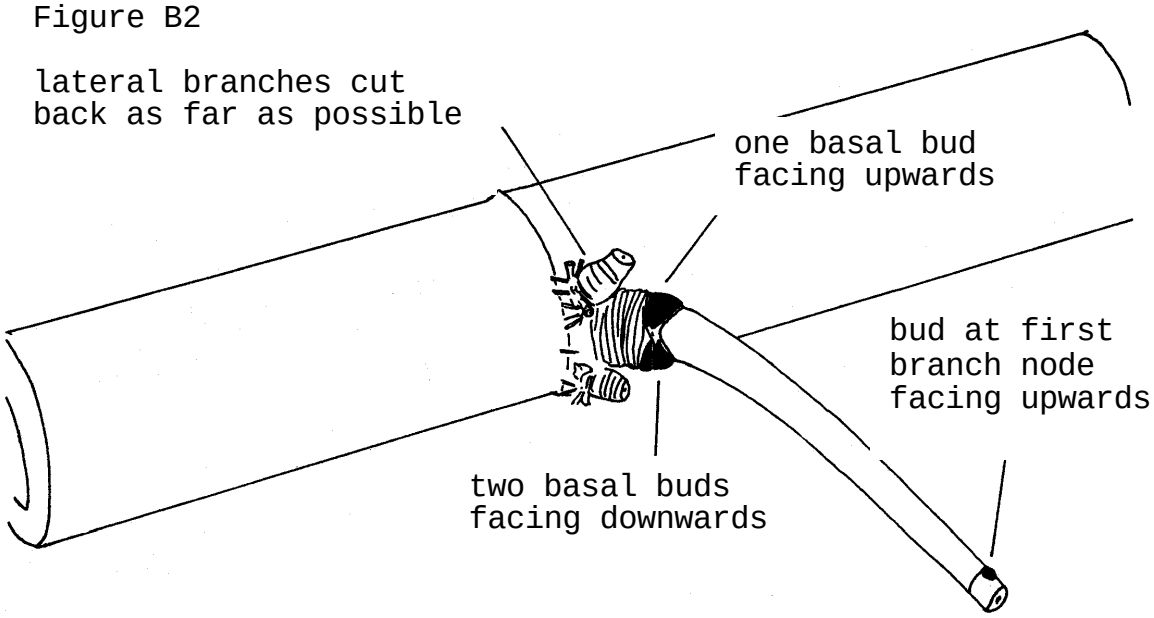
Bury to half way up first internode; compact soil well by stamping very hard all the way round.

Use the entire rhizome, cut at the narrow neck where it branches from the mother rhizome.

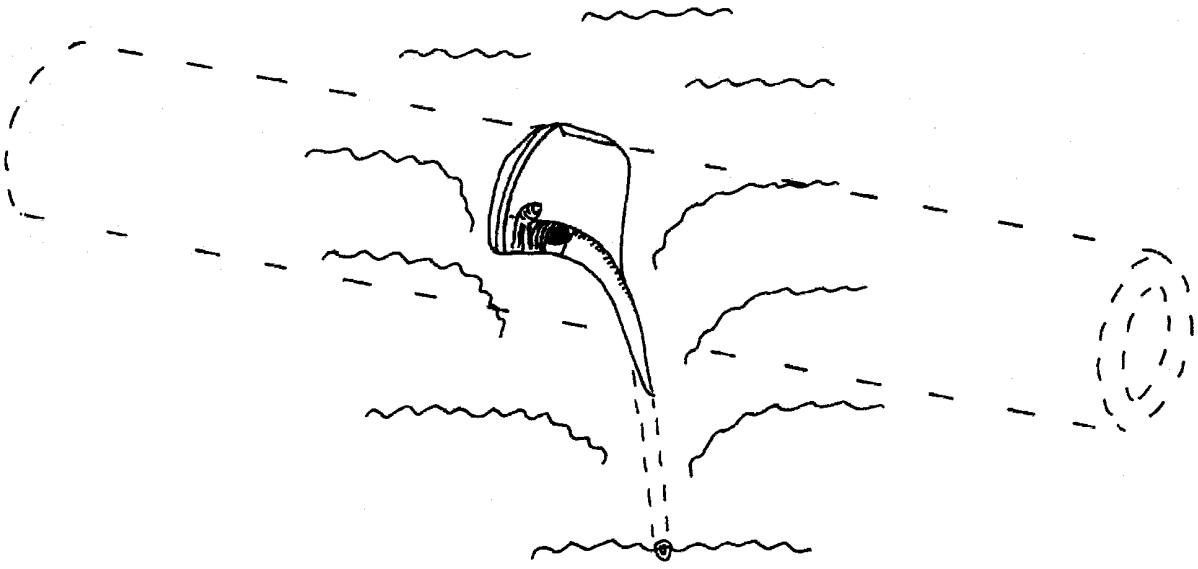
Intact rhizome buds are essential for growth of new shoots.

Leave as many roots as possible.

