

IFEAT

# SOCIO-ECONOMIC REPORT ON CEDARWOOD OILS

BY PETER GREENHALGH

## PART 2: INDIA, MOROCCO, CANADA, AND JAPAN\*

### INTRODUCTION

Cedarwood oil is one of the world's most important essential oils, but as discussed in Part 1 (IFEATWORLD July 2022) the term "cedarwood oil" can be confusing. The most important essential oils in this group are produced by distilling different junipers and cypresses (*Juniperus* and *Cupressus* spp.) rather than from true cedar trees (genus *Cedrus*). The true cedar trees of the *Cedrus* spp are stately evergreen trees commonly divided into four species:

- *Cedrus atlantica* or Atlas or Atlantic cedar from North Africa
- *C. brevifolia*, the Cyprus cedar
- *C. deodara*, the Himalayan or Indian cedar
- *C. libani*, the cedar of Lebanon

The most important commercial "cedarwood oils" are produced in China (from *Cupressus* spp.) and the USA with Texas and Virginian cedarwood oils (from the *Juniperus* spp.). These were discussed in Part 1 along with a general overview of cedarwood oils and their uses and

consumption. Also, in the previous edition of IFEATWORLD is Cathy Chen's *My Favourite: Chinese Cedarwood oil (Cupressus fundbris) and Firwood oil (Cunninghamia lanceolata)* which provides some detailed information on Chinese cedarwood and firwood oils. Part 2 of this socio-economic report will concentrate on Indian, Moroccan, and Canadian cedarwood oils from *Cedrus* and *Thuja* along with some information on other related oils including hinoki oil from Japan.

### USES AND CONSUMPTION

In India, *Cedrus deodara* oil has been shown to possess insecticidal and antifungal properties and to have

some potential for control of fungal deterioration of spices during storage. **Indian cedarwood oil** is invariably a by-product arising from its previous utilisation of cedar trees to produce timber products. *Cedrus deodara* was one of the most valuable Indian timbers used in producing railway sleepers and in beams, posts, and frames in construction work. It is also used for making pencils. The strong odour of the wood and its oily nature limits its use for indoor work. The oil is much favoured in Indian perfumery and Ayurvedic medicine, where it is used as an anthelmintic; decoctions of the wood being considered diaphoretic, diuretic, and carminative. The bark is astringent and used for fevers, diarrhoea, and dysentery, and the oleoresin and oil of the wood are used for the treatment of ulcers and skin diseases.

**Himalayan cedarwood oil** is a yellow-brown oil when crude, but when redistilled the oil is a pale yellow and has the sweet-woody, balsamic characteristics, and many constituents in common with **Atlas cedarwood oil**, hence similar applications such as soap and medicinal products. The oil is used with other essential oils as a fixative and diluent in soap perfumes, sanitary supplies, and polishes and for masking odours in many other industrial products. The largest quantity of cedarwood oil is used in soap industries due to its odour, epidermic, and antiseptic properties. In India the second main use of this oil is to perfume *agarbatti* (incense sticks). Because it is not toxic to mammals and smells good, it is used in room sprayers in place of pyrethrum to control household insects. The oil has been found to be biologically active against the mosquito (*Anopheles Stefani*). A low concentration of cedarwood oil (0.4452%) has proved sufficient to knock down 50% of mosquitoes under laboratory conditions. Special grades of this oil are used for oil-immersion lenses and as a tissue-clearing agent in plant and animal histological work.

Various research studies have been conducted in India on cedarwood oil. Thus, there are indications that some fractions have potent spasmolytic activity; the oil is an effective fungicide; it was found to be non-phytotoxic, non-systemic to paddy plants, and able to control the development of leaf spot disease in paddy; the oil controls the fungal

deterioration of some spices during storage; the alcoholic extract of the stem was found to have anticancer properties.

*Cedrus atlantica* oil from North Africa is widely used as an insect repellent; Turkish carpet shops are walled with cedarwood boards to deter moths. It is also used in local ethnobotanical medicine for a wide variety of purposes. The uses of cedarwood Atlas oil are mostly in woody and amber fragrances, soap perfumes, aromatherapy, and mildly medicinal products. It is only used in its own right as an ingredient.

