

A Latte Opportunity: Improving Sustainability Through Domestic Production of Matcha

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While waltzing through the half-mile stretch between Monroe Hill and 1515, I see six people sipping an eye-catching, vibrant green Japanese tea called matcha. This powdered tea is derived from the leaves of the *Camellia sinensis* and is known for its earthy, umami taste. Unlike regular green tea, matcha uses every part of the *Camellia sinensis* plants' leaves, which provides more caffeine and antioxidants. With 25% of the US food and beverage market being made up by Lifestyle of Health and Sustainability (LOHAS), matcha seems to be an attractive avenue to get the kick from caffeine in a healthier way (Ethos Team, 2017). While coffee has around 96 mg of caffeine per 8-ounce cup, matcha only has 38-88 depending on its preparation. Additionally, matcha contains L-theanine, which is found to reduce stress by increasing alpha waves in the brain. A compelling potential health benefit of matcha compared to coffee stems from high levels of catechins, antioxidants that lower blood pressure and LDL cholesterol levels (Khalesi, 2014).

There are also major sustainability benefits when it comes to choosing matcha as your caffeinated beverage of choice over coffee or other teas. Teas as a whole have an estimated carbon footprint of 1.9 kg CO₂e for each kg of tea produced, which is relatively low for all foods (*Shop-Logic*, n.d.). Beyond that, coffee has a carbon footprint of 10.1 kg of CO₂e for each kg of coffee produced, making tea's carbon footprint 18.8% of that of coffee's carbon footprint. Compared to other teas, it is likely that matcha has a lower carbon footprint since the entire leaf is used, which reduces food waste (Matcha Outlet, 2022).

Recent matcha shortages have impacted price and ability to meet consumer demand. According to Zagorodnya in an article for Forbes, the shortage in 2024 was caused by a variety of factors (2024). One of the main factors in the 2024 shortage and the current shortage is due to the increase in demand mainly caused by the health benefits of the tea being touted on social

media. Additionally, the unique green of the drink photographs well, making it extra attractive for social media influencers to photograph. From the supply side, the stocks of tencha, the leaves matcha is made from, were depleted (Sazen Tea, 2024). Most *Camellia sinensis* used to make matcha is not farmed at large, industrial farms, but rather smaller, independent or family-owned farms located in Japan that are reliant on traditional processing methods. Although tencha can be frozen for years, increased demand caused pre-existing stocks of tencha to be used, leaving tea producers unable to meet demand. Climate change has further worsened crop yields of *Camellia sinensis* due to adverse weather conditions like frost and high rain levels (Christian, 2024).

Between increasing consumer demand in the United States and supply issues, there is a business case to begin growing matcha in the United States. One of the biggest sustainability related challenges with matcha is the high carbon footprint of transportation. Given that tencha is exclusively grown within Asian countries, predominantly Japan, but also China and South Korea, importing goods to the United States from these countries creates significant carbon emissions (Christian, 2024). Given the distance from the geographical center of the United States and Japan by airfreight is a little over 6040 miles, the carbon footprint of importing a kilogram of matcha (without packaging) is 9.13 kg CO₂e (Consumer Ecology, n.d.; Distance.to, n.d.). Due to the significant reduction in carbon footprint that would stem from avoiding the importation of matcha from Japan to the United States, it is worth exploring creating a farm in Charlottesville, VA to grow *Camellia sinensis* and produce tencha.

Charlottesville's environment is relatively well equipped to grow matcha. Farmland that is suitable to grow matcha in Albemarle County is selling for about \$7,033 per acre for 27 acres (LandWatch, n.d.). Matcha needs mildly to moderately acidic soil with a pH of 5.5-6.5 to thrive—luckily, the soil in Charlottesville and the Piedmont region is acidic enough for matcha

due to the clay-loam soils (Mécène Market, 2024; Galbraith, 2023). Furthermore, Charlottesville has an adequate amount of annual rainfall to support the growth of *Camellia sinensis*; Charlottesville's annual rainfall is 121.1 cm and this plant requires annual rainfall between 114.3 and 127 cm (Nishida, n.d.; U.S. Climate Data, n.d.). Finally, Charlottesville's climate is a subtropical climate with mild winters, which is the optimal climate to grow *Camellia sinensis* (Snoflo, n.d.; Ujido, n.d.). However, a barrier stems from Charlottesville's hot summers and frost during colder temperatures. Given that shading is a common technique to protect crops from heat and it is a necessary part of the growth process for matcha, this could occur at no additional cost during the hot summer months to protect the plants (Croptracker, n.d.). Possible ways to alleviate frost-related damage are heavy mulching to protect the plants' roots, using row covers as protection during frost events, and watering before a frost since moist soil retains heat better than dry soil (Food and Agriculture Organization of the United Nations, n.d.).

