The Miyawaki Method: A Comprehensive Review of its Principles, Practice, and Implementation in India, and its Potential for Carbon Credit Revenue Generation

Dr. A. Indira Priyadarsini [@]

[@] **Department of Botany, Govt. Degree College(A), Nagari, AP, India**

Abstract

The Miyawaki method, an innovative afforestation technique developed by Japanese ecologist Akira Miyawaki, focuses on cultivating exceptionally dense and rapidly growing native forests. This review synthesizes global theoretical foundations with practical Indian case studies and ecological critiques. It explores the method's profound benefits, including accelerated forest growth, enhanced local biodiversity, improved climate resilience, and significant carbon sequestration capabilities. Furthermore, a detailed analysis is presented on the burgeoning potential of Miyawaki forests to generate tangible revenue through participation in carbon credit programs, outlining the precise mechanisms of carbon sequestration, credit generation, rigorous verification, and successful market monetization. Through concrete examples from India, this article illuminates successful implementations and their associated economic implications, firmly positioning Miyawaki forests as a promising and multifaceted solution for urban reforestation, ecological restoration, and a viable source of climate finance crucial for India's comprehensive climate change mitigation strategy.

Keywords

Miyawaki method, afforestation, native forests, India, carbon credits, carbon sequestration, revenue generation, climate change, biodiversity, urban forestry, ecological restoration, sustainable development.

1. Introduction

In an era grappling with unprecedented climate change, rapid urbanization, and pervasive biodiversity loss, the imperative for effective and sustainable reforestation strategies has never been more critical. Emerging as a beacon of hope, the Miyawaki method, pioneered by the visionary Japanese botanist Akira Miyawaki in the early 1970s, offers a powerful approach to cultivating dense, biodiverse, and remarkably fast-growing mini-forests. This methodology, rooted in ecological principles, involves the meticulous selection of indigenous plant species

and their strategic planting in a highly concentrated, mixed arrangement, deliberately designed to emulate the complex, multi-layered structure of mature natural forests. While its global adoption has surged, particularly gaining immense popularity across diverse landscapes in India, a comprehensive and critical review of its ecological applicability, long-term impact, and socio-economic implications in varied environmental contexts is essential. This article endeavors to provide an exhaustive analysis of the Miyawaki method's core principles, its practical implementation procedures, and to critically examine its escalating adoption and inherent challenges within the Indian subcontinent. Crucially, it further delves into the transformative potential of leveraging Miyawaki forests for the generation of valuable carbon credits, thereby presenting a dual pathway for robust environmental restoration harmonized with tangible economic benefits.

2. Principles and Practice of the Miyawaki Method

The Miyawaki method distinguishes itself through a rigorous, multi-step process engineered to dramatically accelerate natural forest succession and growth:

Key Stages for Miyawaki Urban Forest Development

Step 1: Soil Analysis and Preparation (Foundation for Growth)

This crucial initial step focuses on understanding and optimizing the soil environment.

- **Detailed Soil Analysis:** Conduct a thorough assessment of soil parameters including physical texture (to understand water holding, root penetration, infiltration, and nutrient retention), organic carbon content, nitrogen, soil pH, potassium, phosphorus, and visible evidence of micro or macro fauna. Loamy soils, with their balanced mix of sand, clay, and organic matter, are ideal.
- **Natural Soil Treatment Design:** Based on the analysis, design natural methods to treat the soil.
    - **Perforation Materials:** Incorporate materials like wheat husks, groundnut shells, corn husks, or rice husks to significantly improve soil aeration and facilitate robust root growth.
    - **Water Retention Materials:** Add substances such as coco peat and sugarcane stock to enhance the soil’s capacity to retain water and moisture.

  - **Nutrient Enrichment:** Improve soil nutrient conditions by adding organic fertilizers like vermicompost and cow manure.
  - **Microbial Enhancement:** Based on deficiency assessments, decide on the addition of bacterial and mycorrhizal cultures. For instance, soils deficient in nitrogen greatly benefit from Arbuscular Mycorrhizal Fungi (AMF) (commercially available or cultured) and nitrogen-fixing bacteria like Rhizobium, which can also be introduced by planting leguminous plants.

- **Mulch Application:** Conclude the soil preparation by adding a 5-7-inch-thick layer of mulch (minimum 0.5 kg per tree), using dried grass, dried leaves, barley stalk, wheat stalk, rice straw, or corn stalk. This protective layer insulates the soil and prevents excessive water loss due to evaporation.