*Thuja occidentalis* L. – white cedar tree – is used to produce cedar leaf oil in Canada and northern USA. *Thuja* absolute and concrete, produced by solvent extraction of the fresh leaves and twigs, are used in perfumery for fresh herbal notes, and in masculine fragrances, etc. It is a common ingredient in pine and cedar blends which are used in room sprays, talc, and insecticides. It is a powerful sanitiser and repellent against unwanted insects. It is a component in embalming fluids, microscope slide slips, industrial cleaners, deodorants, pharmaceuticals, cleaning fluids, salves, liniments, perfumes, shoe polishes, and soaps. Perhaps its largest use is in the preparation of patent medicines, e.g., Vicks rub, a cold remedy. It is also used in the re-odouring of sawdust in "sawdust logs" or instant fire logs, another useful product made from waste. Alongside the oil, the tree has an extensive range of uses including building products, cladding, furniture, and as an ornamental conifer.

In Japan, an essential oil is obtained from the needle-like leaves of the **Japanese cedar** (*Cryptomeria japonica*), which has an exceptionally good aroma with a "refreshing citrus scent". The oil has been researched as a tool for stress management (Nakayama, 2020). Hinoki oil from Japan from *Chamaecyparis obtusa* is used for a variety of different practical things in and around the home. The wood oil can naturally kill bacteria, viruses, and fungus. It can be added to hardwood floor cleaners to prevent termites. It is added to bath and body skin care products and an extra benefit is that it is an effective antiseptic, with antifungal and antiviral actions, as well as being noted for treating rashes, cuts, abrasions,

and minor skin irritations. It is used in Japanese forest bathing practice and in aromatherapy to soothe the senses and ease stress. The oil has a limited use in perfumery. The Japanese government has protected trees of this species since 1982. Hinoki is not just a tree but revered for its timber, decorative foliage, therapeutic benefits of the essential oil, and as a spiritual symbol. Hinoki is an institution.

Major markets for cedarwood oils are the USA, China, Western Europe, India, and Japan.

### GROWTH AND PRODUCTION CHARACTERISTICS

**Quality**  
Both the overall olfactory properties and the chemical composition of cedarwood oils are important quality characteristics. The olfactory properties will be assessed by some purchasers since they are vital for its use in fragrances, while its chemical composition is vital for use as a raw material in derivative manufacture.

Commercial cedarwood oils are alkali washed and vacuum rectified from the crude steam distilled wood oil, to give oils of a very pale yellow colour.

**Cedarwood Atlas oil** is a viscous pale-yellow oil with a sweet woody odour with floral characteristics, and as such is different from the other main origins but resembling the Himalayan oil in having a high level of himachalanes rather than cedrenes. The oil blends well with other essential oils that are woody and floral.

**Himalayan cedarwood oil's** main constituents are:

- p-methyl acetophenyl acetate
- 4-methy Δ<sup>3</sup>-tetrahydro-acetophenone
- α-himachalene
- Iso-himachalene
- β-himachalene
- Cis- and trans-atlantone
- Himachalol
- Allo-himachalol
- Longborneol and deodarone

Higher fractions of Himalayan cedarwood oil are rich in atlantone content.

**Eastern white cedar leaf tree oil** from *Thuja occidentalis* L. contains up to 65% of alpha and beta thujones. Other components include fenchone, sabinene, camphor, l-bornyl acetate, terpinen-4-ol, alpha pinene as well as camphene, p-cymene, fenchene, alpha fenchyl acetate, geranyl acetate, limonene, myrcene, borneol, valerianic acid, vitamin C, alpha terpinene, gamma terpinene, terpinolene, alpha terpinyl acetate, alpha thujene, delta cadinene, and delta cadinol. One source says that "leaf oil composition is often very different from wood but may contain the same types of chemical constituents".

**Western red cedar leaf oil** from *Thuja plicata* contains anti-insecticidal tropones, methyl thujate, and T-muurolol as major components.

**PROCESSING METHODS**

In India the oil is obtained from cedarwood stumps that have been in the ground for many years. The stumps are first chopped and then disintegrated to 1/4" mesh to 1/8" mesh. A batch of 2 MT of this disintegrated material is fed into a still and steam is injected at 35 PSIG at the rate of 1,000 kg/hour for 12 hours, yielding 4-6% of crude oil. This oil is

then rectified. Both cedarwood oil Himalayan crude and cedarwood oil Himalayan rectified are available in the market.

