昆山杜克大学
DUKE KUNSHAN UNIVERSITY
Environmental Research Center

B-LAB

TOWARD A BIODIVERSITY-FRIENDLY TEA CERTIFICATION

Global Industry Analysis & Insights from Yunnan's Ancient Forest Tea Systems

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Authored by:
Judy Song, Binbin Li, & Siqi Liang

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EXECUTIVE SUMMARY

China is the world's largest producer and consumer of tea, and Yunnan's forest tea systems represent one of its most ecologically and culturally significant cultivation models. Unlike monoculture terrace plantations, these agroforestry systems maintain high native tree diversity, canopy cover, and low-intensity management practices, making them promising candidates for biodiversity conservation. At the same time, global and domestic trends show rising interest in sustainable and high-quality agricultural products, suggesting potential market opportunities for an eco-label that differentiates biodiversity-friendly tea.

This report evaluates the feasibility of developing a biodiversity-focused tea certification by analyzing global market trends, existing certification schemes, competitive dynamics within China's tea industry, and findings from field interviews with ancient tea farmers in Xishuangbanna. Certification could formalize traditional ecological practices, facilitate price premiums, open new markets, and complement regional eco-tourism strategies, however several challenges complicate its potential adoption.

Analysis of the current certification landscape demonstrates that biodiversity-specific standards are largely absent from mainstream tea certifications, leaving an unmet niche that has the opportunity to be filled. Drawing insights from other programs like Rainforest Alliance and Smithsonian Bird-Friendly Coffee, the report outlines that the success of a certification hinges on strong branding, consumer education, and supply chain buy-in.

Field interviews revealed mixed interest among growers. Farmers acknowledged that a certification could strengthen brand recognition, signal product authenticity, and attract new buyers. However, most reported limited familiarity with certification processes, uncertainty over market demand, satisfaction with existing sales channels, and concerns about time and opportunity costs. Some also questioned whether a new label could deliver sufficient economic benefit to justify the transition. These hesitations point to the need for substantial awareness-building, technical support, and clear demonstrations of market value.

Despite barriers, a biodiversity-friendly tea certification remains a promising mechanism for reinforcing and promoting sustainable cultivation across both forest tea systems and conventional monoculture farms. Its feasibility will depend on whether the economic, administrative, and ecological benefits outweigh the costs for producers. To that end, the report identifies a need for further research, including cost-benefit analyses, consumer willingness-to-pay studies, and ecological impact assessments that verify the conservation value of certified agroforestry systems.

Overall, while the rationale for a biodiversity-friendly tea certification is strong, successful implementation will require careful design, strategic piloting, multi-stakeholder coordination, and evidence demonstrating tangible value for growers, consumers, and conservation alike.

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1. BACKGROUND

1.1 Tea Overview

Tea, commonly derived from one of two varieties of *Camellia sinensis* originally native to China and India, is the most widely consumed beverage worldwide after water (Mauger et al., 2024). Since its global proliferation, beginning at first to countries surrounding China before spreading to Europe through trade routes in the 1600s, it has arguably become one of the most culturally and economically important commodities around the world (Weisburger & Comer, 2000). During the rapid growth of transoceanic trade throughout the 19th century, British imperial expansionism led to the establishment of tea monoculture cultivation in countries such as India, Sri Lanka, Kenya, and Malawi (Mauger et al., 2024).

Today, over 6.3 million metric tonnes of tea is produced globally with China contributing nearly half of total production (Bermudez et al., 2024). It is estimated that 60% of the global tea supply is produced by smallholder farms (<5 hectares in area) and the proportion is slated to rise in the coming years – within China the percentage is even higher, with 80% of domestic production coming from smallholders (Bermudez et al., 2024). This underscores the importance of this global cash crop as it serves as the primary livelihood for 9 million of small-scale farmers around the world. Despite strong demand and steady market growth, production of plain-quality tea in recent years has grown faster than demand, leading to surplus and drops in price for bulk commodity tea (Bermudez et al., 2024). In contrast, specialty tea production still provides higher returns for farmers. Outside of Japan and China, such production is still uncommon however this may grow as farmers look for opportunities to hedge against unfavourable market conditions and uncertainty in climate change impact (Bermudez et al., 2024).

1.2 Tea Cultivation Systems

Yunnan is a major tea producing region of China. Much like the rest of the country, most of the tea in the province is grown in monoculture terrace farms. Terrace tea farms require the clearing of nearly all native vegetation, single crop planting, and intensive weeding and fertilization – this farm type is common around the world for its uniformity, high yield, and efficiency, however lead to habitat fragmentation and biodiversity loss (Chowdhury et al., 2021; Ahmed et al., 2012).

In the decades following the establishment of the People's Republic of China, there was much investment and effort put into developing terrace tea farms to increase productivity and yield. While this came with strong economic growth, it was to the detriment of natural ecosystems (Wu et al., 2023). However, Yunnan also contains traditional tea gardens in which cultivated tea trees have been grown interspersed among natural forests for thousands of years, tended to by local ethnic minorities (Li et al., 2023). While terrace tea crops are pruned to grow as dense shrubs, traditional forest tea[1] is pruned to spread out in branch formation. In recent years, traditionally grown tea leaves have become a premium commodity due to their perceived quality and complex flavor profile.

Figure 1. Yunnan traditional forest tea garden, photographed from above native canopy (Photo by Binbin Li)

The opportunity to support both local growers and nurture ecosystems arises as these traditional tea forests are more biodiversity-friendly, with many of the native plant species being preserved as opposed to being clear-cut (Figure 1) (Wu et al., 2023). The agroecological methods currently employed within these tea gardens are also much more conducive for biodiversity due to controlled weeding, pruning, and pest control practices (Li et al., 2023).

Such mixed agricultural systems can also be found elsewhere in the world: in Shizuoka, Japan, grasslands are maintained around tea fields to supply mulch that improves the quality of the tea (FAO,

[1] For the remainder of the report, traditional tea garden, tea forest, and agroforest will be used interchangeably. While there also exists wild tea forests in which tea plants grow completely uncultivated, these will not be referenced within the report unless mentioned explicitly.

2013). The biodiversity of these semi-natural grasslands is conserved through periodic mowing and the exclusion of grazing and burning (FAO, 2013). Intercropping can also offer habitat complexity that is not seen in monoculture agriculture. In Dongtingshan, China, farms utilize tea-citrus and tea-chestnut intercropping systems to improve the quality of produce and introduce natural predators to combat tea pests as alternative to using chemical pest control (Chowdhury et al., 2021).

There have also been novel initiatives to improve biodiversity impact of monoculture tea plantations, particularly those around protected areas, such as planting trees to increase structural and habitat complexity of farms, as well as building ecological corridors to facilitate wildlife movement (Bermudez et al., 2024). Leveraging mixed systems and moving towards sustainable agricultural transformation are the keys toward meeting Kunming-Montreal Global Biodiversity Framework targets such as restoring degraded ecosystems and enhancing biodiversity in agriculture while ensuring smallholder livelihoods (Convention on Biological Diversity, 2024).

1.3 Yunnan Tea Cultivation

Yunnan is the second largest producer of tea by province in China and holds the largest wild tea tree population and ancient[2] tea tree plantation area. The indigenous people of the region have been cultivating and harvesting the leaves for over 2000 years (FAO, 2012). While much of the province now also grows conventional monoculture tea, the forest tea gardens continue to be a prominent and unique agroforestry system that serve as the main livelihood driver for many of the local ethnic minorities, particularly in the lower and middle reaches of the Lancang River.

Studies have shown that these traditional tea gardens have far greater ecological diversity, canopy coverage, and tree height compared to monoculture systems (Ahmed et al., 2012). Tea leaves derived from these trees also have greater phytochemical quality, which is directly linked to consumer perception of taste and quality of the product – leading to agroforest tea farmers earning on average 30 to 80 times more per kilogram of dried tea compared to terrace farmers (Ahmed et al., 2012)

The wild and ancient tea trees are distinct from other tea plants that may be grown in partial or full agroforestry systems, as《云南省古茶树保护条例》*Regulations on the Protection of Ancient Tea*

[2] Ancient tea refers to leaves from traditionally managed agroforest tea tree populations that are 100 years or older. While almost all ancient tea can be characterized as forest tea, not all forest tea is considered ancient.

Trees in Yunnan Province states that "Ancient tea trees refer to wild tea trees and their communities, half-domesticated tea trees, and ancient cultivated tea plantations (forests) with over 100 years of human intervention" (FAO, 2012). These communities of tea trees in Yunnan include wild, cultivated, and transitive tea trees, all of which are represented across the Lancang River basin. The cultivated tea forest ecosystems usually consist of three layers: tall canopy tree layer, tea plant and bush layer, and herb layer (Figure 2). This kind of traditional management system has long been maintained by local people as they believe that it leads to better tea quality, and the system itself is self-sustaining as the biodiversity and natural ecosystem ensure balance in the water, soil, and pest management. Ecological stewardship is further reinforced by government policy: in 2022, the Standing Committee of the 13th Yunnan Provincial People's Congress reviewed and approved 《云南省古茶树保护条例》 *Regulations on the Protection of Ancient Tea Trees in Yunnan Province*, specifically prohibiting the use of chemical herbicides and growth regulators (Yunnan Forestry and Grassland Bureau, 2023).

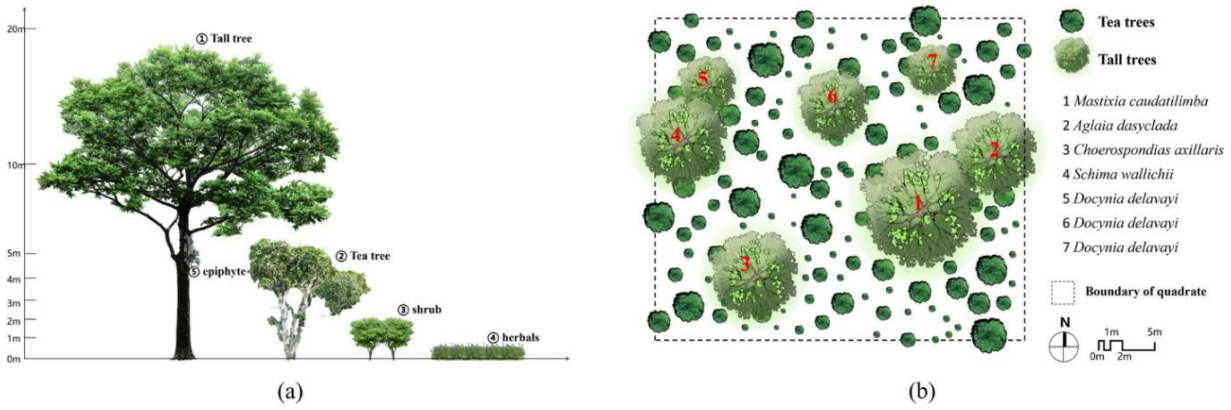


Figure 2. Community structure of traditional ancient tea forests (Li et al., 2023)

For the Blang, Dai, Hani, and other ethnic minorities of the region, tea cultivation and this long-standing agricultural management system is a cornerstone of tradition and cultural inheritance. It is not only their major livelihood, but the importance of tea can be seen through the customs and knowledge that is passed from generation to generation. For example, the Blang people use tea as vegetables and medicine, and the Dai use it as seasoning and skincare (FAO, 2012). The cultivation of tea is a foundational pillar for many of the local cultures, and in conjunction, the traditional knowledge and cultural values are also what has ensured the continued stewardship of ancient tea tree communities and regional biodiversity of forests.

1.4 Eco-Certifications or Voluntary Sustainability Standards (VSS)

In support of the goal to increase biodiversity of tea plantations while protecting farmer income, a certification program can capitalize on the growing consumer demand of high quality, sustainable tea and incentivize farms who practice biodiversity-friendly farming methods. A certification program is a process in which a third party assesses the operations of a business to ensure that it is meeting certain sustainability or environmentally friendly standards – it is also known as voluntary sustainability standard (VSS) compliant. When a product is certified, businesses will often communicate this to consumers at the point-of-sale through the usage of an eco-label, for example displaying "Rainforest Alliance Certified" on the packaging.

Drawing from data the coffee industry, buyers are willing to pay on average a premium of USD0.05 – 0.10 per pound for green coffee beans with certification, although it can extend much higher with more sought-after certifications or those with fixed minimum premiums[3] such as Organic and Fairtrade, to upwards of USD0.40 per pound (Rich et al., 2017). The average price per pound of Arabica coffee beans in 2017 were USD1.51, therefore certified raw beans had on average a 6% premium (O'Neill, 2024). A similar certification scheme for sustainable tea could potentially also have positive economic returns for producers and feasibly encourage more farmers to adopt to biodiversity-forward farming. Furthermore, a certification scheme could potentially bring attention to farms with particularly high ecological value, facilitating possible alternative revenue streams for local communities such as the development of eco-tourism.

Currently, the most common tea certifications around the world are Rainforest Alliance and Fairtrade – however, these programs are not tailored to tea and encompass more holistic standards that include social responsibility and ethical work (Millett, 2021). No biodiversity specific certification exists for tea producers as it does for coffee, such as the Smithsonian Bird Friendly Coffee production certification, therefore there may be an opportunity to develop such an equivalent for the tea industry.

[3] Fairtrade stipulates a minimum price for all major commodities, and a Fairtrade Premium paid by companies on top of the price to be used for reinvestment into the community or business (Fairtrade, 2023).

1.5 Tea Versus Coffee

Tea and coffee are both universally beloved drinks with strong cultural roots that span centuries – the crops themselves are also critically important agricultural categories, employing millions of people around the world. While the processing of tea and coffee differ greatly post-harvest, there are quite a few similarities when it comes to the cultivation. Both plants prefer tropical and subtropical climate with higher elevation production resulting in better quality crop (Athnikar, 2022). 70-90% of global supply for both are produced by smallholders (Gessesse & He, 2021; Poncet et al., 2024). Both are shrub plants that traditionally have been grown interspersed with natural forest, under semi-shaded tree canopy – the concept of the environmentally-friendly shade-grown coffee is a return to the crop's origins of a forest shrub, grown among natural ecosystem which reduces agrochemical input requirement (Poncet et al., 2024). Just as different types of coffee can be derived from the same bean but with different fermentation processes, the different types of tea seen on the market are all derived from the same plant – the leaves are just oxidized differently post-harvest (Athnikar, 2022). As such, it is possible for one certification to cover multiple types of tea that is sold on the market – however, most farms will usually specialize in a single type of tea.

However, despite the parallels between the two crops, there are also marked differences, particularly in consumption patterns. The world can be split into tea and coffee blocs (Appendix 1) with most of the Americas and Western Europe favouring coffee while tea dominates in Asia, the Middle East, and most of Africa (Grigg, 2002). While about 80% more coffee is consumed than tea by weight globally, since it takes about 4-5x more grams of coffee to make a cup of coffee versus that of tea, when comparing by litres consumed there is three cups of tea drunk for every one cup of coffee (Grigg, 2002). This ratio could be even larger, considering that tea leaves are often re-steeped, compared to the single use nature of coffee grounds. The global supply chain patterns of these two crops are counter: while 100% of coffee production takes place in developing countries in the tropics, the majority of it is exported and 71% is consumed in developed countries; for tea, it is also primarily produced in the tropics and subtropics of developing nations, but three quarters of it is also consumed there – only a quarter of it going to developed nations (Grigg, 2002). As such, it can be expected that there is a relationship between GDP per capita and which drink is preferred – there is high correlation between income and consumption of coffee. Although neither are, in most cases, considered a luxury product, coffee is more expensive per cup compared to tea (Grigg, 2002). As sustainable certified products are often sold at a premium and are seen as luxury alternatives to

standard products of the same variety, it could be due to these market differences that sustainability and supply chain transparency has been a larger topic of focus in the coffee world, but as less so with tea. In the U.K for example, since 1950 tea has acted as an inferior good, with consumption of coffee rising and tea decreasing as income has risen (Grigg, 2002) – this relationship between income and coffee preference may have created a market opportunity for the development of a higher-end, sustainable coffee product.

However, this trend of tea becoming an inferior good is not universal, and economic factors are not the only, or perhaps even the strongest, determinant of which beverage is preferred – despite real income rising in much of the world, this has not led to a mass increase in consumption of coffee nor a decline in consumption of tea, indicating there are also deeper cultural factors that influence the preference of drinks (Grigg, 2002). In countries like China where living standards have risen rapidly, coffee consumption is certainly increasing particularly in urban centers and among the younger demographic, but tea maintains its stronghold and shows no sign of decline – in fact the industry is only evolving. Due to millennia old tea tradition and large variety in tea production, the drink in China is simultaneously a product that can serve as an everyday drink for commoners, but also a status symbol, with luxury teas priced at tens of thousands of dollars (Yip, 2022). Thus, the rising disposable income in China and other developing countries that have historically preferred tea likely do not signal a shift towards substituting tea with coffee, but rather a potential growing market opportunity for the development of more premium, certified tea products parallel to those that have long existed for coffee.

