

Bamboo in Nepal: A Management Guide

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1. INTRODUCTION

Preliminary analysis of a countrywide household survey by the Community Forestry Development Project indicates that both householders and community leaders have a consistent interest in bamboo. Bamboos have been selected by this Project as priority species requiring particular attention. This interest is centred largely on the use of bamboos as a fodder source, especially in the Terai where it is ranked third in preference. The survey identified an interest in bamboo as a fuel source in the east, and showed its importance for minor products in eastern, central and western regions. Small genera *Arundinaria* [local name: *Nigalo*] are shown to be particularly important in the mid-west and far-west regions (Lamichhane, 1988).

Planting large bamboos in the past has been severely restricted by lack of knowledge concerning satisfactory vegetative propagation techniques as well as the distribution, uses and site requirements of Nepalese species. Bamboos provide a large proportion of renewable material for building, paper, animal fodder, vegetable and cottage industries in many areas of the Terai and middle hills (Lamichhane, 1988).

2. SITE & SPECIES CHOICE

2.1 Site Choice

Bamboo is particularly useful in preventing soil erosion, as the interlocking rhizomes keep saturated topsoil firmly in place. Planting on steep hillsides and river banks can reduce damage during floods, landslides and earthquakes. Clumps conserve soil moisture and protect an area from drought (Tewari, 1988). Being light-demanding species bamboos should be planted away from the shade of trees (Sharma, 1988). Bamboos should not be planted above the frost line (Stapleton, 1987).

2.2 Choice of Species

For detailed site requirements of Bamboo species in Palpa District see Heyer (1987), pp. 46-49.

For a list of Nepali bamboo species and uses see Appendix I.

2.3 Species Mixture

Using large numbers of only one or two bamboo species is unwise, because of their synchronised flowering habit. Once a flowering has occurred the clumps become weak or die, and there follow several years of poor or nil production of harvestable bamboos. Large scale flowering is also responsible for increased rodent populations and hence cereal crop losses (Janzen, 1976). Instead, a number of species should be used.

3. PREPARATION OF PLANTING STOCK

The most common method of propagation is by the use of rhizome cuttings, as seed supply is erratic. However, rhizome cuttings weigh 40 kg on average (Stapleton, 1987), and so are impractical for planting-up large areas. Culm cuttings are much lighter, weighing about 0.5 kg (Storey, 1981; Stapleton, 198b).

The removal of large numbers of rhizomes can severely damage the parent clump (Khan, 1972). The average clump may provide about 5 rhizome cuttings each year without loss of vigour or productivity (Stapleton, 1985b). This has been the traditional method in Nepal for hundreds of years (Stapleton, 1987). Cuttings flower at the same time as the parent clump, so all may be lost within a few years of planting (Bahadur *et al*, 1980), although this is probably less of a risk than previously thought (Storey, 1988a).

3.1 Seed Collection

While most species of bamboos flower at long intervals, *Dendrocalamus hamiltonii* (Local Name: *Tama bans*) is more sporadic, a flowering clump of this species can be found in most areas at any time. When there are a few flowering plants within pollination distance seed is produced (Stapleton, 1987). There seems little variation within species that cannot be accounted for by differences in site conditions, though as with any seed, there will be differences in vigour (Storey, 1988).

Flowering season: Bamboos can flower throughout the year.

Duration of flowering: This depends on the speed of food reserve depletion, which is related to the amount of pollination occurring. Bamboos often flower for 3 years or more.

3.1.1 Direct Collection

Most seed is collected from the ground rather than from cut culms. The area under a flowering clump should be cleared of litter and vegetation, or covered with sheeting, and seed collected daily. Knocking the culms helps to release the seeds (Stapleton, 1987).

3.1.2 Using Natural Regeneration

If very little seed is produced then natural regeneration can be encouraged by cultivation and protection around the clump. Once germination has taken place the young bamboos can be transplanted (Stapleton, 1987).

3.1.3 Seed Preparation and Storage

Seed is separated from the flowers by rubbing and then winnowing in a tray. After being treated with insecticide and allowed to dry in the sun for one day, prepared seed is then stored in a dessicator with Silica Gel or Cobalt Chloride crystals. Viability is only for one season, declining rapidly after the first monsoon (Stapleton, 1987). In some countries cold storage at 3-5 C is used (Pant *et al.*, 1981). When no drying agent is used exposed seed retains its viability longer than seed in air tight containers (McClure, 1966).

