

***Khaya senegalensis* – current use from its natural range and its potential in Sri Lanka and elsewhere in Asia**

Roger Arnold¹

¹ *ensis* (a joint venture of CSIRO and Forest Research), PO Box E4008, Kingston ACT 2604, AUSTRALIA. Email: roger.arnold@csiro.au

Abstract

Khaya senegalensis (Desr.) A. Juss. (African mahogany or dry-zone mahogany) has long been an important multipurpose tree in its natural range in Africa. It is valued for a wide range of non-timber traditional use products. It also provides a high quality timber and over the past decade demand for this has increased significantly with the United States becoming one of the leading importers. During the same period, prices for *Khaya* timbers have risen due to increasing demand, increasing scarcity of larger trees in natural stands and limits being placed on raw log exports in some African countries. Recent prices for *Khaya* timbers in international markets and their trends over recent years are discussed.

Khaya senegalensis was introduced to Sri Lanka about 30 years ago and in the past 10 years it has become one of the priority species for timber plantation establishment in their dry zone (ca. 1400 mm rainfall yr⁻¹). There, its plantation area is currently more than 500 ha with establishment of about 200 ha per year of new plantations planned for the near future. However, annual establishment rates in Sri Lanka are limited by a dearth of domestic seed production. The interest in *K. senegalensis* among several other Asian countries is also briefly examined with strong interest in the species having recently emerged in Malaysia.

Key words: *Khaya senegalensis*, multipurpose trees, international trade, timber value, Sri Lanka

Introduction

Khaya senegalensis (Desr.) A. Juss. is an important multipurpose tree in its natural range in sub-Saharan Africa. It is particularly valued for timber, fuelwood and medicinal purposes as well as being a popular shade and amenity tree (CAB International 2000). In its natural habitat it is a medium-sized to large tree (up to 30 m) with a wide crown. In cultivation as an exotic it can grow up to more than 35 m high and up to 1½ m in diameter (CAB International 2000; Jøker and Gaméné 2003).

Uses and products

Non-wood forest products

In its natural range *K. senegalensis* provides cattle fodder, edible and cosmetic oils, medicinal products, shade and shelter as well as providing fuelwood and valuable timber. In Mali, Niger and parts of the Sahel *K. senegalensis* rates highly as an agroforestry tree species, based on farmers' preferences, market demand and potential for genetic improvement (Franzel *et al.* 1996). As an exotic, it is valued for both amenity applications and timber production (CAB International 2000; Robertson 2002; Jøker and Gaméné 2003; World Agroforestry Centre 2004).

It is mainly in the drier parts of its natural range that *K. senegalensis* foliage is used as fodder for cattle and other livestock (Walter 2001). However, while its foliage is known to be useful to cure and prevent a range of livestock diseases, it has poor nutritive value relative to the foliage of a range other fodder trees (Petit 2004). Thus, foliage of *K. senegalensis* is typically used as a fodder source in combination with that from a number of other trees of the African savannah, such as *Faidherbia albida* and *Balanites aegyptiaca* (Walter 2001). Spatial and temporal proximity of *K. senegalensis* to other fodder yielding trees is a key factor in determining the value of individual trees as fodder sources (Wittig and Hahn-Hadjali 2001). The bark of *K. senegalensis* is also useful for livestock, being used to treat a range of diseases including liver fluke, ulcers and internal ailments associated with mucous diarrhoea (World Agroforestry Centre 2004).

Human inhabitants in *K. senegalensis*'s natural range also value the tree for its medicinal values. Its bark is very bitter and is well regarded as a fever remedy and also for use as a vermifuge, taeniocide, depurative and for treating syphilis (World Agroforestry Centre 2004). An extract of the bark is reputedly useful for treating a range of maladies including jaundice, dermatoses, scorpion bites, allergies, infection of the gums, hookworms, disinfection of wounds and even constipation. In addition to the bark, both the seeds and leaves have also been used as medicine for treating fever and headache, whilst preparations made from the roots have been used against syphilis, leprosy and as an aphrodisiac (World Agroforestry Centre 2004). Aside from its medicinal values, the bark is can be used for tanning of leather as it is quite high in tannins (Boffa 1999).

In some areas *K. senegalensis* is also valued for the oils that it can provide; seeds of *K. senegalensis* have about 67% oil content by weight (Jøker and Gaméné 2003). This oil is quite rich in oleic acid (66%) and is used in West Africa for cooking as well as in cosmetics (Jøker and Gaméné 2003; World Agroforestry Centre 2004). Although it has been reported that flowers of the species are melliferous (Petit 2004), the nectar is reputed to be slightly bitter and not favoured for honey (Boffa 1999).