2. TEA MARKET

2.1 Global

In 2023, the global tea market was valued at USD260 billion and is expected to grow steadily to USD362 billion by 2029, driven by broad trends leaning toward health-conscious drinks (Statista, 2024a). Following China, the largest tea producers are India, Kenya, and Sri Lanka, while the largest tea importers are United States, United Kingdom, Egypt, Germany, and Japan (Statista, 2024a). The United States alone imported an impressive sum of USD 519.79 million in 2023. However, the top importing countries around the world do not necessarily translate to the top importers of Chinese tea – with Morocco, Ghana and Uzbekistan topping by import volume and Hong Kong, Malaysia, and

Morocco topping by import value of Chinese tea (Appendix 2) (Mei & Liang, 2024). This may be due to the majority of tea production and processing in China being single origin tea[4], therefore exports could favour countries with similar tea consumption habits. In terms of demand for Chinese tea around the world, green tea dominates exports, accounting for 84.2% of all volume sold overseas, with black tea, oolong tea and other categories[5] making up the remaining volume (Mei & Liang, 2024). The top exporting provinces of the country are Zhejiang, Fujian, Anhui, Hubei, and Hunan, each of exporting more than USD100 million in 2023 (Mei & Liang, 2024).

As such, tea drinking culture varies widely across the world, with many countries favouring the convenient tea bag over loose leaf. In the United States, over 70% of tea drinkers indicated that they mostly or only prepared tea using tea bags (Kunst, 2020). This is similarly the case in the United Kingdom, a country that is just as famous for its love of tea as China is, but the culture around the drink is vastly different. In Britain, it is also common to mix tea with milk and sugar, which is rarely the case in China (Gao & Li, 2023). As tea bags are often a granulated blend of leaves from multiple sources, they are often of lower quality compared to single origin tea – this may also indicate a lower propensity for high quality, single origin tea in consumer markets that prefer tea bags over loose leaf.

The global movement towards more sustainable consumption includes tea (Bermudez, 2024). This trend of growing social and environmental consciousness among consumers will likely only grow as the younger generation around the world is increasingly conscious of how their consumption habits can impact the planet and future at large – with youth often being willing to pay more for sustainable goods (Gomes et al., 2023). In India, one of the biggest tea producers and consumers in the world, public awareness of sustainability has increased greatly in recent years and has shifted consumer preferences towards sustainable options (Bermudez et al., 2024). After the 2013 launch of domestic tea certification program *Trustea*, sustainable tea reached 57% of national production market share by 2021, underpinning the strong demand for certified tea (Bermudez et al., 2024).

The amount of global VSS-compliant tea production is estimated to grow by anywhere between 20% to 30% from 2021 to 2025, driven by ambitious sustainable sourcing commitments of large

[4] Single origin tea refers to leaves that come from a single region, sometimes as specific as to a single village or plantation. This is in contrast to blended teas, in which leaves may be sourced from multiple regions.
[5] Virtually all tea in China is from the plant *Camellia sinensis*, which is native to the country, however different types of tea such as green, black, white, oolong, etc. is derived from different oxidization processes.

international tea manufacturers, and continued demand from consumers for companies to prioritize social corporate responsibility and responsible sourcing (Bermudez et al, 2024).

2.2 China

China is the largest global producer and consumer of tea, with an annual revenue of USD106.5 billion, the Chinese tea market is larger than the next top ten tea-consuming countries combined (Statista, 2024b). While it is a major exporter of the good, domestic consumption still dominates two thirds of national production (Statista, 2024c). Within the country, 95% of a sample consumer survey indicated that they were tea drinkers, and 30% saying that they drank tea daily (Statista, 2024c). Consumption continues to stay strong with the revitalized interest in tea culture and growth in online retail channels. Year-over-year sales increased by 8.82% across the country in 2023 and projected to climb in similar fashion over the next few years (Chang & Liang, 2023). The most prominent consumer trends that have risen in recent years are high-quality premium products appealing to tea connoisseurs, and value-added fresh tea beverages popular with a younger demographic (Song, 2024). As such, there has been strong growth in both product segments: traditional tea leaves and freshly made tea drinks (Figure 3).

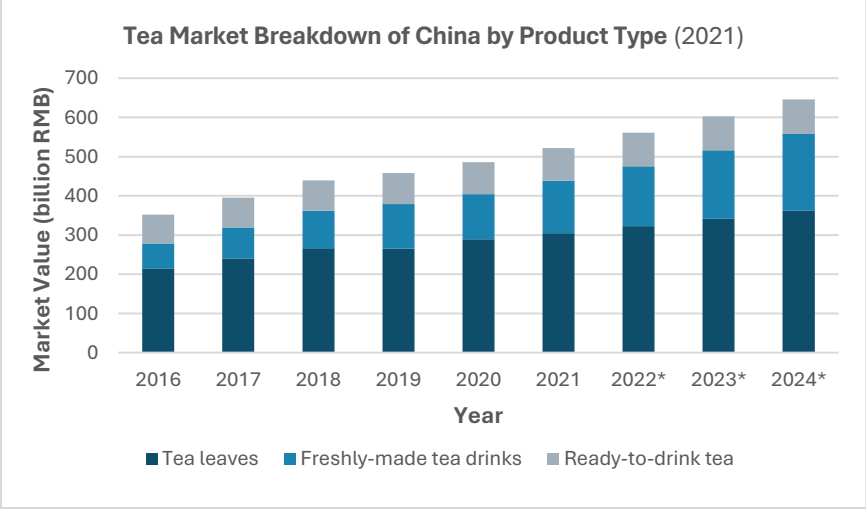


Figure 3. Tea market breakdown of China by product type with projections from 2022 onwards[6] (Frost & Sullivan, 2021)

[6] Tea leaves refer to all varieties sold in different forms including loose leaf, bagged, compressed cake etc.; freshly-made drinks refer to made-to-order drinks including tea lattes, bubble tea, fruit teas etc.; ready-to-drink refers to bottled tea drinks usually found in convenience and grocery stores.

The freshly made tea drinks segment is largely bolstered by the popularization of beverages such as milk tea and bubble tea. Between 2020 and 2024, the market size for these new-style tea drinks grew an astounding 92%, and while year over year growth is projected to slow in the coming years, it is still undoubtedly on the rise as each year sees thousands of new locations opening (Ou, 2024). As of 2024, the market was estimated to be worth USD$20 billion (da Silva, 2024).

Consumers increasingly consider the value and quality of tea when purchasing – even in freshly made beverages, tea bases steeped from well-known tea brands can boost customer preference (Hu & Bao, 2019; Lin et al., 2023). Chinese consumers have also shown a growing interest toward organic food and there is an increased willingness to pay for organic tea with its perceived attributes of health and sustainability (Bu et al., 2020; Chu, 2018). Coffee is also growing in popularity across the country, particularly among the young, urban population with higher disposable income (Interesse, 2022).

When looking at tea consumption habits, Chinese consumers largely prefer loose leaf tea with 67% primarily choosing this form of tea when drinking at home (Luna, 2021). This is not including tea cakes – or compressed loose leaf tea – which is another common way of packaging and selling tea. The popularity of loose leaf tea can likely be attributed to the deep roots of tea culture that originated in China itself, with a focus on consuming high quality single origin, single leaf product (Gao & Li, 2023). For tea drinkers in China, market segmentation not only comes from type of tea, but also the origin, with the perception of taste and profile differing whether it was grown in Fujian or Zhejiang. In this aspect, Chinese tea drinking culture is not unlike that of coffee aficionados in other parts of the world.

Domestic sales are largely dominated by green tea (绿茶), coming in at 53.6% of market share in 2023, followed by black tea (红茶), dark/fermented tea (黑茶), and other types making up the remainder (Appendix 3) (Mei & Liang, 2024). While there is some consumption of imported tea, namely black tea from Sri Lanka, India and select Southeast Asian and African countries, it is a tiny fraction of total domestic tea sales, with the country only importing 39,000 tons in 2023 – less than 2% of total domestic tea sales volume (Mei & Liang, 2024).

As strong consumer demand and trends continue to drive the sector, China is among one of the only major tea producers in the world that tea plantation area continues to rise – in 2023, there was a 3.09% increase in tea garden area equalling 1.54 million mu (Mei & Liang, 2024). However, just as with other countries, there is an increasingly strong emphasis on increasing productivity on existing cropland

through technology integration, along with investment into low-carbon transformation (Mei & Liang, 2024).

2.3 Yunnan

In tea production, Yunnan is second to only Fujian – in 2023, the province produced 439,230 tons of dry unprocessed tea, about 13% of total national tea production (Appendix 4) (Mei & Liang, 2024). Other top producing provinces are Sichuan, Guizhou, and Hubei. While production in Yunnan has stayed relatively stable, with only 1.5% year-over-year growth, other provinces such as Anhui, Shandong, and Gansu have shot up an astonishing 12.4%, 28.6%, and 50% respectively in 2023 (Mei & Liang, 2024). Overall, national production grew by nearly 5%. This could indicate a shift in agricultural production patterns in other parts of the country towards the cash crop, which leads to increased supply and increased competition within the market.

However, compared to production volume, export volume paints a very different picture, with Yunnan not even reaching the top six (Mei & Liang, 2024). While there is no one clear cause for this surprising non-alignment in production and export volume, there could be multiple factors behind the phenomenon. First, while Yunnan produces many different types of tea, it is most well-known for it's Pu'er tea which, while has a strong domestic customer base, is less popular overseas and makes up less than 0.5% of total national exports (Appendix 5) (Mei & Liang, 2024). Other provinces such as Zhejiang and Anhui enjoy stronger recognition for their green tea, which by far makes up the vast majority of Chinese tea that is exported. Furthermore, some top exporting provinces such as Fujian have historically made much investment into export networks and infrastructure and have prioritized international branding and marketing to appeal to markets abroad (Hong & Song, 2015).

2.4 Ancient Forest Tea

While there are other areas of ancient tea grown sporadically through Guizhou, Guangxi, Chongqing, and Sichuan, Yunnan contains 97.7% of the country's total 56.2 million ancient tea trees (Wang, 2024). This gives an important competitive advantage to the province in terms of both market differentiation and perceived quality of tea. There is a marked difference in price between conventional, terrace-grown monoculture tea and traditionally managed forest tea. In field

interviews conducted with tea farmers around Yunnan, raw conventional terrace tea was sold for around 2 – 3RMB/kg compared to the price of raw forest tea which ranged from 50 – 5000RMB/kg, depending on the season that it was grown, age of the tree, and other environmental factors.

Historically, this price difference has not always been the case. Previously leaves grown from forest tea trees were not regarded any differently from conventional tea, which is why many forest tea gardens were cut down in favor of planting terrace tea, which maximized production volume, during China's rapid agricultural expansion period of the late 20th century (Wu et al., 2023). However, over time, many market drivers have led to a steep increase in price for forest tea. Consumers perceive the taste and quality to be better compared to conventional tea – which can be linked to the fact that tea grown in agroforests and mixed cropped systems have higher phytochemicals that are responsible for tea quality and taste compared to leaves grown in terrace farms (Ahmed et al., 2012). Furthermore, there is also the status and luxury aspect of being able to purchase a rare, premium tea, and a compelling story to be told around the cultural and historical mythos of this now not-oft seen traditionally managed ancient tea (Jin, 2024).

That being said, Yunnan ancient tea is not the only premium "luxury" tea on the market – other regions around the country also grow renowned rare and specialized teas. For example, Da Hong Pao tea from the Wuyi Mountains of northern Fujian are a category of black and oolong tea in which several grams can go for tens of thousands of Chinese yuan (Wong, 2022). In China, tea acts not only as a regular consumer product, but also a cultural one – with rare and expensive teas serving as a status symbol just as other luxury goods would. Thus, Yunnan ancient tea can face competition on both fronts as it must effectively position itself both as a quality consumer good, but also a premium cultural product. And while the biodiversity-friendly traditional agricultural management systems of the forest tea gardens are unique, other premium tea growers across the country have also begun to adopt ecologically friendly practices as a way to enhance the quality of their leaves. Fujian has implemented improved fertilization methods in its tea fields and has introduced intercropping with soybeans and rapeseed in the summer and winter months to improve soil and tea quality (Zhong & Liang, 2024). Anxi County, home to the famous Tieguanyin oolong tea, has developed a carbon footprint monitoring system to improve energy consumption and emissions (Zhong & Liang, 2024). As the tea industry continues to evolve and adapt to changing market and climate conditions, ancient tea growers in Yunnan must also ensure they can move forward with trends and retain their competitive advantage.

2.5 Forest Tea Outlook

In 2024, tea growers across China reported relatively stable production, however due to higher temperatures and less rainfall in the spring, production and picking of leaves began slightly later than usual (Mei & Liang, 2025). However, climate conditions can have greatly differing impact from region to region. At sites surveyed in Mengla County, Yunnan, forest tea tree growers reported recent drought conditions leading to sizable drops in harvest levels.

However, the most pressing market concern that has been felt within province is the drop in tea prices. Spring is considered to be prime tea harvesting and purchasing season and is known to be better quality than the "autumn tea" that is sold later in the year. But in March 2024, the prices of both unprocessed and dry semifinished tea fell significantly compared to the same period the previous year (Mei & Liang, 2025). Even with steady growth in consumption, the expansion of tea growing area and increased production likely led to oversupply, and inventory backlog of tea merchants also contributed, as many buyers felt little urgency to procure leaves right at the beginning of the season compared to previous years (Mei & Liang, 2025). While this trend is mostly driven by conventional terrace tea across the broader country, this oversupply issue also has an impact, albeit less pronounced, on forest tea as well, likely due to a weak substitution effect between conventional and forest tea. Furthermore, as the Chinese economy has been in a downturn in recent years, this has also likely impacted the demand for highly elastic goods, such as luxury tea, as consumers have less disposable income.

At the major tea markets across China, trading volume have declined. Interviews with farmers confirmed this: while forest tea continues to fetch a much higher price than conventional tea, even such high-end, highly sought after teas have felt the pressuring decline in sales price and volume. Pricing for forest tea is also far from a monolith – many factors can contribute to prices varying such as rainfall, management methods, and age of the tea trees.

Based on interviews in Mengla County, many ancient tea growers rely on repeat customers who return each year to purchase leaves in bulk, with larger enterprise buyers signing multiyear procurement contracts. Some farms join together to create cooperatives for more bargaining power, and in recent years, online sales have begun to grow, however still account for a small percentage of sales overall. Due to sufficient repeat business and word of mouth around the high-quality ancient tea, local growers still feel satisfied by the level of income but are not ignorant to recent unfavourable

market conditions and are receptive to new opportunities of differentiation or economic development.

One key method for farmers to gain recognition for their tea is by participating in large regional tea competitions. Major competitions in Yunnan include the likes of Gong Cha Tea Festival, Mengla Tribute Tea Culture Festival, and Yiwu Tea Competition. These are large-scale events that are widely attended by industry including farmers, processors, distributors, large tea buyers and sellers, and tea connoisseurs. While these events are not very publicized with the general population, they are high profile among industry and winners of the competitions can often enjoy widespread recognition and respect across the industry afterwards. In an interview with tea expert Yang Wang, based out of Mangzhi Ancient Tea Mountain, a trend toward the promotion of organic, eco-friendly agriculture was identified as regional governments are giving increased focus to strengthening and publicizing local conservation-forward tea growing practices. This has become a rapidly rising priority for major tea producing areas of Yunnan as market trends shift toward sustainable consumption. Product differentiation is also becoming increasingly important as the market suffers from price fluctuation and oversupply, and in most tea competitions and tradeshows the number of varieties of teas that is being showcased grows each year.

Another development strategy that regional governments and tea associations have begun to prioritize is the expansion of alternative revenue streams related to tea production, such as eco-tourism and experiential cultural travel. There is increasing promotion to the public on tea not only as a consumer product, but as a cultural experience, particularly in areas where tea gardens are still widely traditionally managed by ethnic minorities. Yiwu County has recently been pushing the transformation of the surrounding region as both a sightseeing destination and an immersive travel experience, integrating ethnic tea culture into tourism, and showcasing the ancient tea mountains as attractive destinations for an escape from the city.

3. CERTIFICATION LANDSCAPE

There are countless sustainability certifications around the world, but within the tea market the most common are Rainforest Alliance (combined with UTZ[7] as of 2018), Fairtrade, and Organic – which are

[7] UTZ, formerly called UTZ Certified, was a certification program for coffee, cocoa, tea, and hazelnuts focused on environmental and social welfare.

also well-known for certifying coffee, if not more so. These certifications all work beyond just coffee and tea, certifying different types of food and drink such from palm oil to dairy. Fairtrade even covers consumer packaged goods and flowers. Each of these certification programs have a different focus, but overall cover holistic sustainability standards, rather than biodiversity specifically.