In Canada, cedar leaf oil is produced by steam distillation of cedar leaves and twigs, using predominantly cedar hedge trimmings and leaves collected from the forest. Cedar garden clippings give a better yield than forest harvesting where the cedars compete with other species and the leaves are not as rich in oil. Also, greater care is given to cultivated cedar hedges, which invariably act as property borders or privacy screens. Climatic factors can affect yields considerably; heavy rain lowers yields because of the high water content of the leaves. Temperature impacts yields during the extraction process. The best weather for trimming cedar leaf is during warm days and cool nights. Extraction yields for cultivated cedar are 0.6% to 0.75% compared to 0.4% to 0.5% for wild leaves. Distillers have developed cedar leaf collection systems to ensure timely collection and processing of the leaves. Hedge trimmings are usually picked up and processed within 24 hours. Great care is taken in handling the leaves to ensure they do not dry out. One source estimated that there may be as many as 75 distillation units with wide ranging capacities. These distilleries are not limited to cedar leaf oil but rather are used to distil a variety of oils.

**Atlas cedarwood oil** is produced by steam distillation of both the sawdust obtained from wood processing as well as from the branches and roots collected in the forest by local communities. At the distillery the milling of roots and branches is undertaken. A small amount of solvent extraction is reported to take place to produce absolute.

**MAJOR PRODUCERS**

**CANADA**

Canada has been producing cedarwood oils for over 100 years, but is still a relatively small but growing producer of a range of cedarwood oils, including Eastern white cedarwood oil, Western red cedar oil and Nootka oil.

Eastern white cedar oil is sourced from the north-eastern part of Canada, throughout the Great Lakes region. It is a colourless to pale yellow oil obtained by steam distillation from the needles and twigs of the *Thuja occidentalis* tree, a member of the Cupressaceae family. This tree has scale-like leaves in contrast to the needle leaves found on Atlas and Lebanon cedars. The tree can reach 15-20 metres in height, with the foliage forming in flat sprays. The leaves and twigs are harvested between May and September with approximately 90% obtained from cultivated cedar hedge clippings and

10% from wild harvest. It is one of the longest living trees in Canada and the northern USA, living for several hundred years. It is known as the Tree of Life, in part due to its extensive medical and external uses by First Nations. The oil has a sharp, woody, camphoraceous, mentholated, fresh, green, and herbaceous profile and is used in fine fragrances and cosmetics. Annual production is estimated at approximately 50 MT which would require approximately 7,500 MT of hedge clippings to produce.

Western red cedar oil is obtained by the steam distillation of the needles and twigs of *Thuja plicata* tree found in north-western Canada along the Pacific Coast. The tree is an evergreen coniferous member of the Cupressaceae family, which reaches heights of 30 to 70 metres, and is the largest tree in the Cypress family, and it can live for 800 years. The oil is a colourless to pale yellow liquid with a woody and aromatic scent and is used in fine fragrances and cosmetics.

Nootka oil is obtained from the Nootka cypress (*Chamaecyparis nootkatensis* 'Glauca'), a tall evergreen conifer growing on the west coast of Canada and the USA. It has a very long history with the Nootka tribes of Canada. The Nootka oil is also known as Canadian oil, yellow cypress oil, and Alaska cypress oil. The sawdust is distilled and gives a pleasant strong essential oil and the nootkatone provides a pleasant grapefruit note. The *C.nootkatensis* wood is collected and subjected to fractionation and then molecular distillation. The aroma is dry woody cedarwood, cumin spicy, and somewhat leathery, minty, and thyme herbal.

**MOROCCO**

Morocco produces Atlas cedarwood oil from trees in the Atlas Mountains. Volumes are relatively small; in the 1980s annual production was estimated at less than 10 MT while current production is estimated at around 100 MT. The oil is obtained from the tree *Cedrus atlantica* (Endl.) G. Manetti ex Carriere, believed to originate from the biblical "Cedar of Lebanon," which is now a protected endangered species. While growing in the Atlas Mountains of Morocco and north-western Algeria, it is steam distilled exclusively in Morocco from the branches and roots as well as the wood, sawdust, and tree shavings from timber manufacturing. The trees can grow to a height of 65 metres at elevations from 1,400 – 2,500 metres, with a trunk diameter of 1.5 – 2 metres. Atlas cedar covers an estimated 163,000 hectares in Morocco and is now a protected species. The trees are not cultivated and unlike in India there is limited extraction of the oil from tree roots or stumps. The oil is used without being further processed into derivatives.