Figure B2



Planting technique for prepared cutting of Bambusa species, with culm and branch horizontal, and only the branch not covered with soil.
(From Stapleton, 1985a)



Production of large quantities of seed uses up great amounts of reserves which can lead to complete death of the clump, especially in situations of stress. However there is evidence both from experience in other grasses (Lewis 1979), and from observation of Dendrocalamus hamiltonii in Nepal that many bamboos are self—incompatible and can only produce large amounts of seed when cross— pollinated. As most flowerings are sporadic, or involve clumps which are quite separated, completely effective cross—pollination does not usually occur~. Consequently seed production is low and the clumps do not use up all their reserves. When many genetically different clumps flower close together cross— pollination is fully effective and the clumps will often die after producing great amounts of seed, especially at times of low rainfall and in areas prone to drought. Bamboo clumps in the middle hills of Nepal are usually quite well separated, being interspersed with agricultural land. In addition genetic variability is low as they are usually propagated vegetatively. Consequently most flowerings should produce small quantities of seed and the clumps should not die. This has been borne out by experience in Nepal over three years, particularly with Dendrocalamus hamiltonii. However, it will be many years before the flowering habits of all Nepalese bamboos can confidently be predicted.

In Nepal most farmers have several different species of bamboos. This protects them against supply of products being interrupted by flowerings. Monocultures of single species of bamboos over large areas are not recommended both because of the potential disruption of supply and also because large rodent populations can build up after seeding and damage nearby food crops.

Traditional propagation

Bamboos have traditionally been propagated principally by vegetative means throughout their range. As far as is known the Nepalese species had been propagated entirely by traditional vegetative techniques up to about 1975, after which time a few organizations collected small amounts of seed of Dendrocalamus hamiltonii and some Drepanostachyum species. The traditional method used on Bambusa and Dendrocalamus species involves the preparation and planting of a bulky ‘offset’ cutting, which comprises the whole or a subsequent part of a one—year old rhizome section with a 1—3 m length of culm attached and which can weigh up to 40 kg. This method is very reliable if undertaken properly (Stapleton and Tamrakar, 1983). A culm from the previous year should be removed along with its entire rhizome and cut back to 1.5—2.5 m in late May or early June during rainy weather, see Fig. Bi. The rhizome should be protected from the sun (hence superstitions about the planter’s shadow killing the plant) and. buds or new shoots on rhizome and culm should not be damaged. A long pole puts foliage beyond reach of grazing animals. The effectiveness of this method, given sufficient time, is witnessed by the large amount of bamboo which is seen interspersed with agriculture and buildings and which has reportedly nearly all been planted in this way over centuries. Large blocks or plantations, however, are the exception rather than the rule, largely because of the short supply of planting material and the difficulty of transporting and planting more than a few cuttings. It has been widely reported that clumps planted vegetatively will flower at the same time as the parent clump and this has been seen in Nepal. However, as explained above, clumps do not always die after flowering, and if they do they are likely to produce seed or natural regeneration. The first culms to arise from a good offset cutting can reach 4 m in the first year, whereas a good seedling will reach about 1.5 m maximum, so establishment from offset cuttings is usually at least two years quicker. With offset cuttings the advantages of quick establishment, robustness, and independence of nursery facilities are set against the drawbacks of balk, low availability, difficult extraction, transport, and planting, and the possibility of imminent flowering.

Seed collection and handling

It is very fortunate that the widespread and useful species Dendrocalamus hamiltonii (tama bans) very frequently flowers in a sporadic manner. It is locally known that a flowering clump can be found in most areas at any time, and in many cases there are a few clumps within pollination distance and seed is produced. Small-scale gregarious flowerings have been seen, producing vast amounts of seed. Bamboos appear to be able to flower at any time of year and the production of flowers in an isolated flowering clump which does not quickly use up all its reserves by seed production can be continuous for up to three years or more. In all Nepalese species in which seed production has been seen, the course of events in individual flowers from their first development through anthesis to seed falling has taken less than one month. Prompt falling of ripe seed causes difficulties in seed collection. Gathering branches rarely results

in collection of seed, merely empty flowers and immature wet seed which quickly rots. Most bamboo seed is collected from the ground. To simplify this the ground should be cleared of litter and vegetation, or sheets placed under the flowering branches when seed fall is first observed, and the seed should be collected daily. Knocking the culms helps to remove the seed.. Seed which lies on the ground for any time can be destroyed by insects, rodents or fire.

If the amount of seed which is produced is very small, cultivation and protection of the land under the clumps allows the development of natural regeneration which can be transplanted via plastic bags into nurseries, given sufficient care. This may be easier than collecting and sorting very large amounts of flowers containing few seeds.

After collection the seed should be cleaned, treated with insecticide, sun-dried, and stored in sealed containers. Cleaning removes the seed from the flowers so that when the seed is transplanted and stored there is less bulk and there are no insects outside the seed. After rubbing the flowers so that the seed falls out it can, easily be sorted by winnowing on a nanglo (bamboo tray).