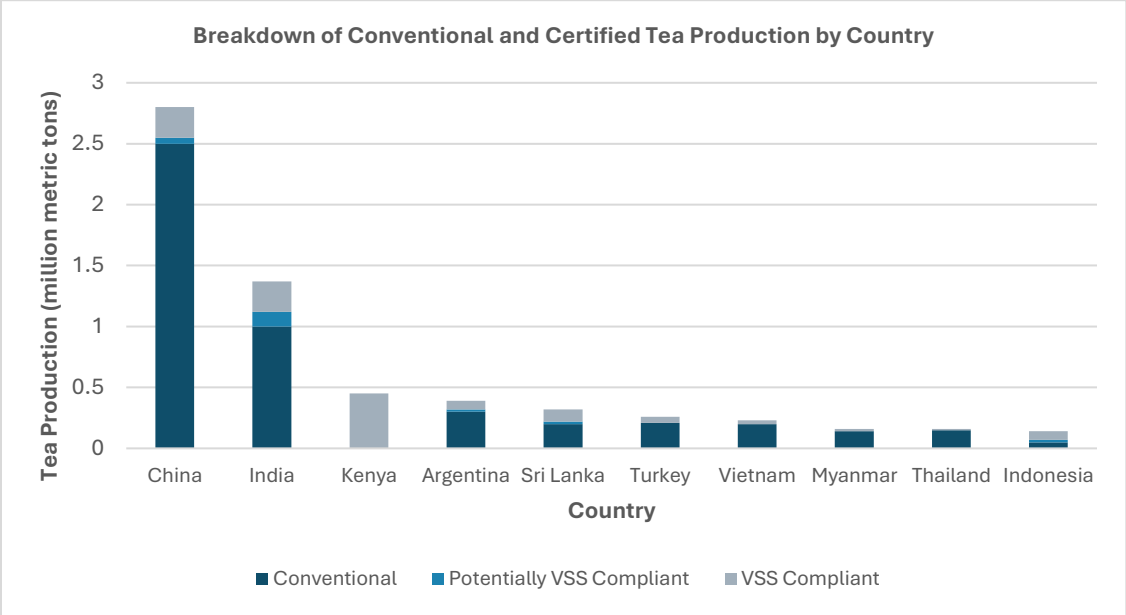


Figure 4. Breakdown of conventional and VSS compliant tea production in the top 10 tea producing regions of the world (Bermudez et al., 2024)

In 2019, 45.4% of total global coffee production was voluntary sustainability standard (VSS) compliant, while only 24.8% of total tea production was (Bermudez et al., 2022; Bermudez et al., 2024). Some countries lead in this certified production – for example, nearly all of Kenya's tea production is certified, particularly by Rainforest Alliance or Fairtrade (Figure 4) (Millett, 2021; Fiolhas, 2024). In 2023, out of the 1.3 million tons of Rainforest Alliance certified tea produced around the world, 596 thousand tons of it was produced in Kenya, making up nearly half of the certified production (Statista, 2023; Fiolhas, 2024). Unlike China where two thirds of production go to domestic consumption, Kenya has an export heavy market: in 2023 they exported at total of 522.91 million kg of tea, compared to domestic consumption of only 3.46 million kg (Tea Board of Kenya, 2024). Much of the high certification uptake in the country has been driven by buyer demand, however as integration of certification standards proved to improve supply chain management and market access, more farms were driven to embrace sustainability standards (IISD, 2019). When breaking down market share of total VSS compliant tea and coffee production by certification,

coffee exhibits a more fragmented certification landscape due to a larger number of existing certifications (Figure 5), however following the merging of UTZ and Rainforest Alliance in 2020, both landscapes have become more consolidated. It is also important to note that some of the market share may be overlapping – for example, many farms that are Rainforest Alliance or Fairtrade certified may also choose to be Organic certified.

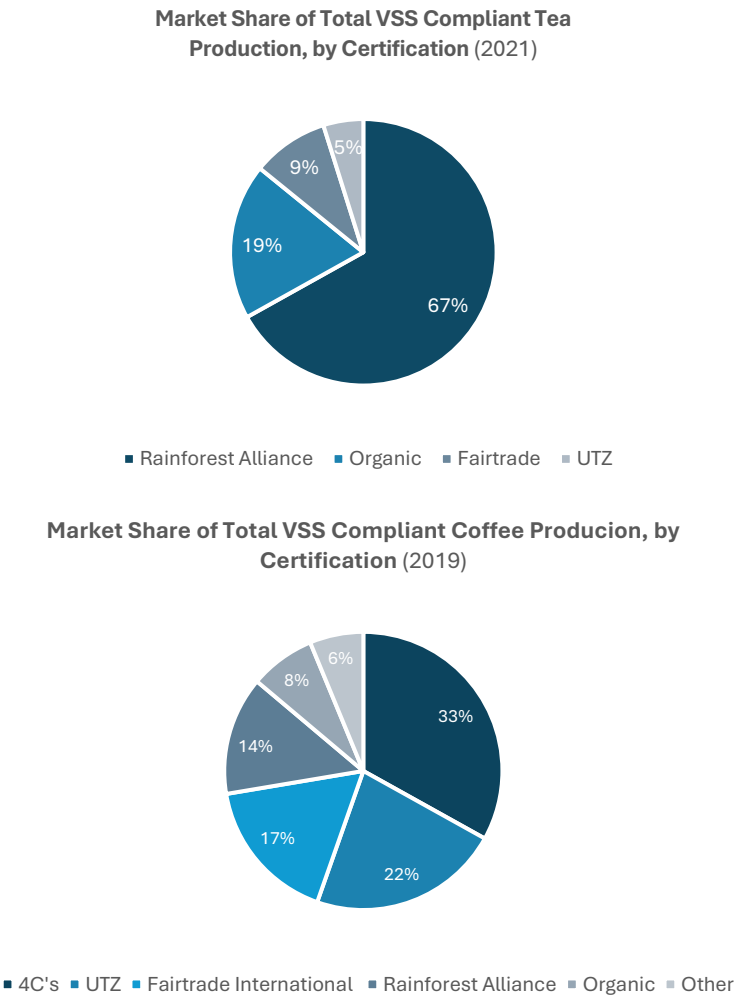


Figure 5. Global market share breakdown of voluntary sustainability standard (VSS) compliant tea and coffee by certification (Bermudez et al., 2022; Bermudez et al., 2024)

Much of the sustainability standard compliant tea produced around the world falls under Rainforest Alliance, Fairtrade, or Organic certifications, and there is little to no certified tea that is produced outside of them. For coffee, the market is dominated by the same three, along with Certification for

Climate, Conservation, and Communities (4C)[8] – however there is also a percentage of share almost as large as Organic that is taken up by various, smaller certifications such as Bird Friendly. This could be due to coffee being dominantly consumed in mature, higher income markets that often have higher demand for eco-certified products, thereby increasing the amount of certified production volume share and competition within the certification space itself. This can also indicate that there is a low barrier of entry into the coffee certification landscape, however it may be difficult to establish into a highly recognizable and trusted logo as too many different eco-labels on the market can often confuse consumers.

Consumers have a willingness to pay around 11% - 44% more for eco-certified coffee, however the amount of premium willing to be paid between an agrochemical-free label (e.g. Organic) versus biodiversity conservation label differs (Gatti et al., 2022). On average, consumers are willing to pay more for organic or pesticide-free coffee over Bird Friendly or shade-grown coffee (Appendix 6) (Gatti et al., 2022). This may be an indication of consumers valuing health benefits over pure environmental benefit, however it can also showcase how consumer preference can be highly dictated by exposure and awareness to a label. As the organic label has been long established and awareness campaigns have effectively informed the public on the positive health and environmental of organic goods, consumers are more likely to understand and perceive the benefit of paying more for this label as opposed to other eco-labels (Gatti et al., 2022). Despite Bird Friendly coffee requiring producers to meet organic standards on top of upholding biodiversity friendly agrosystems, most consumers and retailers are unlikely to know the full benefit of the label due to low awareness and lack of information.

3.1 Tea Certification Overview

The major tea certifications each have their own focus and scope with varying criteria for eligibility (Appendix 7). Rainforest Alliance, Fairtrade, and USDA Organic were selected for comparison due to their dominance in the tea industry. Smithsonian Bird Friendly is also included in the comparison analysis due to its role as a biodiversity-friendly specific certification for coffee, and in biodiversity surveys done in the tea forests of Yunnan, has been used as a proxy for potential biodiversity-friendly tea standards due to the similarities in the two crops. In a high-level comparison of the four,

[8] 4C is a certification system for coffee and cocoa primarily focusing on fair and safe working conditions, and protecting ecosystems and biodiversity.

Rainforest Alliance and Fairtrade encompass more categories of standards – including biodiversity standards, environmental standards, as well as management, transparency, and social welfare standards. Organic unsurprisingly focuses the most on environmental and production management requirements. For the Smithsonian Bird Friendly coffee certification, obtaining a USDA Organic or equivalent certification is required to become part of the program, therefore all Organic standards are included within their requirements as well. However, they additionally require strict biodiversity standards such as plant diversity and high shade coverage, being the only certification out of the four to do so. Specific environmental requirements for each certification are detailed in Appendix 8.

3.2 Rainforest Alliance (www.rainforest-alliance.org)

The Rainforest Alliance certification promotes biodiversity conservation, sustainable land management, and climate-smart practices. It integrates environmental standards with worker well-being, requiring farms to protect forests, soil, and water resources. The certification covers ten types of commodities: bananas, cocoa, coffee, tea, flowers, fruit, herbs & spices, non-timber forest products, nuts, and palm oil. It specifically focuses on four tenets of sustainability: forests, climate, human rights, and livelihoods. It certifies both producers and suppliers – companies who want to source and sell product from Rainforest Alliance certified farms must get a supply chain certification[9] to ensure top to bottom supply chain transparency. The average cost of a smallholder farm to be certified and audited per year is usually under US$1000 and depends on size and production level of the farm. In addition to audit costs, producers must pay a royalty Rainforest Alliance: for tea it is $0.0147 per kilogram and for coffee it is $0.0175 per kilogram.

Requirements for Rainforest Alliance certified farms fall under six main categories, or 'outcomes': management, traceability, income and shared responsibility, farming, social, and environment. Each individual requirement is further segmented into types: core requirements, mandatory improvement requirements, and self-selected requirements. Core requirements must be met to obtain and maintain certification. Mandatory improvement requirements must be met either by a later audit stage or have annual targets and measurement indicators tracking improvement. Self-selected

[9] Rainforest Alliance requires certified suppliers to have chain of custody, indicating that products sourced from certified farms must have tracking and documentation throughout trading, manufacturing, warehousing, and distribution, to ensure the product's claim reflects its certified content.

requirements do not have mandatory implementation and certificate holders determine if and when to comply with the requirement.

Under the farming category, requirements focus on improving farm resilience, maintaining or enhancing ecosystem services, optimizing crop and input productivity, and reducing health and environmental risks. Under the environment category, requirements focus around effectively protecting and restoring natural ecosystems, vegetation, and wildlife, as well as efficient on-site use of water and energy resources. Overall, the standards required by the Rainforest Alliance are holistic and comprehensively cover the different tenets of sustainability. In terms of preserving and enhancing wild habitat and biodiversity, they take a relatively standard minimal harm approach and are not overtly strict – as the minimum canopy coverage for shade-tolerant crops such as tea is only 15%, this is not conducive to high levels of biodiversity preservation. Furthermore, while they discourage usage of agrochemicals and have certain conditions around their usage, they are still permissible to be used under the Rainforest Alliance certificate.

As of 2023, Rainforest Alliance has 456 total tea farm certificate holders[10] across 22 countries – 94 of them being from China (Fiolhais, 2024).

3.3 Fairtrade (www.fairtrade.net)

The Fairtrade certification focuses on equitable pricing and labor conditions, ensuring farmers receive fair compensation and work in safe environments while promoting community development. It covers 18 different types of commodities including bananas, cocoa, coffee, herbs and spices, nuts and oils, vegetables, tea, sugar and rice. Fairtrade supports sustainable resilient livelihoods, gender and social equity, environmental sustainability, and fair supply chains. They certify and have standards for small-scale and large-scale producers, and traders who buy and sell Fairtrade products. One of the main tenets of the certification is the implementation of Fairtrade Minimum Price which guarantees a minimum stable price that protects against price fluctuation and allows for better long-term planning for producers. The Fairtrade Premium is also a guaranteed additional amount of money paid on top of the agreed price, that is then reinvested by producers into education, healthcare, and farm improvements. The minimum price for raw tea leaves ranges from US$1.1 –

[10] Certificate holders include groups of farms (46%), single farms (30%), and multi-farms (19%), with the total number of farms within the Rainforest Alliance certification program being over 1.1 million (Fiolhais, 2024).

2.4/kg depending on country of origin, quality, producer scope, and price level. The Fairtrade Premium on most raw tea leaves are US$0.5/kg. The cost of becoming Fairtrade certified for a small-scale tea producer is estimated to be around US$2000 – 3000 for the first year, and then US$1000 – 2000 for subsequent years, with no royalty fees required. As Fairtrade is largely focused on fair labour and supply chain, many of the standards are aimed towards the goals of improved income, enhanced equity, and transparent business practices. However, there are also environmental sustainability requirements for the certification.

Overall, the Fairtrade certification takes thorough consideration of environmental safety, particularly regarding direct impact on human and ecosystem health. However, in terms of preserving and enhancing wild habitat and biodiversity, they take a relatively standard minimal harm approach and are not overtly strict from this aspect. For example, the minimum tree canopy coverage threshold is 10%, which is considered to be very sparse coverage and would not be conducive to maintaining high levels of biodiversity (WRI, 2025). Furthermore, while they discourage usage of agrochemicals and have certain conditions around their usage, they are still permissible to be used under the Fairtrade certificate.

3.4 Organic (USDA) (www.usda.gov)

Organic is a label that indicates that the agricultural product has been approved using certain farming methods, usually integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity. Practices such as usage of synthetic fertilizers, sewage, irradiation, and genetic engineering are not allowed. Around the world, the organic certification label is managed by different certification bodies with differing standards, however all follow the general guidelines of eco-friendly agricultural practices. With the United States being one of the largest consumer markets in the world, the United States Department of Agriculture (USDA) oversees one of the most recognizable organic certifications. The National Organic Program (NOP) regulates all organic crops, livestock, and agricultural products certified to USDA organic standards. The cost to becoming USDA Organic certified range from US$700 – 3000 per year depending on farm size, however the USDA maintains a cost-sharing program for producers that can subsidize the annual costs of certification significantly.

Overall, the production process requirements for the organic certification are strict and extremely thorough in detailing allowable practices, along with specific situations in which exemptions are granted. However, as expected considering the organic certification is primarily aimed towards regulating food production processes, there are little to no standards directly aimed toward ecosystem and habitat protection, outside of ensuring minimal contamination to soil and water systems. While organic farming processes can be improvement from traditional farming methods, this certification cannot be considered environmental conservation focused.

3.5 Smithsonian Bird Friendly (www.nationalzoo.si.edu)

The Smithsonian Bird Friendly certification holds some of the strictest environmental standards, as it is specifically aimed at preserving critical habitat for birds and wildlife, fighting climate change, and protecting biodiversity. Currently, this certification only covers coffee and cocoa. Bird Friendly specifies a required mix of foliage cover, tree height, and biodiversity that ensures the maintenance of quality habitat for birds and other wildlife. Due to its strict growing standards, the certification provides a premium for labelled products. According to a Smithsonian representative, the average cost of becoming Bird Friendly certified is anywhere from US$500 – 2000, with a smallholder farm of around five hectares being closer to $500. The certification lasts for three years before farms are required to be re-certified. This cost is in addition to the cost of maintaining organic certification, which is one of the requirements of becoming Bird Friendly certified.

The specific requirements to becoming Smithsonian Bird Friendly certified are (Smithsonian's National Zoo & Conservation Biology Institute, 2025):

1. Organic certification or participatory guarantee system
    a. Must have current organic certification by an accredited certification agency
2. Zero deforestation in the past 10 years
3. Biodiversity conservation achieved in **1 of 2 pathways**:
    a. Agroforestry system
        i. Shade cover (30% for cocoa; 40% for coffee)
        ii. 10 shade tree species per hectare
        iii. 60% native trees
    b. Forest conservation

i. 2:3 forest to crop ratio
ii. Stable governance and management plan
iii. Tenure of primary or secondary forest

4. Traceability
    a. Certified coffee & cocoa are separated and labelled throughout post harvest processing and storage, supported by proper documentation

In addition to required criteria, the certification also recommends best management practices such as having multiple canopy layers, soil cover, epiphytes and vines present, limited shade tree pruning, living fences, and riparian buffers. Compared to the more well-known certifications, Smithsonian Bird Friendly has more stringent and specified habitat and biodiversity conservation targets. As the environmental gold standard for sustainable coffee and cocoa production, it is an ideal certification to model after in the creation of a biodiversity-focused sustainable tea certification. However, it is important to note that due to the strict standards and relative niche that Bird Friendly occupies, along with a small operating team, it has lower adoption rates, market share, and brand awareness compared to other eco-labels. Much of their current program expansion relies on word of mouth and support within the existing network. However, as environmental protection legislation is emerging around the world – such as the EU Regulation on Deforestation-free Products enacted in 2023 – more producers may turn to certifications like Bird Friendly to showcase compliance and differentiation in this area. The organization currently has 54 certified farms across 13 countries.

