Section FOUR

# Trade in *Boswellia* species

The key to understanding whether any taxon will benefit from a CITES listing is to determine whether international trade poses a threat to the continued existence of that taxon. Therefore, the amount of global trade is often cited as a measure of such a threat. This is clearly justifiable where individuals of the taxon in question are killed or significantly damaged during the harvesting process. In the case of timber, the volume of trade can be directly linked to the number of trees and areas felled; in the case of herbaceous plants this can be linked to the removal of plants from natural habitats and their disappearance or reduction at monitored sites (eg. orchids harvested to make salep, Ghorbani *et al* 2014, Kreziou *et al* 2016; jatamansi harvested in the Himalayas, Smith-Hall *et al* 2023).

Frankincense has been a valuable commodity for thousands of years. Used in religious rituals, traditional medicine, perfumery and personal care products, frankincense remains a significant product in global trade. The trade in frankincense is a complex interplay of ecological, economic, and cultural factors; while it provides livelihoods for many and supports important global markets, overharvesting, habitat loss, and inequitable supply chains threaten the long-term sustainability of *Boswellia* species. Addressing these challenges requires concerted efforts from producing, importing and re-exporting countries, international organisations, and the private sector to ensure that this trade continues to thrive in a sustainable and equitable manner.

While the harvesting of resins from frankincense trees does not directly kill the plants, if undertaken at unsustainable levels it can seriously damage individual plants directly as well as encouraging damaging insect activity. Over longer time periods, this can also reduce trees' ability to flower, fruit and reproduce which can lead to local declines and extinctions. Several publications have highlighted that traditional harvesting communities have developed sustainable harvesting protocols, and also that some species can only be harvested by collecting naturally exuding resins as cutting the stems does not induce additional resin production. However, it is clear that there are many instances of unsustainable harvesting including observations of de-barking that produce both short term and long term effects. It is for this reason that CITES has taken an increasing interest in the frankincense trade, in order to ascertain whether a listing in the CITES Appendices could be beneficial in ensuring frankincense is harvested and traded sustainably.

There are therefore several questions to be addressed when considering whether the global trade in gums and resins poses a threat to *Boswellia* species and whether that threat warrants a CITES listing proposal - and whether such a listing would be beneficial in regulating trade to the benefit of the trees and the communities that depend upon them.

Section 5.1

## Is it possible to estimate trade in *Boswellia* globally?

It is clear from a wide range of sources that trade in *Boswellia* spp. is extremely complex. This complexity ranges from not knowing which species are being harvested, through complex and variable supply chains, through a lack of specificity in tracking traded items, all within the added complexity of numerous countries involved in supply, export, import and tracking. Below are outlined more specifically some of the challenges in tracking and quantifying trade in *Boswellia* and its products.

*Challenges in trade monitoring*

Firstly, frankincense is derived from several *Boswellia* species and the absence of species-specific tracking codes or the requirement to report at the species level complicates efforts to monitor the exploitation levels of particular species, increasing risks to sustainability. Tracking codes that can include several species increase the risk that while some species are not threatened by over-harvesting others may be under extreme threat but without the ability to track the effect that trade contributes to that threat.

General reports and cursory examinations of trade data suggest that only a few species of *Boswellia* are harvested on a commercial scale. *B. sacra* from Somalia, *B. papyrifera* from Ethiopia and *B. serrata* from India make up the majority of global trade. However, almost all the 24 species of *Boswellia* are traded to some degree and until now there is little information as to how these trends might change due to industry pressure. *Boswellia* products are used in a wide range of industries, and it is difficult to predict how fashions and uses might change and therefore what impact this would have on individual species.

In broad terms, there are some major market directions that can be ascertained from global trade data coupled with a large number of specific studies in range States. The European Union and the United States dominate demand for processed frankincense oils, while countries in the Middle East and Asia primarily import raw resin.

