

Striking a Sustainable Chord: *Comparing Sustainable and Mainstream Wood Use in Guitar Manufacturing*

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INTRODUCTION

The history of guitar manufacturing is rich. The career of a luthier¹ not only relies upon crafting a working guitar, but one that is beautiful, reliable, and most importantly sought after in the economic market. However, we face a growing resource issue due to many of the most popular wood species for guitar manufacturing now becoming endangered and protected. Until recently, wood species like ebony and mahogany have been historically popular materials in guitar construction, but their use is now restricted due to their endangered statuses.

Additionally, a significant portion of the wood in a guitar may come from endangered species - with some sources citing up to 70% of guitar material coming from endangered tropical woods. This has led to a rise in finding more sustainable wood species, but not without critique. Despite its positive impact on the environment, emotionally attached consumers argue that these endangered woods are the only ones that can create the desired tone and aesthetic of a guitar.

This report will compare traditional woods used in guitar manufacturing and more sustainable woods, accounting for not only their sustainable impact, but how accurately it can perform against more environmentally harmful guitars in terms of sound and craftsmanship, and how it can fit into the existing guitar market.

BACKGROUND ON GUITAR MANUFACTURING AND WOOD USE

A recent report took a look at the world's 14 major acoustic guitar manufacturing companies to determine the most commonly used types of wood in these processes. Table 1 shows the most commonly used wood for each part of a guitar and its sustainable impact, as well as giving an alternative option. As promised, the species of wood and its environmental impact is not the only thing being considered in this report. Qualities like sound are also extremely important to the value of a guitar.

This report found that spruce wood is the most commonly used wood for the soundboard, and the only wood used for braces (Silvana, et al). The type of wood used for the soundboard of a guitar is critical because it requires a high Young's modulus value in relation to the density of the wood.

This relation enables the wood to vibrate more easily, which is a key feature of efficient sound emission.

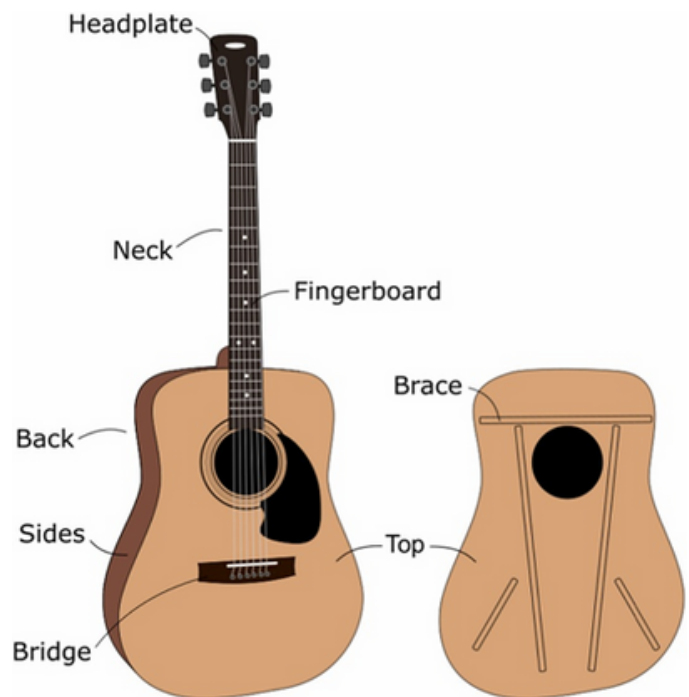


FIGURE 1. PARTS OF A GUITAR (SILVANA, ET AL.)

[1] A LUTHIER IS A SKILLED CRAFTSPERSON WHO MAKES STRINGED INSTRUMENTS, TYPICALLY WOODEN INSTRUMENTS LIKE GUITARS, VIOLINS, OR MANDOLINS.

Ebony and mahogany are the most commonly used woods for every other component of the guitar, with rosewood falling right behind them. Other components of the guitar don't impact sound, but rather the durability of the guitar. Therefore, these species are sought after due to their hardness levels.