Harvesting takes place from March to November since during the winter months it is too cold in the Atlas Mountains. The cedarwood branches and roots are collected by cooperatives based in local communities near the growing areas. During the winter months the sawdust and other waste by-products from the cedarwood

timber manufacturing sector are used for heating but at other periods it is distilled into oil.

**Atlas cedarwood oil** is produced by steam distillation of the sawdust obtained from wood processing and from the roots and branches collected in the forest by local communities. In recent years the Moroccan Government's Department of Forests and Water has regulated access to the forest resource, alongside training local communities and facilitating the development of cooperatives. The authorities launch calls for tenders to grant operating permits to "forest operators" (*exploitants forestiers*) and cooperatives. For some cooperatives, which are basically made up of rightful claimants, the authorities allocate some plots to them by mutual agreement. In addition, the authorities involve them in monitoring work in the forest against fires or planting new trees while paying them for this work, or by deducting the corresponding amount from the amounts they must pay for the exploitation of the allocated plots.

The cooperatives and the operators cut the trees considered dead and sometimes remove some trees to make room for those left under the supervision of the authorities. Only farms have the licence to cut trunks that they bring back from the forest or that are sold to them

**CANADA:**

*pruning, preparation, and steam distillation of Thuja occidentalis*



**MOROCCO:**  
*Cedrus atlantica* and steam distillation.



SOCIO-ECONOMIC REPORT ON CEDARWOOD OILS

by the cooperatives, either directly or through calls for tenders. Trunk cutting can only take place in sawmills approved by the authorities.

Distillers turn to sawmills to get sawdust and waste to process in their distilleries to produce oil. Transportation of the wood to the distillery, as well as the oil from the distillery, requires a "Permit de Colportage de Produits Forestiers Issus Des Forêts De L'Etat ou Soumises au Regime Forestier". At the distillery the milling of roots and branches is undertaken and steam distilled and then the oil is transported to the exporter. Since the Moroccan Government initiated this procedure, the forest resource has become more sustainable. The local communities are more willing to help protect the forest resource, in part because they are benefiting through employment and income creation. Another source of cedarwood oil is the steam distillation of sawdust and trunk shavings produced as a by-product from the cedarwood furniture manufacturing industry.

**INDIA**  
**Himalayan cedarwood oil** is obtained from *Cedrus deodara* (Roxb, ex D. Don) G. Don (ISO 4720) a Pinaceae tree, which reaches heights of 50 metres - or even more. It grows at high altitude (1,650 - 2,400 metres) on the slopes

of the Himalayan Mountains, in India, Pakistan, and Afghanistan. In India the tree is found in Jammu, Kashmir, Himachal Pradesh, and Uttarakhand states. In the past, a lot of trees were cut for various products when timber extraction was legal and no one took out the roots and stumps, which take 60 - 100 years to decay. Cedarwood used to be a major source of railway sleepers for the extensive Indian railway system but this was discontinued in the early 1980s.

Himalayan cedarwood oil is distilled from the roots and stumps left after the cutting of trees for both legal and illegal timber extraction in the past or because of natural calamities. While the essential oil is found in the whole of the plant, for commercial reasons the oil is only distilled from the stumps and roots. The stumps and roots are removed in a scientific manner following agreement with the State Governments. The cedarwood forests are now protected from any unauthorised use and it is illegal to cut trees. Also, distillation from the leaves and bark is not permitted as it affects the growth of the plant.