Treatment with insecticide is necessary for D. hamiltonii, and probably other species as well. A small narrow brown moth, Sitotroga cerealella, lays eggs on the seed. The larvae burrow into the seed where they grow and eat the contents before emerging, leaving a round hole with distinctive white papery remnants of the cocoon visible. These moths have a short life cycle of five weeks in warmer areas and can destroy 60% of the seed within six months.

Drying in the sun for one day should reduce the moisture content satisfactorily. Indian experience with Dendrocalamus strictus suggested that 8% moisture content was best for storage, (Gupta and Sood, 1977). Drying in the sun for several days could reduce the moisture content below this and damage the seed. If the moisture content is much higher the seed will rapidly deteriorate.

Germination of seed of D~ hamiltonii collected in January and stored in cloth bags after sun drying fell from 92 to 75% before the monsoon and to 7% after the monsoon in November. Dried seed stored in a sealed container with silica gel and dried seed stored in a refrigerator without silica gel gave 25 and 22% germination respectively in April, after 62 weeks. Thus with proper storage the seed can still be of some use the following season while without proper storage it is only viable for one season, losing its viability in the monsoon. Dormancy in bamboo seed is not known (McClure, 1966).

Raising plants from seed

Bamboo seedlings are more susceptible to water stress than many other seedlings. They require ample regular watering and good shading to protect them from direct sunlight. They grow best in nurseries in cooler damper areas rather than those on low exposed south—facing slopes. As Dendrocalamus, Bambusa, and Drepanostachyum species are not generally frost-hardy they should be raised below the frost line.

The optimum temperature for germination of D. hamiltonii seed is most probably higher than that for many temperate forest tree species and sowing should be delayed until the weather is quite warm. As germination may be expected to be low, and transplanting seedlings is not reliable in any but the best conditions, seed should be sown directly into containers. Two to five seeds should be put into each depending upon the age and quality of the seed. Germination in D. hamiltonii is very prompt with fresh seed (2—7 days), but takes 6-8 weeks after over one year. Campbell (1983a) recommended a pre-treatment of 2 days in water.

Campbell (1983a) recommended raising ‘seedlings in beds for annual division. Seedlings in beds may not grow as fast as those in containers, however, although division is easier. Division of seedlings is only suitable after they have at least four healthy shoots. It is especially feasible in Drepanostachyum species (ningalos) which produce more shoots of smaller stature than Bambusa and Dendrocalamus species. Dividing the entire cylinder of. root and soil from a containerized plant with a razor blade so that each half has a strong young shoot, and replacing these in containers with some fresh soil has been successful in a hot dry nursery as well as a cooler one in all three genera. In the hotter nursery, however, growth rates have been higher and the plants have also had to be divided in the growing season, which is only possible by covering each divided plant with a sealed polythene tube, under very good shading, fox two weeks. This technique also had to be used for transplanting seedlings in

the hot dry nursery in the growing season. Thus it seems that division of seedlings is only suited to cooler or more humid nursery locations.

Culm cuttings

There are many species which rarely produce seed and cannot be planted in quantity by the traditional technique but which are very important and desirable species for local planting programmes. Several species of Dendrocalamus and Bambusa have now been propagated by the use of small culm cuttings in nursery beds. In this technique branches are forced to grow in a manner which encourages the basal region to resemble a rhizome and~ produce roots. (Stapleton, 1985, 1986). This technique is not yet completely understood and has only been attempted on a small scale on a restricted number of species so far, but it is hoped that it can quickly be made more reliable as its potential is very- great. The simpler technique described by Campbell (1983a) of planting pole sections without rhizomes direct under field conditions cannot be recommended in Nepal.

Cuttings which consist of a single node with its branches cut back to 10-20 cm and half the internode on each side are used in the new technique. This allows the branches to be oriented correctly and provides maximum reserves and maximum area for water intake at the cut culm ends for each node.

In Bambusa species culms two or three years old have given the best results. Culms with strong branching have been more successful than those with small branches, and those from the top of the culm less than 4 cm diameter have usually failed. The stronger the branching the more the branch bases resemble rhizomes, and the more readily will the cuttings root. These cuttings are planted in very well watered shaded beds with the large central branch horizontal at the soil surface and the earth mounded up over the culm especially at the ends, (see Fig. B2) to reduce desiccation from sun and wind.

In two Bambusa species used it has generally only been shoots from the base of the central branch which have rooted. Moreover the shoots which have developed downwards first and then turned up to reach the light have rooted much better than those which go upwards from the top of the branch.

In those Bambusa species which do not have aerial roots on the nodes of culms or from the bases of the central branches on the standing culm, the soil covering the ends of the culm cuttings must not dry out or the new shoots will die. Dendrocalamus species and some Bambusa species have such roots and can survive more arduous conditions. Root production is much more abundant overall in these species, and success rates have been much higher, with many nodes giving more than one rooted shoot. When this technique is undertaken carefully each pole used can produce fifteen to thirty plants without having disturbed the rhizome system of the mother clump at all.