Step 2: Determination of Native Species and Floral Composition through Quadrat Survey (Ecological Blueprint)

This step is vital for ensuring the forest's ecological authenticity and biodiversity.

- **Quadrat Survey:** Conduct a quadrat survey in a healthy native forest within the same agro-climatic zone as the proposed Miyawaki site. This survey helps determine the potential natural vegetation (PNV) of the region.
- **Secondary Information Validation:** Validate the survey findings using reliable secondary information, such as published flora of the region (e.g., from the Botanical Survey of India).
- **Plant Community Composition:** Utilize the collected quantitative and qualitative data to develop a diverse plant community composition for the Miyawaki forest, ensuring it includes all natural forms: trees, shrubs, and herbs.
- **Species Selection Strategy:** Choose a mix of species that offers various ecological and functional benefits (flowering, medicinal, timber, fruiting).
  - **Dominant Species:** The five most dominant native tree species identified from the quadrat analysis should constitute approximately 50% of the forest's floral diversity.
  - **Next Abundant Species:** The next most abundant native species will make up 25-40% of the forest.

- **Remaining Native Species:** The rest of the forest will comprise native species found in the next level of abundance during the quadrat study.

Step 3: Procurement of Saplings (Quality Assurance)

This step focuses on securing high-quality planting material.

- **Reputable Sourcing:** Identify nurseries capable of providing good quality saplings of the desired native species. Prioritize well-known private nurseries and those maintained by the State Forest Department.
- **Quality Standards:** Ensure that all planting materials adhere to defined quality standards and are free from any form of adulteration.
- **Ideal Sapling Height:** The ideal height for each sapling should be 60-80 cm.

Step 4: Preliminary Preparation for Plantation (Logistical Readiness)

Before planting begins, proper site and logistical preparation are essential.

- **Site Identification and Access:** Confirm the plantation site and ensure it is easily accessible for trucks, earthmovers, and water tankers. Construct access roads if necessary.
- **Equipment and Infrastructure:** Procure all necessary equipment. Identify and prepare dedicated spaces for a site office, equipment storage, sapling storage, and a resting area for laborers.
- **Water Supply Design:** Design and establish an adequate water supply system (e.g., pipeline, overhead tank, borewell, tanker). This is critical as saplings will require daily watering for the first two years.

Step 5: Undertaking Plantation (Critical Execution)

This is the most pivotal step for the successful establishment of the Miyawaki forest.

- **Bed Area Layout:** Clearly draw out and demarcate the separate plantation bed areas within the site.
- **Deep Excavation:** Excavate the soil to a depth of 3-4 feet.

- **Soil Mixing and Backfilling:** Thoroughly mix the excavated soil with the appropriate amounts of perforators, organic fertilizers, and water retainers. Carefully put the mixed soil back into the land, ensuring it remains aerated and loose, avoiding compression.
- **Pit Digging:** Mark the leveled soil with chalk and dig pits (12”x12”) at every 1.5-2 feet in a triangular manner.
- **Sapling Placement:** Place the saplings into these pits, taking extreme care to ensure that saplings of the same species are never planted next to each other to promote natural diversity and competition.
- **Sapling Support:** Insert 4-5 feet bamboo sticks close to each sapling immediately after planting. These supports will prevent the young saplings from drooping or bending during their initial months of growth.
- **Final Mulch Layer:** Apply a final 5-7-inch-thick layer of mulch (minimum of half kg per tree) to the soil surface.
- **Initial Watering:** Water the saplings extensively for an hour immediately after planting to ensure the mulch and soil settle properly.
- **Density Goal:** Aim for an ideal tree density of 3 trees per square meter.

Step 6: Maintenance and Monitoring (Long-term Nurturing)

Post-plantation care is essential for the forest's early survival and establishment.

- **Two-Year Maintenance:** Undertake site-specific maintenance and monitoring diligently for two years following plantation. This includes regular watering (as established in Step 4), weeding to prevent competition from undesirable plants, and general health checks of the saplings. After this period, the forest should become self-sustaining.

Comprehensive Workflow for Miyawaki Urban Forest Development in India

This conceptual flowchart visually represents the sequential and interconnected steps necessary for the successful establishment of a Miyawaki forest, emphasizing the structured approach required from planning to post-plantation care.