3.6 Case for Biodiversity-Friendly Tea Certification

The opportunity to create a biodiversity friendly tea certification program within China or even globally certainly exists as it is a niche within the market that is currently unoccupied and inadequately addressed by current major certifications due to encompassing sustainability standards that are more holistically or socially focused. This certification would provide a way to differentiate tea producers who go above and beyond in sustainable farming methods and preserving valuable habitat for wildlife. A good candidate would be the forest tea tree farmers in Yunnan who not only manage their crops without the use of agrochemicals but maintain the traditional management methods of low ecosystem intervention, allowing the crops to grow interspersed with wild plants and native trees – an organic certification would not differentiate them from terrace tea farms who also

employ organic practices, but a biodiversity focused certificate would. Furthermore, the current trends within the tea market shows promise in investment potential for eco-certified tea, particularly if there can be a perception built of correlation between environmentally friendly and high quality. Lastly, a certificate could create market incentive for more farmers to shift towards agroecological practices that can help adaption and mitigation against climate risks.

4. INSIGHTS FROM YUNNAN

In December 2024, semi-structured in-person interviews were conducted of 24 farmers and 4 leadership figures in Gaoshan (高山) Village, Mengla County, Xishuangbanna, Yunnan to understand the attitudes of ancient forest tea producers on certification (Appendix 9).

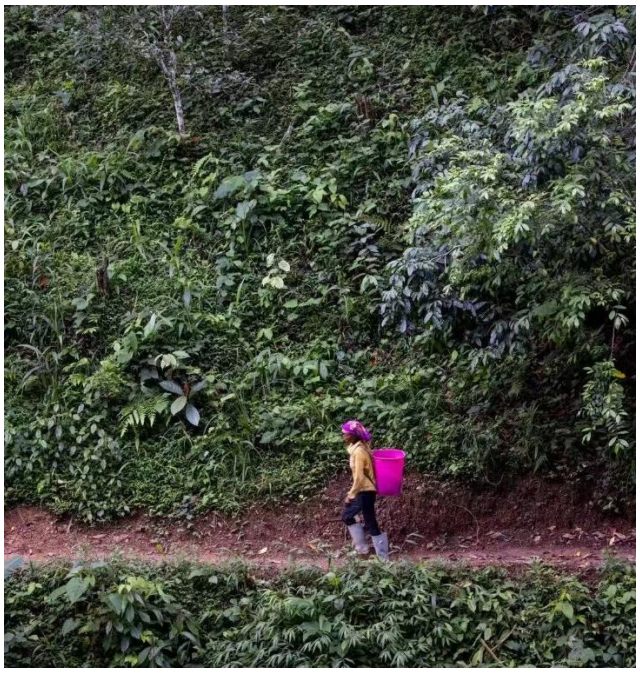


Figure 6. Local woman walking among forest tea gardens in Xishuangbanna, Yunnan (Photo by Binbin Li)

Mengla County is located in Xishuangbanna Dai Autonomous Prefecture of Yunnan – it has a population of 306,500 with three-quarters consisting of ethnic minorities such as Yi, Yao, Aini, Dai, and others (Xishuangbanna People's Government, 2023). This town, located at the edge of the Xishuangbanna National Nature Reserve, is home to 493 people. Essentially every household within the village participates in the production and processing of tea, with each household owning around 30 mu of tea growing land, on average. As with the rest of Xishuangbanna, this region is a famous tea-

producing area in China and is well known for its thousand-year-old forest tea trees. Due to the neighbouring protected area, as well as the persisting traditions of local ethnic minorities, the village is surrounded by lush forest. While there has been some land cleared for conventional terrace tea, much of the tea that they produce still come from hundred-year-old trees that grow interspersed with natural vegetation and have been passed down family generations (Figure 6).

Among tea enthusiasts, the leaves from this region are well-known for their quality and aroma, and the current market price reflects this. Unprocessed spring tea grown from Gaoshan sells for 135 – 400 RMB/kg, while autumn tea sells for 100 – 300 RMB/kg The biodiversity of the forest is an active contributor to the unique flavour, giving it it's famous "wild" taste. Farmers will even sometimes purposely plant other fruit or flowering tree species nearby, to give the flavour profile an added layer of complexity. Beyond their existing traditional agroforestry ecosystem management practices, government policies have also further strengthened sustainability standards.

4.1 Eco-Certification Attitudes

83% of farmers had heard of the concept of "eco-certification" prior to the interview – mainly organic certification – however knowledge level usually did not go beyond simply knowing the existence of certifications as most of them outlined a lack of understanding in the actual processes, requirements, and standards of becoming eco-certified. Out of all interviewees, there was only one farmer who has gone through the certification process before, and this was at the request of a distributional company with whom he had contract – and even in this case, it was mostly the company who had taken care of the administrative and regulatory process to get the certification for the farmer.

Overall, there was a lack of interest from most of the farmers for the existing certifications on the market and therefore they had felt no need to gain greater understanding of them. First, there was little to no demand from their existing customer base to obtain certification. As previously mentioned, the majority of their business came from core, repeat buyers who came annually to purchase the tea at harvest season or existing multi-year buyer contracts (Figure 8).

This customer base primarily comprised of tea distributors, and subsequent downstream customers of tea connoisseurs and specialty tea houses, was already extremely familiar with their crop management and quality of tea, therefore likely feel no need to have third-party verification on the farms. Second, the current most common certifications on the market provide little differentiation of

ancient tea from its competitors. For example, one farmer outlined that organic certification may be helpful for conventional tea growers who decide to forgo the use of agrochemicals and thus can indicate that their tea is of higher value and quality than other conventional teas – however, for forest tea growers such as those in Gaoshan, they have long eradicated the use of agrochemicals and indeed go above and beyond in their sustainability and ecosystem management practices and thus felt an organic certification would provide them little value. As forest tea is already priced much higher than conventional tea due to its unique growing standards, most of the farmers believed an organic certification would likely bring little additional return on investment. And lastly, compounded with the lack of demand and perceived lack of value, the absence of resources and support is also a major hindrance to many when it comes to pursuing a certification. Due to the low level of knowledge and understanding, many farmers indicated that in order for them to become interested in becoming certified, they would require more resources and technical support to aid in the process. This would also bring more confidence on the veracity of the certification, as some brought up the existence of certification scams which further muddle their trust and in certification programs in general.

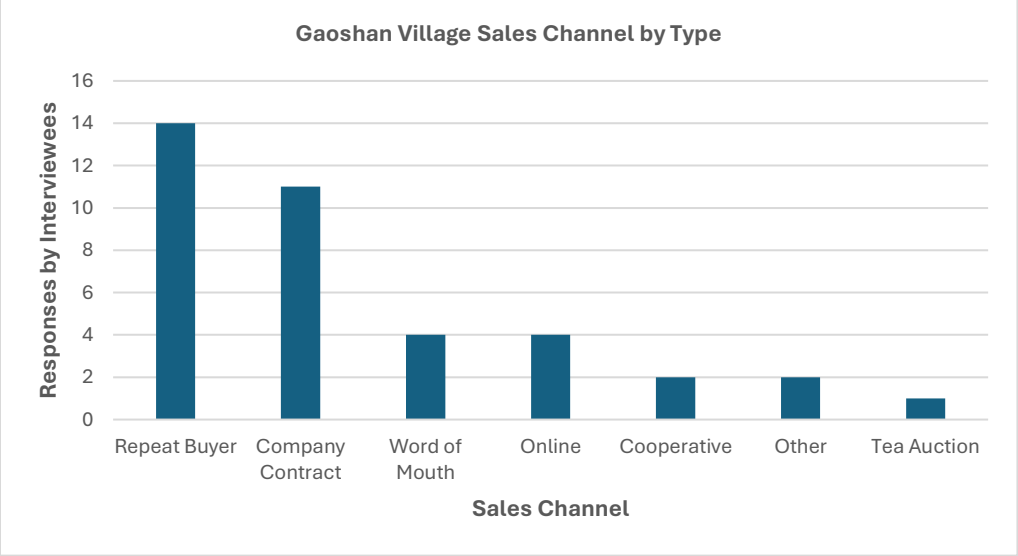


Figure 8. Interviewed farmers recorded responses of sales channels and methods of ancient tea

4.2 Biodiversity Certification Attitudes

When asked about their interest in a biodiversity-specific eco-certification for their tea that would allow them to showcase the full extent of their ecologically friendly management practices, 29% of farmers expressed strong support and interest (Figure 8).

There were very few interviewees who expressed outright disinterest in such a certification. Most of the farmers expressed consideration for participation but were hesitant and required more persuasion. Many expressed that they could see the potential of a biodiversity-friendly certification to increase the recognition and visibility of their tea in the market, which could boost sales from the seller's perspective. From the buyer's perspective, it could provide a guarantee of tea quality and tea growing environment, which can increase customer trust and brand perception. However, without concrete market evidence on the benefits of such a certification, many farmers would not commit to definitively participate in the program.

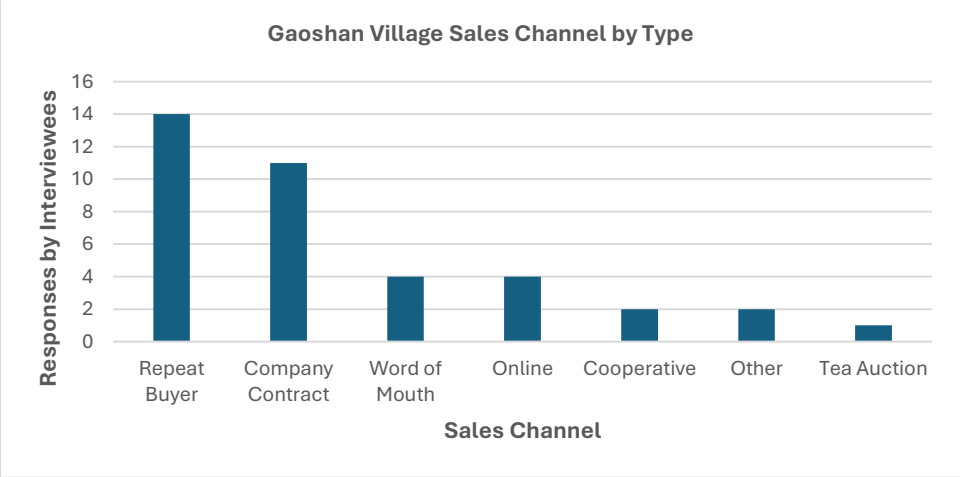


Figure 8. Interviewed farmers recorded responses of sales channels and methods of ancient tea

Some farmers also expressed satisfaction with the status quo given that the ancient tea already sold well enough, and thus there was no need to spend additional time and resources on obtaining a biodiversity-friendly certification. Similar to concerns expressed previously about existing certifications, this is compounded by the sense of a lack of understanding of the certification process, as not only would they be investing resources into meeting certification requirements but also would be investing time into having to learn the regulatory process.

4.3 Biodiversity Certification Motivators

There were several points that interviewees mentioned would act as strong motivators for them to implement a biodiversity-friendly certification. First, there was an emphasis on the efficacy of the certificate to communicate to customers the quality and superior growing environment of the tea leaves, which would increase the perceived value of the leaves, allowing farmers to sell at higher

prices. Second, interviewees mentioned the importance of the certification's ability to increase recognition of their tea and brand, enhancing both the marketability and brand value of their products. Similar to awards won from tea competitions, the interviewees pointed to certification as a potential way to bring prestige to their product. Furthermore, due to oversaturation, there is extreme variation in price and quality among products available in the market, which can lead to confusion among most consumers who do not possess a strong understanding of tea – therefore, there is also opportunity for the certification to serve as a method of standardization, a trusted guarantee of a certain level of quality for customers. Some interviewees also mentioned the synergistic potential of the certification in promoting tourism. A biodiversity specific certification can indicate to the public the well-preserved, ecological environment of Gaoshan, which could help attract more tourists and their revenue to the village.

Lastly, many interviewees expressed that if the certification process were to be organized by leadership and carried out by the village as a collective, this would greatly enhance the persuasiveness and credibility of a certification both for the farmers and the buyers. As the villagers seemed to hold strong trust in their leadership, they felt that an official push towards certification would override many of their existing concerns about such programs, particularly on the legitimacy of the certification and current lack of guidance.

4.4 Biodiversity Certification Barriers

Interviewees also raised multiple concerns that serve as the main obstacles and challenges to implementing a biodiversity-friendly certification. One of the most frequently mentioned were the opportunity and time costs of certification. While the price of becoming certified was not a major detracting factor, what seemed to be worrisome for producers was the time and resources needed for the entire process, particularly if it would take away from primary production and operation activities, which would bring about the risk of economic losses. Since most of them are not currently knowledgeable about what would be required to obtain the certification, one of the largest concerns was the opportunity cost of investing significant time into understanding and implementing the processes.

Secondly, because the current market and existing customer base had not indicated a demand for tea certification, producers are worried about whether the market recognition of such a potential

certification would be high enough that would make it worthwhile to invest in. For example, if this biodiversity focused certification were to be introduced, it may end up only being recognized by experts but not the general tea-consuming public, resulting in a "waste of effort" in the end.

Furthermore, due to the current lack of knowledge among the farmers and the requirement of being audited by a third-party institution, interviewees outlined wariness and doubt towards over-relying on outside experts and personnel. This lack of trust would be particularly difficult to overcome without some support or backing by village leadership or other official government channels.

4.5 Assets and Opportunities

The strong, consistent loyal customer base of annual repeat business is a core business strength for producers as it can ensure stability against market fluctuations and provides more predictable year over year demand, thereby reducing revenue volatility. Compared to conventional monoculture tea growers with less market differentiation, strong customer loyalty can ensure resiliency against both poor market and climatic conditions. Many farmers also indicated that their customer base would often act as brand advocates and recommend their tea to other buyers – this is extremely beneficial as word-of-mouth referrals are overall more trusted and cost-effective than paid advertising (Bughin et al., 2010). This also creates a strong foundation for growth as high customer retention allows for opportunities of investment into product enhancement, new marketing strategies, and expansion of sales channels. Furthermore, long-term customers who know the product well can provide data and feedback on future changes in the tea, with tea merchants especially being able to provide farmers who are less familiar with the competitive landscape with insights into industry trends and shifts.

Previous decisions regarding agroforestry management were made through community consensus, and high levels of guidance and trust in town leadership. This collective consciousness is an important asset as it is one of the pillars of the continued success and effectiveness of traditional tea forest management. The emphasis held towards preserving the forest and engaging in sustainable farming practices is a shared value, and while there are agreed upon boundaries between households, the forests are a collective resource and thus it is critical that all those involved in tea production within the village agree on the management standards that are expected. The high confidence in leadership can also lead to quicker decision-making should town leaders advocate for strategic changes in the future.

The foremost opportunity for tea growers in Yunnan is to leverage their near monopoly of ancient forest tea within China. As the tea market faces heightened competition, it will become increasingly important for forest tea producers to effectively communicate their points of differentiation to consumers. Regional and international tea competitions will be an important channel to leverage, particularly for business-to-business growth as these industry events are well attended by buyers and sellers. Such events would be ideal venues to publicize new product enhancements and showcase differentiation in comparison to other producers. International events such as the annual World Tea Expo and Global Tea Championship are particularly significant opportunities for expansion of forest tea as there is still relatively little understanding and exposure to the complexities and varieties of Chinese tea overseas (World Tea Expo, 2025).

Regional farmers may also benefit from the current push for eco-tourism development in Yunnan by local county governments, which aligns with a broader global trend in which the eco-tourism industry is projected to grow at an annual rate of 13.9% through 2028 (Statista Research, 2025). Compared to conventional monoculture tea farms that can be commonly found throughout China, the forest tea gardens in Yunnan have unique cultural and environmental value that would be attractive to tourists looking for an immersive travel experience (Pan, 2023).

4.6 Constraints and Risks

Despite being somewhat more insulated from market fluctuations compared to average tea growers due to the high-end nature of forest tea leaves and core customer base retention, the forest tea growers of Xishuangbanna and Yunnan at large still face vulnerability to unfavourable conditions.

Some of the core business strengths of having a tight-knit tea growing community can also have their drawbacks. Without growth strategy, relying only on repeat business can lead to a lack of diversification in customer base and sales channels, which heightens risk during times of swift market volatility and change. Through expansion in both customer type and channel, tea growers can find exposure in new demographics who previously may not have had the opportunity to try their product before. This not only allows for growth in revenue and increased brand awareness, but also more security against market shocks as they are not overly reliant on a narrow customer base. However, such shifts in business strategy may be difficult for insulated communities to take as their strong collective consciousness can be a drawback when adapting to new practices. Many of the

growers in villages such as Gaoshan have been farming tea for their entire lives and have a strict adherence to tradition, which can at times stifle new ideas or progress. Even the younger generation, who are often taking over in their families' business, although having more exposure to current trends and technology, still mostly show a strong reliance on keeping practices "as they have always been". While tradition is extremely important, particularly in the respect of maintaining unique ancient tea agroforestry practices, too much rigidity can lead to a lack of ability to adapt to market trends and find ways to modernize traditional ways of doing business.