The best time for planting the cuttings is just before spring growth commences, when the buds are ready to burst. This obviously varies greatly with location and must be observed to determine exactly when it occurs. At 1500 m in the Kosi Zone it occurs in late March, in the Kathmandu valley in late April. If the cuttings obtain enough water from the beds and do not dry out, shoots will develop in one to two weeks. Most of those shoots will grow to about a metre in height and produce leafy branches before beginning to root after about three months. Irrigation and shading must be maintained all this time. Ironically it has been after the monsoon rain has started that cuttings have dried out in our trials, because nursery workers have ceased to take enough care over watering, assuming that the showers are providing enough water. Intense sun after a short shower quickly dries out the air and soil and watering should continue unless continuous rain is falling. Watering and rainfall will remove the soil from the cuttings. This should be replaced. Encouragement of a ground cover of small weeds, mosses etc. keeps the soil in place and indicates that watering is sufficient. Watering should continue after the monsoon and through winter to the planting season, but it is not so critical after roots have developed.

The plants can be lifted after 9—12 months and transplanted into unshaded beds given ample irrigation, so that the shaded bed can be used for more cuttings. This is probably best done in cold rainy weather in midwinter. Dendrocalamus species have produced two or even three separate plants from some nodes. In addition some nodes may produce plants which break easily into two complete plants after 12 months. These can be planted separately. Rooted cuttings should not be planted in the field until the monsoon arrives. They can be cut back a little to ease transportation and reduce desiccation. More care is

required than with containerized stock as the root system is more disturbed during planting.

Planting and management

Whatever technique is used for planting bamboos there is likely to be a shortage of planting. material, so the bamboos should be planted at the desired final spacing, at least 5 X 5 m. On difficult sites it may be necessary to use a 'nurse crop or to introduce bamboo by underplanting. The trees should be thinned out to allow the bamboo enough light when Dendrocalamus and Bambusa species are planted. Drepanostachyum species are shade tolerant but would be more productive under a relatively light canopy.

Harvesting of bamboos is ideally an annual operation. Bambusa and Dendrocalamus culms which are grown for structural uses should be cut in their second or preferably third year leaving the younger culms to grown on. To season them they can be severed at the base and left in the clump until dry, then extracted and trimmed later. Drepanostachyum culms for weaving are cut after 16—20 months. All culms removed are steeped in water to remove starch and make them more flexible, either before or after splitting into strips. The remaining culms are tied together to prevent them collapsing after the support of the older culms is removed.

Use of fertilizers is a common practice with bamboos, which respond well. Household refuse and manure are often applied. Rhizomes are susceptible to drying out if they are not covered so the clump should have earth piled into it to counteract soil erosion and encourage good rhizome development.

If a stand of bamboo flowers and dies, the area should be protected against grazing animals and fire until it has re-established itself from seedlings.

Pests and diseases

The most serious pests of bamboos in Nepal are the larvae of shoot—boring moths of the family Noctuidae. The commonest species in the eastern hills is a Pareuplexia species (Stapleton, l985b). The brown eggs are laid on new culms in the monsoon and the small larvae eat their way into the culm cavity through a hole in the softest region of the internode towards the base. Once inside they eat extensively into the walls of the culm, progressing upwards to where the tissues are softest, leaving a small circular hole in each nodal diaphragm and long grooves on the walls which may show through to the outside as streaks or slits. In severe cases the top of the culm dies and may fall off. The white larvae with brown head capsules can reach 5 cm in length and more than one hundred have been found in a single culm. In Dendrocalamus species the larvae usually return to over—winter in the internode which they originally entered, sealing the hole in the diaphragm above to keep dry, and pupate about two to four weeks before emerging through the original entrance hole as adult brown large—bodied~ moths. They may also occasionally over-winter in the dead top of an infected shoot between the culm sheaths. In Bambusa species a gelatinous substance is produced in the internodes when they are damaged. This kills many larvae and usually prevents over—wintering inside the culms in these species, though a few larvae can over—winter higher up.

The incidence of shoot borers is related to management. Where this is intensive and culms are regularly cut incidence is relatively low. It would be very high in a plantation during establishment and special sanitary measures would be necessary. In Dendrocalamus hookeri in one Panchayat around 10% of new shoots were infested on average; increasing to 25-30% in totally neglected clumps.

Cutting out infested culms over winter and removing dead culm tops would quickly control this insect. Simpler measures such as blocking the entrance hole (which is usually at a convenient height 0.5—2 m above the ground) may be effective in reducing numbers appreciably. As most moths emerge from Dendrocalamus species attention to these alone may be sufficient.

Other species of moth attack small bamboos, but the incidence appears to be much lower. One Drepanostachyum species produces a thick gelatinous coat on the outside of new shoots, which may be an adaptation to protect against attack by shoot borers. Being nocturnal, noctuid moths are seldom seen around the clumps, and it is a popular misconception that the damage is caused by a different insect which is more conspicuous. Another popular misconception is that shoot—borers are encouraged by cutting culms on Sundays and Tuesdays.