START
Initiative to Develop a Miyawaki Urban Forest
STEP 1: SOIL ANALYSIS & PREPARATION
• Assess Physical & Chemical Properties (NPK, pH)
• Identity Microbial Needs
• Add Perforators (Husk, Shells)
• Add Water Retainers (Coir, Sugarcane Bagasse)
• Apply Organic Nutrients (Compost, Manure)
• Apply Mulch Layer (6–7 inches
6TEP 2: NATIVE SPECIES SELECTION
• Conduct Quadrat Survey (Potential Natural Vegtatio
• Validate with BSI Flora
• Define Floral Mix (Trees, Shrubs, Herbs)
• Select Functional Species (Flowering Medicial, etc.)
• Prioritize Dominant Tree Species (Top 5 = 50%
STEP 5: 3APCTNGEPRROCUREMENT
• Source Good Quality Saplings (60–80 cm height)
• Use Reputable Nurseries (Private / State Forest Deet:
• Ensure Quality Standards
STEP 4: PRELIMINARY PREPARATION
• Identify & Prepare Site Office & Storage Areas
• Plan & Establish Water Supply (Daily for 2 Years)
• Ensure Site Accessibility (Trucks, Earthmovers)
STEP 6: UNDERTAKING PLANTATION
• Mark Plantation Beds
• Excayate Soil (3–4 feet deep)
• Mix & Backfill Soil (Aerated)
• Dig Planting Pits (12' x12' at 1 5·2 ft, Triangular Layout)
• Place Saplings (No Same Species Adjacent)
• Insert Bamboo Support Sticks
• Apply Final Mulch Layer
• Initial Extensive Watering
• Achieve Density: 3 Trene/m²

3. Implementation and Benefits in India and Other Countries

The Miyawaki method has transcended its Japanese origins to become a globally recognized strategy for rapid ecological restoration, finding success in diverse geographical and climatic zones across Asia, Europe, North America, and South America. Its adaptability to various climates and urban settings has made it a favored approach for creating green infrastructure quickly.

In India, the method has been embraced with significant enthusiasm as a powerful tool for large-scale reforestation and critical urban greening initiatives. The country's acute need for enhanced green cover and biodiversity has propelled numerous projects, often driven by government bodies, corporate social responsibility (CSR) programs, and local communities.

Key Projects and Initiatives in India:

- **Smart City and CSR Initiatives:** Numerous cities across India, including **Vijayawada, Visakhapatnam, and Tirupati** in Andhra Pradesh, have actively integrated Miyawaki plantations into their Smart City development plans and various CSR initiatives. These projects are strategically designed to transform barren or underutilized urban plots into thriving mini-forests, contributing to local air quality improvement, temperature moderation, and aesthetic enhancement. Andhra Pradesh, for instance, showcases consistent progress in reforestation and urban forestry, with these Miyawaki projects directly contributing to the state's impressive 23% green cover.
- **Ahmedabad Urban Development Authority (AUDA) CSR Project:** A monumental undertaking, this project involved the planting of **1.2 lakh (120,000) trees across 99,000 square meters** within 11 distinct garden sites. This initiative stands as a prime example of successful public-private collaboration, demonstrating the immense scalability of the Miyawaki method in densely populated urban environments and its potential to significantly rejuvenate degraded land.
- **Miyawaki at the Maha Kumbh (Prayagraj, 2025) – A Special Note**
- A groundbreaking application of the Miyawaki afforestation method took place during the Maha Kumbh in Prayagraj, one of the largest and most spiritually significant religious congregations in the world. Acknowledging the vast and often underutilized stretches of land occupied temporarily by millions of pilgrims, the event organizers

launched an ambitious green initiative using the Miyawaki technique. Over 1 lakh (100,000) native saplings were planted in compact clusters around ghats, campsites, and public zones. This large-scale plantation drive was made possible through the active participation of religious bodies, local NGOs, and thousands of youth volunteers, reflecting a collective commitment to ecological restoration. The project offered immediate environmental benefits—such as enhanced air quality, dust control, and shaded resting spots—in an otherwise exposed and bustling environment.