<u>Wood Species</u>	<u>Traditional Use</u>	<u>Sustainability Status</u>	<u>Alternative Options</u>
Rosewood	Fretboards, back/sides	CITES[2] Appendix II (restricted)	Ovangkol, walnut
Mahogany	Neck, back/sides	Overharvested in some areas	Sapele, Spanish cedar
Ebony	Fretboards, bridges	Endangered in Africa	Urban salvaged ebony
Sitka Spruce	Soundboards	Sustainably managed in Alaska	Engelmann spruce

TABLE 1. COMPARISON OF COMMON TONEWOODS USED IN GUITAR MANUFACTURING, THEIR TRADITIONAL ROLES, SUSTAINABILITY STATUS, AND VIABLE ALTERNATIVE SPECIES. WHILE HISTORICALLY FAVORED FOR THEIR ACOUSTIC PROPERTIES, MANY OF THESE WOODS FACE INCREASING REGULATORY AND ECOLOGICAL SCRUTINY, DRIVING INNOVATION IN SOURCING AND SUBSTITUTION. (SILVANA, ET AL.)

Historically, these woods have been attractive because they were initially abundant and cheap to access. This can be attributed to global trade expanding and colonial extraction intensifying during the 19th and 20th centuries. Part of the craftsmanship and appeal of these instruments is maintaining the historical integrity in the form of materials used. In other words, the history of guitar manufacturing has created a market for the use of these woods. There was also an onset of mass manufacturing during this time, and these woods became locked into the formula for mass production of guitars. So, there is not only an aesthetic history, but a huge functioning supply chain to consider when talking about alternatives to these woods; nonetheless, it must be considered. Resource scarcity due to overharvesting, deforestation, and increasing restrictions on trade of endangered wood has forced the market to examine more sustainable materials.

SUSTAINABILITY ISSUES IN TRADITIONAL GUITAR MANUFACTURING

Issues related to sustainability started to emerge in guitar manufacturing as early as the 1960s, which coincided with the folk music boom. Naturally, guitar manufacturing was targeted early due to its relation to the demographic rallying for environmental sustainability. One species of wood in the spotlight was Brazilian rosewood sourced from the Amazon. The Amazon was already experiencing extreme deforestation due to other projects following the inauguration of the Trans-Amazonian Highway in 1972 (Gibson and Warren). A rising concern for the sustainability of the forest produced a series of environmental regulations to protect the biodiversity. In 1992, Brazilian rosewood was listed on CITES Appendix I, making it an illicit commodity. Regulation of other endangered woods quickly followed.

[2] CITES (THE CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES OF WILD FAUNA AND FLORA) IS AN INTERNATIONAL AGREEMENT BETWEEN GOVERNMENTS. ITS AIM IS TO ENSURE THAT INTERNATIONAL TRADE IN SPECIMENS OF WILD ANIMALS AND PLANTS DOES NOT THREATEN THE SURVIVAL OF THE SPECIES. [HTTPS://CITES.ORG/ENG](https://cites.org/eng)

This threw a huge wrench in the supply chain of guitar manufacturing because the majority of guitars are made with these heavily protected woods. Where there was once a relatively simple supply chain, there is now a regulation check at almost every step. However, this did not deter manufacturers from using these woods. Instead, a new global production network emerged in response to the growing restrictions. Before, companies would rely on sawmills and timber traders for their wood procurement, but these suppliers weren't in charge of documenting sources of wood. With the new regulations in place, manufacturers require new suppliers that could work within the regulations to still provide them with endangered wood. This entails a whole new network between suppliers and manufacturers – in between them is now a whole team of specialist procurers, verification and certification consultants, and government environmental protection agencies.

Additionally, the procurement of wood kept shifting to the next best option until CITES got ahold of it. Following Brazil's ban on mahogany harvest and export, traders just shifted to other countries with weaker regulation or to genetically related species that were not yet protected by CITES. When Brazilian rosewood was banned, other Dalbergia species from other countries saw an increase in harvest, such as East Indian rosewood, Madagascar rosewood, and Honduran rosewood. After a while, these too would become overharvested and under the protection of CITES, and the cycle would continue of traders finding similar species or less regulated countries. Even still, illegal harvesting accounts for 5-15% of total global timber trade across all species (Gibson and Warren).