A bamboo blight observed in Bangladesh has not been seen in Nepal. Important species

Because the taxonomy of bamboo species and genera is at present being revised worldwide some of the names given below are likely to be altered in the future, especially the generic names. There is also likely to be controversy for some while as to which name is correct and different authors may use different names, hence the great importance of specific names and local names. I have adopted type numbers for the species I know well. These can remain consistent while local names and Latin names vary. Names for the new species are being published. Illustrations of most of the eastern species with further details for identification can be found in Stapleton 1982b. Species verified at Kew are listed at the end. A key to the genera found in Nepal based on the species known so far is given at the end of the section.

Group 1. BAMBUSEAE Benth. and DENDROCALAMAE Benth.

Large stature bamboos (‘bans’)

Bambusa and Dendrocalamus species

Holttum (1956) and Grosser and Liese (1973) consider that these two groups should be merged as the original distinctions made by Munro and Bentham conflict with vegetative and floral similarities, and are artificial. However by interpreting the original distinction loosely and adapting new criteria such as proposed by McClure (1966) and Lin (1972) we can maintain a very useful natural division into two genera with fairly clearly defined differences in uses, floral and vegetative morphology, propagation and susceptibility to insect attack in Nepal.

Bambusa species generally have thicker walls, more uniform branching extending to the base, less aerial rooting, larger culm sheath auricles, less culm pubescence and glossy culms, smaller leaves,~ and longer flowers which appear spiky rather than orbicular, relative to Dendrocalamus species. Three Bambusa species and four Dendrocalamus species are well known.

1. Bambusa nutans Wall. Mal bans. Type B1 

The principal large-stature bamboo in east Nepal, used for all constructional purposes, but inflexible so not best for weaving. Culm sheath hairs black, culms always round, well spaced. Sporadic flowering very infrequent and seed never seen. Not known to have flowered in abundance in living memory. Propagation by culm cuttings is difficult as there are no aerial roots, but a sufficient trial has not yet been undertaken. Very resistant to drought but not to frost, occurring from the terai up to 1600 m. This species has long straight internodes, no nodal swelling and relatively light branching, making it very highly prized indeed.

2. Bambusa sp. Tharu bans, sate bans. Type B2l 

The central Nepal equivalent of B. nutans, very similar in all respects and difficult to distinguish though it ha~ dark brown culm sheath hairs, a groove on small culms, and shorter rhizomes making the clumps more congested. The flowers are completely different. sporadic flowering has been noted in several localities over the past years, but no seed has been produced. Propagation by culm cuttings is difficult as there are no aerial roots but it sees to be easier than for B. nutans, possibly because branches are larger, and 15% success has been achieved with careful planting in a cool nursery. This species is a little inferior in form to B. nutans. It occurs at least as far west as Kaski district, where it is known as sate bans.

3. Bambusa balcooa Roxb. Dhanu bans, bhalu bans. Type D23

A central species less common than the previous one, met more frequently toward the west. Stature if not harvested intensively becomes much larger than that of the previous two species, up to 16 cm dbh as opposed to 12 cm. This species combines features of both genera, Bambusa and Dendrocalamus. Culm walls are

thick and strong, branching is dense and slightly thorny low down, both Bambusa features. Culms are covered in brown pubescence at first though glossy later, calm sheath auricles are completely absent, mid—cub central branches are large and aerial rooting is well developed, all Dendrocalamus features. In the absence of culm sheaths the leaf sheaths, which are brown pubescent at first, distinguish it from the previous species, which have glabrous leaf-sheaths.

Sporadic flowering has been observed in Kathmandu for several years but no seed has been produced. This species should respond well to propagation by culm cuttings but this has not been tried.

Because of its large stature which makes it unsuitable for village use, and the congested thorny nature of the clumps which make it difficult to manage, it is not recommended for general use though it might be suitable for some special uses such as scaffolding for large buildings.

Two other Bambusa species are occasionally met. They have both probably been introduced recently:

4. Bambusa arundinacea Wild. Kante bans 

Planted because of seed availability in India this large bamboo is extremely thorny, producing interlacing thorny branches that make the culms difficult to extract (Troup, 1921). It may occur naturally in far—western Nepal up to 1250 m.

5. Bambusa vulgaris Schrad.

Planted because of ornamental value due to its yellow stripes, this species is smaller in stature than all the Nepalese Bambusa species, with shorter internodes, raised nodes, heavy branching and sometimes crooked culms. It is inferior to the Nepalese species but because of its ease of vegetative propagation and as it is not reported to flower it has been widely planted in many countries, mainly for pulp rather than the more sophisticated Nepalese end— uses.

Four Dendrocalamus species are well known:

6. Dendrocalamus hamiltonii Nees & Arn. ex Munro. Tama bans, ban bans, choya bans. Type D4

Common in eastern, central and western Nepal from 300 to 2000 m. It is probably the most widely distributed Nepalese species, being an eastern equivalent of the widely distributed Indian species D~ strictus. It is better adapted to wetter and higher regions to the east and north of the natural range of Dendrocalamus strictus. It is the ultimate multipurpose species,. being large enough for constructional purposes, flexible enough for low—grade weaving, with large leaves for fodder and palatable shoots for human consumption. It is not as strong as Bambusa species, however. It is reported to flower gregariously and sporadically and provides seed in many areas. It also responds well as culm cuttings, with more than 70% of the nodes rooting even under arduous conditions. It is recognized by its dense and persistent white arid brown culm pubescence, naked triangular culm sheath auricles, and narrow dentate culm sheath ligule.