Once land is purchased, *Camellia sinensis* must be grown. Assuming a large, developed plant can be purchased for \$94.00, its diameter is 10 feet, each plant must be two feet apart, and each acre will have 40% of the surface area allocated towards rows between the plants for workers, each acre can have 218 plants for a cost of \$20,492.00 for *Camellia sinensis* plants per acre (Lots of Plants, n.d.; Miles & Shrestha, n.d.). The irrigation system could cost \$1,800 to \$2,500 per acre, and given that the range is from 2009, the highest end of that range will be used to estimate cost (U.S. Department of Agriculture, Natural Resources Conservation Service, 2009). Finally, assuming rows are unshaded, shading infrastructure for material that blocks 70% of light costs approximately \$7,008.00 per acre (Farm Plastic Supply, n.d.). For *Camellia sinensis* to be planted on five acres, the cost of the plants, irrigation system, and shading would cost a total of \$150,000.00.

A facility must be created to turn the leaves of the *Camellia sinensis* into matcha. Reports cite that the average expected cost per square foot is \$210 to \$800 (Carlson, 2025). Given that this range includes the equipment and machinery, which can be highly specialized and varies by industry, this financial analysis of the cost of the building itself will be conducted within the lower side of the range at \$300 per square foot, meaning the expected initial cost to build the facility will be \$1.50 million assuming a facility of 5,000 sqft. Purchasing the steaming equipment can cost between \$2,000 and \$5,000 for a machine, which would preserve the vibrant green and overall freshness of the tea (Deli Agroforestry Machinery Co., Ltd, n.d.; Quanzhou Deli Agroforestry Machinery Co., Ltd., n.d.). Machinery used to dry and de-stem the tea costs \$16,000 and \$10,000 for a total cost of \$26,000 for both machines, and the product of this step will be the tencha needed to make matcha (Hefei Taihe Intelligent Technology Group Co., Ltd, n.d.; Shandong Honor Automation Technology Co., Ltd., n.d.). Purchasing 10 granite stone commercial mills to grind the matcha will be \$4,120 per mill for a total of \$41,200 for all mills (Hangzhou Chama Machinery Co., Ltd., n.d.). The reason why more mills will be needed is due to the grinding process taking a relatively long time, especially for ceremonial grade matcha. The last step of production is packaging—since tin cans are more easily recyclable than plastic bags, the matcha will be packaged in tin cans, similarly to how brands like Chamberlain Coffee, DAVIDsTEA, and Ippodo Tea package theirs (Chamberlain Coffee, n.d.; DAVIDsTEA, n.d.; Ippodo Tea, n.d.). A machine to package the powder into tins will cost \$1,500 per machine (Zhengzhou Vtops Machinery Co., Ltd., n.d.). The estimated sum of all processing facility setup related outlays is \$1,573,700.00.

The estimated sum of the initial outlays (land, crops, and facility setup) would be \$1,913,600.00. However, this does not account for operating expenses. Assuming that this farm

were to hire one farm manager, four full-time farm workers, two seasonal workers for three months each, and two processing technicians, the total annual cost of labor is estimated to be between \$325,000 and \$365,000 (Indeed, n.d.; ZipRecruiter, n.d.-a; ZipRecruiter, n.d.-b; ZipRecruiter, n.d.-c). Assuming an annual budget for electricity for the plant of \$20,000.00, water for the plant and irrigation of \$8,000.00, equipment maintenance of \$16,000.00, and cleaning costs of \$5,000.00, the estimated annual utilities and maintenance costs will be \$49,000.00. Additionally, branding, marketing, and shipping costs must be considered. Website costs will be around \$10,000 annually, the marketing budget will be \$15,000 annually, and the packaging and distribution budgets will be \$25,000 annually. The total estimation of operating expenses will be \$464,000.00 annually.