The creation of this new global production network speaks to the rigidity of the customer base. Other industries dependent on timber like paper milling, furniture, and construction are much less emotionally tied to wood species and have therefore been able to switch over to substitutes more easily. Dick Boak from C.F. Martin & Co explains why convincing guitarists to switch from traditional wood to more sustainable wood is so hard: “musicians, who represent some of the most savvy, ecologically minded people around, are resistant to anything about changing the tone of their guitars” (Felton 2011). This is what makes the acoustic guitar industry so hard to change – it's not only a discussion about changing manufacturing processes, but a resistance to change due to loss of artistry and performance. Switching to more sustainable guitars depends on sustainable materials, but also on the ability to have a market for these new products; without customers accepting guitars made from different wood, the market that jumps through all the loopholes to get endangered wood will always exist.

CASE STUDY: TAYLOR GUITARS AND SUSTAINABLE PRACTICES

The future of sustainable guitar manufacturing isn't all gloomy. One company in particular has been a pioneer in the sustainable guitar space: Taylor Guitars. Taylor Guitars currently has 3 different sustainability projects, each unique in their impact on sustainability. The first focuses on restoration and research efforts in Cameroon, the second about repurposing end of life urban wood, and lastly restoration of native forests in Hawaii. In addition to these projects, they have implemented new technologies in their manufacturing processes that have reduced waste significantly, making their manufacturing more sustainable not only through their materials but through their processes.

In Cameroon, Taylor Guitar's sustainability initiatives can be seen in many different aspects. In 2011, the company purchased an ebony mill with the intention of having direct responsibility for their ebony supply chain, making sure that all of their sourcing was legal and ethical. A huge discovery for them was the amount of waste usually produced from harvesting ebony. As mentioned before, ebony is a traditional wood used for guitars, and with that comes expectations for the wood. Traditionally, customers would only buy all-black ebony even though it has no impact on the function of the wood for musical performance, which is not how it always naturally grows. Many trees experience varied coloring which can't be seen until the tree has been cut down. In the past, sawyers would leave these trees on the forest floor since they had no value to customers. However, Taylor Guitars - now under their own jurisdiction - was able to reject this. To reduce the number of trees wasted, they embraced the varying coloring of ebony into their own guitars, thus creating a market and setting an example for other guitar companies. Additionally, the company launched a separate line of products with this ebony wood that wasn't suitable for guitar manufacturing, like guitar accessories and knife blocks, further showing how to reduce waste and make the most out of the wood that is harvested.



Figure 2. Stump harvested from an ebony tree, showing the varying coloring (Taylor Guitars)

Furthermore, Taylor Guitars was focused on the future of this species and finding a way to regenerate what they have taken. Before this, very little was known about the actual reproduction process of ebony. It's one of the reasons it became endangered, because it wasn't being replanted out of lack of knowledge. The company funded a research project that has produced research into the ecology of ebony and has already planted over 15,000 ebony trees.

Another project that Taylor Guitars has launched is their end-of-life urban wood line. This report has talked about the many different sources of traditional wood, most being exotic and endangered. This line reveals how local wood can make just as good of a guitar in a much more sustainable way. End-of-life wood refers to trees that are about to be removed by municipalities because they are at the end of their lifecycle and need to be replaced with new trees. Usually, these trees end up in a landfill or are converted into products like woodchips or firewood. However, these removals have a cost attached to them, so municipalities are looking for a way to reduce that cost. Taylor Guitars has partnered with West Coast Arborists to source and manage these end-of-life urban trees and turn them into guitars. This is great because not only is it using a more sustainable material, but it creates a circular economy for urban wood, making the wood economically valuable instead of just waste.

The last sustainable project this report will cover is the restoration of koa forests in Hawaii. Koa forests in Hawaii face a lot of issues currently, most of them to do with land conversion to agriculture. In 2018, Taylor Guitars purchased 565 acres of land in Hawaii for the sole purpose of planting back native koa trees. In addition, they have entered an agreement that allows them to harvest koa wood in exchange for regeneration projects, essentially paying for the ability to have future wood. The intention here is sincere, as these trees won't be available for harvesting for another 30 years when they have matured.