7. Dendrocalamus sp. Phusre bans, khosre bans, tama bans. Type Dl3 

This species is also very widespread in the hills between 1500 and 2000 m, though it is less frequent in the western region. In the east it is distinguished from the previous species because it is not so flexible and not good for weaving. In the central region the two species are not distinguished and both are known as tama bans. While similar in appearance to Dendrocalamus hamiltonii it can be separated by the culm sheath auricles which are small and ciliate. The culms are straighter with less nodal swelling and the sheaths are very closely pressed to the culms. Culm sheath hairs are a light brown rather than dark brown colour, and the ligule is wide and serrate. While this is an acceptable species for weaving in central Nepal, it is not suitable for the higher standard weaving in the east, and is used as a general purpose species.

It flowers sporadically. No seed has been collected, but ample regeneration has been transplanted. Culm cuttings have not been tried but should be very successful.

8. Dendrocalamus hookeri Munro. Kalo bans, bhalu bans. Type Dl

Common in the eastern hills from 1500 to 2000 m. It is the most cold-resistant Nepalese Bambusa or Dendrocalamus species. It is also reported from the far west. It is very similar to B. balcooa but has thin walls, no low branches, and culm sheath auricles with long bristles. The dense brown pubescence on culms and culm sheaths gives it the name 'bhalu' (bear) which it shares .with B. balcooa. When not harvested intensively this species attains larger stature than the other Dendrocalamus species, reaching 18 cm dbh, but is commonly managed to produce smaller poles, which are not so vigorous and hairy and are usually called 'kalo bans'. Sporadic flowering has only rarely been seen and no seed or seedlings have been produced. Culm cuttings gave nearly 85% success under arduous nursery conditions.

9. Dendrocalamus sp. Dhungre bans. Type D6 

Locally common in the hills of eastern Nepal and more common in the central region between 1500 and 2000 m. As with type Dl3 it is difficult to separate from D. hamiltonii, and the name is not satisfactory as it is used for many other species when they attain large stature and can be used as a dhungro (cylindrical container). It has corrugated culm sheath blades and short wide internodes which are often swollen and give the culm a zig—zag appearance. Dhungros were the principal water containers before clay and metal pots were introduced and they are still used in poorer areas. Apart from containers this stocky species provides pillars for small buildings and is especially used for fodder. The large branches can-be used for weaving material, although the culms are unsuitable. Sporadic flowering is infrequent. As only very old flowers have been found it is not known whether this is-really a separate species or just a variety of D. hamiltonii. As it produces strong aerial rooting it should be very successful when propagated by culm cuttings, but it is similar to D. hamiltonii which is much easier to propagate, producing ample seed.

10. Dendrocalamus patellaris Gamble. Nibha bans, lyas bans. Type T3 

The smallest of the Dendrocalamus species. It attains a maximum dbh. of around 4 cm and is almost semi—scandent, the apex sometimes nearly reaching the ground or resting on tree branches. The internodes are long and ribbed, the nodes have a wide frilly collar, and the culm sheaths have very long-fringed edges. It is frequent in Mechi zone and occasional in Koshi zone between 1950 and 2600 m, where it is known as 'nibha', and has also occasionally been seen in western Nepal in the high rainfall area around Pokhara, and in Palpa district where it is known as 'lyas bans', (Schaltenbrand, 1982). It produces good quality weaving material but is too small for constructional purposes. Cultivation outside these areas is not considered likely to be successful except as an understorey crop. It is also used for making flutes and hence it is sometimes called 'murali bans'. Gregarious flowering occurred in the east between 1980 and 1982 and some seedling regeneration had attained almost full stature by 1984 in Pakhribas.

One other Dendrocalamus species has been widely planted because of seed availability in India and may occur naturally In far western Nepal up to 1000 m:

11. Dendrocalamus strictus Nees

A small species reaching only 7 cm in diameter (Gamble, 1896). This species is limited to low areas below 1000 m, and according to Troup (1921) is not found in moist localities. He considered it to be the hardiest of all Indian bamboos, being found in low areas prone to excessive drought and frost.

Deogun (1937) described it as flourishing in areas where the humidity is low, beyond the influence of sea breezes, and stated that it could stand a mean average rainfall of 750 mm and minimum temperature of —6°C. He also stated that it -does not grow on water—logged or heavy soils, preferring a sandy loam overlying boulders. Thus its use seems to be restricted to the Siwaliks and non—

alluvial terai deposits in the mid or far western region of Nepal. It has been planted elsewhere, however, especially around Tansen, Palpa district.

Group II. ARUNDINARIAE Steud.

Small Stature Bamboos (not 'bans').

Types of 'nigalo' or 'ningalo' and others e.g. 'malingo'

Drepanostachyum, Arundinaria, and Thamnocalamus spp.