If each acre of farmland yields an estimated 800 kg of tencha annually and which can be used to produce 400 kg of matcha, the farm can produce an estimated 2,000 kg of matcha annually. Given the price point of matcha can range from \$25.00 to \$65.00 per 30 gram container, the price will be set at \$30.00 per 30 gram container, or \$1.00 per gram (Redger, 2025). Due to the matcha shortage caused by lack of supply, little to no product should be unsold. Since 2,000 kg of matcha is produced annually, assuming that 50% of this is converted to DTC sales, revenues will amount to \$1 million annually under the DTC model. The other 50% of the matcha can be sold to local suppliers, such as cafés, specialty tea shops, and bakeries. Likely beneficial local partnerships within Albemarle County include Grit Coffee, The Twisted Branch Tea Bazaar, and SBroco's Donuts and Espresso. These locally owned shops already sell matcha or matcha desserts; given their proximity to Grounds at the University of Virginia, this matcha will be introduced to the target audience of younger, health-conscious tea drinkers and students. If the wholesale price is set at \$500 per kg of matcha powder, the wholesale model will yield

total annual revenues of \$500,000.00. So is this venture profitable? The hurdle rate we will use is 15%. Given the initial capital expenditure in year 0 of \$1,913,600.00, annual operating expenses of \$464,000.00 years 1-4, and annual revenues of \$1,500,000.00 years 1-4, the net present value of this investment at the end of Year 4 is \$1,044,157.58.

The production of 2000 kg of matcha within Charlottesville, VA will have significant environmental impact. Given the high carbon footprint of importing matcha into the US, production within Charlottesville, VA will ensure 9.13 kg of CO₂e emitted from importation are not emitted per kg of matcha. Should this venture prove to be viable, operations could expand, which further lessen the carbon footprint of American consumers buying matcha. Further, the global coffee market is expected to grow at a CAGR of 5.4% from 2024 to 2030 while that of matcha is expected to grow at a CAGR of 7.9%, so it is likely that some of the demand for coffee will be captured (Grand View Research, 2024a, 2024b). Given that matcha has a lower carbon footprint than coffee, this slowed growth of demand for coffee would slow the rate at which coffee production harms the environment. Given the connection of coffee to food waste and deforestation, this could have significant environmental returns (Fern, 2025). Beyond that, since matcha is often grown with regenerative farming, some regenerative farming practices like low/no tilling and the use of natural pesticides and fertilizers can be implemented (Tellatin, S, 2024; Wild Orchard Tea Company, n.d.). Regenerative agriculture would further mitigate carbon emissions, improve soil fertility through increased biomass production, protect biodiversity, and optimize land use efficiency (Holsether & Reid, 2023).

The social returns from this endeavor stem from the opportunities for education. Given this would be the first farm in the United States to grow and process the *Camellia sinensis* needed to make matcha, the farm could partner with schools, agriculture/environmental sciences

departments, tourism boards, and wellness centers to the process of growing tea and making matcha. This would address a major cultural barrier; consumers lack knowledge about matcha quality and preparation. By partnering with different groups, particularly schools and tourists, this farm could lead short workshops to teach others about the production process by taking visitors for tours of the farm and factory, matcha grades like ceremonial-grade and culinary-grade matcha by leading taste testing and baking classes, and hosting matcha making workshops teaching about whisking, sieving, and correct water temperatures. These various classes could eventually provide another source of income for the farm whilst increasing consumer comfort about matcha preparation and origins. This should also be used as an avenue to counter another barrier of cultural appropriation. Matcha has strong roots in Japanese culture as it is used in the traditional Japanese tea ceremony known as Chanoyu or Sado to celebrate hospitality, harmony, and respect, and has also been used within Buddhist practice (Matcha Outlet, 2023). By celebrating Japanese roots, honoring and differentiating local terrior, and partnering/consulting with Japanese tea masters and cultural institutions, this farm can respect and share tea culture with the American market. Despite some of the cultural barriers that arise from beginning matcha production in the United States, the social returns from cultural exchange and education are sure to make this a worthy endeavor.

In the matcha industry and the world at large, climate change and cultural disconnection serve as great threats. The domestic cultivation of matcha within Charlottesville offers a rare convergence of economic innovation, environmental stewardship, and cultural respect. Our community is poised to pioneer in sustainable matcha production and meet the needs of American consumers. By sustainably cultivating crops and cultural appreciation, this farm could serve as a blueprint for food systems that prioritize people, planet, and profit in equal measure.

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