- More importantly, this initiative served as a pioneering model of "green pilgrimage", demonstrating that even temporary, high-footfall events can integrate sustainable environmental practices. By using the Miyawaki method in this context, the Maha Kumbh set a precedent for future religious gatherings—proving that large-scale events can leave a positive ecological footprint, promote biodiversity, and significantly raise environmental consciousness among millions of devotees.
- This unique effort underscored the adaptability and rapid impact of the Miyawaki method, and its capacity to transform even transient spaces into vibrant, native micro-forests—making spiritual journeys more sustainable and environmentally mindful.
- Link : https://www.pib.gov.in/PressReleasePage.aspx?PRID=2091250

Universal Benefits of Miyawaki Forests:

- **Rapid Growth and Establishment:** A hallmark of the method, Miyawaki forests exhibit significantly accelerated growth rates, reaching ecological maturity and self-sufficiency in a fraction of the time required by conventional reforestation efforts.
- **Enhanced Biodiversity:** The deliberate inclusion of a wide array of native species in dense, multi-layered plantings fosters a remarkably rich and complex ecosystem, attracting and supporting diverse local flora and fauna, thus enhancing ecological resilience.
- **Superior Carbon Sequestration:** These densely packed, fast-growing forests act as highly efficient carbon sinks, absorbing and sequestering substantial amounts of atmospheric carbon dioxide. Studies indicate that Miyawaki forests can often sequester more carbon per unit area than traditional, monoculture plantations, making them powerful tools in climate change mitigation.

- **Improved Local Environmental Quality:** Beyond carbon sequestration, Miyawaki forests contribute profoundly to local environmental health. They effectively combat the urban heat island effect by lowering ambient temperatures, significantly reduce air and noise pollution, and contribute to improved soil quality and groundwater recharge.
- **Resilience to Climate Change:** By establishing robust, biodiverse, and ecologically rich ecosystems, Miyawaki forests inherently possess greater resilience to the impacts of climate change, including extreme weather events and pest outbreaks, compared to less diverse forest types.

4. Criticisms and Challenges

Despite its compelling advantages and growing global adoption, the Miyawaki method is not without its critics and inherent challenges:

- **Questionable Universal Applicability:** Some ecological restoration practitioners' express reservations about the method's universal applicability, particularly in ecologically sensitive or highly diverse biomes. They argue that a "one-size-fits-all" approach may not be ideal for all of India's vast and varied ecological environments, and that detailed pre-site assessment is paramount.
- **High Initial Costs:** The intensive nature of the method, particularly the deep soil preparation, procurement of a wide variety of native saplings, and dense planting, necessitates a significant upfront financial investment. While proponents argue that these initial costs are offset by long-term ecological benefits and reduced maintenance, the initial capital outlay can be a barrier for large-scale implementation, especially in resource-constrained developing regions.
- **Scalability for Large-Scale Projects:** While successful in urban and peri-urban settings, some experts contend that the intensive labor and specific site preparation requirements of the Miyawaki method might limit its practicality for truly massive-scale reforestation projects spanning thousands of hectares, suggesting it might be better suited for smaller, focused initiatives.
- **Reliance on Expert Knowledge:** Successful implementation requires a deep understanding of local ecology, native plant species, and soil science. The method's effectiveness hinges on accurate species selection and proper site preparation, which

necessitates expert consultation and skilled labor, potentially increasing complexity for amateur groups.

5. Carbon Credits and Revenue Generation from Miyawaki Forests

The substantial carbon sequestration potential of Miyawaki forests positions them as a highly attractive asset for generating revenue through participation in voluntary carbon credit markets.

- **Carbon Sequestration Mechanism in Miyawaki Forests:** As highly efficient, rapidly growing ecosystems, Miyawaki forests excel at absorbing vast quantities of atmospheric carbon dioxide (CO_2) during photosynthesis. This carbon is then naturally stored within the biomass of the trees (trunks, branches, leaves) and locked away in the enriched soil. This process of atmospheric carbon removal is the fundamental basis upon which carbon credits are generated.
- **Understanding Carbon Credits:** A carbon credit, often referred to as a carbon offset, represents a verifiable unit of greenhouse gas reduction or removal. Specifically, one carbon credit is equivalent to one metric tonne of carbon dioxide equivalent (CO_2e) that has been either prevented from being emitted or actively removed from the atmosphere. These credits are internationally recognized and traded commodities.
- **Generating Revenue through Carbon Credits:** Afforestation and reforestation projects, including those utilizing the Miyawaki method, are prime candidates for generating carbon credits. Project developers, whether government bodies, private entities, or community groups, can monetize these credits by selling them to corporations, industries, or even individuals who seek to offset their own unavoidable greenhouse gas emissions as part of their sustainability goals or regulatory compliance. The voluntary carbon market is experiencing exponential growth, with projections indicating a potential value of $100 billion by 2030, signifying a lucrative opportunity for well-managed forestry projects.
- **The Process of Monetization:**
    1. **Project Identification and Development:** The initial phase involves identifying suitable land (often degraded or non-forest land to ensure 'additionality' – meaning the carbon sequestration would not have occurred without the project), defining clear project objectives, and meticulously planning the Miyawaki forest development.