The source of the raw resins and the essential oils depends on which species grow where and the location of processing plants. The main species in trade are as follows:

- *Boswellia sacra* - Oman, Yemen, and Somalia. The main exporter is Somalia, encompassing Puntland and the autonomous region of Somaliland which supply the majority of the resource.
- *Boswellia papyrifera* - mainly harvested in Ethiopia, Eritrea, and Sudan but also occurs in Nigeria, Cameroon, Chad, Central African Republic, South Sudan and Uganda.
- *Boswellia serrata* - endemic to India.
- *Boswellia frereana* - endemic to Somalia.
- *Boswellia neglecta* - mainly harvested in Kenya but also found in Tanzania, Uganda, Ethiopia and Somalia

Major regional trade hubs are as follows:

- Middle East: a major market for frankincense, particularly for religious and cultural use. United Arab Emirates is a central hub for re-exporting frankincense, especially to Europe and Asia. Oman, Yemen, and Somalia supply significant volumes.
- Europe: the largest importer of frankincense for perfumery, aromatherapy, and pharmaceutical industries.
- United States: an increasingly large market due to the popularity of essential oils and natural remedies.
- Asia: China is an important consumer, for domestic use in traditional medicine and incense as well as for re-export.

Frankincense trade involves multiple intermediaries, including harvesters, local traders, exporters, and international buyers. These fragmented supply chains lead to reduced traceability of products back to their source, making it challenging to ensure sustainability and ethical sourcing practices and leaving significant volumes unaccounted for.

Some regions experience unregulated harvesting and informal trade networks, further complicating efforts to monitor and regulate the trade. Informal and undocumented trade

accounts for a significant portion of the market, especially in East Africa; without proper data it is difficult to implement conservation measures and ensure fair trade practices. Few, if any, countries have robust frameworks to regulate frankincense harvesting and trade.

Tracking trade in frankincense is further complicated due to the lack of specific global Harmonized System (HS) codes for these products. HS codes, maintained by the World Customs Organization, classify goods traded internationally, enabling statistical data collection and trade monitoring. However, frankincense often falls under broader categories such as general trade categories like "essential oils not elsewhere specified" or "gums and resins" making precise tracking difficult and limiting the ability to assess volumes accurately.

Some countries (eg. China, Saudi Arabia, India) and regions (eg. Gulf Co-Operation Council) have more specific codes but these still do not operate at the species level: for example India uses the code HS13019032 "olibanum and frankincense" but many entries in global databases do not explicitly state which species are being traded. It is inaccurate to assume these are *B. serrata* because this species is endemic to India as these data may contain re-export data and India also imports *Boswellia* from a range of supplying countries. Essential oils are often traded via alternate HS Codes further complicating the trade data.

*Existing methods of tracking trade*

Estimating the amount and value of global trade of frankincense using bills of lading (shipping documents) involves aggregating data from export and import declarations. This process offers insights into trade volumes and monetary value but requires extensive data collection from customs, trade databases, and shipping records. To ensure an accurate and comprehensive analysis of trade data, it is essential to cross-reference information from multiple data mining firms. Each firm tends to have gaps in its coverage of data fields, particularly as reflected in bills of lading. Even when these datasets are available, extracting relevant information is an extremely labour-intensive process. Mixed-container shipments, which often include diverse items, are especially challenging due to inconsistent or vague product descriptions provided by exporting and importing companies. Furthermore, inaccuracies in the use of Harmonized System (HS) tariff codes compound the difficulty of identifying specific goods, requiring meticulous effort to resolve discrepancies and validate the data.

Several companies provide services to access bills of lading data. The most comprehensive service, Panjiva (https://panjiva.com/) no longer offers monthly trial subscriptions and has an annual subscription fee of USD $10,000 which is beyond the scope of this project and certainly beyond the scope of many non-commercial users. Other services include Zauba (https://www.zauba.com/) which requires a monthly subscription of USD $99 or annual subscription of USD $799. Zauba only allows visualization of the first 20 records of each search for free. Export data from India under HS 13019032 revealed that only two of the 20 transactions visualized mentioned *B. serrata* by name, and 15 different countries received shipments. ImportKey (https://importkey.com/) allows access to US Bills of Lading starting at USD $29.99 per month for startups with no options for free trials. It is also possible to search some country specific services online, although these are often time and date limited. One example is Import Export Data (https://www.exportimportdata.in/) which shows data from India. A search for HS13019032 allowed visualisation of the first 50 entries (eg. from 1 December 2015 until 24 November 2016), of which only six mentioned *B. serrata* by name.