All small—stature bamboos were once put into the genus Arundinaria which became unwieldy, with 482 species at one time. Many botanists have divided the genus progressively and Nepalese species have repeatedly been put incorrectly into different genera without proper inspection. There has been much controversy, which will undoubtedly contin4.ie. Twelve new genera have been described by Chinese researchers in the past five years. Three distinct groups of small stature woody bamboos are commonly found in Nepal, and these can now be assigned to genera, which are distinguished on the natural grounds of morphology, ecology, uses and local names. -However, as the diversity of small bamboos is great and their range, from 1200 to 4000 m, covers so much difficult terrain it will be a very long time before all the species are properly known, and other genera may come to light.

By far the most important group of species usually occurs below areas of severe frost. They are mostly known as kinds of nigalo. They all grow in clumps and none has the pronounced chequered leaf venation known as tessellation found in truly frost—hardy genera at higher altitudes. While some are resilient and are commonly cultivated in the open down to about 1200 m, others will only grow well above 2000 m, preferably under a forest canopy.

Despite the great importance and prevalence of this group in Nepal none of the many generic names produced in sub—dividing Arundinaria had been applicable to them until 1983 when Keng in China published a name for them - Drepanostachyum. Most earlier names applied to non clump-forming groups of species.

All Drepanostachyum species can be used- for weaving, though some are very superior to others, and one is not used at all for that purpose as it is very sharp and cuts the hands. Some produce edible shoots while others are bitter ('tite'). Two species are very abundant, commonly cultivated and of great importance:

3. Drepanostachyum intermedium(Munro) Keng. Tite nigalo Type T1

The common small-stature bamboo in eastern Nepal, found from 1200 to 2400 m, both in cultivated land and occurring naturally in forest areas, usually from 1200 to 1800 m, attaining progressively larger stature with decreasing altitude. This is a resilient species often encountered on hot dry exposed banks or between rocks, where no other small stature bamboo except the following species could survive. Its leaves are often curled up completely to reduce water loss, but it appears to thrive in such sites.

It is used mainly for weaving into baskets and mats Its leaves are good as fodder and fed to goats and sheep while the culms are being woven in winter. Its importance lies in supplying quantities of reasonable quality readily available weaving material for harvesting, sorting, transporting and storing agricultural produce, especially where there is limited access to the forest bamboos found at higher elevations, which is increasingly the case throughout the country.

It is reported to frequently flower sporadically (Gamble, 1896), and this has been observed. Small quantities of seed have- been obtained, and dense regeneration has been transplanted into the nursery for several years.

Recognition of this species is by its long spreading setae on the auricles of its hairy leaf sheaths and the long ragged ligule on its culm sheaths, which are rough inside towards the top, and glabrous outside.

2. Drepanostachyum khasianum (Munro) Keng. Tite nigalo. Type T2l 

A direct equivalent of D. intermedium which it replaces in central and western Nepal. It is distinguished from D. intermedium by the eventual lack of setae or auricles on the glabrous leaf sheaths, and the ring of dense brown hairs at the base of the culm sheath. It has not been found in flower and the identification is speculative as this species has few distinctive vegetative features.

Several other Drepanostachyum species have been found, but their occurrence has generally been local. They all require a cooler and damper environment and care should be taken to plant them in sites where they can be successful. A few are important enough to deserve mention.

3. Drepanostachyum hookerianum (Munro) Keng. Padang. Type T4 

A distinctive eastern species with blue culms which is cultivated above 2000 m, and attains a larger stature than the previous two species, up to 3 cm dbh. It is considered no better than the previous species for weaving although the larger size makes it easier to use. The culm sheath is distinctive, narrowing concavity almost from the base, while others narrow from at least half-way up the sheath. It has not been seen in flower.

4. Drepanostachyum sp. Malinge ningalo~ Type T3/2B 

A less well known eastern species which is also cultivated outside the forest, though on a smaller scale. The short internodes (15 cm maximum) distinguish this from the other cultivated eastern species which all have longer internodes, up to around 25 cm. It has no auricles or setae on the leaf—sheaths and short ligules on the culm sheaths which attenuate convexly, not concavely as in all the previous species. Flowers have not been seen. This species apparently produces better material for weaving than all the previous species, and has been found cultivated at 1800 m in the open.

5. Drepanostachyum sp. Malinge ningalo. Type T29 

This central species occurs from 1800 to 2800 m along the Langtang khola, but how far it is distributed into other areas is not known. It has not been observed in cultivation, only in natural forest stands. It is quite similar to the previous species but has long erect setae on the culm sheath shoulders, and small auricles with long erect setae on the leaf sheaths. One sporadically flowering clump has been seen. It also yields weaving material of superior quality from longer internodes.

6. Drepanostachyum sp. Malinge ningalo. Type T24 

This western species is similar to the previous two, and is remarkable for its long internodes, up to 40 cm in length, and its large diameter, up to 3 cm dbh. It is very highly valued and managed intensively at 2500-3000 m in the forests around Pokhara for weaving material and also for its edible shoots. It appears to be more exacting in its site requirements than the previous two species which are found at lower altitudes, and differs by having copper coloured cilia on the edges of the culm sheaths and a very short broad ligule. While the leaves are not clearly tessellate the transverse veinlets are just visible.