3.2 Culm Collection

Cuttings should be collected in cool weather from January to early March, or in the pre-monsoon or early monsoon. However, more cuttings will rot in wet weather, and during the monsoon people are usually too busy to be planting bamboo (Storey, 1989a). Cuttings are planted directly onto the hillside.

The culms should be more than 3 cm diameter and have strongly developed side-branches (at least half the diameter of the main stem at their bases) and leaves (Storey, 1989a). This usually means that 2 year old culms should be used, but this depends on their position in the clump (Storey, 1988a) [See also 8.1, i] Only bamboos which produce aerial roots will grow from culm cuttings (Stapleton, 1987; Gurung, quoted in Storey, 1988b). In order to ensure a good supply of suitable culms, the tops of new culms should be removed the year before planting is planned. This stimulates strong branch development. If all the buds at the base of the branches have already grown, then the culm is too old. Do not use diseased or insect-damaged culms (Storey, 1989a). See [8.2] for how to cut the culms up.

3.2.1 Standard Culm Cuttings: [See also 6.2.1]

These are not always as successful as rhizome cuttings, but are still very useful, when you take into consideration that you only get one plant from a root, but several from a stem. Some species (e.g. *Taru bans*) are propagated more successfully from a good culm cutting than from a rhizome cutting (Bradshaw, 1989a). Others, such as *Laurei bans*, cannot be propagated from stem cuttings (Storey, 1988a; Bradshaw, 1989a). In difficult situations, some species will need two node cuttings, while others only one. Two node cuttings are usually more successful (Bradshaw, 1989a & b). Appendix I shows species found to grow successfully from culm cuttings. The branches should be cut above the first bud with a clean cut so that the branch does not split. Smaller basal twigs may be removed (Storey, 1989b).

3.2.2 Man Bahadur's Method. NOTE: This technique is not proven!

This technique makes use of the top of the culm which would normally be too thin to be used in propagation. A length of culm longer than two nodes is planted about 20 cm deep, with the main side-branches left long so that they stick out of the soil (Storey, 1989b). The butt-section may also be planted using this method and may prove successful in difficult situations where a two-node cutting would fail. As the butt-section contains greater reserves its chances of survival are greater (Storey, 1989a). [See also 6.2.2]

3.3 Rhizome collection: [See also 6.3]

Rhizomes should be collected during December to March, during cool weather to avoid dehydration, to (perhaps) benefit from the winter rains and be settled in before the onset of hot weather. By April roots are too well developed to be moved without being damaged (Storey, 1988a).

A culm of at least one Season's growth and at least 8 cm dbh (Meyer, 1987) should be selected, preferably from the outside of the clump, and cut at about head-height, just above a node. Recent tests indicate that short culms (about 30 cm long) produce shoots much faster than longer ones and may be less susceptible to drying out, but are also more easily destroyed by grazing (Bradshaw, 1989a). The selected culm should have leaves on it, if it does not, then it is too young. Its side-branches should be cut just beyond the first node (Storey, 1989a).

The rhizome is then uncovered and cut at the tough neck where it branches from its mother rhizome. It can then be dug and levered out of the ground without damaging the buds and leaving a large number of roots. Trim off all broken, crushed or damaged roots with clean cuts. Remove all leaves to reduce water loss. Establishment is more successful with undamaged rhizomes, so treat them with care (Storey, 1989b). If the rhizome is not to be planted immediately it should be kept out of the sun, and its roots should be kept wet (Stapleton *et al.*, 1983), using sacking (Storey, 1988a).

4. NURSERY PRACTICE

This is not practical for culm cutting propagation.

5. SITE PREPARATION

5.1 General

The planting site should be fenced and grazing animals excluded; the lighting of fires stopped, and dead grass cut and removed.

5.2 For Rhizome Cuttings

If possible planting pits should be prepared well in advance and 'catch' gullies dug to direct water into them (Storey, 1988a).

6. ESTABLISHMENT

When preparing the planting pit, put topsoil and subsoil into separate heaps. When putting in the plants, roots or cuttings, put the best soil where the roots are or will be (Storey, 1989a).