Data recorded by Volza (https://www.volza.com/) can be accessed under a free trial before incurring an annual fee of USD $1500. Data was accessed under a free trial covering exports of *Boswellia serrata* from India was analysed for a two-month period 2 January 2024 – 2 March 2024. 24 countries imported products and derivatives of this species over this period, with a total of 38,725 kg exported, included in nine HS codes, several of which were unidentifiable or

no longer in current use. The value of these products was around USD $1,607,000. The main importers were the US, China and the EU.

*EU Trade following the listing of the genus in Annex D of the EU Wildlife Regulations*

All *Boswellia* species were listed by the EU in Annex D of the EU Wildlife Trade Regulations (EU WTR) on 19 January 2022. Importer reported data is currently available on the CITES Trade Database for the years 2022-2023. Countries are required to report at a species-specific level, but some importer countries, notably France, appear to only report at the genus level. Most products are reported as extracts or powder, but other terms include derivatives, wax, dried plants and plywood. Trade is mainly recorded in kg.

EU recorded trade totalled 128,135kg. The main exporters are India (37,744 kg of *B. serrata*) to Germany, Belgium and Italy; Sudan (32,000 kg reported as spp.) to France, and Somalia (30,000 kg, reported as spp.) to France. The next largest exporter is Egypt, which is not a range State, reported as 10,000kg of spp. to France. The main importer is France (79,879kg) followed by Germany (33,804kg).

The inclusion of the genus in the EU WTR enables a more accurate trade analysis than any other available platform and is a vital component in assessing the global trade of frankincense.

Section 5.2

## Case study: *Boswellia* in the cosmetics and personal care industry in Europe

*Boswellia* is a genus in the Burseraceae family and is well-known for the longstanding use in trade of its resin as frankincense. The genus contains 24 species of which five appear dominant in trade. Although currently no *Boswellia* species are CITES-listed, the substantial national and international usage as well as a continuously increasing demand has led to concerns regarding the sustainability of the trade. Gaining an overview of the total amounts traded is challenging, since the unified trade codes for frankincense are often non-specific and are aggregated with other natural gums and resins. Moreover, a substantial amount of *Boswellia* resin is obtained from areas where it has been difficult to conduct research over the past decades.

As HS Codes are not uniformly applied and do not track data at the species level, in order to assess whether alternate methods can be used to track the amount of trade in Boswellia resins and products this review aims to give an overview of the use of *Boswellia* by the cosmetics and personal care industries in Europe. In order to obtain data on the amounts of *Boswellia* material used in this industry, companies were contacted and asked to complete a survey on their use and trade of *Boswellia*.

The survey questionnaire is given in Appendix 5.1.

*Cosmetic and personal care product nomenclature*

Frankincense is a valued oil in aromatherapy and is increasingly used in cosmetics and personal care products. Products which contain derivatives of *Boswellia* are body oils, face creams, face oils, lipsticks, moisturizers, night creams and serums. In the European Cosmetic Ingredient Database (CosIng) a total of 28 *Boswellia* ingredients are listed: *Boswellia carteri* bark powder, gum, gum absolute, gum extract, gum oil, gum water, oil and resin extract; *Boswellia frereana* resin, resin extract and resin oil; *Boswellia neglecta* resin oil; *Boswellia papyrifera* resin oil; *Boswellia papyrifera/sacra/serrata* resin extract; *Boswellia sacra* bark, resin/gum extract, resin oil, resin water; *Boswellia serrata* extract, gum, gum extract, leaf cell

extract, oil, resin extract, water; olibanum; *Saccharomyces/Boswellia serrata* gum ferment extract. This includes four that have been added since this case study was compiled.