2. **Registration with a Recognized Carbon Standard:** To ensure credibility, transparency, and marketability, the Miyawaki forest project must be rigorously registered with an internationally recognized carbon standard. Prominent examples include Verra (Verified Carbon Standard - VCS) and Gold Standard. These standards provide methodologies and frameworks for quantifying carbon benefits.

3. **Monitoring, Reporting, and Verification (MRV):** This is a continuous and crucial phase. It involves systematically monitoring the growth and health of the forest, accurately quantifying the amount of carbon being sequestered over time, and meticulously reporting these findings. Crucially, independent third-party verification bodies then audit and validate these reports. This stringent MRV process ensures that the reported emission reductions or removals are real, quantifiable, additional (beyond business-as-usual), permanent, and avoid leakage.

4. **Issuance and Sale of Credits:** Upon successful verification by a third party, the corresponding number of carbon credits is officially issued by the chosen standard. These certified carbon credits can then be sold on various carbon marketplaces (e.g., global exchanges, brokered deals) or through direct bilateral agreements with interested buyers.

- **Indian Context and Promising Examples:**
    - **Greater Chennai Corporation (GCC):** Demonstrating forward-thinking urban planning, the GCC has issued a Request For Proposal (RFP) to engage a specialized consultant to evaluate and subsequently facilitate the sale of carbon credits generated from their various greening initiatives, including extensive Miyawaki urban forests. This initiative underscores the recognition of Miyawaki forests as a unique and viable source of additional revenue, which the GCC intends to reinvest into other vital urban infrastructure and development projects.
    - **Indian Farmers Fertiliser Cooperative Limited (IFFDC):** A pioneering example of community-centric carbon credit generation comes from IFFDC. They successfully registered a carbon credit project with the Verra Registry, leading to the issuance of 78,000 carbon credits. A subsequent sale of 41,229

credits yielded **₹6.72 million**, with the revenue being equitably shared among participating forestry cooperatives and the individual land-owner farmers. This model effectively demonstrates a sustainable financial incentive for rural communities to engage in afforestation.

- **Alaap Initiatives:** Organizations like Alaap have been instrumental in establishing large-scale Miyawaki forests across India. Their strategy often involves attracting corporate investments, driven by the desire for carbon sequestration. These projects not only contribute significantly to environmental goals but also generate direct income for villagers through the mechanisms of carbon credit sales, creating a symbiotic relationship between ecological restoration and rural economic empowerment.

- **Financial Outlook and Market Demand:** While initial upfront costs and the inherent long-term nature of forestry projects can pose challenges, the rising global demand for high-integrity, nature-based carbon credits is making such ventures increasingly attractive. In 2022, high-quality forest-based carbon credits traded between **₹664 to ₹1,245 per metric ton of CO_2e** (approximately USD 8 to USD 15, based on a representative exchange rate of 1 USD = 83 INR), with market analysts projecting continued price increases as corporate and governmental net-zero commitments strengthen. This growing demand, coupled with increasingly stringent environmental regulations, positions carbon credit generation from Miyawaki forests as a promising and sustainable long-term revenue stream.

6. Conclusion

The Miyawaki method stands as a powerful, scientifically grounded, and scalable solution to address the intertwined challenges of urban deforestation, biodiversity loss, and climate change in India and globally. Its core principles of dense, native planting foster remarkably rapid ecological revival, transforming barren or degraded lands into vibrant, resilient green spaces within urban and peri-urban landscapes. Beyond their profound ecological merits, Miyawaki forests offer a compelling avenue for securing climate finance through the generation and monetization of carbon credits. By diligently quantifying and rigorously verifying the carbon sequestered by these thriving mini-forests, project developers, local communities, and government bodies can strategically tap into the rapidly expanding voluntary carbon market. This creates a powerful, self-sustaining revenue model that not only incentivizes further

afforestation efforts but also contributes directly to local economic development. The continued and collaborative support from engaged citizens, forward-thinking civic bodies, visionary policymakers, and proactive private entities is absolutely crucial to scaling these successes across the country, allowing Miyawaki forests to fulfill their immense potential as a dual-purpose solution for both robust environmental restoration and tangible economic empowerment within India's overarching climate action strategy.

