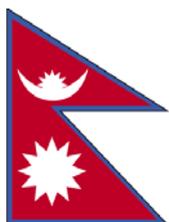


A brief introduction to Semal (*Bombax ceiba* Linn).



For: Dendrology and Wood Science

Lecture: Dr.Uwe Muß



Rajendra K.C.
Georg-August University
Goettingen, Germany
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Bombax ceiba Linn.

(Synonymous: **Bombax malabaricum** DC.
Salmalia malabarica (DC.) Schott & Endl.)

Local name: **Semal**

Sanskrit name: **Salmali**

Common Name: **Silk cotton tree, red silk cotton tree, Semal**

Trade Name: **Semal**

TAXONOMICAL CLASSIFICATION:

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Malvales
Family: Malvaceae (Bombacaceae)
Genus: Bombax
Species: ceiba
Binomial name: *Bombax ceiba* L.
Bombax malabaricum D.C.
Salmalia malabarica (DC.) Schott & Endl.



The family Bombacaceae consists of about 22 tropical genera and 150 species. The largest genera includes Bombax (60 species), Ceiba (15 species), Durio (15 species), Salmalia (10 species) and Adansonia (10 species). Some species such as *Bombax ceiba* produces large sized timber of light weight which is used for variety of purposes that is from manufacture of match box and match splint to veneer and plywood. This is very important for the conservation of Asian vultures which is near to extinction. Other commercial products derived from this family include Floss (Kapok) from *Ceiba pentandra* and Silk cotton from *Bombax ceiba* (Semal). In the tropical regions of world, there are about 55 species of Bombacaceae that yields floss similar to Java kapok. (Troups, 1981 reprint)

SALIENT FEATURES OF FAMILY BOMBACACEAE:

This family has mostly the large trees with buttressed trunks. This family has the **Leaves** Simple or Digitate, often curved with scurfy scales, alternate. In most of the species it has the palmate type of compound leaves but in many species we can find also the simple leaves. It has the complete flowers which are bisexual, generally large and showy, arranged in crowded fascicles with the **Calyx** mostly



five toothed, persistent and **Petal:** often elongated. It bears medium to large size fruits (capsules) which dry in most cases but also has the fleshy, loculicidally dehiscent or indehiscent in nature. It has the valves and because of large size and weight, it could not fall away from the tree base. The **seeds** are found generally embedded in hairs from the wall of the fruit, with little or no albumen.

5 species of trees belonging 3 genera occur in India. They are *Bombax ceiba*, *Bombax insigne*, *Bombax scopuloram*, *Ceiba pentendra* and *Cullenia rosayroana*. However they have already planted many species in their land such as *Ochroma lagopus* (Balsa), *Adansonia digitata*, *Durio zibenthinus* etc.

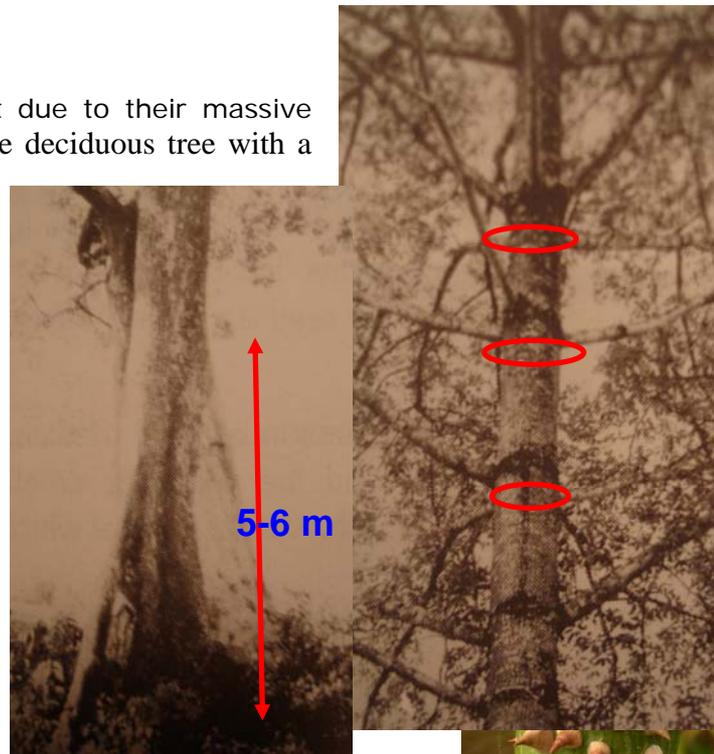
But in Nepal, only 3 species *Bombax ceiba*, *Ceiba pentendra* and *Bombax insigne* are found. *Bombax ceiba* is found in tropical areas (in south) whereas *Bombax insigne* is found in low hills i.e subtropical areas of Nepal. Besides, *Ceiba pentendra* is the exotic species for Nepal which is mostly found in plantations. This *Ceiba pentendra* has been introduced since roughly 2 decades earlier.