| INCI Name/ Substance Name | CAS | EC |
|---|---|---|
| *Boswellia papyrifera/sacra/serrata* resin extract | | |
| *Boswellia carterii* bark powder | 89957-98-2/ 1491152-64-7 | 289-620-2 |
| *Boswellia serrata* gum | 97952-72-2 | 308-366-6 |
| *Boswellia frereana* resin extract | | |
| *Boswellia carterii* gum water | 89957-98-2 | |
| *Boswellia serrata* oil | 97952-72-2 | 308-366-6 |
| *Boswellia serrata* resin extract | 97952-72-2 | 308-366-6 |
| *Boswellis serrata* extract | 97952-72-2 | 308-366-6 |
| *Boswellia frereana* resin | | |
| *Boswellia serrata* gum extract | 97952-72-2 | 308-366-6 |
| *Boswellia carteri* resin extract | 89957-98-2 / 8050-07-5 | 289-620-2 / 232-474-1 |
| *Boswellia carteri* oil | 89957-98-2 / 8050-07-5 | 289-620-2 / 232-474-1 |
| *Boswellia neglecta* resin oil | | |
| *Boswellia sacra* resin oil | | |
| *Boswellia frereana* resin oil | | |
| *Boswellia papyrifera* resin oil | | |
| *Boswellia sacra* gum/ resin extract | | |
| *Boswellia serrata* leaf cell extract | 97952-72-2 | 308-366-6 |
| *Boswellia serrata* water | 97952-72-2 | 308-366-6 |
| *Boswellia papyrifera* resin water | | |
| *Boswellia sacra* resin water | | |
| *Boswellia carterii* gum extract | 89957-98-2 / 8016-36-2 | 289-620-2 / 232-474-1 |
| *Boswellia carterii* gum oil | 89957-98-2 | 289-620-2 |
| *Saccharomyces/Boswellia serrata* gum ferment extract | | |
| *Boswellia carterii* gum | 89957-98-2 | 289-620-2 |
| Olibanum | 8050-07-5 | 232-474-1 |
| *Boswellia carterii* gum absolute | 89957-98-2 / 8016-36-2 | 289-620-2 / 232-474-1 |
| *Boswellia sacra* bark | | |

Table 5.1. CAS, EC and INCL numbers relating to Boswellia ingredients in the EU.

The CAS[1] numbers, EC numbers[2] and INCI[3] names (the latter used in the fragrance and cosmetic and personal care industries) for frankincense, covering various species and forms (extracts, resinoids, oils) are listed in Table 5.1. However, these numbers are not a guarantee of ingredient safety or that such ingredients comply with any laws or regulations. Ingredients can be added to the database by submitting a proposal and paying a small fee but are otherwise unregulated.

*Extraction process*

Resin destined for the fragrance, cosmetic and personal care product and aromatherapy industries is converted to a resinoid using solvent extraction, either hexane and/or ethanol, to a resin absolute following filtration and vacuum concentration of the resinoid and to an essential oil by steam distillation or supercritical fluid extraction using carbon dioxide, methanol and ethanol. Distilleries are located in the EU (France, Bulgaria, UK) and China, Oman, Kenya and Saudi Arabia, amongst other countries. The constituents of frankincense oil vary according to the climate, harvest conditions and geographical sources of the frankincense resin. One estimate is that it is composed of about 4–9% essential oil, 50–85% alcohol-soluble resins, and the remaining water-soluble gums.

*Commercially traded forms*

Not all of the 28 *Boswellia* ingredients listed in the CosIng database seem to currently be in use. *Boswellia sacra* and *Boswellia serrata* appear to be the most common and *Boswellia sacra* is still often traded under the name *Boswellia carterii*.

*Survey data*

A survey was sent out to companies selling *Boswellia* products in the cosmetics and personal care, fragrance, essential oil and extraction industries in Europe. The companies were either approached through their trade organisations such as FEBEA[4], CTPA[5] and EFEO[6] or directly (111 companies). Surveys were also sent out to companies that were mentioned as suppliers by others and had not been contacted before. Responses were poor; in total 17 companies filled out the survey and one company provided information through email, although in some cases not all questions were answered. All but two of these companies were located in Europe.