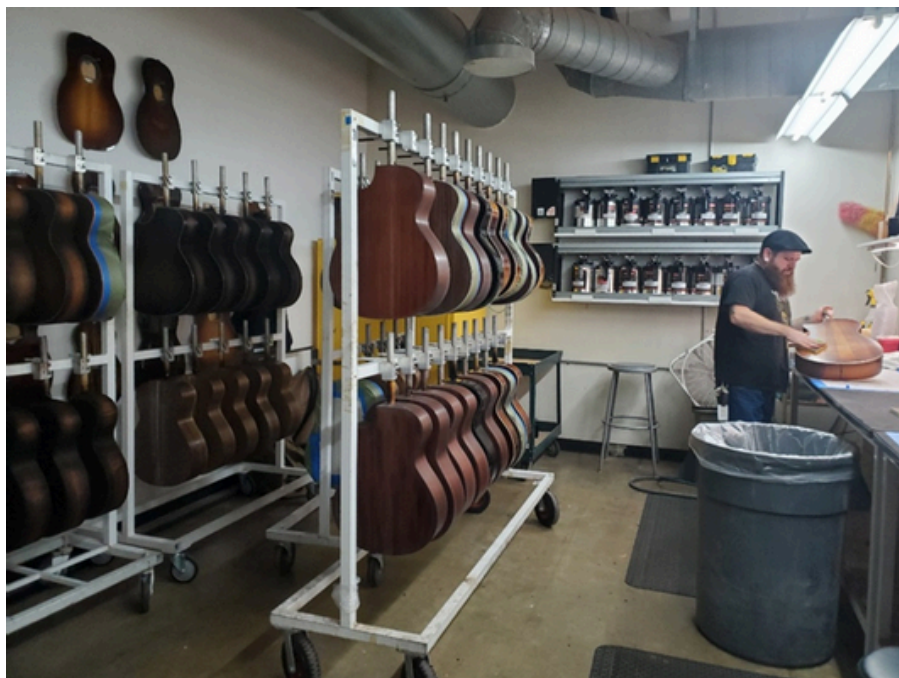


Figure 3. An array of guitars in the middle of the manufacturing process at Taylor Guitars. The multicolored wood varieties showcases Taylor Guitars commitment to showing the viability of numerous wood species in the production and market for guitars.

In addition to these sustainable projects that focus on the wood, Taylor Guitars has implemented a series of new manufacturing processes that have allowed them to reduce their waste significantly. They were the first company to use Computer Numerically Controlled (CNC) milling machines in their manufacturing process. This dramatically reduced both the amount of wood needed for their guitars and the amount of waste produced. Another technology that reduced their waste is a robotic spray paint process. Traditionally, spray painting creates a lot of waste due to a large amount being left in the air instead of sticking on the guitar. The robotic spray paint that Taylor Guitars uses magnetizes both the paint and the object, which allows the paint to easily stick to the guitar and therefore much less paint is needed.

Taylor Guitars is a company that is great to highlight in this report because they talk about a couple different solutions to the barriers that sustainable companies face when trying to shift away from more traditional manufacturing practices. The following sections will talk more about these barriers, the differences in environmental impact of sustainable and traditional manufacturing, and what it means for the future of not only sustainable guitar manufacturing but broader manufacturing processes as well.



Figure 4. A snapshot of guitars displayed at Taylor Guitars manufacturing center that showcases their use of various wood species.

COMPARISON WITH MAINSTREAM PRACTICES AND INDUSTRY TRENDS

This section will compare the costs of producing traditional guitars and more sustainable guitars. The first thing to note is the overall trend of woods being used over roughly the past 60 years. We've seen a lot of change, mostly due to regulations on traditionally used wood in guitar manufacturing. As seen in the figure below, wood species that now fall under CITES regulation used to make up almost all of guitar manufacturing. We see a couple dips due to increasing regulation and restriction, but it's worth considering if these regulations are the only thing causing use of CITES-regulated wood to be going down.