Being insulated in a relatively closed circle of buyers and sellers can also lead to a lack of new knowledge of opportunities that could potentially strengthen the business. For example, during interviews in Gaoshan, while most villagers had acknowledged hearing about sustainable certifications before, very few had in-depth exposure to the process and were not familiar with many farms who had gone through the certification process before. As most merchants that they worked with had long, sustaining relationships with the farmers themselves and were familiar with the tea, buyers also did not often feel the need for the product to be tied to a certification.

Erratic weather patterns brought about by climate change can have a major impact on income. During the interviews with farmers from Gaoshan, they outlined drought conditions of recent years as a major hindrance to both the harvest volume and quality of tea leaves. Other regions have even reported dry seasons resulting in no early spring harvest, leading to a fall in profit. On the other hand, swift and sudden rainfall can lead to an abundance in harvest volume, but poor-quality leaves. The forest tea produced from such a season will usually fetch a lower price per kilogram, as the taste and quality are impacted from the hastened growth period. As the impacts of climate change accelerate across the globe, tea growers in Yunnan will face difficulties similar to other agricultural sectors and will likely need to find alternative ways to ensure livelihood resiliency.

As industry pressure mounts from both climatic and market forces, there is a risk of farmers turning to unsustainable practices to compensate. While traditional forest tea management is more biodiversity friendly than conventional monoculture tea cultivation, it can still face threats of overharvesting, ecological degradation, and unsustainable practices for the pursuit of short-term economic incentives. There have been some reports of producers and collectors overharvesting tea leaves to bolster production volume, as well as stripping bark from surrounding native trees to ensure that nutrients are not being drawn away from the tea trees (Shi & Shen, 2021). While outlawed, this practice of bark stripping takes an extended period to severely damage or kill the host trees, making

it difficult to track and find sufficient evidence to convict offenders (Shi & Shen, 2021). There have also been some reported instances of farmers encroaching on protected areas to plant tea trees as leaves grown in certain pristine forests can fetch much higher prices.

Although such reports remain relatively limited, and community norms around long-standing forest-preserving traditions still strongly shape farmers' behaviour, these instances of extractive practices nonetheless pose serious risks. They can threaten the health and longevity of the tea trees and undermine the ecological integrity of the mixed forest systems that make forest tea cultivation uniquely biodiversity friendly. Without strong regulation, enforcement, or community pressure, the biodiversity and sustainability advantages of these traditional systems risk being eroded by opportunistic and damaging behaviors. In 2020, Yunnan enacted the "*Special Rectification Work Plan for Illegal Occupation of Forest Land, Tea Planting, Deforestation, and Other Illegal Issues*" with the aim to both strengthen enforcement as well as raise public awareness on ecological knowledge – helping villagers understand that economic and ecological development can be advanced hand in hand (Shi & Shen, 2021).

5. TEA CERTIFICATION FEASIBILITY

5.1 Strengths

The global shift of consumer preferences toward healthier, more sustainable products and unwaning appetite for tea within China signifies a positive market outlook for the sector and indicates that it may be worthwhile to invest into continued innovation and seek opportunities to capitalize on growth trends. As there is already a pre-existing market for high-end, luxury teas within China due to the strong tea culture, there is no barrier of consumer perception that must be overcome to position tea as a premium product. There already exists a strong willingness to pay for high quality tea, thus increasing the likelihood of commercial success should a premium, eco-labelled tea was to enter the market.

Trusted sustainability partnerships have become near standard for companies who aim to build their reputation and brand power, as consumers have increased demand for corporate social responsibility and transparency. In many cases, environmental sustainability labels are also tied to the perception of quality – for example, shade-grown coffee not only ensures consumers of decreased deforestation impact, but it is often seen as being superior in quality and taste to sun-

grown coffee due to its slower maturation. As such, market positioning and marketability of a certificate beyond its intended sustainability goals can play a big role in the willingness of consumers to pay a premium for it.

As the tea certification landscape is less fragmented than that of coffee, this can be seen as a benefit for those wanting to enter the eco-certification market. When there are too many different types of sustainability labels for a product, this can become confusing and frustrating for consumers to understand what each mean and which to trust, thereby breaking down the efficacy and messaging of the label. Therefore, it may be advantageous that tea certifications are consolidated under only a couple major eco-labels as it can make the point-of-purchase decision for consumers much easier, not necessitating the differentiating of many different sustainability certificates.

Beyond favorable market dynamics, the development of a biodiversity-friendly tea certification in China is also strengthened by its alignment with existing policy and institutional priorities. China has increasingly emphasized ecological civilization (生 态 文 明), biodiversity conservation, and sustainable agricultural transformation within both national strategies and provincial initiatives. Yunnan occupies a unique position following its role as host of the Kunming–Montreal Global Biodiversity Framework and the enactment of provincial regulations protecting ancient tea trees and restricting agrochemical use. In this context, a biodiversity-focused certification could function as a market-based complement to existing regulatory frameworks, reinforcing conservation goals through economic incentives rather than additional top-down enforcement. This alignment reduces institutional friction and increases the feasibility of piloting such a certification within China.

5.2 Weaknesses

In China, there is still relatively low awareness of sustainability certifications as well as a lack of trust for domestic certifications. For example, the China organic label is perceived to be of questionable quality and authenticity compared to EU or USDA organic label within the Chinese market due to mislabelling and health safety scandals in previous decades (Wang et al., 2020). Although the Chinese government has since taken action to improve the authority and authenticity of domestic certification bodies, many organic food producers who wish to obtain the organic label will pursue both the China organic certification, along with an international certification such as EU or USDA,

especially as consumers have been shown to increase their willingness-to-pay with the addition of an international standard (Wang et al., 2020).

In 2023, domestic consumption accounted for 90% of China's total annual tea production (Mei & Liang, 2024) indicating the market is heavily reliant on domestic consumers. As such, the success of a sustainable tea certification would hinge first and foremost on the buy-in of Chinese tea consumers. This may be a drawback as the demand for environmentally sustainable products is much more established in more mature markets, whereas it is only now a growing segment of consumer goods within China. Depending on the region or consumer group within the country, some consumers may be price-sensitive to a premium, certified product (Bermudez et al., 2024). Furthermore, those that are looking to purchase high quality, premium teas may continue to do so based on a growing region's reputation, rather than looking to an eco-label to inform them of the quality.

A weakness within the tea supply chain is how value is distributed – fresh tea and primary processing retain about 25% of the value, with refining and blending retaining 15%, and wholesalers and retailers achieving the greatest margins, retaining up to 40% (Bermudez et al., 2024). Therefore, while it would be the primary producers who must invest the time and funds into improving farming practices, more money is made by downstream supply chain actors. Furthermore, growers face a major challenge of often having to sell certified tea as conventional and not receiving the premium that should have been garnered with sustainability compliance (Bermudez et al., 2024). In 2020, Fairtrade-certified smallholder tea producer organizations sold only 7% of their production on Fairtrade terms – this could lead to a difficulty in covering certification costs and lack of future incentive to invest into certification (Bermudez et al., 2024). Lack of sufficient financial return could lead to decreased farms willing to pay for certification costs, therefore strong commitment and support may need to come from processors and retailers to bolster producer action.

In creating a biodiversity-friendly certification, there also may be a difficulty of translating biodiversity outcomes into market-recognizable value – a fear that is outlined by some of the interviewees in Gaoshan. Unlike organic certification, which is often associated with direct consumer health benefits, biodiversity conservation delivers ecosystem services that are indirect, long-term, and less visible at the point of purchase. As a result, consumers may struggle to differentiate biodiversity-friendly tea from other sustainability claims. As demonstrated by the small market share and lower willingness to pay premiums held by Bird Friendly coffee, a strict biodiversity-focused certificate is niche both due to its level of difficulty in compliance as well as marketability. It may have a more

difficult time capturing market share in comparison to more generalized sustainability certificates without concerted marketing efforts and awareness building.

Beyond market and supply chain constraints, the development of a biodiversity-friendly tea certification also faces governance and implementation challenges. Certification systems inherently impose administrative, financial, and time burdens on producers, which disproportionately affect smallholders who dominate tea production in China and globally. Compliance requires documentation, audits, and ongoing monitoring – activities that may divert labor and attention away from core production activities. Without adequate technical assistance or collective organization, these transaction costs can become a significant deterrent, even when certification fees themselves are relatively modest.

5.3 Opportunities

Given the sheer size of China's tea market, the largest in the world, the opportunity to increase certified tea consumption is massive in of itself, along with the potential environmental impact that this could have. 70% of Chinese consumers have indicated an interest in purchasing sustainable products and between 2016 and 2021 retail sales of organic tea rose by 13% annually (Bermudez et al., 2024). Sustainability is a fast-growing, emerging priority for consumers, especially with its perception to be more health positive compared to conventional goods. This presents an opportunity to create a certification that capitalizes on the growing demand for sustainable product. Even if the certification were to capture a relatively small market share of total production and sales, due to the size of the domestic market, this would still account for tens of thousands of kilograms in volume. Furthermore, with the proliferation of milk tea and bubble tea shops throughout China, there is an opportunity to partner with freshly made tea beverage brands to enable greater access to a younger audience looking for innovative, fresh consumer products. As these beverage shops vary from budget to premium, there are certainly potential channels to promote higher-end, sustainable tea.

Considering the current lack of stringent biodiversity standards among the sustainable tea certifications currently offered on the market, there is an opportunity to occupy this niche the way that Smithsonian Bird Friendly does for coffee. While the market may be smaller compared to the more general organic certification, it provides a way for farmers who go above and beyond in habitat protection and restoration to differentiate themselves from others in the field. For example, while

terrace tea and forest tea can both be considered organic if they follow the regulated standards for the label, there is vast difference between the two in terms of impact on deforestation and habitat loss. A biodiversity specific certification would communicate to consumers that there are different levels when it comes to environmental sustainability and reward producers who perform better. Filling this gap in the tea certification landscape would leverage the current increasing awareness of health and environmental concerns among Chinese consumers. As income level as risen across the country, consumers will have higher willingness to pay for products that are regarded to be healthier, more sustainable, and higher quality. This could be further magnified by the revitalization of interest in tea culture, as tea enthusiasts look to spend their money on high grade tea.

The relatively consolidated tea certification landscape further creates a strategic opening for a biodiversity-specific standard to establish first-mover advantage. This is an opportunity to define clear benchmarks for biodiversity-friendly tea production, shape consumer understanding, and set normative expectations before competing standards emerge. Establishing an early, credible certification could allow for brand recognition and trust-building at scale, reducing the risk of fragmentation while positioning biodiversity conservation as a core dimension of premium tea quality rather than a secondary attribute.

From a supply chain perspective, certification also offers a mechanism to address information asymmetry, particularly in markets where current producer–buyer relationships are absent. While experienced tea buyers may rely on reputation, origin, or long-term trust, newer consumer segments often lack the knowledge required to distinguish between conventional, organic, and biodiversity-rich tea systems. A biodiversity-friendly certification can serve as a trusted signal of verified ecological performance, lowering transaction costs and enabling market access for producers beyond existing networks. This signaling function is especially relevant for Chinese tea in global markets, where certification can act as a shared language for sustainability across cultural and informational divides.

Finally, a biodiversity-friendly tea certification may strengthen long-term resilience across the sector. Biodiverse agroforestry systems are increasingly recognized for their role in buffering climate risks and stabilizing yields under variable environmental conditions. By formalizing and rewarding such practices, certification can position biodiversity not only as an ethical or environmental concern, but as a strategic asset for risk management and long-term supply stability. This framing broadens the

appeal of certification beyond environmentally motivated consumers, attracting buyers and institutions interested in reliable sourcing, climate resilience, and long-term value creation.

5.4 Threats

One threat to the tea industry is the rising coffee consumption around the world – in China particularly, the alternative beverage grows increasingly popular alongside bubble tea with young, urban populations. While it currently has not stymied the growth of tea, if the substitution rate between the two drinks grows, it could become a detriment to the tea market. Furthermore, as coffee has on average, been the more expensive of the two commodities, further insight may be needed on whether coffee is replacing high-quality, high-priced tea as the luxury good of choice.

Secondly, as exemplified by the China Organic scandals and subsequent loss of public trust in the label, much of the success of a certification is dependent upon the public's perception of the certifying bodies and government bodies who oversee them (Wang et al., 2020). This trust must further be built on the assurance that certified farms are strictly following requirements, as misleading or mislabelled products have previously been the target of public ire in previous scandals. As such, the trust and public awareness of a certification is highly dependent on many different actors and stakeholders within the regulatory and supply chain space. A resulting consequence from this is the sheer difficulty of creating a trusted certification brand, and there could be a high risk of being unable to win over consumers and farmers alike if the label is unable to build a reputable and consistent image. Furthermore, there is the risk of brand damage in the future should there be bad actors in the market that mislabel conventional tea as certified.

Another threat is the relatively limited amount of published literature and data strongly supporting the improvement of biodiversity as a result of biodiversity-friendly tea farming practices, thereby reducing the credibility of a potential certification that champions such standards. There have been several studies conducted demonstrating higher native plant species diversity in traditional agroforestry tea systems in places such as China, Thailand, and Sri Lanka (Chowdhury et al., 2021; Srithi et al., 2017; Ahmed et al., 2012) For bird diversity, Raman et al., found that mixed-shade tea in the Western Ghats, India had 40% higher species richness and 83% higher bird abundance compared to that of conventional monoculture (2021). In comparison, there is far more extensive literature on biodiversity impact of shade-grown coffee – with studies done across South Asia and

Latin America demonstrating varying positive results such as improved bird species richness and abundance and higher mammal density and presence (Anand et al., 2018; Caudill & Rice, 2016; Hardt et al., 2015). While the basic hypothesis behind biodiversity-friendly tea is strong and can draw support from adjacent coffee plantation studies, there is still further research and evaluation that must be completed to confirm the benefits toward biodiversity.

Additionally, without formal standards or certification to define and verify what qualifies as "forest" or "biodiversity-friendly" tea, mislabeling and greenwashing can also become a risk in the market. Some producers may be dishonest about planting practices, or may mix lower quality, conventional tea with forest tea to increase output volume. This threatens consumer trust and the reputational value of truly sustainable tea producers who adhere to more ecologically sound methods. Combined, these pressures present a threat to the ecological sustainability, cultural integrity, and long-term market stability of Yunnan's forest tea industry. Measures such as formal certification schemes, enhanced monitoring, and educational outreach are needed to protect the region’s valuable tea forests from degradation and to ensure that the demand for high-value tea does not come at the expense of the ecosystems that make it unique.

Lastly, an ever-present threat towards tea producers and the market at large is the vulnerability to changes in weather and climate. During field interviews conducted with forest tea farmers in Xishuangbanna, Yunnan, they outlined drought conditions of recent years as a major hindrance to both the harvest and quality of tea leaves. The market price of tea and subsequent income for producers can fluctuate dramatically with weather conditions – yields around the world are projected to shrink anywhere from 5% to 25% by 2050 due to erratic rainfall and drought (Bermudez et al., 2024). Without plans for strengthening climate resiliency for growers, this could become a threat to livelihood and industry. That being said, the promotion of biodiversity-friendly agroecological practices such as agroforestry, landscape mosaics, shade-tree planting, and deforestation prevention are all recommended climate adaptation and mitigation strategies that can counter climate risks and increase carbon sequestration, benefitting both the farmer and the wider environment (Ahmed, 2018).

6. TOWARD A BIODIVERSITY-FRIENDLY TEA CERTIFICATION

6.1 Impact on Traditional Forest Tea

A biodiversity-friendly tea certification has the potential to provide a significant positive impact on traditional forest tea growers in Yunnan, helping them gain market recognition, financial stability, and access to new customers while reinforcing their commitment to sustainable farming.

Forest tea growers in Yunnan are already practicing biodiversity management practices due to their firmly rooted beliefs of better-quality tea coming out of strong ecological protection. However, most tea drinkers, both in and outside of China, other than the most knowledgeable, may not be aware of such practices despite potentially being interested in such a biodiversity-friendly product. Therefore, a certification would legitimize and differentiate tea farms that are already in engaging in traditional, biodiversity forward management cultivation. In a highly saturated and competitive tea market, particularly in China where thousands of tea brands compete for consumer attention, a highly stringent eco-label would serve as a stamp of authenticity and help distinguish forest-grown teas from conventionally farmed terrace tea. Furthermore, variation also exists within the forest tea segment as some tea trees, although not grown terrace-style, are grown without the high canopy coverage that is present in traditionally managed forest tea gardens, thus it is important to discern even within the forest tea niche as the quality and environmental impact can differ. This differentiation is important in attracting segments of the market previously unaware of the product, but are interested in making high-quality, environmentally conscious decisions.

A certification could also command a higher price point, or provide greater price stability, which is imperative especially in current market and climate conditions where tea prices have seen large drops, giving way to livelihood risk. Although forest tea growers already enjoy higher income per kilogram of leaves compared to conventional monoculture growers, they are still vulnerable to such fluctuations. Existing certified teas such as Organic or Fairtrade sell at a premium – similarly, a biodiversity friendly certification with even stronger environmental standards would firmly position Yunnan forest tea as a high-value product, appealing to luxury and specialty tea buyers. This price premium could provide growers with more stable income streams, reducing price volatility risk in the commodity tea market. In the same vein, a biodiversity-friendly tea certification would broaden consumer reach. While traditionally managed ancient tea is well known within tea connoisseur communities within China, certification could introduce the product to new audiences who may not

have previously been familiar with forest tea trees or traditional cultivation methods. This would allow farmers to diversify their customer base, expanding beyond longtime buyers and regular customers to attract other environmentally conscious or tea-enthusiast market segments, and potentially even attract more international market attention.