This tree, which was previously known as *Salmalia malabarica*, is a species of the moist tropics and occurs in India, Burma, and the sub Himalayan region.

Semal is a very large, conspicuous and attractive tree, growing to 40 meter tall on occasions. It is deciduous, but even when leafless, the tree can be easily recognized by the arrangements of branches which grow out from the trunk in regular whorls (whorl branching).

Growth Habit:

Semal is called Kings of the Forest due to their massive size and showy flowers. It is a large deciduous tree with a straight cylindrical stem and horizontally spreading branches in whorls. This horizontally branching system in whorls, large size and the buttress at the base are the first seen characteristics to distinguish the species in the forest. The tree reaches up to 40 meter in height and 2 meter in diameter with the clear bole of 24-30 meter. Large trees are invariably buttressed at the base. Stem buttresses at the base and go up to 5-6 meter in height.



MORPHOLOGY:

The young stem and branches are covered with sharp, straight, stout prickles up to 1.2 cm long with woody conical bases.



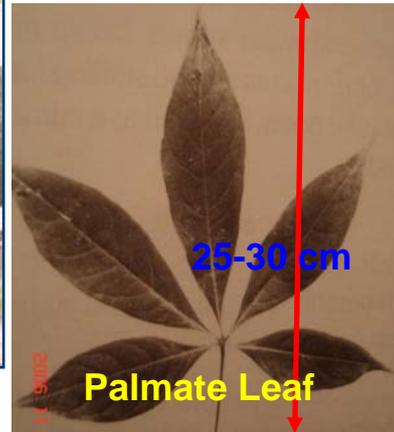
Bark:

Bark of Semal looks pale ashy to silver grey, 1.8 -2.5 cm thick, smooth up to middle age, becoming rough with irregular vertical cracks on older trees.



Leaves:

Semal tree has the compound leaves which is palmate in appearance. It is exactly appears as the palms appear in man. It is digitate, large, spreading, glabrous which has common petiole, and the size of leaf is 15-30 cm long. One leaf is composed of several leaflets. Five leaflets are common in one leaf but sometimes up to the seven leaflets could be found. The size of leaflets varies from 10 to 20 cm. generally the leaflets found in the centre are longer as in the fingers in palm. The leaflets are lanceolate, acuminate, more or less coriaceous and entirely glabrous.



Flowers :

The bright red flowers, which appear in January to March, are large and conspicuous on the leafless trees. It presents a strikingly remarkable sight in winter and spring when the usually bare branches are covered with large, fleshy, red flowers. Birds are attracted to them, and are probably responsible for their pollination. These flowers form a scarlet carpet on the ground for few weeks (2-3 weeks) after dropping.