Ornamental and amenity applications

Khaya senegalensis is often planted by the roadsides for shade in countries of its natural range (in Africa) and also increasingly in tropical zones of other continents. In West Africa the species has become an important urban amenity tree (World Agroforestry Centre 2004). In Australia, it has been planted as a street around Darwin since the late 1950s (Robertson 2002). In China's tropical Hainan province surveys have found it to be among the most popular of the planted shade and amenity trees (Fu *et al.* 1996). In Sri Lanka many of the earliest plantings of the species have been for shade and amenity purposes around houses and villages and along roadsides in the intermediate and dry zones of the northern part of the country (Tilakaratna 2001).

Wood characteristics

Timber of *K. senegalensis* is highly valued because of its beautiful figurative grain and its rich reddish mahogany brown colour. It reputedly has the best surface-finishing of all the African mahogany timber species and is used for quality furniture and cabinetwork, joinery, fixtures, flooring, boat building, decorative veneers, construction and even for manufacture of household utensils (TRADA 2004). In Burkina Faso its timber is used in traditional handicrafts and in parts of West Africa it is reputedly used as a source of fibre for pulp production (World Agroforestry Centre 2004). On account of the timber's strength and hardness it is a popular timber in East Africa for lorry bodies, construction work, and decking in boats.

Excellent descriptions of the main physical and mechanical characteristics, processing properties, macroscopic appearance and information on other important traits of the timber of *K. senegalensis* have been published in various venues (see for example Cirad-Foret 2003).

Timber and trade

In international timber trade the name African mahogany commonly includes several species of *Khaya*, even though timbers of the different species vary somewhat in character, particularly in density and colour (ITTO 1986). The main traditionally traded species has been *K. ivorensis*. *K. anthotheca* (syn. *K. nyasica*) is also readily accepted in the market as is some *K. grandifolia* (Anonymous 2004). Although *K. senegalensis* was primarily sold into local western African markets in earlier times, it is now being exported more widely. This is due to both decreasing availability of the other *Khaya* species (Anonymous 2004) and increasing demand for *Khaya* timber as a consequence of increasing prices for, and declining availability of, American mahogany (*Swietenia macrophylla*) (Traffic 2000).

Although often traded under the one name, the different timber characteristics of the common *Khaya* species can affect their market acceptance. The bulk of the timber shipped in the past has been of *K. ivorensis* and *K. anthotheca*, both of which are of low to moderate density¹ and pale to medium-red colour. It is such timbers that have in the past been commercially accepted as African mahogany (TRADA 2004). Timber of *K. senegalensis*, and of most *K. grandifolia*, has higher density and darker colour than what has been generally accepted as African mahogany (TRADA 2004). Indeed, the Timber Research and Development Association of the United Kingdom has suggested that *K. senegalensis* and denser *K. grandifolia* be marketed separately under the name of 'heavy African mahogany' (TRADA 2004).

The trade in African mahogany reputedly commenced in about the 17th century and escalated significantly in the latter half of the 20th century due to of strong demands yet limited availability of American mahogany (Traffic 2000; UNEP-WCMC 2002). In recent years, the United States market has come to dominate international trade in African mahogany and it is now the leading importer (Anonymous 2004; ITTO 2004).

African mahogany is now widely used in United States furniture sector as a substitute for American mahogany. Companies there have been keen to replace increasingly costly and scarce American mahogany with more competitive timbers whilst also reacting to domestic and international pressures associated with use of American mahogany² from natural stands. Due to such factors, the United States' imports of African mahogany (as logs and sawn timber) increased dramatically during the 1990s – from 4,100 m³ in 1991 to more than 20,000 m³ in 1998 (Traffic 2000). Also due to the increasing cost and scarcity of American mahogany, there has been increasing interest in African mahogany from timber importers and furniture manufacturers in China. China is the leading furniture exporter to the United States and there has also been strong growth in its domestic market for quality timber furnishings associated with its increasing economic prosperity (Zhang 2004). Unfortunately though, there is very little data directly available on the volume of African mahogany that appears in the international market in the form of finished products such as furniture.

As demand for African mahogany was increasing in the later part of the 20th century, large individual trees of *Khaya* species in natural stands started becoming increasingly rare. This has reputedly resulted in a decline in the volume in international markets in the last few years and many West African countries have imposed limits on raw log exports (UNEP-WCMC 2002). Associated with this,

¹ Indicative densities for the various species of African mahogany are *K. ivorensis* 530 kg/m³; *K. anthotheca* 540-590 kg/m³; *K. grandifolia* 720 kg/m³; *K. senegalensis* 800 kg/m³ (source: TRADA 2004).