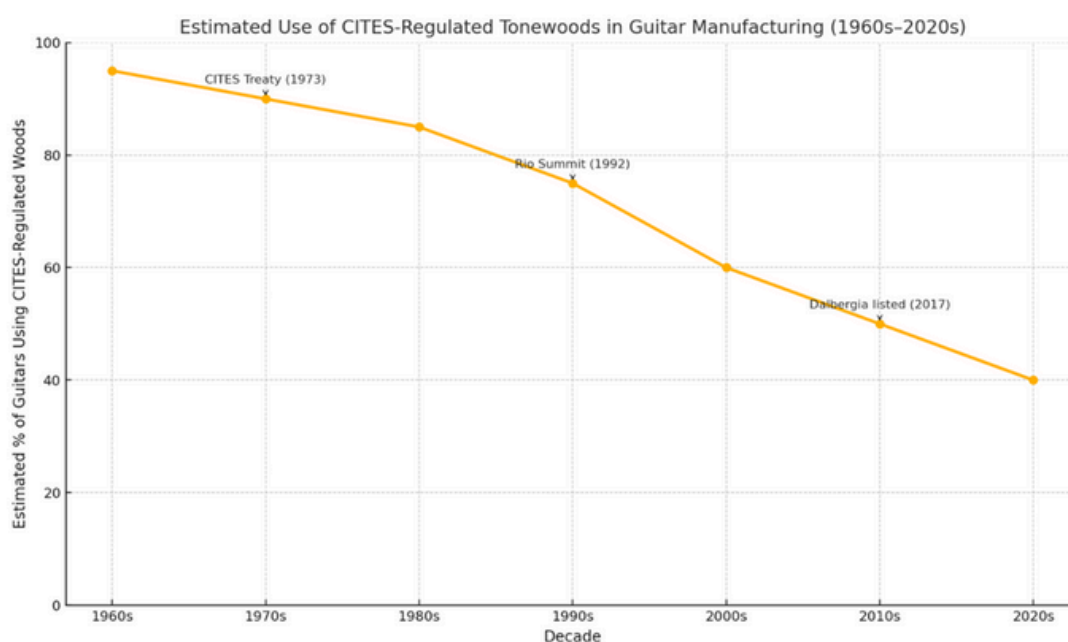


Figure 5. Estimated percentage of acoustic guitars manufactured using CITES-regulated tonewoods from the 1960s to 2020s. The trend reflects the industry's historical reliance on tropical hardwoods such as rosewood and mahogany, followed by a gradual decline in usage due to rising environmental awareness, material scarcity, and regulatory interventions. Notable milestones—such as the signing of the CITES treaty (1973), and Rio Earth Summit (1992), and the 2017 listing of *Dalbergia* species—marked turning points in the regulation and sourcing of tonewoods.

As stated before, regulations on endangered wood has created a new global production network to allow for the procurement of these types of wood. A big point of contention for customers of sustainable guitars is whether sustainable guitars would fit into the existing market for guitars. In other words, is it going to be way too expensive? It's a valid concern; often newer sustainable products can range in higher price points compared to their traditional counterparts. However, when it comes to guitar manufacturing, comparing the costs becomes more complex due to these regulations causing an extreme increase in price. Before the regulations, manufacturers could just purchase the wood. But now, they must go through a series of inspections to make sure their wood is ethically sourced, which has its own costs, not to mention the costs the company incurs due to an increase in processing time because of all of these additional steps.

The price for making a mistake is also costly. The Lacey Act, enacted in 1900, prohibited the trade of any illegal fish, wildlife, or plant. In 2008, a revised version of the Lacey Act exemplified this punishment with a costly maximum fine of \$20,000 and/or up to 5 years imprisonment. Furthermore, guitars are never made out of just one type of wood, so manufacturers have to go through all of these steps for every single type of wood they are procuring. All of this creates extreme additional costs when compared to conditions before the regulations, which in turn is great for the market of sustainable guitars.

Let's now compare these costs to the costs of manufacturing a guitar out of sustainable wood. For starters, sustainable wood, if it's local, doesn't have to go through the extra paperwork or inspections associated with CITES, import, or customer regulations. Additionally, the timeline of creating the guitar has just decreased significantly, which also saves money and lowers costs. To talk real numbers, the average guitar made from sustainable materials costs around \$500-\$600. For guitars that use CITES-regulated wood, the cost of top blanks accounting for regulation fees is around \$100 and backs around \$200 (French and Handy). Just the materials for these 2 parts of a guitar made from endangered wood is almost the cost of a fully complete sustainable guitar. It's safe to say that a market exists for sustainable guitars in regard to affordability. There will always be a market for traditionally made guitars, but it will only continue to rise in price as materials become more valuable due to scarcity.

LIFECYCLE AND ENVIRONMENTAL IMPACT COMPARISON

It's important to consider the environmental impact as well as the economic impact when comparing traditionally manufactured guitars and more sustainable ones. There are 4 main components when assessing the environmental impact of guitar manufacturing in general: source of wood, transportation, manufacturing, and waste.