The flower of Semal

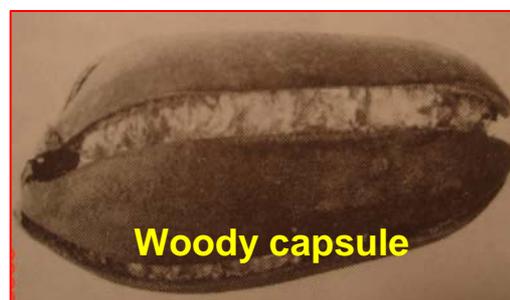


are very showy, attractive and visible from long distances also. Because of its beautiful and attractive flowers, people like to plant it as the ornamental plant in the botanical garden, garden or as the avenue species. Flowers are numerous, large, 10-12.5 cm across. It clustered towards the ends of branches at the time of flowering. It has the thick, fleshy and cup shaped Sepals. It bears generally 5 petals in one flower which are 7.5-15 cm long oblong, recurved above, and fleshy, of bright crimson (rarely yellow or orange) colour.



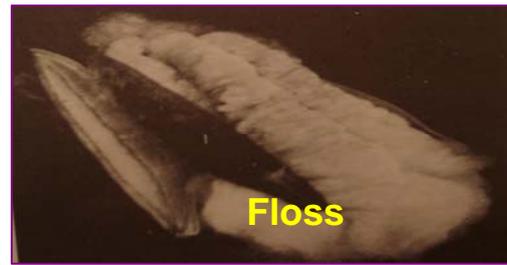
Capsule:

The pods are about 10-18 cm in length, oblong-oval in shape, locucidally 5 valved; valves woody, downy outside, lined with silky hairs within.



Seeds:

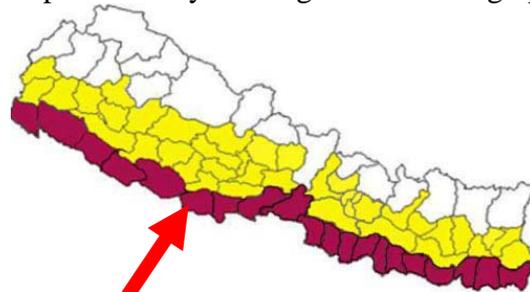
Within the capsule it has many seeds which are obovoid, smooth, 6-9 mm long in size. These seeds are oily and surrounded by a thick mass of long silky hairs or floss, hence easily blown about by wind.



GENERAL DISTRIBUTION:

Samal is widely distributed in Indian subcontinent except extremely arid regions ascending up to 1200 meters and occasionally up to 1500 meters. In Nepal, it is found from Terai (70 m) up to about 1300 meters.

It seeks moist, protected valleys preferably flat ground near stream banks where it is often gregarious. Though typical of the alluvial Savanna type of forests, it also grows sporadically in mixed deciduous forests in the lower valleys and in the Sal (*Shorea robusta*) forest. Though it is generally scarce in the hills, it is very common in the Bhabar and Terai tracts (tropics) of Nepal and India especially in the open grazing grounds in miscellaneous forests. It is often found growing in association with Sal (*Shorea robusta*).



It is often only tree species left in villages in the Terai.

Although it has a very wide range of distribution, it is nowhere very common, usually occurring scattered in mixed deciduous forests. Occasionally, it tends to be gregarious on alluvial soils near river banks and grassy savanna lands.

It also occurs in India, Sri Lanka, Pakistan, Bangladesh, Myanmar, Java, Sumatra and Northern Australia.

SITE FACTORS:

Climate:

Samal occurs in regions showing a wide range of temperature and rainfall but thrives best in a comparatively moist tropical climate. In the natural habitat, excluding the places where it is found up to 1200 m elevation in the hills, the absolute maximum temperature varies from 37.5 to 50 degree Celsius and the absolute minimum from minus 2.5 to 17.5 degree Celsius. The mean daily maximum temperature in May, which is generally the hottest summer month, varies from 30 ° C -42°C; the mean daily minimum temperature in January, which is coldest month of the year, varies from 4.4°C to 23.9°C.

It grows in regions with an annual rainfall ranging from 750-4570 mm or more, showing best development in place with a high rainfall well distributed throughout the year. In its habitat, frost is not uncommon, particularly in the low lying areas.