[1] Chemical Abstract Service (CAS) numbers are universally used to provide a unique, unmistakable identifier for chemical substance. They offer a reliable, common and international link to every specific substance across the various nomenclatures and disciplines used by branches of science, industry, and regulatory bodies. Almost all molecule databases today allow searching by CAS Registry Number

[2] An EC number (European Community number) is a unique identifier assigned to chemicals commercially available within the European Union, used primarily for regulatory purposes within the EU

[3] INCI (International Nomenclature of Cosmetic Ingredients) names are used in the United States, the European Union, China, Japan, and many other countries, for listing ingredients on cosmetic product labels.

[4] FEBEA - Fédération des Entreprises de la Beauté.

[5] CTPA - Cosmetic Toiletry and Perfumery Association

[6] EFEO – European Federation of Essential Oils

*Boswellia carteri* oil

Description: *Boswellia carteri* oil is the volatile oil obtained from the Boswellia carteri, Burseraceae

Functions: fragrance, tonic.

CAS Number: 89957-98-2 / 8050-07-5

EC Number: 289-620-2 / 232-474-1

Finished product types: body oils; face creams; facial oils; moisturizer; night creams; serums


Figure 5.1. Selection of finished products containing *Boswellia carteri* (syn. of *Boswellia sacra*) oil.

*Boswellia serrata* oil

Description: *Boswellia serrata* oil is the oil obtained from *Boswellia serrata*, Burseraceae

Functions: fragrance, skin conditioning

CAS Number: 97952-72-2

EC Number: 308-366-6

Finished product types: face creams; lipsticks; serums


Figure 5.2. Selection of finished products containing *Boswellia serrata* oil.

*Species and amounts traded*

Most companies (70.5%) only used *Boswellia sacra*, three companies (17.5%) used both *B. sacra* and *B. serrata* and two companies only used *B. serrata* (12%). The reported annual quantities for *B. sacra* differed substantially between companies and ranged from 0.3kg to 100kg. For *B. serrata* the quantities ranged from 25kg to 5000kg (however 20,000kg was mentioned by one company for the annual quantity of *B. sacra* and *B. serrata* combined). The use of *B. frereana*, *B. neglecta*, *B. papyrifera* and other species was not reported, although these were listed as

options in the surveys. Further online research indicates that several essential oil companies based in Europe offer oil from *B. sacra*, *B. neglecta*, *B. serrata*, *B. rivae* and *B. dalzielii*, ranging in price from Euros 9/10ml (*B. serrata*) to Euros 36/10ml (*B. neglecta*).

*Supply chain*

Eight companies state that they rely on a single supplier for all their material and nine rely on multiple suppliers. Somalia is mentioned as a source country for *Boswellia sacra* by 11 companies (69%), sometimes specified as Somaliland or Puntland and sometimes together with other source countries. Oman is mentioned twice as source country, Ethiopia once and European resellers are mentioned twice, but without the source country. *Boswellia serrata* is all reported to be sourced in India.

The supply chain for *Boswellia sacra* used by the cosmetics and personal care industry generally consists of four to five components: local/nomadic harvesters tap the trees and collect the resin, the resin is accumulated in collection centres in the source country, followed by cleaning and grading by large companies (often in the source country as well), which in some cases refine and distil the material themselves, but often export the material for extraction and downstream use. Occasionally the grading is done overseas as well, for example in Saudi Arabia. Although the multistep approach describe above seems to be common, some companies report a two-step supply chain, with only the harvesting collective in between them and the harvesters. In total 11 suppliers were mentioned in the surveys. All were contacted, however only two filled out the survey.

*Perceived availability and sustainability*

When asked about the availability of *Boswellia* raw material, one of the companies describe the current situation as acceptable and all other companies as normal to good. The cosmetics and personal care companies describe that they have not experienced any fluctuations in price, whereas all but one companies in the fragrance industry report that they did experience a strong price increase in recent years, linked to the increased demand of the aromatherapy industry or to climate issues and war in neighbouring countries. With regards to the perceived sustainability of the product most of the companies report that this is unknown to them, but some report that action has already been taken to address this and that local stakeholders are aware of the sustainability issues. One of the companies describes *Boswellia sacra* as being at medium risk, mainly due to over-tapping. All *Boswellia* material is reported to be harvested from the wild, although one company sourcing from Oman mentioned that plantations are increasing, that the government does not allow the export of large amounts of resins and that all processing needs to happen in country.