7. References

1. **Boomforest.** (n.d.). *The Miyawaki's forest restoration method.* https://boomforest.org/en/pages/miyawaki_method (accessed June 15, 2021).
2. **Creating Tomorrow's Forests.** (2020). *The Miyawaki Method for Creating Forests.* https://creatingtomorrowsforests.co.uk/blogs/news/the-miyawaki-method-for-creating-forests (accessed June 15, 2021).
3. **Empowering Forest Landowners to Measure and Monetize Carbon Credits.** *Tata Consultancy Services.*
4. **FairPlanet.** *Miyawaki method: a game-changer for urban reforestation?*
5. **Forest Creators.** (n.d.). *Miyawaki Method of Afforestation.* https://forestcreators.com/miyawaki-method/ (accessed December 28, 2021).
6. **Grow Billion Trees.** *How to Sell Carbon Credits in India: Platforms and Compliance.*
7. **Grow Billion Trees.** *Carbon Credit Project: Steps to Launch and Monetize.*
8. **Heng, R. K. J., Majid, N. M. A., Ahmed, O. H., & Gandaseca, S.** (2016). Assessment of carbon stock in chronosequence rehabilitated tropical forest stands in Malaysia. *Journal of Forest and Environmental Science, 32*(3), 302–310. https://doi.org/10.7747/JFES.2016.32.3.302
9. **Heng, R. K. J., Majid, N. M. A., Gandaseca, S., Ahmed, O. H., Jemat, S., & Kin, M. K. K.** (2011). Forest structure assessment of a rehabilitated forest. *American Journal of Agricultural and Biological Sciences, 6*(2), 256–260. https://doi.org/10.3844/ajabssp.2011.256.260
10. **LytHouse.** *Selling Carbon Credits: A Complete Guide to Monetizing Sustainability.*

11. **Miyawaki, A.** (1999). Creative ecology: Restoration of native forests by native trees. *Plant Biotechnology, 16*(1), 15–25. https://doi.org/10.5511/plantbiotechnology.16.15

12. **Miyawaki, A.** (2019). *Miyawaki Method of Forest Creation.* Afforestt. https://www.afforestt.com/methodology (accessed December 28, 2021).

13. **Miyawaki, A., & Golley, F. B.** (1993). Forest reconstruction as ecological engineering. *Ecological Engineering, 2*(4), 333–345. https://doi.org/10.1016/0925-8574(93)90002-W

14. **Mongabay – Vashisth, N.** (2019). Role of Miyawaki forests in mitigating urban heat island effects. https://india.mongabay.com/2019/09/role-of-miyawaki-forests-in-mitigating-urban-heat-island-effects/ (accessed June 15, 2021).

15. **Rots, A. P.** (2019). Trees of tension: Re-making nature in post-disaster Tohoku. *Japan Forum, 33*(1), 1–24. https://doi.org/10.1080/09555803.2019.1628087

16. **Schirone, B., Salis, A., & Vessella, F.** (2011). Effectiveness of the Miyawaki method in Mediterranean forest restoration programs. *Landscape and Ecological Engineering, 7*(1), 81–92. https://doi.org/10.1007/s11355-010-0117-0

17. **Wakker, E.** (1993). Mitsubishi's unsustainable timber trade: Sarawak. In Lieth, H., & Lohmann, M. (Eds.), *Restoration of Tropical Forest Ecosystems* (pp. 217–226). Springer, Dordrecht. https://doi.org/10.1007/978-94-017-2896-6_21

18. **Yagi, K.** (2011). Plant Native Trees, Recreate Forests to Protect the Future: Respected Ecosystem Scientist Akira Miyawaki. *Japan for Sustainability.* https://www.japanfs.org/en/news/archives/news_id030816.html (accessed June 15, 2021)

19. **BCG – Boston Consulting Group.** *How Forests Can Revitalize Carbon Markets.*

20. To walk through a 15-month-old forest grown bottom-up the Miyawaki way, visit: https://youtu.be/l4tvAizYfGw