Topography:

Semal prefers valleys and flat or undulating ground with deep soil. It can also grow on well drained hill slopes. It is almost gregarious on flat alluvial ground in grasslands near river banks.

Geology / Soil:

Semal is distributed widely throughout the Indian subcontinent; its occurrence in a particular locality is governed more by edaphic rather than by climatic factors. It prefers a deep sandy loam soil derived from granite. It is rather scarce on quartzite, schist and khondalite soils. It occurs extensively on deep alluvial soil along stream banks in Terai region of Nepal and generally avoids clayey and marshy soils. It grows even on badly drained sites but the growth is comparatively slow and the development poor, the trees remaining stunted, with tapering boles.

Semal occurs mostly in the alluvial savanna forests and is also quite common both in dry mixed deciduous and moist deciduous forest.

Though primarily a seral species, it is commonly dispersed in the climax type of vegetation as well.

Some believe that the species possesses evergreen characters and shade tolerance in early years. Due to this any seeds falling in the soil under an evergreen canopy are also able to grow as healthy seedlings even faster than the seedlings growing in open where even in the first year it is characteristically deciduous. Once the tree grows above the top canopy level of the evergreen forests it becomes strongly deciduous and thus is able to exist in harmony with strong light demanding species in the top canopy of the evergreen forests.

PHENOLOGY

In some cases particularly in dry situations, the leaves turn yellow and commence to fall at the beginning of December, the tree being leafless by the end of that month when other trees, particularly in moist situations, may remain in full leaf till March or may never be entirely leafless. The new leaves appear on March-April.

The large, round, dark brown buds become visible in the month of December. The showy scarlet flowers appear in February-March and are conspicuous on the trees which are usually leafless at the time of flowering but if in leaf their flowers are, as a rule, not so numerous. The trees when in full bloom, flowering was observed from far from, and presents a striking blaze of crimson.

The nectars in Semal flowers attract birds and insects which act as pollinating agents. Birds, particularly the clumsy crows, are rather wasteful in their pollination habits as, in feeding upon the floral nectar; they often knock the flowers off their brittle bases. The carpets of floral debris that one commonly sees on the ground below a Semal tree in bloom consists of whole flowers also, besides other remains. Squirrels, deer and other mammals, however greedily feed upon this floral litter.

The fruits develop very rapidly, sometimes reaching a length of 7.5 cm while there are still flowers on the tree; they ripen from March to May. The fruits open usually while still on the tree,

but sometimes after falling. The seeds which are numerous, surrounded by masses of white silky hairs, and are thus easily blown about by the wind. Strong dry winds are frequently prevalent at the time the fruits open and where Semal trees are numerous, the air is full of flecks of silk cotton, which are blown far and wide, bearing the seeds with them.

GERMINATION AND SEEDLING STAGES:

The germination is epigeous; the testa splits and the radicle emerge from the narrow end of the seeds and descends. The hypocotyl elongates, arching at first, and in straightening, carries above ground the cotyledons, which are much crupled in the seed but soon expand. The root is tape roots. The primary root long, at first thin, afterwards thickening greatly becoming fleshy, tapering upwards and downwards from the fleshy part, at first white, afterwards yellow or light brown, lateral roots few or moderately numerous, chiefly upper part of main root.

Seedlings are subject to the attacks of various animals; rabbits nibble the stem, rats gnaw the taproot, and pigs and porcupines grub up the roots.

The growth of seedlings during the first season is slower than it is subsequently. In Dehardun (India), seedlings attained a height of 8-15 cm by the end of the first growth season, while those which are regularly weeded and watered grew rapidly during the second season, some reaching a height up to 1.7 m by the end of the season: in more tropical climates, the growth is very much faster. On stiff soil and on other unfavourable ground, the seedlings remain small for two or three years or more, growing only a few centimeters.

In dry localities, they may die back annually for a few years before establishing themselves and commencing upward growths.