A certification can also build upon synergies that tie into the development of eco-tourism and experiential travel. As public and consumer interest in sustainability grows, and program brings further attention to unique, traditionally managed tea growing regions, tea forests can become recognized not only for their cultural heritage and excellent tea, but also as biodiversity hotspots. This alignment with eco-tourism initiatives could create additional revenue streams through farm visits, tea-tasting tours, and sustainable travel experiences, boosting local economies while promoting conservation.

Lastly, certification can also encourage and reinforce the existing biodiversity-friendly farming practices, ensuring that farmers continue long-term land stewardship as it creates a standard framework to maintain. By offering an incentive for responsible agroforestry and traditional tea management methods, certification could motivate farmers to maintain and improve biodiversity conservation efforts, supporting both ecosystem health and long-term agricultural productivity. Furthermore, it creates a mechanism to distinguish producers who are genuinely committed to traditional agroecological practices from those who merely seek to exploit the higher price point of forest tea.

6.2 Impact on Conventional Monoculture (Terrace) Tea

A biodiversity-friendly tea certification could also have substantial impact and influence on conventional monoculture tea growers, providing incentives for more sustainable farming practices while potentially turning monoculture agricultural land into biodiversity restoration sites.

One of the most significant motivators toward impact would be the economic incentive that certification can instill for monoculture tea farms to transition toward biodiversity-friendly methods. With certified products often selling at higher market prices and current consumer demand trending towards higher quality and environmentally sustainable options, certification could motivate terrace tea farmers toward meeting ecological standards for growing so that they can better differentiate themselves in a highly competitive market and insulate against commodity price drops. By adopting

biodiversity friendly farming methods, such as integrating shade trees, reducing chemical inputs, and enhancing soil health, conventional monoculture farms could gain greater public recognition and access to premium pricing. This shift would not only improve farm profitability but also align with growing consumer preferences for sustainable and ethically sourced products.

Additionally, this transition could present the opportunity for some monoculture tea farms in Yunnan and beyond to become ecological restoration sites, improving habitat and biodiversity across the country. Many terrace tea plantations have historically contributed to deforestation, habitat loss, and soil degradation due to their reliance on monoculture farming and intensive agrochemical use (Chowdhury et al., 2021). However, with the introduction of biodiversity-friendly certification, these farms could adopt regenerative agricultural practices, such as reforesting sections of plantations, restoring soil health, and creating wildlife corridors. By doing so, they could not only produce higher-quality tea but also contribute to climate resilience, increased landscape connectivity for wildlife, carbon sequestration, and improved ecosystem services in their regions.

Similar projects around the world have been implemented, such as the case of Conserving Biodiversity Through Sustainable Tea Farming project implemented by Rainforest Alliance in collaboration with local partners in Burundi. The Itombwe-Nyungawe corridor acts as an important ecosystem and wildlife corridor between Kibira National Park and Nyungwe National Park in Rwanda – parts of this area have historically been cleared for monoculture tea farms including Teza Tea Factory (Hartter & Southworth, 2009; CEPF, 2015). As part of the project, worker training and ecological restoration was implemented across Teza and adjoining smallholder farms covering a total of 5,500 hectares that focused on integrating biodiversity conservation into tea farming through sustainable land management training, tree-planting initiatives, and safeguarding of existing biodiversity corridors (CEPF, 2015). One of the key outcomes was the implementation of sustainable agricultural practices across 10,579 smallholder farms, covering over 6,000 hectares (CEPF, 2015). The project helped tea farmers create new conservation areas and improve land-use management, reinforcing the importance of maintaining tree cover and wildlife corridors (CEPF, 2015). More than 36,000 native and agroforestry trees were planted, and a monitoring program demonstrated an increase in bird biodiversity by 20 – 120% across different zones within the restored areas (CEPF, 2015). Additionally, the project improved wastewater management at the tea factory, ensuring that untreated waste no longer polluted local water sources.

In the long run, the success of a biodiversity-friendly tea certification could drive widespread adoption of sustainable practices across the industry. As more conventional monoculture farms recognize the economic and environmental benefits of certification, it could shift the tea sector toward a more regenerative model, ultimately benefiting both producers and the environment.

6.3 Proposed Certification Standards

From 2023 to 2025, a Duke Kunshan University research team conducted fieldwork in Xishuangbanna and surrounding areas on vegetation structure, tea plantation management practices, and bird and mammal biodiversity. The results indicated that the structural diversity of forest tea is between that of monoculture tea plantations and natural forests. The main differences between existing forest tea gardens and monoculture tea plantations are reflected in the following aspects: forest tea retains native trees with relatively high canopy cover, significantly higher native species richness and individual abundance; tea trees are planted at lower densities and have greater average height; and overall management intensity is lower, including pruning frequency, the use of chemical inputs, tillage frequency, and fertilizer application.

In terms of biodiversity, mammal communities were very different between the two management types. Although the mammal species composition in both forest tea and terrace tea plantations is lower than in natural forests, mammal species diversity is significantly higher in forest tea cultivation areas compared to that of monoculture. Typically, only two highly adaptable small carnivores — the leopard cat (*Prionailurus bengalensis*) and the small Indian civet (*Viverricula indica*) — are found in terrace tea plantations.

With regard to avian biodiversity, bird species diversity in terrace tea plantations is also lower. Since monoculture tea constitutes of highly engineered and intensively managed open landscapes, most native forest bird species are unable to survive or maintain stable populations within them. As a result, conventional monoculture tea plantations are often dominated by open-habitat species that occur less frequently in natural forests. In contrast, bird communities in traditional forest tea gardens partially overlap with those in natural forests, while also supporting a certain number of generalist bird species, reflecting their transitional characteristics in terms of habitat structure and ecological function.

Based on these surveys, we propose that a future biodiversity-friendly tea certification should adopt these core criteria grounded in the existing best practices of forest tea farmers:

1. **Vegetation Structure**
    a. Tree canopy cover ≥ 40% (with tree height ≥ 5 m).
    b. The production area contains ≥ 10 tree species, and native tree species account for ≥ 85% of both species richness and individual abundance.
2. **Tea Management**
    a. No platform-style intensive pruning
    b. No pesticides are used (including but not limited to herbicides, bud-promoting agents, and insecticides), and no chemical fertilizers are applied.
3. **Habitat Protection**
    a. Tea fields must be located within areas where tea cultivation and harvesting are legally permitted.
    b. Since the end of 2005, no new forest clearance or forest degradation has occurred within the tea field.

(Note: Canopy coverage and tree species identified in certification standards do not include tea plants)

7. CONCLUSION

The findings of this report reveal a meaningful opportunity to develop a biodiversity-focused tea certification, with potential benefits for both conservation and rural livelihoods. Yunnan's ancient agroforestry tea systems already embody many of the ecological characteristics that biodiversity standards aim to promote, and global trends in sustainable consumption suggest room for market differentiation. As both global and domestic markets increasingly reward sustainable production, such a certification could elevate traditional agroforestry systems while aligning economic incentives with long-term conservation goals.

However, realizing this opportunity requires acknowledging several structural constraints. Developing a successful certification depends not only on ecological rigor but also on consumer awareness, trust in certification bodies, and the willingness of supply chain actors to reward compliance. In China, public confidence in domestic certifications has historically been uncertain due to past scandals, and while interest in sustainable products is growing, many consumers remain

unfamiliar with biodiversity-focused labels. These dynamics complicate market-entry prospects for a new certification and raise questions about product–market fit. Nonetheless, China's sheer market size and significant share of global tea exports mean that even modest uptake could yield substantial impact. In addition, clearly defining the scope of existing forest tea can lay the groundwork for best practices, thereby reducing unregulated expansion of tea cultivation area that comes at the expense of forest destruction under the guise of "forest tea."

Field interviews further indicate that while a certification could help formalize and communicate the ecological value of forest tea cultivation, adoption is not guaranteed. Farmers expressed interest in principle but also hesitation, driven by limited familiarity with certification processes, unclear market demand, and the time costs associated with compliance. These concerns underscore the importance of demonstrating tangible benefits, such as price stability, expanded buyer networks, or alignment with emerging eco-tourism initiatives.

More broadly, the findings suggest that a biodiversity-friendly tea certification should be understood not merely as a label but as an adaptive process. Early-stage certification efforts may require phased implementation, pilot programs, or collective participation models that lower barriers to entry while building producer trust and market recognition over time. Rather than expecting immediate uptake, a gradual approach would allow standards, auditing mechanisms, and market partnerships to co-evolve alongside farmer capacity and consumer awareness.

Looking ahead, further research will be essential to evaluate the feasibility of implementing such a certification system. In particular, formal cost–benefit analyses are needed to assess whether expected price premiums, market stability, expanded customer bases, and potential eco-tourism revenues would justify the time and opportunity costs borne by producers. Complementary studies should assess consumer willingness to pay, evaluate international market potential, and empirically quantify biodiversity outcomes in certified versus non-certified systems. Together, these analyses would help determine whether a biodiversity-friendly tea certification is not only conceptually valuable but also practically viable for farmers, markets, and conservation goals.

Overall, a biodiversity-friendly tea certification offers a promising pathway to recognize and reinforce ecologically beneficial cultivation practices, particularly within Yunnan's ancient tea landscapes. Yet, as the field evidence makes clear, success cannot be assumed. Certification systems gain traction only when they deliver clear economic value, maintain manageable requirements, and are supported

by credible institutions and engaged supply-chain actors. Pilot programs, participatory design with farming communities, and collaboration with processors, distributors, and government agencies will therefore be critical to building legitimacy and reducing adoption risks. If carefully designed and supported, such a certification could strengthen rural livelihoods, protect biodiverse agroecosystems, and contribute to the sustainable evolution of one of China's most culturally significant agricultural industries.

APPENDIX

Appendix 1

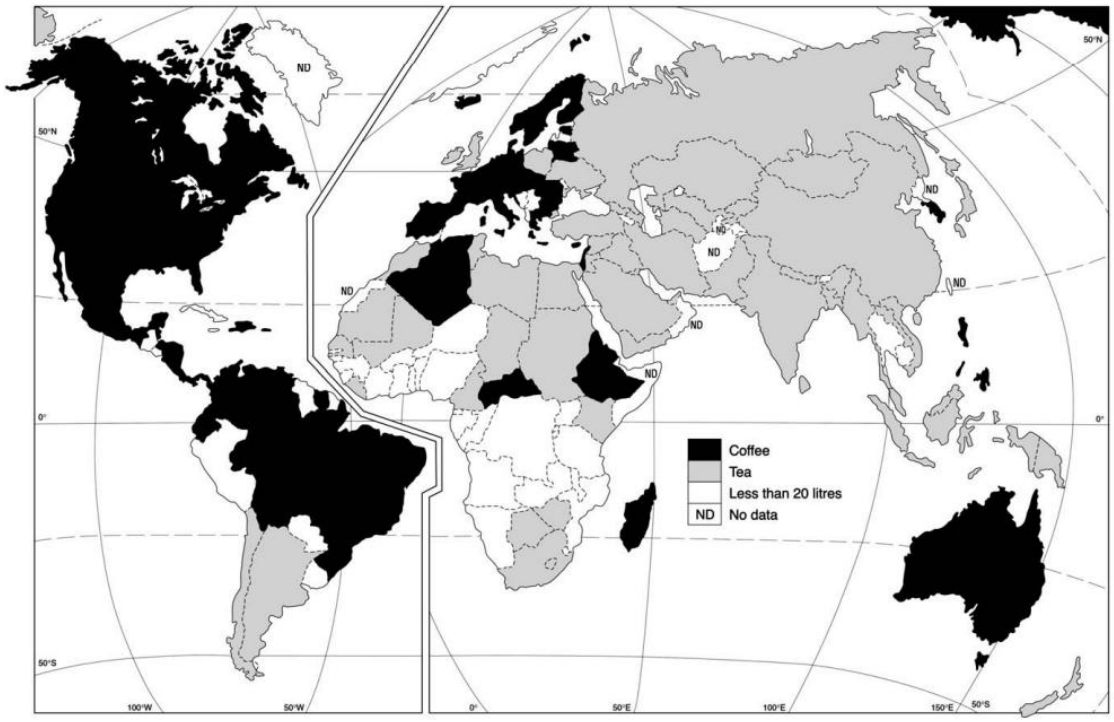


Figure 2. Countries where tea or coffee was the leading beverage 1994–1996. Consumption is measured in litres, and countries with a consumption of less than 20 litres of tea and coffee combined per capita per year are excluded. Source: FAO, (2001).

Tea-drinking versus coffee-drinking countries around the world (Grigg, 2002)

Appendix 2

	Tea Export Volume Ranking		Tea Export Value Ranking	
	Country/Region	*Quantity (kg)*	*Country/Region*	*Value (USD)*
1	Morocco	59,831,511	Hong Kong	220,235,331
2	Ghana	35,289,670	Malaysia	208,793,390
3	Uzbekistan	27,228,453	Morocco	190,075,842
4	Algeria	20,265,540	Ghana	141,710,820
5	Senegal	16,677,813	Algeria	70,858,046
6	Mauritania	15,825,529	Senegal	69,139,040
7	Russia	14,759,323	Mauritania	67,161,799
8	Mali	11,956,421	Vietnam	64,561,272
9	Japan	10,317,711	USA	56,125,566
10	Cameroon	10,173,366	Russia	54,195,576
11	Benin	9,821,960	Japan	52,545,803
12	Germany	9,000,736	Uzbekistan	52,101,337
13	USA	8,619,472	Mali	50,320,939
14	Hong Kong	8,334,141	Germany	35,769,773
15	Malaysia	8,208,268	Thailand	33,773,437
16	Gambia	8,048,163	Benin	31,182,580
17	Thailand	7,282,389	Gambia	29,529,465
18	Niger	6,767,787	Libya	27,248,877
19	Libya	6,158,819	Togo	22,575,970
20	Poland	5,657,037	France	20,212,190

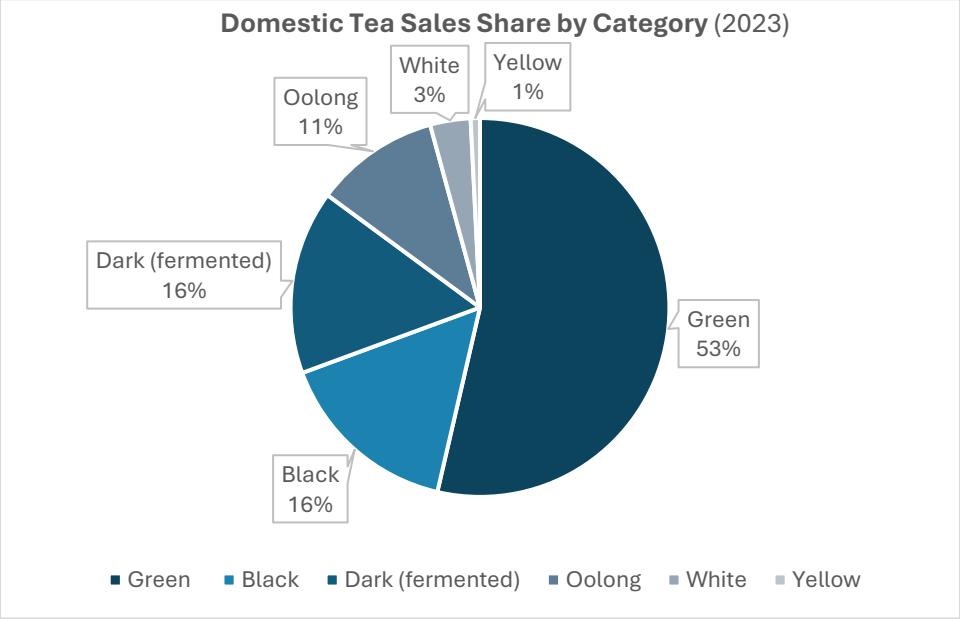
Source: China Customs

Top Export Destinations of Chinese Tea, by Volume and Value in 2023 (USD) (Mei & Liang, 2024)

Appendix 3

Domestic Sales Statistics of China's Six Major Tea Categories (2023)				
Type	*2023 (000s tons)*	*2022 (000s tons)*	*Change in volume (000s tons)*	*Rate change*
Green	1289	1311	-22	-1.6%
Black	379	381	-3	-0.7%
Dark (fermented)	378	364	14	3.7%
Oolong	256	248	8	3.2%
White	83	81	1	1.6%
Yellow	19	11	8	72.3%
TOTAL	**2404**	**2398**	**7**	**0.3%**