*Methods of extraction*

The most common extraction methods mentioned in the survey were steam distillation and solvent extraction. Steam distillation is mainly used for the production of essential oil and is mostly reported to have a yield of 5.8% to 8% (one company reported a 16.7% to 25% yield). Solvent extraction is used for the production of resinoids and absolute and has a reported yield of 55% to 75%. The obtained resinoid can also be further extracted to produce oil. For solvent extraction ethanol and hexane are commonly used, but sometimes supercritical fluid extraction is used to produce certain odour profiles. The different extraction procedures for *Boswellia* each result in their own distinct chemical profile and thus fragrance, depending on which chemical groups are stripped during the extraction. Less frequently mentioned methods were drying, grinding, maceration and the solubilisation of gum powder.

*Conclusion*

This case study highlights many knowledge and information gaps. As noted, responses to the survey were poor despite the engagement of the trade associations, and confidentiality concerns over releasing details of supply chains led to a lack of transparency. Despite a niche market for the lesser-known species, it appears that this industry, in particular the fragrance sector, relies heavily on one or two species, due to the necessity of producing a consistent odour, and it seems unlikely that this will change in the future. The majority of respondents indicate that prices for the raw material have remained relatively stable over the past few years. However, knowledge and due diligence regarding supply chains appear lacking throughout the industry and further research is needed in both importer and exporter countries to understand the levels of compliance with relevant national and international legislation and management measures.

Case study – Fragrance industry

Company A is a large, international fragrance manufacturer which makes perfume for different brands. They produce fragrance to be used in the following end products:

- Fine fragrance
- Cosmetics and toiletries
- Oudh for use undiluted
- Candles
- Reed diffusers
- Pot pourri
- Refresher oils

They only use *Boswellia carterii,* a synonym of *B. sacra*; no other species is used due to differences in odour. The product they buy has CAS number 8016-36-2, defined as 'olibanum, oils'; all the necessary chemical processes are carried out on the resin by their supplier pre-purchase.

The resin is sourced from Somalia, Somaliland and Ethiopia; however, it should be noted that this species occurs only in Oman, Somalia (Somaliland and Puntland) and Yemen. The gum is collected by nomad communities by tapping the tree and collecting the exudate, at this stage called "tears", which are sold on to local buyers or collectives, who buy and sell in commercial quantities. The big producers then buy from several collectives, clean, sort and grade the gum into four qualities and further refine the material into resinoid, absolute and essential oil, either in country or abroad. As far as Company A are aware, the nomads are not the owners of the trees and Company A is not aware of any regulations regarding tapping control; they state that Nagoya Protocol compliance is managed by the collective. As users of the end product, they only keep paperwork from their immediate supplier.

They use less than 200kg of oil a year, and as they are only one of many other fragrance manufacturers, they are unaware of the annual global use of this product by their industry.

Section 5.3

## Is estimation of global trade in *Boswellia* reliable and relevant?

The short answer to this question is no and no.

It has been demonstrated above that due to a variety of factors it is almost impossible to calculate with any degree of accuracy what the total amount of trade in *Boswellia* products is on a species-by-species basis. This includes lack of specificity, lack of consistency in reporting standards, and a low response from commercial entities as to revealing trade amounts and types.

The second part of the question is more conceptual. It can easily be argued that even with the minimal data available it is possible to say that there is "significant" trade in *Boswellia* products globally, but little attempt has been made to quantify what is meant by "significant". When assessing the tropical timber trade, it is more simplistic and realistic to be able to estimate the volume of timber extracted based upon estimates of the number and size of trees of a given species in a given area, and that the existence of timber in trade equals trees that have been felled – at times illegally. However, the "standing crop" of resin that can be harvested from *Boswellia* trees is extremely difficult to calculate accurately and as such it is difficult to say what amount of trade globally – and locally – could be considered sustainable.