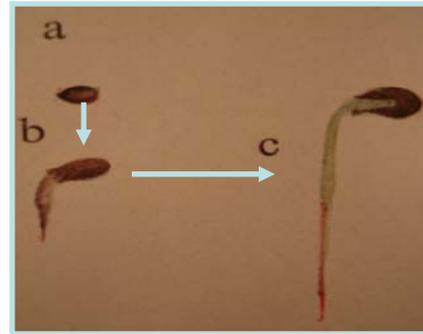
The Bombax is frost sensitive and shows the die back in seedlings.

SILVICULTURAL CHARACTERISTICS:

Semal is a strong light demander. It resists slight frost, but is affected by severe frosts in hills.

Growing as it does in savanna tracts; it is subject to severe burning: in the seedling and sapling stages, it is repeatedly burnt back, but has good power of recovery from the base, and once it is established, its thick bark enables it to resist damage by fire better than most species.

It coppices in its early years but cannot later. It also produces root suckers, but these survive only if the parent trees are small. Many of them tend to die after 2-3 years. It suffers from grazing and, in its young stages, benefits much from the protection of thorny bushes because these thorny bushes protect them from grazing.



REGENERATION:

NATURAL REGENERATION:

Semal seeds freely every year and the seeds get widely dispersed by wind. Natural regeneration establishes itself under favourable conditions freely on new alluvial flats, savanna and open spaces. In Nepal and north India, it is one the first trees to appear on alluvial ground in the process of natural succession of vegetation, after the stage in which the land is occupied predominantly by *Dalbergia sissoo* and *Acacia catechu*. During early stage, the thorny shrub such as *Zizyphus mauritiana* protects it from grazing. In heavily grazed areas, the saplings establishes themselves freely under the protection of dense clumps of *Zizyphus mauritiana*, *Zizyphus xylopyrus* and other thorny shrubs, or in the tussocks of coarse grass where they are out of reach of cattle.

ARTIFICIAL REGENERATION:

The seeds are collected locally from Mid March to Mid may. The capsules or seed pods are knocked off from the tree when they are just about to open and placed in the sun under wire netting and they soon burst.

Seeds are separated from floss by putting them in a gunny bag and thrashing with a stick until the seeds get separated.

The weight of 100 dry capsules is about 2 Kg of which the floss constitutes about 0.57 kg and the seeds 0.45 Kg. The seed weight varies from 21,430 to 38,500 per Kg. Germinative capacity has been found to vary from 14-75%. The seed is viable for two years. It can be stored in sealed tins for 1 or 2 years with only slight decrease in germinated capacity. Viability of seeds stored in gunny bags decrease considerable at the end of first year.

Semal seed does not require pre treatment before they are sowing. Experiments show that the untreated seeds germinate (63%) better than cold water treated seeds (60%).

Nursery Technique:

Semal is eminently suitable for afforestation of new ground and of grasslands in the riverain tracts, on soil consisting of alluvium in mixture with wilt or sand by any of the methods described here:

The seed is sown in nursery in May or June 5 cm x 23 cm and regularly watered till the monsoon starts. Seedlings should be shaded from the afternoon sun during hot weather. They are suitable for stump planting when one year old. Also 1-2 years old stock is used for entire planting.

Semal can be raised by direct sowing, entire planting as well as stump planting. But trial shows that the sowing has very few success story and other methods are successful.

Plantations technique:

Direct sowing:

For direct sowing, the seeds may be sown in raised patches of loose mineral soil at 3.7x3.7 m spacing just before or at the commencement of the rains using 3-6 seeds per patch. If spaced

7.4 m x 7.4 m, other species could also be grown in between to form a mixture which helps in minimizing the damage from shoot borers.

Entire planting:

Entire planting has been found successful in the regions with comparatively high rainfall. Tall 1 to 2 years old plants are used to plantation after pruning all leaves except the young ones at the tip. If planting out is done in rainy seasons and there is a good spell of rain afterwards, the plants get established quickly and are able to withstand competition from grass and other weeds successfully.