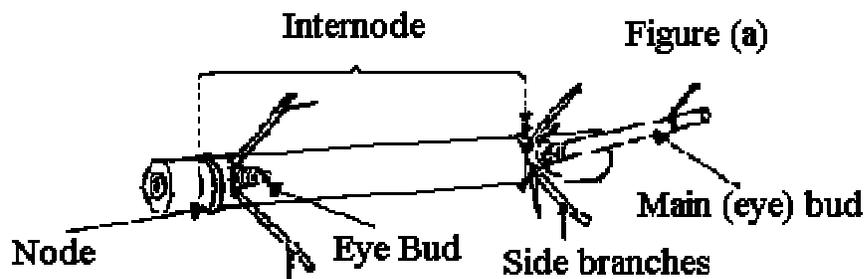
6.1 Seedlings

In India seedlings raised in polythene bags are used to reduce mortality in planting out. Although 2 year old seedlings establish quickly, raising them is time consuming and expensive. Hence the practice is to use 1 year old plants. Great care must be taken in planting out as seedlings are liable to wither if their roots are exposed to the sun (Bahadur *et al.*, 1980). They are very susceptible to drying, cutting and grazing (Storey, 1988a).

6.2 Culm Cuttings

It is important to plant the cuttings as soon as possible after collection. Carry the selected pole to the planting site and cut it up as required. keep cuttings in a shaded place (Storey, 1989a).

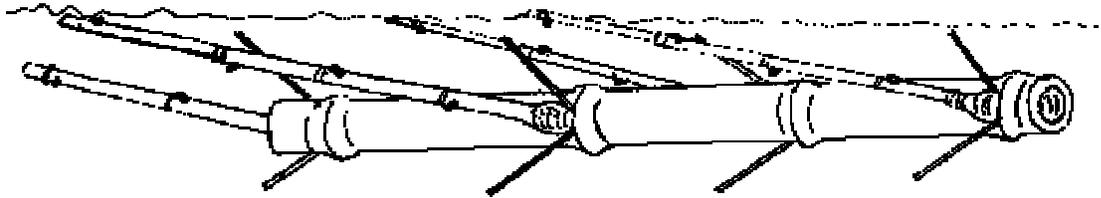
6.2.1 Standard Culm Cuttings; [See Figures (a)]



The side branches are cut just beyond their first node and the stem planted horizontally in a trench, buried to the depth of about 5 cm (shallower in the monsoon as they tend to rot). The main side branch(es) should also lie horizontally (Storey, 1988a). Place the largest basal buds downwards to allow strong root development (Storey, 1988a). Moisten with water as the culm is buried (Storey, 1989b).

6.2.2 Man Bahadur's Method: [See Figure (b)]

Figure (b)



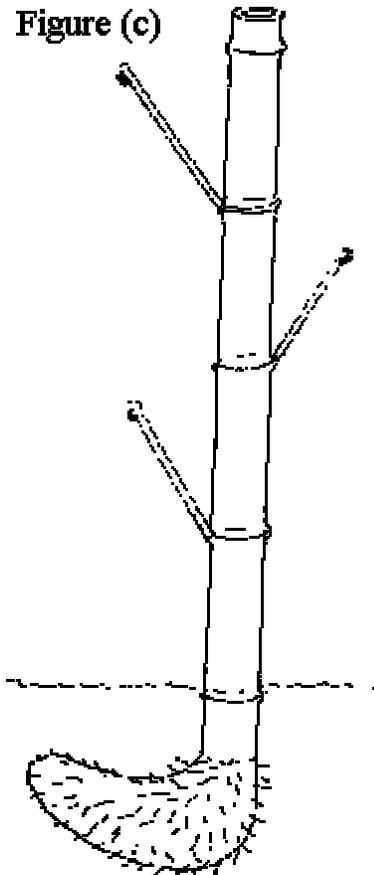
A section with up to eight nodes is planted horizontally (or on a slight incline, with the basal end lowest) in a trench with branches pointing upwards (Storey, 1988a).

6.3 Rhizome Cuttings

The planting hole should be prepared before or at the same time as the rhizome is collected. Aim to plant at the coolest time of the day. Do not plant into a dry hole (Storey, 1989a).