Commercial production of cedarwood oil began in 1957 at the Drug Research Laboratory Factory at Srinagar, Kashmir. Consumption grew rapidly within India, where it found applications in the perfumery and

soap industries as an alternative to imported American Virginian cedarwood oil, and an export market developed. Up until 1980 the oil was produced mainly from waste material from the pencil and furniture industry. However, the emergence of large-scale illegal harvesting of trees resulted in the imposition of controls in the forest areas. The State Forest Departments introduced a scheme whereby private companies could harvest the tree roots remaining from prior tree felling, provided that the distillation company replanted the area with many saplings. If one stump is removed and three or four new saplings are planted then a new forest will come up in 20 years. Otherwise, it could take 60 - 100 years for the roots and stumps to decay. In addition, if the stumps were left then pathogens would develop which attacked both new germinating and old plants. Thus, removal of stumps helps protect forest hygiene and helps in germinating new trees. The distillation of the stumps makes their removal a viable proposition and facilitates the development of new forests and the local environment. In addition, the residues left following distillation are used by farmers as fertilisers in their fields. The government's policy not only led to the regeneration of many forest areas but also provided additional income to distillers, and created employment



**INDIA**  
*Himalayan cedarwood distillation unit*

as well as government revenues. All the distillation companies are in the private sector.

Annual cedarwood oil production in the late 1980s was estimated at approximately 25 MT, almost all of which was consumed domestically. Later data show larger levels of production. Thus, during 2010 - 11 and 2011 - 12 some 200 MT (valued

at US\$1.2 million) and 150 MT respectively was produced with a target for 2012 - 13 of 300 - 400 MT as the Government of Himachal Pradesh had entered into an agreement with six industries for 6,000 MT of raw material, and units in Jammu and Kashmir were also getting raw material. Annual production of Indian cedarwood oil since 2018 has been approximately 600 - 700 MT. In 2020

an estimated 600 MT of cedarwood oil was produced valued at US\$ 7.3 million, and in 2019/20 Indian Himalayan cedarwood oil exports totalled 130 MT. This compares with exports of 12 MT in 2009 - 10, 20 MT in 2010 - 11, and 30 MT during 2011 - 12. The main export markets for Himalayan cedarwood oil included the USA, Germany, Australia, Switzerland, the EU, Malaysia, and Singapore.

**INDIA:**  
*Cedrus deodara* trees, logs and boiler



SOCIO-ECONOMIC REPORT ON CEDARWOOD OILS



**SUNDAY 8 - THURSDAY 12 OCTOBER 2023**  
 INTERCONTINENTAL BERLIN HOTEL



**ifeat.org**  
 conference@ifeat.org

**JAPAN**

Cedars and conifers are grown extensively in Japan, although cedarwood oil production is very small. Large numbers of cedar were planted in many regions after World War II mainly for use as timber and wind breaks. Nakayama (2020) outlines the various cedars grown in Japan and some of their olfactory properties. The planted forests included Japanese cedar (*Cryptomeria japonica*) and various branded cedars, many of which require substantial maintenance. Local government groups and forest associations are promoting the benefits of these trees including use as an essential oil, the development of cedar plate ware and the use of woodchip powder in food. In addition, the leaves are dried and used for incense sticks, though its use has decreased as the number of workers collecting branches and leaves has shrunk due to the time-intensive process of forest harvesting. Japanese cedar has a distinctive aroma and is used to scent sake via storage of this alcoholic beverage in cedar barrels.

Efforts are continuing to be made to extract essential oil from Japanese cedar (*Cryptomeria japonica*) utilising branches and leaves from forest thinning, which the landowners carry out of the forest along with the timber. Extraction of the cedar oil from the sawdust is difficult because of low yields. Also, essential oils are extracted from

popular Japanese cypress trees namely hinoki (*Chamaecyparis obtuse*) and hiba (*Thujopsis dolabrata*) using waste from timber processing operations. Hinoki, means "white cedar." A different connotation is "fire tree" as it is still utilised to make fire through friction in traditional Shinto shrines. Production of hinoki oil is very small but distillery capacity has been increased along with improved quality control.

**SOCIAL AND ECONOMIC CHARACTERISTICS**

**India**

An estimated 400 – 500 local people are employed in the harvesting and production of cedarwood oil and their families are provided with health care, education, and water purification. In addition, there are other ancillary industries and services involved that benefit. As outlined earlier, government policies have helped to generate replanting of cedarwood and the creation of an economic resource to generate future incomes, employment, and government revenues.

**JAPAN:**  
 Hinoki branches and log



**Morocco**

The tree has been important in the socio-economy of Morocco, being good for furniture making. In addition, the harvesting and distilling of cedarwood oil generates income in the rural economy. No data were available on employment and income generated.