Stump planting:

For stump planting, stumps are prepared from 1 to 2 years old nursery raised seedlings, keeping only 4 cm of shoot and 30 cm of root and pruning all side roots. The stump diameter at the collar may be 8-20 mm. Bigger stumps, 2-5 cm in diameter and 60 cm in length, are reported to have given better results than small results in Bengal. The appropriate time is just after the outbreak of monsoons. Planting can be done in pits of 30 cm x 30 cm filled with well worked soil. The soil around the stumps should be compacted and water should not be allowed to stagnate around it.

TENDING OPERATIONS:

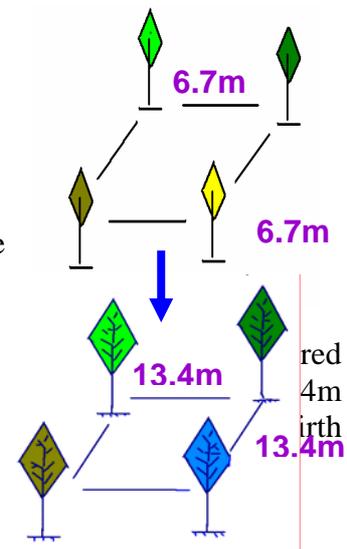
Weeding:

Semal is a rapid grower and requires little weeding after the first 1 or 2 years. Sometime climber cutting is also done with weeding. Weeding lowers the competition and provides loose soil to expand their roots.

After 2-3 years pruning is required.

Thinning:

Semal being a strong light demander requires full growing space throughout its life for proper development. Hence thinnings are necessary in plantations and have to be done in two or more stages during the rotation. Where the initial spacing of 6.7 m x 6.7 m (22 suitable for plantations, it is considered best to thin to a final crop spacing i.e. 55 plants per hectare. This conclusion is based on the fact that trees of 1.8 m (which is the exploitable size) will have a crown spread of 12



MANAGEMENT AND SILVICULTURAL SYSTEMS:

If grown pure, Semal in the final crop would have to be very widely spaced and the resulting yield would be very small, considering the crown size and the characteristic branching habit of this species. Pure crops of Semal may be undesirable for any of the following reasons:

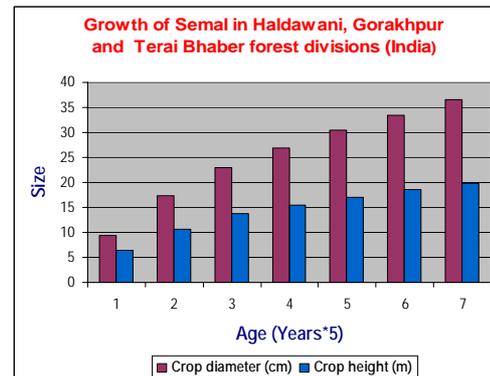
- ❖ Deterioration of soil conditions,
- ❖ Epidemic attacks of insects, fungi or *Loranthus*,
- ❖ Poorer growth form and
- ❖ Low productions.

Natural growth of Semal has been worked under the selection system with an exploitable diameter limit and a felling cycle which varies from place to place. In some places, it has been worked under the clear felling system followed by concentrated artificial regeneration adopted with a rotation of 20-30 years and exploitable diameter of 57 to 61 cm.

GROWTH STATISTICS:

Growth data obtained from Haldawani, Gorakhpur and Terai Bhabar forest divisions show the following growth rate:

Age (years)	Crop diameter (cm)	Crop height (m)
5	9.4	6.4
10	17.3	10.7
15	22.9	13.7
20	26.9	15.5
25	30.5	17.0
30	33.5	18.6
35	36.6	19.8
Source: The Silviculture of Indian Trees, Vol III		



INJURIES AND PROTECTION:

Insects:

Large number of insects and larvae found, but only the *Tonica neviferana* is dangerous. This shoot borer attacks seedlings and destroys shoots and often killing the plants.

In April May, the fallen seeds on the ground are attacked by the mature and wingless young Semal bug (*Dysdercus cingulatus*). They suck out the juice from seeds, and the seed loose their germination capacity.