6.3.1 Upright [See figure (c)]

Figure (c)



Stability is very important for the growth of new roots, so the rhizome must be planted deep enough to support the pole and the earth stamped down around it. The pole can be leant against a bank or a tree as long as this does not allow animals to graze it. It may be necessary to plant the pole through a hedge or thorn tree to protect it from grazing animals; planting long poles at an angle prevents animals rubbing on them (Rana, quoted in Storey, 1989a).

Rhizomes should be planted at the depth they were in the clump (Storey, 1989a), and should always be watered in, even if no further watering is possible (Stapleton *et al.*, 1983; Storey, 1988a). Make the plant bed into a mini-terrace with a slight back slope (Storey, 1989a).

6.3.2 Buried (or layered): [See Figure (d)]

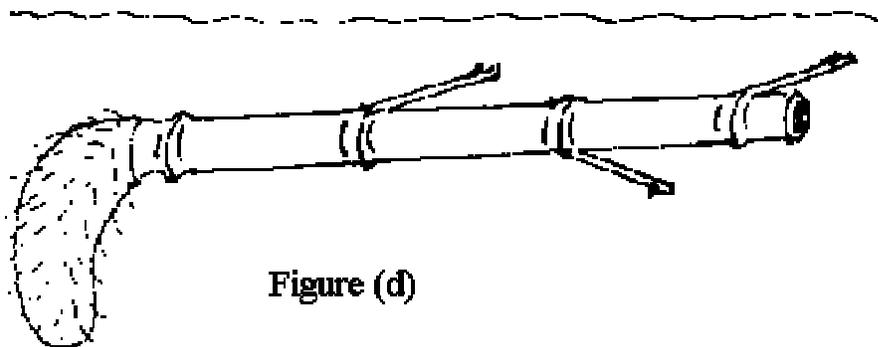


Figure (d)

The rhizome is buried in a damp place, horizontally or sloping slightly upwards from the rhizome. The best branches should be turned upwards and others cut just beyond the first node (Storey, 1988a).

7. PROTECTION & MAINTENANCE

Grass and weeds should be cut if they start to cover the new bamboo shoots. **Care must be taken not to damage the growing shoots or rhizomes, as this will cause death or severe setback.**

Clumps take 10-15 years to produce culms of full size (Haun *et al.*, 1961), depending on species, soil, humidity and position of the culm in the clump. Rhizome cuttings may produce mature culms in 3-6 years (Storey, 1988a). Individual culms live from 5-12 years (Raun *et al.*, 1961).

Earth should be piled on exposed rhizomes as they are susceptible to desiccation (Gautam, 1986). Manuring is beneficial to young plants (Sharma, 1988). Young bamboos need protection from pigs, cattle, goats, people and indiscriminate fodder collection. If damaged early in life, only stunted, bushy clumps will be produced (Bahadur *et al.*, 1980).

If a stand of Bamboo flowers and dies, the area should be protected against animals and fire until it has re-established itself from seedlings (Stapleton, 1987).

8. HARVESTING

Local management practices seem to vary according to the end product required. In the case of *Bambusa* and *Dendrocalamus* spp. [*bans*] demand for poles is often sporadic and the harvesting of culms is not always at the optimum age for maximum productivity. Farmers consider containment of the clump important, to reduce interference with other crops (Lamichhane, 1987).

1988).

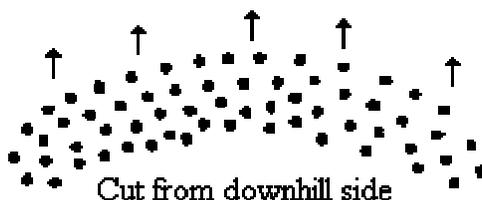
8.1 Harvesting Guidelines

The following guidelines should be followed:

