(IJRST) 2023, Vol. No. 13, Issue No. I, Jan-Mar **e-ISSN: 2249-0604, p-ISSN: 2454-180X**

Miyawaki Method: A Convalescent Approach to Urban Forestry in Greater Hyderabad[1]

K. Sarojini Chakravarthy
Department of Botany, Government Degree College, Khairatabad, Hyderabad, Telangana, India.

DOI:10.37648/ijrst.v13i01.015
Received: 26 February 2023; Accepted: 19 March 2023; Published: 27 March 2023

ABSTRACT

The study evaluated the soil, water, and environmental characteristics of selected Miyawaki Urban Forests in GHMC areas of Hyderabad**.** The dominant species, *Pongamia pinnata*, exhibited high carbon sequestration potential, contributing to dense vegetation and a 99% plant survival rate. Soil analysis revealed higher organic carbon, phosphorus, and potassium levels in Miyawaki forest soils compared to adjacent non-forest areas, indicating improved fertility and microbial activity. Micronutrient concentrations (Zn, Fe, Cu) were similar across sites, while manganese was higher in outside soils. Water samples were slightly alkaline (pH 6.99–7.67) with chemical parameters within permissible limits, except for elevated nitrates at Chinthal Basti and lower calcium in Khairatabad. Environmental observations showed reduced temperature (22–24°C)**,** lower noise (31–46 dB)**,** and decreased particulate matter (46–57 µg/m³) inside Miyawaki forests compared to outside areas. Overall, the results confirm that Miyawaki Urban Forests effectively enhance soil quality, water safety, and urban microclimate**,** demonstrating their potential as sustainable tools for ecological restoration.

Keywords:
Miyawaki Urban Forests; Soil Fertility; Organic Carbon; Micronutrients; Water Quality; Air Pollution; Urban Ecology; Microclimate Improvement; Carbon Sequestration

Introduction

Forest ecosystems are considered as one of the most significant and powerful livelihood-supporting systems globally and provide great benefits (Balderas Torres et al., 2015; R. Wang et al., 2002). They are rich in biodiversity, important in addressing climate change (European Commission, 2022) as forests hold annually 2.4 billion tonnes of carbon globally (Pan et al., 2011). However, forests around the world continue to disappear at an alarming rate. Since the last ice age, the global world has lost one-third of its forest, approximately equal to an area double the size of the USA (Kump, 2004; Ritchie & Roser, 2021).

Therefore, forest restoration is being advocated to reach carbon sequestration goals (Keenan, 2015; Stanturf et al., 2014). The Miyawaki Forest method (MFM) is an afforestation method developed by Professor Akira Miyawaki in the 1970s based on the Japanese temple sacred shrine forest (Chinju-no-mori) (Miyawaki, 1993; Rots, 2015). The MFM has its theoretical grounding in the concepts of successional vegetation ecology and potential natural vegetation generation; any vegetation that occurs in a particular area without human interference or-impact (Chiarucci et al., 2010; Tüxen, 1956). The MFM places an emphasis and advocacy to use trees native to an area to mimic the natural processes of forest regeneration (Miyawaki, 1993, 1998; Webber, 2022). The method claims that it can create local forests at a faster rate than traditional tree planting (Riyas, 2022). MFM communities require short establishment time, low costs, and easy management for establishing a natural ecological environment with whole community structure,

[1] *How to cite the article:* Chakravarthy K.S.; Miyawaki Method: A Convalescent Approach to Urban Forestry in Greater Hyderabad; *International Journal of Research in Science and Technology*, Jan-Mar 2023, Vol 13, Issue 1, 142-155, DOI: http://doi.org/10.37648/ijrst.v13i01.015

rich forest structure, and species diversity (Lewis, 2022; Miyawaki, 1993). More research is required to explore survival rates and how the public perceive the MFM in the range of settings in which it has already been applied.