Fungi:

Semal is not known to suffer from any serious fungal disease; however Ganoderma lucidium, root rot fungus has been noticed in Taungya plantations.

Animals:

Porcupines, rats, deer, mice etc eats and gnaws its seedlings.

Mostly the natural methods are applied for the protections however some pests and insecticides can be applied in plantations.

UTILIZATION:

Physical and mechanical properties of wood:

The wood is usually white or pale pink, turning pale yellowish brown on exposure. There is usually no color differentiation between heartwood and sapwood. The wood is very soft and light. The wood density is **373 kg /m³ (at 12% moisture content)**. It is straight-grained, even and very coarse textured with large open pores. Growth rings are not always distinct to the eye, but clearly visible under the hand lens.

It is easy to saw and work but its surface remains rough after planing due to its large pores. It does not crack while nailing. It can be peeled on a rotary lathe and made into plywood veneers.

As the wood is liable to rapid decay due to fungus and insects attack and also sap stain, it must be promptly converted and dried by air or preferably kiln seasoning. It is easy timber for kiln seasoning which takes about 4-5 days.

The untreated wood is highly perishable. It can, however, readily be treated with preservatives and penetrations is usually complete, even with even with an open tank treatment. It is extremely durable under water.

PRESENT DAY USES:

Semal timber is in great demand as matchwood. In India, almost the entire annual yield of standing trees is reserved for matchwood industry. Semal has the reputation to be linked with the pioneer industry of Nepal. The first modern industry established (1942), was the “**Juddha Match Industry**” which was largely based on Semal tree. But with the decline of Semal availability, lots of match

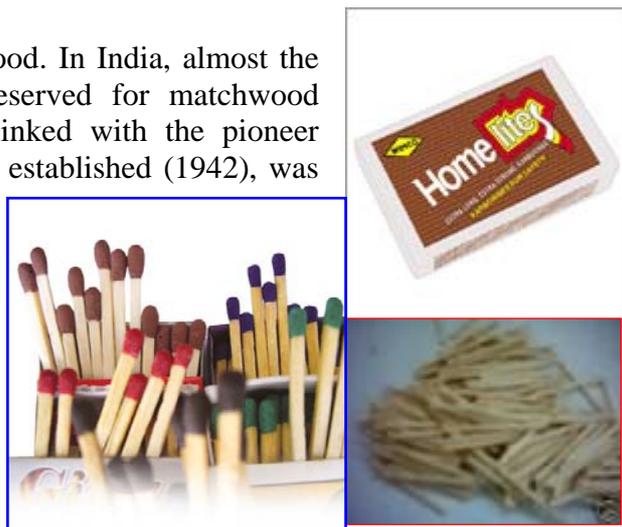
factories shifted towards the waxed paper stick or already closed up.

It is used to make plywood, being eminently suitable for light plywood containers not requiring high strength properties. It is also used for packing cases, boarding (especially in ceilings), planking (especially in dug outs for Katha manufacture), shingles, toys, scabbards, coffins, brush handles, inside partitions of Opium chests and as well curbs.

It is also considered as the “**Wood wools**” which is used as valuable packing material. The floss from Semal seeds is the silk cotton or Indian Kapok of commerce. It is used for the manufacture of life saving appliances, for stuffing cushions and pillows, upholstery, wadded cloth quilts, as insulating materials for refrigerators and as packing.

The floss of Semal is popularly known as Indian Kapok. It is light, buoyant, soft, strong, elastic, resistant, water repellent and suitable for stuffing lifebelts, mattresses, instruments, laces, etc.

In Nepal, Semal is being used in construction of boats, boatyards and canoe. In famous tourist lakes of Pokhara valley, the semal boat is used for the fishing, boating and other purposes



however the life expectancy of the boat is far less 2-3 years only. It is made with the view of cheap in constructions. (<http://www.fao.org/docrep/field/003/13251e/13251e05.htm>)



Among traditional healers of Chhattisgarh, the Semal tree as medicinal plant holds a reputed position. Its one to two years old roots are known as Semal Musli. Like other Musli viz. Safed Musli, Kali Musli etc. Semal musli is also used very frequently by the healers. There is good demand of Semal Musli in national and international drug markets.