In terms of the environmental impact of these different woods, it's pretty obvious that sustainable guitars will beat out traditional guitars. The main reason for this being sustainable guitars only source wood from abundant sources, meaning none of the wood they get is endangered or harms the biodiversity of an existing forest. Additionally, many sustainable guitar companies will reinvest in restoration projects, like we've shown at Taylor Guitars. Traditional wood has a negative impact on the environment because it adds to the already existing issue of biodiversity and habitat loss. So, for the environmental impact for the source of wood, sustainable guitars win.

Transportation also accounts for a large majority of the environmental impact of making a guitar. This comes in a couple different forms, but transportation of source wood to manufacturing site accounts for the largest sector. Other things to consider are transportation to customers and stores, but these can be extremely varied for both sustainable and traditional guitars. When looking at the differences at a holistic level, a lot of sustainable guitars have less transportation required due to their nature of sourcing more local wood.

Not all sustainable guitars use local wood, but compare them to traditional guitars that use exclusively international wood. Even if only 10% of sustainable guitar companies sourced their wood locally, they would still have a lower environmental impact in source transportation than compared to traditional guitar companies. So again, sustainable guitars will have a lower environmental impact this time in transportation.

Moving forward we look at manufacturing processes. This is where things can get dicey for sustainable guitars. Of course, every company will have different processes, but generally speaking sustainable guitar companies will incur higher energy costs due to more sustainable technology and higher upfront costs. If we take a look at Taylor Guitars for example, they have some really interesting technology that allows them to reduce their waste, but not without sacrificing low energy production. Traditional guitar companies usually stick to what they know and avoid updating their manufacturing processes, which can lead to lower energy costs. Again, it's hard to make a definitive claim without assessing individual companies, but it can be argued in either direction. So, this report can't determine whether sustainable guitar companies or traditional guitar companies have a lower environmental impact in terms of manufacturing, however it is worth noting that this sector usually has a lower impact on environmental assessment than others.

The last piece of the puzzle is waste. Sustainable guitars usually create less waste because of their frequency to use more of their source wood than traditional guitars. For example, above we talked about how ebony has traditionally been harvested only for its pure-black wood. This only makes up a small number of ebony trees, where the rest of the wood is left for landfills. Compare that directly to sustainable guitar companies that make use of the whole tree, disregarding the market that only values the pure-black wood. Additionally, we've seen sustainable companies reduce waste in their manufacturing processes as well, whether that means recycling wood into other products or making use of processes that may take more time but require a smaller amount of wood to be used. So, for this final sector of environmental impact, sustainable guitars wins.

DISCUSSION AND POLICY IMPLICATIONS

One thing is certain: sustainability in guitar manufacturing isn't just an environmental issue, it's a systemic challenge. As stated before, a huge reason why it's been so hard to get sustainable guitars on the market is because customers don't believe it will sound as good as a regular guitar, even though that has been disproved. It speaks to a larger issue about customer perception and consumption.

Additionally, we have to think about the effect that policy and regulation has had on guitar manufacturing, and if it's a model we can look at for future industries. We know that since the CITES regulations, there has been a dramatic decrease in the amount of endangered wood used in guitar manufacturing. This is because the regulations make the wood extremely costly to attain. So, in terms of policy, it's a relatively good model to look at, but hard to apply to a lot of other sustainability issues. Additionally, we still have the customer to consider. Even with the extreme upcharge of endangered wood, there will still be a market as long as there is demand. This is an issue policy can't address, but rather a social issue tied to status signaling and excess wealth.

However, we have seen a huge increase in the market for sustainable guitars, and a lot of that can be attributed to sustainable guitar luthiers finding a way to make their product work in the existing market. This report explored the trade-offs of both sustainable and traditional guitars and found that sustainable guitar manufacturers actually have a significantly lower cost. Again, a lot of this is because their source material is a lot cheaper than traditional wood due to regulations. This relationship can show us that with the correct policy, sustainable products can have a market value when combined with policy that supports their cause. To compare it to another product, it's similar to electric vehicles. At market value, a decent number of electric vehicles are more expensive than the average gas car, but with policy tools like subsidies for having an electric vehicle, it makes it more attractive to customers in the existing market.