² American mahogany from many Central and South American countries is classified by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) as an 'Appendix II' species, which means that "although not necessarily now threatened with extinction [it] may become so unless trade in [the] species is subject to strict regulation in order to avoid utilization incompatible with [its] survival" (CITES 2004).

international prices for both logs and sawnwood of *Khaya* species generally moved to record highs in 2003, although prices can vary considerably between country and even between shipments (ITTO 2004). In 2003 logs of *Khaya* (species not specified) traded internationally at around AUD \$280 m⁻³ whilst sawn timber traded around AUD \$670 to \$850 m⁻³ (cf. sawn timber of American mahogany from Central America at around AUD\$1600 in the same year) (ITTO 2004).

SRI LANKA

Domestication and development

Khaya senegalensis is at an early stage of domestication in Sri Lanka. It is thought to have first been introduced there less than 40 years ago and it is only in last 10 years or so that it has begun attracting significant interest as a plantation timber species. Prior to this, interest for *K. senegalensis* was limited. Thus, by the late 1990s its total plantation area in Sri Lanka was less than 150 ha (Tilakaratna 2001). Various trials and early plantings have now proven it to be well adapted to sites in the country's intermediate and dry zones (mean annual rainfalls 1400 mm to 2200 mm) (Arnold *et al.* 2004).

In the later half of the 20th century substantial areas of *E. camaldulensis* plantations were established in Sri Lanka's dry zone on sites unsuitable for teak (*Tectona grandis*). However, despite promising growth and productivity shown by some of the earlier plantings and trials, most of the country's *E. camaldulensis* plantations have displayed very poor form and productivity (Davidson 1993; Arnold 1996). Recent surveys have revealed that this is due largely to fungal pathogens, especially *Cryptosporiopsis eucalypti* (Old 2000). In the 1990s the Forest Department placed a moratorium on eucalypt plantation establishment in their dry zone and turned attention to identifying other potential plantation species for those areas. Subsequently, *K. senegalensis* was identified as one of the more promising species (see Tilakaratna and Weewardane 1992; Tilakaratna 1996) and it is now considered a priority species for plantation establishment in the country's dry zone (Tilakaratna 2001).

Increased establishment of forest plantations on marginal sites, particularly in the country's dry and intermediate zones, is one of the key priorities identified in Sri Lanka's Forestry Master Plan formulated in the mid 1990s (Anonymous 1995). In pursuit of this objective the Forest Department has been establishing substantial areas of *K. senegalensis* plantations in the dry zone in recent years, primarily on sites considered unsuitable for teak. By the end of 2003 the plantation area of this species had increased to more than 500 ha (N.D.R. Weewardane, Sri Lankan Forest Department, Kurunegala, *pers. comm.*).

As there are very few mature *K. senegalensis* plantings and no productive seed orchards or seed production areas in Sri Lanka at present, few seeds of this species are available from within the country. Thus, substantial quantities of seeds have been imported in recent years. In 2003 the Forest Department alone imported about 100 kg of seed of this species, of unknown provenance, from international seed merchants (K.P. Ariyadasa, Sri Lankan Forest Department, Colombo, *pers. comm.*). Assuming an average of 3,750 viable seeds per kg (Jøker and Gaméné 2003) and a nursery efficiency of 60%, this quantity of seed would equate to about 225,000 seedlings, which should be sufficient for establishment of around 200 ha. Most of these seedlings were for use by the Forest Department, and only limited numbers were made available to the public. Whilst there is reputedly strong demand for *K. senegalensis* seedlings from farmers and smaller growers in the dry and intermediate zones, availability is exceedingly limited. Recognising this, at least one private company in Sri Lanka began importing seeds from Australian sources in 2003.

The Sri Lankan Forest Department recognises that a significant limitation to the development and domestication of *K. senegalensis* is the lack of understanding of its provenance variation (K.P. Ariyadasa, Sri Lankan Forest Department, Colombo, *pers. comm.*). In most cases, the actual provenance origins of the seed they have been importing are uncertain. Also, no provenance trials of this species have been established in Sri Lanka due to the difficulty of obtaining good quality

collections from a suitably diverse range of provenances and seed sources. Thus, they have to date been unable to initiate a breeding program for *K. senegalensis*.

Pests

Although sporadic occurrences of attack by *Hypsipyla* shoot borer have been observed on *K. senegalensis* in Sri Lanka, this insect is not, as yet, seen to pose a major problem to the species there (Tilakaratna 2001). In fact, *K. senegalensis* is generally considered to be less susceptible to this insect than is American mahogany by most Sri Lankan growers (E. Daniels, Wisdom Agribusiness Services, Colombo, *pers. comm.*). In many areas of the country's dry zone the biggest pest problem for *K. senegalensis* is elephants. It can be difficult to exclude wild elephants, which roam freely and widely in much of the dry zone, from young plantations. In Sri Lanka elephants can inflict severe damage to forest plantations including debarking, breakage of stems and branches, and trampling of younger trees.