For example, for each species of *Boswellia* in trade, it is possible to obtain estimates of how much resin can be harvested or gathered from each tree annually, and then to average these estimates across larger areas given data on tree size and population level estimates of tree size as well. There are very few studies that accurately predict the density and size range of trees across such large ranges. Both these measures would need to be averaged over large areas to estimate how much resin can be harvested. In reverse, the amount of resin and essential oil traded globally could be measured (but currently they cannot, due to the issues mentioned above) although in the case of essential oils the yield from a given quantity of resin – which is extremely variable and also methodology dependent – would need to be estimated also. All these measures would need to be averaged over huge areas, and the resulting estimates would have large error bars and uncertainties associated with them. Little confidence can be placed in data extrapolated in this way.

The inevitable conclusion is that knowing the amount of trade is extremely difficult to reconcile with whether that trade is a threat to the species in question. The exception is those species that are known to be rare in terms of either numbers of individuals or in area of extent – any trade, whether local or global, is likely to be a threat especially if a significant increase in that trade occurs through marketing. Obvious examples are the endemic species on Soqotra, and those species that have limited ranges.

Section 5.4

## How does the amount of global trade compare with the amount of local trade?

Given that the threat to any species of *Boswellia* – or indeed any species that is harvested for its resin – is the act of harvesting itself and whether this is done sustainably or not, it is necessary to gather information on the total amount harvested rather than just that in international trade. While it is almost impossible to calculate the exact amount in global trade, this is clearly a significant amount but whether that is a significant portion of the total amount harvested remains unknown. This is because while trade can be recorded through the use of country or species-specific HS codes, local trade falls outside that system. To our knowledge, no range State has enforced legislation in place that records in detail the amount of resin

harvested for any species, let alone how this relates to what could be conceived as a sustainable total annual harvest.

Many range States have reported on the amount of trade in frankincense and other resins, most often through State Statistics Offices. However, these rarely contain any detailed information on how such data was gathered and how reliable it is believed to be. Further, these often refer to trade amounts rather than harvesting amounts. There are numerous publications and reports that state that trees are in poor condition largely through over-harvesting and in some cases de-barking but rarely have formal measures of the significance of this been collected or published: decision makers currently must rely on the opinions of "experts" rather than data gathered locally with local incentives for sustainable practices.

There are mechanisms available that could be used to gather such information while at the same time ensuring that total harvest amounts are recorded and the comparison between local and international trade can be calculated.

(i) Firstly, a licensing system could be implemented. This might involve a local State department issuing licenses to harvesting communities, cooperatives or companies which requires them to report on the amount of resin harvested and in which areas. This would further enable monitoring as a requirement to survey and monitor tree health and harvesting amounts and times could be included. The negative aspect of such a system would be that some staff and capacity to implement it would be required, although if it were extended to additional species for which resins and gums are harvested then both sustainable harvesting and conservation of tree resources could be ensured which may add a premium to prices obtained by harvesting communities. There are already examples of local companies that record such information voluntarily, but currently this is by no means ubiquitous.

(ii) Secondly, blockchain analyses have been promoted as a transparent way to enable sustainable resin supply chains. These systems use technology to track all transactions in the supply chain, from harvest through all financial transactions and trades. The negative aspects of such a system are twofold: firstly, there is no in-built requirement for tree monitoring and sustainable levels of harvesting as this is left to supply chain actors to implement, and secondly this system is most often implemented by commercial entities from outside the range States which can be viewed as a negative concept to local actors. The same argument can be levelled at certification schemes that cost local actors to implement, and very few studies have calculated the benefits of enhanced prices through certification against the cost of that certification.

Some range States have in the past established groups to promote, monitor and research the gums and resins trade because these are such high value commodities for local communities and in some cases national exports. Some States are going through the process of establishing such groups. Information sharing among *Boswellia* range States is to be encouraged, with lessons learned from experiences shared being advantageous.

## Section 5.5

## Is it possible to tell which species of *Boswellia* are being traded?

The answer is both yes and no, but realistically not in enough detail to target conservation actions.

*Boswellia* resins and products are very often sold with the species of *Boswellia* noted and used as a selling point, so it is relatively easy to demonstrate that all but a few very rare species can be purchased directly. However, the levels of trade differ considerably by volume, and while

products are sold with the species names attached to them this is not the case in most trade tracking systems currently implemented.