Like other Musli, it is also used as aphrodisiac. Roots are aphrodisiac, cardiac and astringent

The bark exudes “**Mocha ras (juice)**” used for medicinal proposes.

The gum is stimulant, tonic, demulcent, anti dysenteric, analgesic and useful in giardiasis and diarrhea. Seed oil is used in the manufacture of soaps and lubrication substances.

Semal, one of the most sturdy and splendid of ornamental trees planted in Botanical gardens, gardens and avenues.

Young Flowers and Calyces are being used by people for vegetables or pickles

ECOLOGICAL IMPORTANCE OF SEMAL:

Tens of millions of vultures used to be present across India, Pakistan and Nepal. Since the early 1990s three vulture species have undergone catastrophic declines. Populations have decreased by at least 97% in India over the last 12 years and 92% in five years in Pakistan. Vulture numbers year, placing three Asian Vultures critically endangered species on the brink of extinction.



continue to decline at around 40% a

Extensive research has identified the cause of the declines to be diclofenac, an anti-inflammatory drug routinely administered to livestock in Asia and declined of Semal population. Vultures are exposed to the drug



when they consume carcasses of animals that were treated with diclofenac a few days before death. Diclofenac is highly toxic to vultures, causing them to die of kidney failure.



The potential loss of these vulture species has profound ecological and social consequences in Asia. Vultures play a vital ecosystem service by rapidly disposing of carcasses that would otherwise pose a risk of disease. With the decline of vultures there has been a dramatic increase in feral dog numbers, which pose a real risk to human health and safety.

Since the Semal trees is very large and tall, it becomes the favorite roosting and resting sites for the large birds especially the vultures, eagles and bats. Vultures prefer to live in the Semal tree. In Hindu custom, vulture is considered as the symbols of ill-fate, hence people do not like to keep the Semal tree in the vicinity. Also the Semal tree has been exploited heavily due to its commercial uses. Because of this, the availability of Semal trees has declined sharply. That ultimately assists in marginalizing the vulture population.

With keeping all these facts and figures, Nepal Government put it into the list of protected tree species since 1999 and banned the harvesting. At present no one is allowed to harvest the Semal tree no matter whether it is planted in their private land. Government supposes that with this measure, not only the highly exploited species, but also the vulture could be protected.

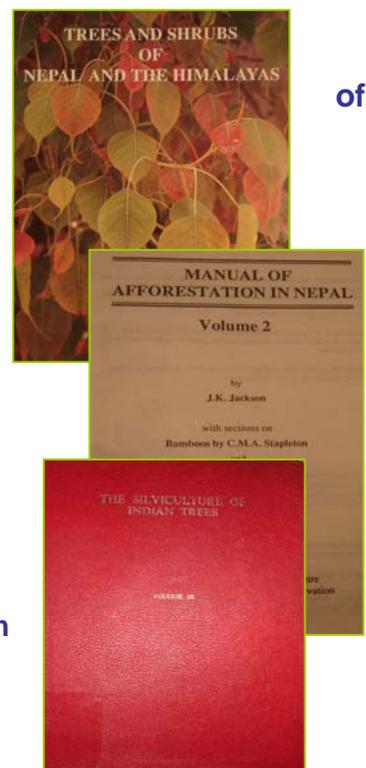
With the ban imposed by Government in harvesting of Semal tree, lots of people who planted Semal are losing the returns from it. Also lots of Small scale veneers, core stocks factories were already closed up due to the lack of raw materials.

CONCLUSIONS:

-  *Bombax ceiba* is one of the most important tree species that has economic and ecological importance.
-  Bombax should be conserved also for the ecological perspectives.
-  The Nepalese government should uplift the ban and encourage the cultivation of this threatened species.

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