Above the range of Drepanostachyum species, bamboos are smaller in stature and have tessellate leaves. By holding a leaf up to the light a chequered pattern is clearly seen, contrasting with the parallel venation seen in non—tessellate groups. This could be a physiological adaptation allowing quick transport of fluids in and out of leaf cells to allow frost—hardiness.

The high altitude bamboos are clearly separated into two genera, according to whether they normally have short rhizomes (pachymorph) and form clumps or have long rhizomes (leptomorph) and produce solitary culms arising a substantial distance apart. Only the spreading (leptomorph) species can be put into Arundinaria. In 1973 McClure and Holttum recognized Arundinaria species from Nepal (probably maling and racemosa), and the opinion of two of the most eminent

bamboo taxonomists cannot lightly be disregarded Nevertheless some Chinese taxonomists have ‘decided that Arundinaria is a monotypic American species, and A. maling certainly seems to have rather different branching to the American type species. For the time being these bamboos can be considered Arundinaria species.

Leptomorph bamboos have different requirements to pachymorph bamboos. Shoot growth is typically in- the spring, rather than the summer or autumn. Consequently they are more abundant in areas with a more uniform pattern of annual rainfall and in Nepal have only been found in eastern Nepal at higher elevations. They are not yet known from central to western Nepal, nor from lower elevations in the east, but they may well reappear in high winter-rainfall areas of mid— and far—western Nepal. One species is very well known and one not yet seen.

7. Arundinaria maling Gamble. Malingo. Type T9

The common high altitude eastern species, which can occasionally be found as low as 2300 m but becomes widespread above 2800 m. It is recognized by the very rough internodes on younger culms which feel like sandpaper towards the top. It is apparently the most highly valued bamboo for basket work in Nepal, producing very durable material indeed. It has not been found in flower. Propagation by offset cuttings in leptomorph bamboos requires the excavation of a greater length of rhizome than in pachymorph bamboos to include sufficient rhizome buds and roots and should be undertaken much earlier in the year. Very little is known of propagation by culm cuttings in leptomorph bamboos

8. Arundinaria racemosa Munro

Blatter (1929) reports this to be found above the previous species in eastern Nepal, and to be distinguished from it by its smooth internodes.

9. Thamnocalamus spp

The c1ump—forming tessellate species can be put into Thamnocalamus, a genus created for the Himalayan species by Munro (1868) rejected by Gamble (1896), re-established by Camus (1913), rejected again by Blatter (1929) and now recognized again by McClure (1966) and Yi (1983) for very good reasons.

These species are of little value in central and western Nepal, as the culms are brittle and of no use for weaving. The leaves are used for fodder but are sma11. They make very good brushes as they are stiff and inflexible and as the branches are almost parallel to the culms

Gamble (1896) gives two species in this group which may be found in Nepal, one (T. aristatus) - a Sikkim species which may well occur in Mechi zone, and the other T. spathiflorus, known as ‘ringal’ which occurs under deodar and fir forest above 2000 m from the Sutlej to Nepal, and so is likely to be found at least in the far western region. These two species, along with T. falconeri are included in the enumeration by Hara, Steam, and Williams (1978) of non-cultivated Nepalese plants.

Three other species of Thamnocalamus are known so far, one from central Nepal (ca11ed ghore in Lanqtang) and two from western Nepal (called ‘chigar’ and ‘jarabutto’). They have limited value, although the western species are important food for the Nepa1ese national bird, the Impeyan pheasant, and for the Himalayan black bear, see Stapleton and Tamrakar (1983b) which includes a key for identification of the small—stature bamboos in the Seti Khola valley north of Pokhara, western region).

The following species have been verified at the Royal Botanic Gardens Kew, by comparing flowering and vegetative material with the herbarium specimens kept there:

Species	Type No.
Bambusa nutans Wall.	B1
Bambusa balcooa Roxb.	D23
Dendrocalarnus hamiltonii Nees and Arn. ex Munro	D4
Dendrocalamus hookeri Munro	D1
Dendrocalamus patellaris Gamble	T3
Drepanostachyum intermedium (Munro) Keng	T1

Vegetative key to principal Nepalese genera

1. Culms attain a maximum dbh of more than 3.5 cm — 2

   Culms attain a maximum dbh of less than 3.5 cm — 3

2. Culm walls thick and strong, branching usually fairly uniform from upper mid—culm to base — Bambusa

   Culm walls thin, basal branches usually much smaller than mid culm branches or absent — Dendrocalamus

3. Leaves with clearly visible transverse veinlets in addition to the longitudinal veinlets giving a chequered appearance when held up to the light — 4

   Leaves without visible transverse veinlets or with visible veinlets which are much more obscure than the longitudinal veinlets, culms arising in clumps — Drepanostachyum

4. Culms arising singly from long slender running rhizomes, which have elongated internodes — Arundinaria

   Culms arising in clumps from short rhizomes which are thicker than the culms and have short internodes, dead sheaths very persistent — Thamnocalamus