**ENVIRONMENTAL AND SUSTAINABILITY INITIATIVES**

Economic utilisation of a renewable resource is usually beneficial but considerable care needs to be taken. For example, East Africa used to be an important source of cedarwood oil but over-exploitation of the wild resource has led to negligible production. Ideally exploitation of wild trees is only warranted where there is a high degree of natural regeneration or where the plant is considered a weed. In these cases, some form

of controlled, semi-formal cultivation might be possible. Utilisation of trees to produce various cedarwood oils is increasingly subject to government controls to minimise over-exploitation.

Canadian oil producers used to harvest the leaves of *Thuja occidentalis* directly from the boreal forest. Today the cedar tree has become a very popular ornamental shrub in Canadian gardens. These shrubs require yearly trimming to ensure optimal growth. Instead of sending tonnes of cedar leaf clippings to landfills, high quality oils can be made from these trimmings. Recycled cedar leaf oil is a waste-free, sustainable and non-destructive process. Every part of the cedar leaf clipping is used, including the dregs of the extraction process.

Alongside the direct economic and social benefits generated by the sector, there are important environmental and sustainability contributions. Increasingly initiatives are being undertaken in the sector facilitating greater sustainability and assisting in combating climate change.

Many cedarwood oils are obtained from wild trees but little information is published on the extent to which oil production may have affected the natural resource. For a variety of reasons, e.g., population growth, urbanisation, over-exploitation and deforestation, the available resource has declined. A prime example is Kenya where over-exploitation of the timber

and oil has led to a serious depletion of the wild trees.

Some cedarwoods are cited under CITES (the Convention on International Trade in Endangered Species). These include Atlas cedar (*Cedrus atlantica*) from Algeria and Morocco marked as "endangered," Spanish cedar (*Cedrela odorata*) from many origins marked as "vulnerable," Port Orford cedar (*Chamaecyparis lawsoniana*) marked as "near threatened," and Virginian and Himalayan cedars marked as being of "least concern."

Atlas cedarwood is on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species as endangered. With some estimates reporting declines of up to 75% natural occupancy in recent years. Drought has also led to further declines and it is likely to continue if the regional climate continues to become more arid. Cedarwood is slow-growing, which means once the wild population has been diminished it takes decades, if not centuries, to regrow. With the boom in demand for natural products for the aromatherapy and natural markets a heavy demand has been placed on the supply to meet the needs of today's consumers. This has added strain on an already fragile species.

**India**

As outlined in the India section above, the regulation of cedarwood felling, as well as the extraction of tree stumps and roots to extract oil, has led to considerable environmental benefits alongside the economic benefits of employment and income creation. The environmental benefits include the generation of new forests and all the benefits that this creates, as well as a reduction in pathogens and creation of residues for use as fertiliser.

**Morocco**

Cedarwood Atlas trees are well conserved in specific areas of parkland, but the ecosystem is

very fragile and the margins are subject to degradation by erosion, demineralisation, dehydration, desertification, etc. resulting in areas of complete desolation. Various organisations in Morocco are reported to be doing all they can in very difficult circumstances to conserve the rich biodiversity of plants in Morocco. In addition, the cedarwood forests provide habitat for the endangered Barbary macaque.

**Canada**

Estimates of the employment generated are not available. Alongside the benefits from utilising a renewable resource, the fact that the majority of cedarwood oil is obtained from hedge trimmings that would otherwise go into landfill should also be considered. Gardeners cooperate in the recycling process by gathering their trimmings for collection and in return can obtain free of charge the residues from the extraction process. This mulch makes very good organic fertiliser and insect repellent for the soil as well as providing a thermal shield to keep the soil cool and restrict weed growth. The mulch is also sold to garden centres. In 2008 it was estimated that one Canadian distiller saved the local authority it served between \$61 and \$86 per tonne of leaves that would otherwise have ended up in landfill or an estimated total of \$122,000 – \$172,000 a year in garbage collection fees, as well as the savings associated with the unused area in the landfill.

**SOME CONCLUDING REMARKS**

There are dozens of tree species that have the common name "cedar" and they cover hundreds of thousands of hectares of the world's surface. Trees are vital for our planet, providing oxygen, storing carbon and slowing the rate of global warming, stabilising soil and reducing flooding, lowering temperatures, providing a habitat for wildlife, and providing timber and other materials for a wide range of economic uses. It is critical that they are preserved and sustainably managed. The production of essential oils is one of the ways that trees can be utilised to provide an economic resource to facilitate the sustainable management of the resource.