Further, because a species is endemic to a particular country does not mean it can be assumed that all trade from that country represents that species. Trade tracking systems do not detail whether articles are directly exported or re-exported, and a number of range States also export species that are not native there. Further, both resins and derived products are re-exported, often under different HS Codes.

Section 5.6

## Conclusions and recommendations

While trade data on its own has little conceptual value in assessing whether a specific volume of trade in gums and resins poses a threat to particular species, except where that species is named and is known to be extremely limited in extent and in number (eg. endemic taxa on Soqotra), it can have additional value. For example, accurately estimated figures of national trade in terms of income can give a measure of importance to that State and the communities and businesses that trade supports.

Knowing how much global trade is exported from each state has value if there is an accurate estimate of total harvesting quantity, as then a measure of local vs global trade can be calculated. This would mean that individual States could assess whether threats to these species and the communities they support are better evaluated and regulated by addressing global trade through CITES listing or by national regulations and incentives to better protect species and habitats that are frequently used and at threat from over-harvesting.

A multi-faceted strategy is needed to address these challenges combining stakeholder collaboration, policy changes and technology. There are several recommendations to address this:

*Introducing species specific HS Codes*

- Engaging with the World Customs Organization to create dedicated HS subcategories for frankincense oil, resin and other parts and derivatives is crucial. This change would require cooperation among producer and consumer countries to push for reclassification, with the caveat that this could also be applied to other gum and resin producing species as is already the case, for example, with gum Arabic.

*Introduction and implementation of country-level HS codes:*

- In the interim, individual countries could introduce national-level trade codes to better distinguish frankincense products and enable regulation of unsustainable harvesting and trade.

*Strengthening national, regional and international regulations*

- The development of species-specific legislation focussed on the frankincense trade would enable producer countries to accurately track quantities, support legal trade and enforce any necessary penalties for violations. This could act as a test case for regulation and conservation of other valuable gum and resin producing species.
- With such legislation in place, countries could list their populations on Appendix III of CITES, ensuring international support to monitor global trade in their native species.

- Producer countries could establish certification systems for frankincense, requiring exporters to document the source and volume of harvested resin. Certification could be tied to sustainability standards, ensuring compliance with legal and ecological requirements.
- Governments could mandate detailed reporting of frankincense exports, including information on species, volumes, and destination markets. Such data would improve transparency and aid in international tracking efforts

*Technology-based tracking systems*

- Blockchain can provide transparent and tamper-proof records of frankincense transactions from harvest to sale. This technology ensures traceability and accountability, particularly in global supply chains, but should be operated by local regulators.
- Producers could tag frankincense batches with unique identifiers, such as barcodes or QR codes, containing information about the species, origin, harvest date, and trade route. These tags could be scanned along the supply chain, creating a digital trail.

*Collaboration among stakeholders*

- Establish partnerships between producer and consumer countries to share data and enforce trade regulations
- Companies involved in the frankincense trade can play a key role by adopting sustainable sourcing practices and sharing supply chain data. For instance, essential oil producers could provide detailed sourcing information to buyers and regulators.
- Research and data collection should be supported and field studies and market surveys conducted to improve understanding of frankincense trade dynamics using comparable methodologies.

Section 5.7

## References

Ghorbani A, Gravendeel B, Zarre S & de Boer H (2014) Illegal wild collection and international trade of CITES-Listed terrestrial orchid tubers in Iran. *TRAFFIC Bulletin* 26: 52-58.

Kreziou A, de Boer H & Gravendeel B (2016) Harvesting of salep orchids in north-western Greece continues to threaten natural populations. *Oryx* 50: 393-396.

Smith-Hall C, Pyakurel D, Meilby H, Pouliot M, Ghimire PL, Ghimire S, Madsen ST, Paneru YR, Subedi BP, Timoshyna A & TreueT (2023) The sustainability of trade in wild plants – a data integration approach tested on critically endangered *Nardostachys jatamansi*. *PNAS Nexus* 2: 1-9.