The last thing to consider is how a shift to more sustainable and often more local product will affect global trade. A lot of developing countries rely on timber exports to fund their economy. If we want to switch to a more local model, it's hurting these countries. However, this issue didn't arise because of sustainable manufacturing. In the early 2000s when CITES regulations were becoming really strict, we discussed how these harvesters would move around to different countries that had less restrictions until CITES got ahold of them. This process was extremely exploitative and left a lot of developing countries economically abandoned once CITES put regulations on them and harvesters would move to the next country. So, the main issue for these countries is overharvesting and abandonment.

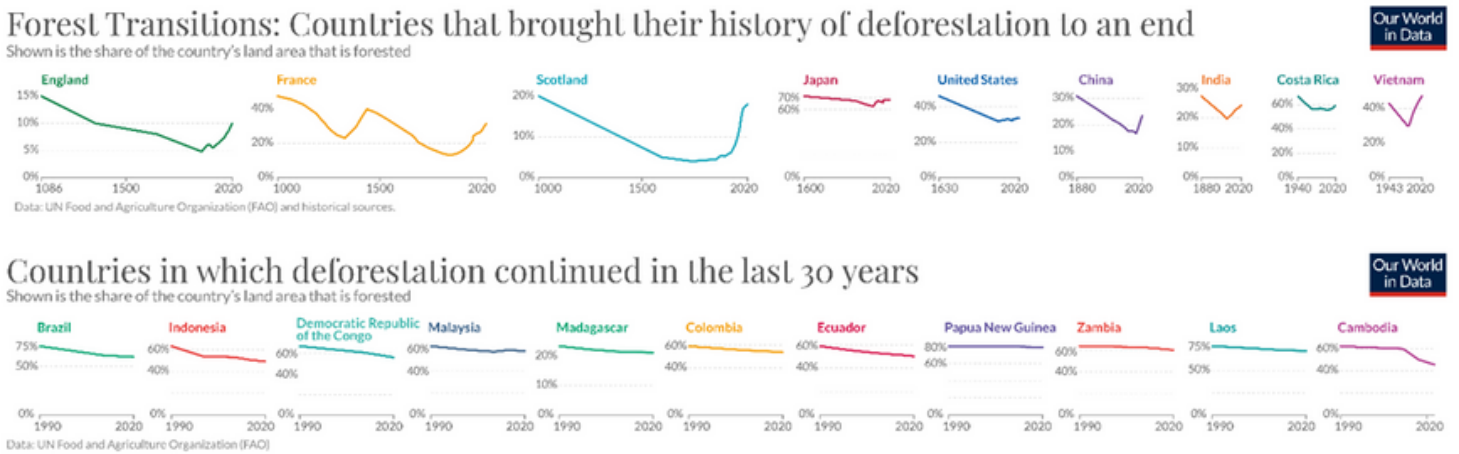


Figure 6 & 7. A comparison of graphs showing forest coverage between developed and developing countries. Although time axes are different, developing countries share a trend of continuous deforestation while developed countries have the resources to provide reforestation efforts, further exemplifying the exploitation of resources that is seen in developing countries with less independent economies (Our World in Data).

This is an issue that sustainable manufacturing can help with alongside policy implication. We must recognize that this is just a point in time for these countries; the US was once dependent on exports, too. However, we can help these countries by supporting the shift of their economies from raw material to value added processing and manufacturing. We can look to Taylor Guitars as an example for working with developing countries without exploiting them. Their mill in Cameroon allows them to harvest the highly sought after ebony in a sustainable way, while also providing jobs for the people living there. Furthermore, their reforestation research allows the ebony forests to be protected and reforested, benefiting both them and their relationship with the developing country, allowing them some economic security.

CONCLUSION

In examining the contrasts between sustainable and traditional wood sourcing in guitar manufacturing, it becomes clear that the industry stands at a critical juncture. While mainstream practices have historically prioritized aesthetics and tonal quality, they have also contributed to deforestation, supply chain fragility, and ecological harm. In contrast, companies like Taylor Guitars demonstrate that ethical sourcing, innovative material use, and environmental stewardship can coexist with commercial success. Through strategies like vertical integration, urban wood utilization, and consumer education, sustainable manufacturing models are reshaping what it means to build a quality instrument. Yet challenges remain, from consumer expectations to the global inequities embedded in timber trade. Moving forward, both policy interventions and industry leadership will be essential in shifting the guitar world toward a model that respects both sound and sustainability. This transformation will require not just new materials, but a new mindset: one that values forests as much as fretboards.

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