Markets

As very few *K. senegalensis* plantings in Sri Lanka have yet reached utilisable ages the timber has yet to be traded on the domestic market. Even so, the Forest Department and other growers envisage the timber of this species selling in the 'luxury class' of timbers in Sri Lanka, based on both limited experiences with some logs processed from early amenity plantings and the timber's international reputation (N.D.R. Weerwardane, Sri Lankan Forest Department, Kurunegala, *pers. comm.*). Due to increasing demand and limited supplies of logs of other locally grown luxury timbers (e.g. American mahogany and teak), prices for these have been increasing rapidly in recent years in Sri Lanka. From 1985 to 1997 these increases averaged about 35% per annum (Fernando 2002) and by 2002 Sri Lankan grown teak and mahogany logs were selling on the domestic market for around AUD \$200-\$300 m⁻³ (*cf.* quality eucalypt logs from local plantations at around AUD \$75 m⁻³) (Ariyadasa 2002).

At present and for the foreseeable future, there is a substantial deficit between production and domestic demand for most classes of timber in Sri Lanka. Thus, Sri Lanka is a significant net importer of sawlogs, sawn timber and solid timber products (CAB International 2000; FAOSTAT 2004). Consequently, most forest plantations now being established there (and also those planned for the future) are targeting timber production for the domestic market.

Other countries in Asia

Some *Khaya* species have been tested in Indonesia starting from about the 1950s (Anto Rimbawanto, Indonesia, *pers. comm.*; Rachmatsjah and Wylie 2001). However, the most commonly planted species to date in much of Indonesia has been *K. anthoteca*. On some sites in Indonesia *K. anthoteca* reputedly grows better than American mahogany, with mean annual increments of between 15 to 24 m³ha⁻¹yr⁻¹ on rotations of around 30 years.

Khaya species are also thought to have been introduced to Malaysia in about the 1950s but have to date been planted on only a very limited scale. *K. ivorensis* has been established for timber production in enrichment plantings in cutover forests and also interplanted into rubber plantations in both Sabah and Peninsula Malaysia. In the mid-1990s its total plantation area in Malaysia was estimated to be around 200 ha (Ghee 2001). Although *K. senegalensis* had until recently been primarily used for urban forestry in Malaysia, at least one Malaysian company (operating in Sarawak) recently began importing substantial quantities of seed from Australian suppliers (>30 kg in 2003) for plantation establishment.

In Vietnam *K. senegalensis* has to date primarily been planted as a street tree (Do 2001). In Thailand although there have been limited plantings of some unspecified species of *Khaya* for timber production (Eungwijarnpanya 2001), Limpiyaprapant *et al.* (2000) indicated that *K. senegalensis* is a recent introduction to Thailand. Although early growth of the latter species has been quite promising there, a lack of local seed production is seen to be a constraint to further plantings (Limpiyaprapant *et*

al. 2000). Over the past 20 years or so the species has been included in several species trials in southern China but few if any plantations have yet been established (Bai Jaiyu, Research Institute of Tropical Forestry, Guangzhou, *pers. comm.*). However, the species is popular as a shade and amenity tree in some parts of southern China, particularly on Hainan Island (Fu *et al.* 1996).

Despite the increasing interest in *K. senegalensis* elsewhere in Asia, no provenance trials of this species are known to have been established as yet in the region (as is the case with Sri Lanka). Certainly it is clear that no tree improvement programs have yet been initiated to date, as a requisite for such a program would be access to seeds/trees from good quality collections from a suitably diverse range of provenances/seed sources. At present, the best short to medium term improvement option for countries with significant interest in planting the species would be programs of selection, vegetative propagation/cloning, testing, clonal reselection and clonal propagation *en masse* to provide somewhat improved material. At the same, it would be prudent for them to endeavour to source genetically diverse material/provenance collections that would be adequate to support longer term breeding and ongoing improvements.

Conclusions

Khaya senegalensis has long been an important multipurpose tree in its natural range in Africa. It has also been planted as an exotic in trials of plantation species and as an amenity tree for 50 years or more in Asia. Over just the past decade its potential as a plantation species for production of high value sawn timbers has become recognised in at least Sri Lanka and Malaysia.

World wide demand for quality cabinet and joinery timbers seems certain to increase steadily in the short to medium term future as the economic prosperity of China and other countries increase. In combination with this, scarcity and increasing prices of some more traditional luxury timbers such as American mahogany and the international conservation pressures surrounding the use of natural forest hardwoods, seem certain to create good markets for quality, plantation grown timbers of species such as *K. senegalensis*.

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