Cedarwood oils are some of the world's most important essential oils and produced in a diverse range

of countries. Three main genera, namely *Cedrus*, *Cupressus* and *Juniperus* spp. account for a large proportion of commercial cedarwood oils, alongside some other minor sources. Sadly, information and data on the socio-economic contribution of cedarwood oils to these economies is limited. Nevertheless, they provide important sources of income and employment, as well as export earnings, in the various rural communities where various types of cedarwood and cedar leaf oils are produced. This includes Canada, China, India, Morocco, and the USA. The raw material is invariably harvested from the wild. In the two major producing countries of China and the USA, as well as Canada – the continued availability of raw material is not of major concern. However, in Kenya the resource has become almost totally depleted.

Alongside the direct economic and social benefits generated by the sector there are also important environmental and sustainability contributions. Increasingly initiatives are being undertaken in the sector facilitating greater sustainability and assisting in combating climate change. In both India and Morocco the authorities have introduced measures to protect cedarwood from total eradication. In Morocco a quota is set for how many trees can be felled each year and only dead trees can be taken from the forest. New plantations are also being introduced to re-grow the cedarwood forest and early indications are promising. In India initiatives to replant cedar have been underway much longer and are proving to be successful. Nevertheless, it is so important to source sustainability, with producers and consumers being more mindful of the damaging effects of the products they consume.

**BIBLIOGRAPHY**

Boucard, Gueric and Garrick (2016) *Recent advances in the steam distillation of essential oils*, Texarome, USA.

Burfield, Tony (2002) *Cedarwood Oils Part 1.2*, and 3 *Aromatherapy Times*, Vol 1 No.55 pp14-15 Winter 2002, No.56 pp14-16 Spring 2003, No.57 pp 16-18 Summer 2003.

Chen, Doing Xia Cathy (2006) *Status and development of China's aroma chemicals manufacturing industry*

paper presented at the IFEAT international Conference in Budapest, 30 October 2006 pp.

FAO (1995) *Non-Wood Forest Products: Flavours and fragrances of plant origin*, by JJW Coppen Chap. 10 Rome.

Greenhalgh, Peter (2017) IFEAT USA Study Tour 13th – 21st August 2016 pp. iv + 131.

Lawrence, B.M. (1980) *Cedarwood oil*. *Perfumer and Flavorist*, 5(3), 63.

Lawrence, Brian M (1976-2017). *Essential oils*. Carol Stream, IL: Allured Publishing Corporation, USA.

Mohan, Surendar (2011) *Natural essential oils from the western Himalayas: their role in fragrances and flavours, quality parameters, sustainability, and conservation*. Paper presented at the IFEAT international Conference in Singapore, 4 - 8 November 2012 pp.63-81.

Mike Milchard et al (2019) *Application of Gas-Liquid Chromatography to the Analysis of Essential Oils: Fingerprint GLC of selected Texas, Virginia, China, Atlas and Himalaya cedarwood essential oils intended for REACH registration*. *Perfumer & Flavorist* November 2019 pp. 30 - 42.

Nakayama, Hiro (2020) *The Olfactory Power of Japanese Cedar*, *Perfumer and Flavorist* January 2020 pp. 34 - 37.

Pierre Trahan (2008) *Cedarleaf Oil from Thuja Occidentalis* IFEAT Montreal Conference September - October 2008 pp. 199 – 204.

Ramakant Harlalka (2005) *Essential Oils from India's Forestry Sector* IFEAT Cochin Conference October 2005 pp.32 - 37.

Ultra International BV (2018) *Healing With Hinoki/Scents of Healing Market Report* Spring 2018.

**ACKNOWLEDGEMENTS**

IFEAT would like to acknowledge the information and photos provided on India by Surender Mohan of Natural Biotech Products, the largest producer of Himalayan cedarwood oil; Morocco by Amine Bennani of Santis SARL and Jalal Charaf of Atlassence; Canada by Eloi Zayat and Mikael Zayat; Japan by Geoffrey Henrotte of HinokiLab Co., Ltd.