Source: China Tea Marketing Association



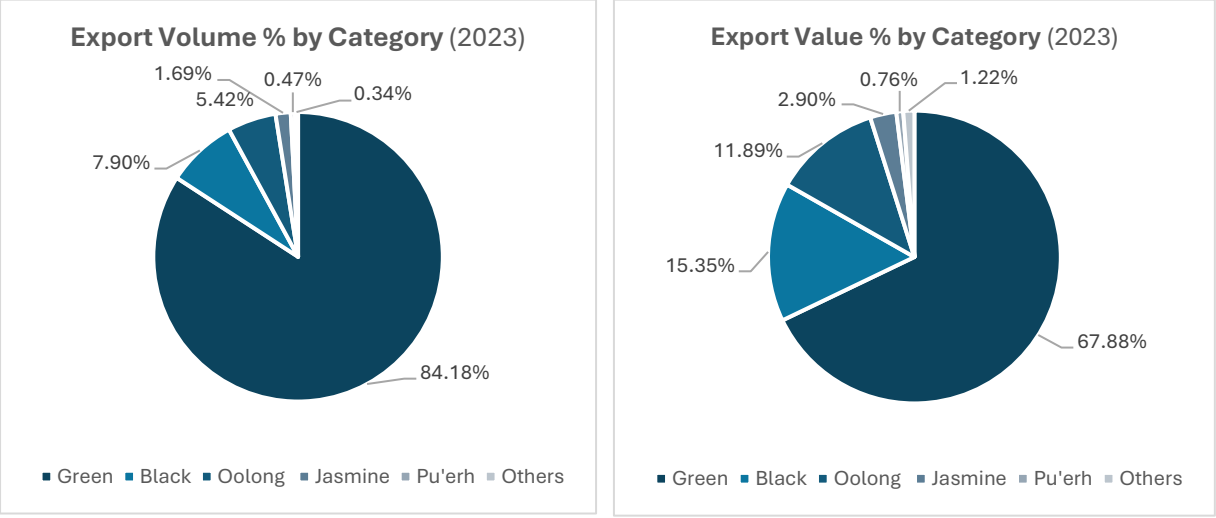
Market Share by Tea Type (Mei & Liang, 2024)

Appendix 4

Total National Output of Dried Tea Leaves (2023)				
Province	***2023 (tons)***	***2022 (tons)***	***Change in Volume***	***% Change***
Fujian	483200.0	459674.4	23525.6	5.12%
Yunnan	439230.0	432904.1	6325.9	1.46%
Sichuan	379250.0	366292.7	12957.3	3.54%
Guizhou	361900.0	344857.8	17042.2	4.94%
Hubei	347730.0	314515.3	33214.8	10.56%
Hunan	268400.0	247542.9	20857.1	8.43%
Zhejiang	201700.0	193500.0	8200.0	4.24%
Anhui	173200.0	154100.0	19100.0	12.39%
Guangdong	150018.0	148000.0	2018.0	1.36%
Shaanxi	125800.0	119689.5	6110.5	5.11%
Guangxi	123900.0	130300.0	-6400.0	-4.91%
Henan	102005.0	94282.7	7722.4	8.19%
Jiangxi	76900.0	83700.0	-6800.0	-8.12%
Chongqing	52000.0	47300.0	4700.0	9.94%
Shandong	40650.0	31601.7	9048.4	28.63%
Jiangsu	10500.0	10400.0	100.0	0.96%
Gansu	2300.0	1533.5	766.5	49.98%
Hainan	800.0	844.6	-44.6	-5.28%
TOTAL	**3339483.0**	**3181038.9**	**158444.1**	**4.98%**

Tea (Dry, Unprocessed) Production by Province (Mei & Liang, 2024)

Appendix 5



Top: Export Volume/Value by Tea Type (Mei & Liang, 2024)

Appendix 6

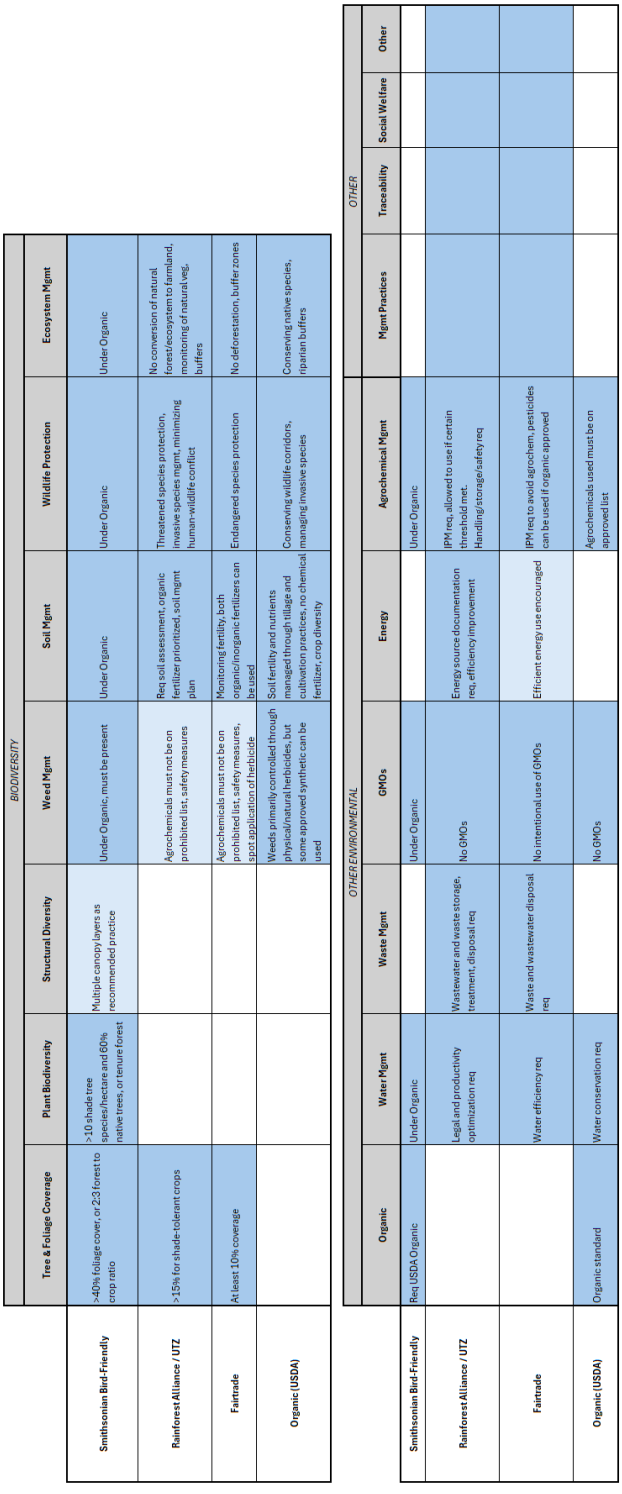
Table 5. Willingness to pay (WTP) for sustainable attributes.

Model 3: ML with correlations	**Shade-grown**	**Bird Friendly**	**Organic**	**Pesticide-free**
Mean WTP	1.44	2.23	5.76	3.59
2.5th percentile WTP	−0.32	0.56	4.01	2.07
97.5th percentile WTP	3.20	3.91	7.50	5.11
Observations	23,220			

Note: WTP confidence intervals are calculated using the delta method.

Willingness to pay for eco-label (average premium above regular coffee) (Gatti et al., 2022)

Appendix 7



	BIODIVERSITY							OTHER ENVIRONMENTAL					OTHER			
	Tree & Foliage Coverage	Plant Biodiversity	Structural Diversity	Weed Mgmt	Soil Mgmt	Wildlife Protection	Ecosystem Mgmt	Organic	Water Mgmt	Waste Mgmt	GMOs	Energy	Agrochemical Mgmt	Mgmt Practices	Traceability	Social Welfare	Other
Smithsonian Bird-Friendly	>40% foliage cover, or 2:3 forest to crop ratio	>10 shade tree species/hectare and 60% native trees, or tenure forest	Multiple canopy layers as recommended practice	Under Organic, must be present	Under Organic	Under Organic	Under Organic	Req USDA Organic	Under Organic		Under Organic		Under Organic				
Rainforest Alliance / UTZ	>15% for shade-tolerant crops			Agrochemicals must not be on prohibited list, safety measures	Req soil assessment, organic fertilizer prioritized, soil mgmt plan	Threatened species protection, invasive species mgmt, minimizing human-wildlife conflict	No conversion of natural forest/ecosystem to farmland, monitoring of natural veg, buffers		Legal and productivity optimization req	Wastewater and waste storage, treatment, disposal req	No GMOs	Energy source documentation req, efficiency improvement	IPM req, allowed to use if certain threshold met. Handling/storage/safety req				
Fairtrade	At least 10% coverage			Agrochemicals must not be on prohibited list, safety measures, spot application of herbicide	Monitoring fertility, both organic/inorganic fertilizers can be used	Endangered species protection	No deforestation, buffer zones		Water efficiency req	Waste and wastewater disposal req	No intentional use of GMOs	Efficient energy use encouraged	IPM req to avoid agrochem, pesticides can be used if organic approved				
Organic (USDA)				Weeds primarily controlled through physical/natural herbicides, but some approved synthetic can be used	Soil fertility and nutrients managed through tillage and cultivation practices, no chemical fertilizer, crop diversity	Conserving wildlife corridors, managing invasive species	Conserving native species, riparian buffers	Organic standard	Water conservation req		No GMOs		Agrochemicals used must be on approved list				

LEGEND
- Included requirement
- Included w/ conditions (ie. optional)
- No requirement

Comparison matrix of major tea and coffee certifications

Appendix 8

Certification Requirements – For each certification, only farming and environmental requirements are detailed for relevance in comparing against biodiversity-friendly practices. All other types of requirements such as management and social welfare are only summarized. Full details of each certification standard can be found on their official websites.

A8.1 *Rainforest Alliance*

Under the management category, requirements focus around improving group management effectiveness, knowledge-building on sustainability for workers, strengthening position and capacities of young and female workers, and instituting responsible business practices throughout the supply chain. Under the traceability category, requirements focus around effectively managing product and transaction data, to increase credibility of assurance and traceability certified product. Under the income and shared responsibility category, requirements focus around improving living standards of workers and their families, implementation of the Sustainability Differential which is a mandatory monetary payment paid to producers on top of market price for certified crop, as well as Sustainability Investments which are made by market actors to contribute to the improvement of sustainability practices in the farm or group. Under the social category, requirements focus on preventing human rights and workers rights violations on the farm level and throughout the supply chain, ensuring healthy and safe working conditions, and ensuring an improved standard of living. Under the farming category, requirements focus on improving farm resilience, maintaining or enhancing ecosystem services, optimizing crop and input productivity, and reducing health and environmental risks. Under the environment category, requirements focus around effectively protecting and restoring natural ecosystems, vegetation, and wildlife, as well as efficient on-site use of water and energy resources.

The mandatory core **(C)** and improvement **(I)** farming requirements are (self-selected requirements are not listed) (Rainforest Alliance, 2023):

1. Planting and Rotation
    a. **(C)** Planting materials are free of pests and diseases.
    b. **(C)** New plantings have a well-established cropping system which takes into account: requirements of the variety used; geographical, ecological, and agronomic conditions; diversification and intercropping crops with different rooting depths and soil uses; planting density.
    c. **(I)** Producers implement measures to prevent pests and diseases and to break their biological cycles to support soil health and improve weed management.
2. Pruning and Rejuvenation of Tree Crops
    d. **(C)** Management implements a pruning cycle for adequate formation, maintenance, and rejuvenation pruning according to crop needs, agroecological conditions, and applicable pruning guidelines.
    e. **(I)** Producers carry out pruning according to the above requirement.
3. Genetically Modified Organisms (GMOs)
    f. **(C)** The certified crop is not genetically modified.
4. Soil Fertility and Conservation
    g. **(C)** Management conducts a soil assessment for a representative sample of areas and must be updated once every 3 years.

h. **(C)** Based on the soil assessment, management identifies soil management measures and includes these in the management plan to build up soil organic matter, increase on-farm nutrient recycling, and optimize soil moisture.
i. **(C)** When available, producers use by-products including organic fertilizer produced on the farm first. If more nutrients are needed, these are supplemented where possible by other organic fertilizers, or by inorganic fertilizer.
j. **(I)** The soil of the production area is not left exposed, and is protected by measures such as cover crops, crop residues, or mulch.
k. **(I)** Fertilizers are applied in such a way that nutrients become available when and where crops need them, and contamination of the environment is minimized.
l. **(I)** Producers monitor and optimize the use of organic and inorganic fertilizers.

5. Integrated Pest Management (IPM)
   m. **(C)** Management implements the IPM strategy developed by a competent professional.
   n. **(C)** Producers regularly monitor and record pests.
   o. **(C)** For pest prevention and control, producers use biological, physical, and other non-chemical control methods first, and document the use and effectiveness of these methods. When threshold levels of pests are reached, producers can use agrochemical applications with advice of a professional.
   p. **(C)** Producers and workers that are involved in pest management activities are trained about the IPM strategy.
   q. **(I)** Producers have implemented the IPM strategy.
   r. **(I)** Producers enhance natural ecosystems near crop production areas to increase habitat for natural enemies.
   s. **(I)** Producers monitor and reduce the use of pesticides.
   t. **(I)** Producers regularly monitor and record the main natural enemies of pests.
6. Agrochemicals Management
   u. **(C)** No agrochemicals are used that are: On the Rainforest Alliance List of Prohibited Pesticides or List of Obsolete Pesticides; prohibited by applicable law; not legally registered in the country where the farm is located
   v. **(C)** If producers use pesticides included on the Risk Mitigation list, all respective risk mitigation practices, as described in Annex Chapter 4: Farming, Pesticides Management, are implemented.
   w. **(C)** Persons handling pesticides are skilled in the preparation and application of pesticides and receive annual training. Persons handling pesticides use the Personal Protective Equipment (PPE) as prescribed in the product's label or Material Safety Data Sheet (MSDS).
   x. **(C)** Persons handling pesticides bathe, change and wash clothes after application.
   y. **(C)** Pesticides are prepared and applied according to the label, MSDS or security tag, or as recommended by an official national organization or a competent technician.
   z. **(C)** Mechanisms are established and maintained to avoid contamination by pesticides, through spray drift or other pathways, from treated areas to other areas including all aquatic and terrestrial natural ecosystems and infrastructure.
   aa. **(C)** Aerial application is only allowed under the conditions as outlined in Annex Chapter 4: Farming.
   bb. **(C)** Pesticide applications are recorded.
   cc. **(C)** Empty pesticides containers and application equipment are washed three times, and rinsing water is used in the last batch of the mix to apply to the crop. After

application of pesticides, application equipment is washed three times, and the surplus mix is disposed of in way that minimizes the negative impact on the environment and human health.

dd. **(C)** Agrochemicals and application equipment are stored in accordance with the label instructions and in a way that minimizes negative impact on the environment and human health.

ee. **(C)** An up-to-date pesticide stock inventory is available and maintained.

ff. **(I)** The equipment for mixing and applying agrochemical is calibrated at least annually, after each maintenance and before using it for a different type of agrochemical.

7. Harvest and Post-Harvest Practices

gg. **(C)** Producers conserve and optimize quality and quantity of product during harvest and post-harvest handling, including: loading, processing, packing, transportation, and storage.

hh. **(I)** Producers take measures to respect the maximum residue levels (MRLs) set by the production country and known destination countries of the product.

1. Forests, and other Natural Ecosystems and Protected Areas

a. **(C)** From January 1st, 2014, onward, natural forests and other natural ecosystems have not been converted into agricultural production or other land uses.

b. **(C)** Production or processing does not occur in protected areas or their officially designated buffer zones, except where it complies with applicable law.

c. **(C)** Management includes the mitigation measures from the Risk Assessment Tool with regard to High Conservation Values in the management plan. Management implements these measures.

2. Conservation and Enhancement of Natural Ecosystems and Vegetation

a. **(C)** Management develops and implements a plan to conserve natural ecosystems.

b. **(C)** Farms maintain all remnant forest trees, except when these pose hazards to people or infrastructure.

c. **(I)** Producers maintain and management monitors natural vegetation cover and reports annually on the indicator from year one onwards. If there is less than 10% of the total area under natural vegetation cover or less than 15% for farms growing shade-tolerant crops, management sets targets and takes actions for farms to reach these thresholds as required.

d. **(I)** There is natural vegetation cover: on at least 10% of the total area for farms growing non-shade tolerant crops; on at least 15% of the total area for farms growing shade-tolerant crops.

3. Riparian Buffers

a. **(C)** Farms maintain existing riparian buffers adjacent to aquatic ecosystems.

b. **(C)** Producers maintain additional safeguards for the protection of drinking water in case the farm is located closer than 50m from a river, lake, or other water body that is frequently used as the main source of drinking.

c. **(I)** Aquatic ecosystems are surrounded by riparian buffers with the following riparian buffer width parameters: 5m horizontal width along both sides of water courses between 1 - 5m wide; for farms < 2 ha, the width of the buffer may be reduced to 2m at both sides; 8m horizontal width along both sides of water courses between 5-10m wide, and around springs, wetlands, and other water bodies; 15m horizontal width along both sides of rivers wider than 10m wide.