- i) Immature culms of 1-2 years have a very high water content and shrivel up when cut - this makes them useless for construction (Haun *et al.*, 1961). Speed of development depends on the condition of the clump and the position of the culm: if the clump is vigorous and the culm is in an exposed position it matures much sooner; culms at the centre of a poor clump mature more slowly (Storey, 1988a).
- ii) In a clump containing 12 culms or more, at least 6 culms over 1 year old should be retained, and in a clump containing less than 4 mature culms over 1 year old, all should be retained during felling (Bahadur *et al.*, 1980). Mature culms should be left evenly distributed throughout the clump to provide mechanical support as well as nourishment (Gautam, 1988).
- iii) All culms older than 4 years should be removed.
- iv) Culms should never become so overcrowded that they touch one another at the base. There must be sufficient space between them to allow movement of the cutting instrument (Sharma, 1988).
- v) The culms should not be cut lower than the first node above ground level, to ensure that the rhizome is not damaged and not higher than 30 cm (Gautam, 1988). Thinning the clumps reduces rhizome overcrowding and encourages the production of new culms in the centre of the clump (Sharma, 1988)
- vi) Large bamboos (local name: *bans*) should (ideally) be thinned annually during the winter, as this is the time when the plants growth is slowest. However, it is possible to harvest at any time except when new shoots are developing (Storey, 1988a).
- vii) Damaged culms, debris and cut branches which may have become infested with shoot-boring moths (family: *Pareuplexia*), should be removed (Bahadur *et al.*, 1980; Stapleton, 1985a) and burnt (Storey, 1988a), as well as all dead and dry culms (Gautam, 1988).
- viii) The smaller *Arundinaria* and *Drepanostachyum* species [*nigalo*] are (according to local practice) harvested by removing the shoots of a lighter green colour, which are readily distinguishable in March (Thompson, 1986). Harvesting age should be 16-20 months (Stapleton, 1987). This leaves the clump uncongested and produces culms of consistent size and quality (Lamichhaney, 1988).

8.2 Harvesting Method

The culms should be severed by cutting round once with the blade of a *hasya* (a curved pruning knife shaped like a small sickle) angled at 45 degrees to the stem, then again with it angled the opposite way to produce a wedge-shaped notch. This avoids splitting the culm (Storey, 1988b). Clumps should be harvested in such a manner as to produce the following pattern (Sharma, 1985):



This pattern allows easy access to the culms, while leaving some undisturbed outside surface. The arrows indicate the direction the clump should spread. Peripheral shoots should never be cut even if they are malformed as they are required for the potential production of new shoots (Champion, 1968; Gautam, 1988). The tendency to harvest only peripheral culms leads to congestion in the centre and extraction problems later on (Sharma, 1988).

9. TREATMENT OF HARVESTED CULMS

9.1 No Treatment

Cut culms can be left to stand in the clump until dry, or they can be cut, stripped and stacked if the leaves are to be used as fodder. Stacked culms should be dried in a shady, well-ventilated place, laid horizontally on a rack, with supports every metre to avoid bending. When drying large quantities of culms they should be tied butt-to-tip in bundles to prevent the development of new curves (Haun *et al.*, 1961).

Expected service life of culm:

- i) When in the open on the ground - 1 - 2 years.
- ii) Under cover, not on the ground - 5 years.

9.2 Water Leaching

Culms are soaked in water to increase flexibility and remove starch (which makes them unattractive to *Bostrichidae* and *Lyctidae* beetles). Leaching can be carried out before or after splitting (Stapleton, 1987). The bamboo must be completely submerged, weighted down if necessary, for between 3 days and 3 months (Pant *et al.*, 1961). Running water gives the best results as stagnant water sometimes causes staining to occur.

9.3 Steeping

Freshly cut culms with crown and branches are stood vertically in a container holding preservative to a depth of 30-60 cm. Transpiration draws the solution into the stem (Pant *et al.*, 1981). **THIS IS NOT SUITABLE WHEN LEAVES ARE USED FOR FODDER.** This technique is unlikely to be useful in Nepal were the average farmer would not be able to afford to buy chemicals.

9.4 Sap Displacement Method

Green, round or split bamboos are stood vertically in preservative as for 9.3, but with leaves and branches removed. The solution rises gradually to the top by 'wick' action due to the replacement of sap (Pant *et al.*, 1961). For protection against fungi and boring beetles dip for 5 minutes in a solution of 2 percent borax and 1 percent pentachlorophenol.

9.5 Whitewash and Tar Coating

These are effective when done repeatedly (Pant *et al.*, 1981). Creosote can also be used (Sharma, 1988).

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