4. Protection of Wildlife and Biodiversity

a. **(C)** Threatened animals and plants are not hunted, killed, fished, collected, or trafficked.
b. **(C)** Producers do not hold wildlife in captivity.
c. **(C)** Producers do not intentionally introduce or release invasive species.
d. **(C)** Producers do not use wildlife for processing or harvesting of any crop.
e. **(C)** Erosion by water and wind is reduced through practices such as re-vegetation of steep areas and terracing.
f. **(C)** Fire is not used for preparing or cleaning fields, except when specifically justified in the IPM plan.
g. **(I)** Producers minimize human-wildlife conflicts that affect workers, wildlife, crops, or farm assets with locally appropriate mitigation measures.
h. **(I)** Producers take measures to contain and reduce existing invasive species.

5. Water Management and Conservation
    a. **(C)** Management complies with the applicable law for withdrawal of surface or groundwater for agricultural, domestic or processing purposes.
    b. **(C)** Irrigation and water distribution systems are maintained to optimize crop productivity while minimizing water waste, erosion, and salinization.
    c. **(I)** Irrigation and water distribution systems are managed to optimize crop productivity
    d. **(I)** Management takes measures to reduce the use of processing water per unit of product. Water use and reduction are monitored and documented from year one onwards.
6. Wastewater Management
    a. **(C)** Tests for processing wastewater are conducted at all discharge points during the representative period(s) of operation, and results are documented.
    b. **(C)** Human sewage, sludge, and sewage water is not used for production and/or processing activities. Sewage is not discharged into aquatic ecosystems unless it has been treated.
    c. **(C)** Wastewater from processing operations is not applied to land unless it has undergone treatment to remove particulates and toxins.
7. Waste Management
    a. **(C)** Waste is stored, treated, and disposed of in ways that do not pose health or safety risks to people, animals or natural ecosystems.
    b. **(C)** Producers do not burn waste, except in incinerators technically designed for the specific type of waste.
    c. **(I)** Producers segregate and recycle waste based on available waste management, recycling, and disposal options. Organic waste is composted, processed for use as organic or used as input for other processes.
8. Energy Efficiency
    a. **(C)** Management documents the types of energy sources and the energy used for production and processing of certified product.
    b. **(I)** Management sets targets for increased efficiency in energy use and for reduced dependency on non-renewable energy sources. The progress is monitored and reported yearly.
    c. **(I)** If biomass energy is used for processing operations and/or domestic use, producers minimize the direct and indirect effects of biomass use on natural ecosystems.

A8.2 *Fairtrade*

Fairtrade is largely focused on fair labour and supply chain, many of the standards are aimed towards the goals of improved income, enhanced equity, and transparent business practices. There are also environmental sustainability requirements for the certification. They are divided into core requirements **(C)** which are mandatory and development requirements **(I)** which are continuous improvements that certified organizations must make on average against a scoring system defined by the certification body.

The Fairtrade Standard for Small-Scale Producer Organizations that fall under environmental safety or sustainability are (Fairtrade International, 2019):

1. Environmental Management
    a. **(C)** Responsibility for environmental development - A person in the organization is given responsibility to lead the operational steps required for the organization to comply with the requirements in section 3.2 Environmental Development.
2. Pest Management and Hazardous Materials Use
    a. **(I)** Integrated pest management training - Members are trained on integrated pest management.
    b. **(I)** Responsible pesticide application - Members are able to demonstrate that pesticides are applied based on knowledge of pests and diseases.
    c. **(C)** Training on safe handling of hazardous materials - Members and workers who handle pesticides and other hazardous chemicals are trained on the risks of handling these materials and on how to handle them properly.
    d. **(C)** Personal protective equipment use - Ensure that all people, including members and workers, wear appropriate personal protective equipment (PPE) when handling pesticides or hazardous chemicals.
    e. **(C)** Awareness of hazardous materials-related risks - Raise awareness amongst all members and workers of the hazards and risks related to pesticides and other hazardous chemicals, even if they are not directly handling these materials.
    f. **(C)** Buffer zones for application of hazardous materials - Members do not apply pesticides and other hazardous chemicals within 10 meters from ongoing human activity, unless there is a barrier that effectively reduces pesticide drift.
    g. **(C)** Buffer zones for spraying hazardous materials by air - If pesticides or other hazardous chemicals are sprayed from the air, members do not spray above and around places with ongoing human activity or above and around water sources.
    h. **(C)** Central storage of hazardous materials - If there is a central storage area for pesticides and other hazardous chemicals, it is maintained in a way that minimizes risks.
    i. **(C)** Members' storage of hazardous materials - Members store pesticides and other hazardous chemicals in a way that minimizes risks, especially so they cannot be reached by children.
    j. **(C)** Labelling hazardous materials - Members have all pesticides and hazardous chemicals clearly labelled.
    k. **(I)** Prevention and handling of accidents and spills - Members plan spraying in such a way as to have no or very little spray solution left.
    l. **(C)** Use of hazardous materials containers - Members do not reuse pesticide and other hazardous chemical containers to store or transport food or water.

m. **(C)** Cleaning and storage of hazardous materials containers - Members triple rinse, puncture and store empty pesticide and other hazardous chemical containers properly. All equipment that has been in contact with hazardous materials must be cleaned and stored properly.
n. **(C)** Choice of pesticides – A list of the pesticides that are used on Fairtrade crops is compiled and updated.
o. **(C)** Hazardous Materials List - Members do not use any of the materials on the Fairtrade International Red List on all Fairtrade crops that the organization is certified for and also on the fields where they are grown.
p. **(C)** Use of materials in the Orange List - Members use the materials in the Orange List on Fairtrade crops only under specified conditions.
q. **(C)** Procedure for compliance with Hazardous Materials List - Develop a procedure to ensure that members do not use any materials on their Fairtrade crops that appear on the Fairtrade International Red List.
r. **(I)** Minimizing use of herbicides - Minimize the amount of herbicides used by members through other weed prevention and control strategies.

3. Soil and Water
    a. **(C)** Identification of land at risk of soil erosion - Identify land at risk of soil erosion and land that is already eroded in fields where your members plant Fairtrade crops.
    b. **(I)** Training on prevention of soil erosion – Train members of organization where risk of soil erosion or already eroded land has been identified on practices that reduce and/or prevent soil erosion.
    c. **(I)** Training on fertilizer use - Train members on the appropriate use of fertilizers.
    d. **(I)** Enhancing soil fertility - Members implement measures to enhance soil fertility.
    e. **(C)** Identification of sources of water - List sources of water used for irrigating and processing Fairtrade crops.
    f. **(I)** Availability of water – Must be informed about the situation of the water sources in area.
    g. **(I)** Training on sustainable water use - Train members on measures to use water efficiently.
    h. **(I)** Efficient use of water - Members follow practices that improve water resources management.
    i. **(I)** Handling wastewater from processing facilities - Members follow practices that improve water resources management.
    j. **(I)** Training on wastewater and health risks - Train members on waste water and the health risks it bears as well as on the prevention of risks and treatment methods of waste water and their implementation.
4. Biodiversity
    a. **(C)** Conservation of protected areas - Members avoid negative impacts on protected areas and in areas with high conservation value within or outside the farm or production areas.
    b. **(C)** Protection of forests and vegetation - Members avoid negative impacts on protected areas and in areas with high conservation value within or outside the farm or production areas.
    c. **(C)** Prevention of deforestation - Procedure in place to ensure that members do not cause deforestation or degradation of vegetation. The guidance that they provide is that: deforestation is the conversion of forest to other land use or the permanent reduction of the tree canopy cover below the minimum 10 percent threshold.

d. **(I)** Enhancing biodiversity - Members take measures to protect and enhance biodiversity.
e. **(I)** Maintenance of buffer zones - Members take measures to protect and enhance biodiversity. Memebers maintain buffer zones around bodies of water and watershed recharge areas and between production areas and areas of high conservation value, either protected or not.
f. **(C)** Wild harvesting - Members that carry out wild harvesting of Fairtrade products from uncultivated areas assure the sustainability and survivability of the collected species in its native habitat.
g. **(I)** Raising awareness about rare or threatened species - Raise awareness among members so that no collecting or hunting of rare or threatened species takes place.
h. **(I)** Raising awareness about alien invasive species - Raise awareness among members so that alien invasive species are not introduced.

5. Waste
    a. **(C)** Storage and disposal of hazardous waste - Ensure that members keep their farms free of hazardous waste.
    b. **(I)** Designated areas for waste storage and disposal - Members have designated areas for the storage and disposal of hazardous waste.
    c. **(I)** Organic waste and disposal - Raise awareness among members about re-using organic waste through the implementation of practices that allow nutrients to be recycled.
6. Genetically Modified Organisms (GMOs)
    a. **(C)** No intentional use of Genetically Modified Organisms
7. Climate Change Adaptation and Mitigation
    a. **(I)** Climate change adaptation - Implement measures on adaptation to climate change.
    b. **(I)** Efficient energy use - In central processing facilities where non-renewable energy is used, take measures to use energy more efficiently. Replace non-renewable sources by renewable ones as far as possible.
    c. **(I)** Greenhouse gas emission and carbon sequestration - Organization or members take measures to reduce Green House Gas (GHG) emissions and increase carbon sequestration.

A8.3 *USDA Organic*

Organic production and handling requirements specifically pertaining to crops include (USDA, 2000):

1. Organic production and handling system plan
    a. The producer or handler of a production or handling operation, except as exempt under § 205.101, intending to sell, label, or represent agricultural products as “100 percent organic,” “organic,” or “made with organic (specified ingredients or food group(s))” must develop an organic production or handling system plan that is agreed to by the producer or handler and an accredited certifying agent.
2. Land requirements
    a. Any field or farm parcel from which harvested crops are intended to be sold, labeled, or represented as “organic,” must: (a) Have been managed in accordance with the provisions of §§ 205.203 through 205.206; (b) Have had no prohibited substances, as listed in § 205.105, applied to it for a period of 3 years immediately preceding harvest of the crop; and (c) Have distinct, defined boundaries and buffer zones such as runoff

diversions to prevent the unintended application of a prohibited substance to the crop or contact with a prohibited substance applied to adjoining land that is not under organic management.

3. Soil fertility and crop nutrient management practice standard
    a. The producer must select and implement tillage and cultivation practices that maintain or improve the physical, chemical, and biological condition of soil and minimize soil erosion.
    b. The producer must manage crop nutrients and soil fertility through rotations, cover crops, and the application of plant and animal materials.
    c. The producer must manage plant and animal materials to maintain or improve soil organic matter content in a manner that does not contribute to contamination of crops, soil, or water by plant nutrients, pathogenic organisms, heavy metals, or residues of prohibited substances.
    d. A producer may manage crop nutrients and soil fertility to maintain or improve soil organic matter content in a manner that does not contribute to contamination of crops, soil, or water by plant nutrients, pathogenic organisms, heavy metals, or residues of prohibited substances.
    e. The producer must not use: Any fertilizer or composted plant and animal material that contains a synthetic substance not included on the National List of synthetic substances allowed for use in organic crop production; sewage sludge (biosolids) as defined in 40 CFR part 503; and burning as a means of disposal for crop residues produced on the operation: *except,* that, burning may be used to suppress the spread of disease or to stimulate seed germination.
4. Seeds and planting stock practice standard
    a. The producer must use organically grown seeds, annual seedlings, and planting stock, with some exceptions.
5. Crop rotation practice standard
    a. The producer must implement a crop rotation including but not limited to sod, covercrops, green manure crops, and catch crops that provide the following functions that are applicable to the operation: (a) Maintain or improve soil organic matter content; (b) Provide for pest management in annual and perennial crops; (c) Manage deficient or excess plant nutrients; and (d) Provide erosion control.
6. Crop pest, weed, and disease management practice standard
    a. The producer must use management practices to prevent crop pests, weeds, and diseases including but not limited to: (1) Crop rotation and soil and crop nutrient management practices, as provided for in §§ 205.203 and 205.205; (2) Sanitation measures to remove disease vectors, weed seeds, and habitat for pest organisms; and (3) Cultural practices that enhance crop health, including selection of plant species and varieties with regard to suitability to site-specific conditions and resistance to prevalent pests, weeds, and diseases.
    b. Pest problems may be controlled through mechanical or physical methods including but not limited to: (1) Augmentation or introduction of predators or parasites of the pest species; (2) Development of habitat for natural enemies of pests; (3) Nonsynthetic controls such as lures, traps, and repellents.
    c. Weed problems may be controlled through: (1) Mulching with fully biodegradable materials; (2) Mowing; (3) Livestock grazing; (4) Hand weeding and mechanical cultivation; (5) Flame, heat, or electrical means; or (6) Plastic or other synthetic

mulches: *Provided,* That, they are removed from the field at the end of the growing or harvest season.

d. Disease problems may be controlled through: (1) Management practices which suppress the spread of disease organisms; or (2) Application of nonsynthetic biological, botanical, or mineral inputs.
e. When approved mechanical or physical practices are insufficient to prevent or control crop pests, weeds, and diseases, a biological or botanical substance or a substance included on the National List of synthetic substances allowed for use in organic crop production may be applied to prevent, suppress, or control pests, weeds, or diseases.
f. (f) The producer must not use lumber treated with arsenate or other prohibited materials for new installations or replacement purposes in contact with soil or livestock.

7. Wild crop harvesting practice standard
    a. A wild crop that is intended to be sold, labeled, or represented as organic must be harvested from a designated area that has had no prohibited substance, as set forth in § 205.105, applied to it for a period of 3 years immediately preceding the harvest of the wild crop.
    b. A wild crop must be harvested in a manner that ensures that such harvesting or gathering will not be destructive to the environment and will sustain the growth and production of the wild crop.

Appendix 9

Gaoshan Field Research – Methodology

The primary aim of this field study was to assess the feasibility of developing a biodiversity-friendly tea certification from the perspectives of traditional tea farmers and local leaders, and to evaluate whether tea gardens in the study area would meet the ecological standards required for a high-level certification similar to Smithsonian Bird Friendly Coffee.

Accordingly, the survey focused on two guiding questions:

1. What are local attitudes toward the potential adoption of a biodiversity-friendly tea certification?
2. Are tea farms in Xishuangbanna suitable candidates for a certification centered on biodiversity conservation?

To address these questions, the study employed qualitative research methods, relying primarily on semi-structured interviews with tea farmers and local governance representatives.

Research Design

To better understand stakeholder attitudes, the research team designed an interview questionnaire covering three major areas: 1) current conditions of tea production and land management in the village; 2) awareness, perceptions, and past participation in ecological or sustainability certifications; and 3) motivations, concerns, and barriers influencing willingness to participate in a biodiversity-friendly certification

To ensure validity and minimize bias, the questionnaire underwent expert pre-testing. Dr. Binbin Li reviewed the initial design, providing feedback based on professional expertise in conservation and community-based research. Recommended revisions were incorporated to improve clarity, reduce leading phrasing, and enhance data reliability.

Upon arrival in Gaoshan Village, the team also conducted on-site pre-testing with a small number of tea farmers and village leaders. This allowed the questionnaire to be refined for cultural, linguistic, and contextual appropriateness. Pre-test feedback revealed very low participation in existing eco-certification schemes, so the final questionnaire placed greater emphasis on understanding reasons for non-participation.

Sampling Method

The research adopted a purposive sampling strategy to select tea farmers and local leaders who could provide diverse and relevant perspectives.

<u>Tea Farmers</u>

Tea farmers were the primary focus of the survey. Sampling aimed to capture variation across age groups, education levels, production roles, and household structures. Younger farmers (often with

junior high school education or higher) were included for their newer perspectives on tea production and market engagement. Middle-aged household heads, despite generally lower formal education, were prioritized for their extensive experience in tea cultivation and village-level industry knowledge. Initial interviewees were recommended by local leaders. Subsequent participants were identified using snowball sampling, where interviewed farmers referred the team to additional candidates. To improve demographic representativeness, the research team also conducted random household visits during the later phase of fieldwork.

Village and County Leaders

Because the number of village-level leaders is limited, the team interviewed all key leaders in Gaoshan Village to ensure a complete governance perspective. Additionally, county-level officials involved in agricultural or ecological programs were interviewed to capture broader policy insights.

Sample Summary

A total of 27 participants were interviewed:

- 23 tea farmers (T1–T23)
- 3 village leaders (L1–L3)
- 1 individual with dual roles as a tea farmer (T24) and county-level leader (L4)

Age Distribution

- ≤18 years: 3.7% (1 person)
- 19–25 years: 3.7% (1 person)
- 26–35 years: 18.5% (5 people)
- 36–45 years: 40.7% (11 people)
- 46–60 years: 29.6% (8 people)
- ≥60 years: 3.7% (1 person)

Gender Distribution

- 81.5% male (22 people)
- 18.5% female (5 people)

In several households, interviews were conducted with both husband and wife present; however, women often deferred responses to their husbands, so the data reflect perspectives primarily represented by male household heads. Additional demographic factors such as education level, ethnic background, and annual household income were collected during interviews.

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昆山杜克大学
DUKE KUNSHAN UNIVERSITY
Environmental Research Center

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