Many economies gave up acres of their lands in their drive for greater profit to further industrialization and improved infrastructure. However, without a healthy natural ecosystem and a green environment, no economy can sustain for very long. Earlier, the city of Hyderabad was flourished with baghs (parks) located in different places enriching the city with greenery. Due to urbanization and pollution the city lost its vegetation converting it into a concrete jungle. This deterioration alarmed GHMC to initiate massive greenery programme to regain the past glory and converting the city as ecological hub. This was accomplished partly by developing major parks, colony parks, traffic islands, urban forests etc. In this hour of extreme climate change and global warming, we have to adopt a solution-based approach. The greatest way to achieve these things is by afforestation. Among these urban afforestation is the need of the hour because Urban forests are the backbone of the green infrastructure, which can ameliorate a city's environmental footprint. The Greater Hyderabad Municipal Corporation (GHMC) has initiated urban forestry adopting Miyawaki method 3 years back in 2019. The method of Miyawaki is to bring out forest environment in urban areas to bring enormous change in the environment and creating awareness among the people's attitude towards conserving their own environment. The Miyawaki technique is such a method for urban forestation. Hence, Urban forests are developed in different GHMC zones adopting Miyawaki method.

What is Miyawaki method?

A human-planted forest takes typically at least 100 years to reach maturity when left to nature's methods. Utilizing an accelerated process, the Miyawaki method of plantation creates a miniature forest environment. When growing forests on tiny land holdings, the Miyawaki approach and related techniques are incredibly effective.

Miyawaki technique is based on the practices of Japanese forester Akira Miyawaki, a Japanese botanist, and an expert in the study of Natural Forest and the Restoration of Natural Vegetation. He had expertise in plant ecology and developed the technique of plantation back in the 1980s in which a variety of plants are sowed within a small distance i.e 3-4 plants/sq. meter. It created a dense forest with a mixed variety of plants in a small area and within a short time.

As a land restoration tool: Miyawaki Method

Natural forests function in a different cycle. Forests are made up of more than just trees. It is home to a variety of plants, fungi, wildlife, and microorganisms. This flora and fauna community plays an important role in sustaining the forest and allowing it to thrive. Birds disperse seeds into the forest, animal dung nourishes the land, leaf litter from fallen trees is broken down by decomposers to create healthy soil, and plant roots hold the soil in place.

However, the process by which forests grow, generate multiple canopy layers, and become self-sustaining takes time. The Miyawaki method accelerates forest development by constructing soil, utilizing native plant diversity, growing healthy saplings, and planting them close together.

The Miyawaki method gives a stepwise procedure for restoring native forests. The care given during the initial years of planting ensures that the majority of the saplings planted survive and the forest ecosystem is established in a fraction of the time taken for forests to develop naturally.

Miyawaki Technique in India and Hyderabad

- The Miyawaki technique is widely acknowledged and used in India, primarily in Telangana. The state government of Telangana has adopted the Miyawaki plantation method in that state under the "Telangana Ku Haritha Haram" (TKHH) (Fig 1).
- In addition, many people, social workers, and NGOs are working on the Miyawaki Method in India and converting their backyards into small forests.
- Under a 100-day plan put up by the West Bengal government, dense forests using the Miyawaki method would be planted in a few districts of Howrah.

- The first urban forest in India, called "Anand Van', was officially opened on October 17th, 2020 by Mr Prakash Javdekar, the environment minister, for establishing a habitat for the more than 59 indigenous species that were there. The Minister mentioned in his speech that the Miyawaki Method of plantation can help in making denser urban forests in less time.

Fig 1: Miyawaki Forest at Shamshabad

In view of importance of urban forestry, this study is undertaken to assess the convalescent approach to urban forestry through Miyawaki technique done by GHMC in Greater Hyderabad and to investigate the advantages and disadvantages of Miyawaki forests.

Materials and Methods

A survey was conducted in different Miyawaki urban forest locations in GHMC Khairatabad zone during November to December, 2022. Khairatabad zone was selected as our college was located in this zone.

Under Khairatabad Zone Miyawaki Urban Forests were developed by GHMC in the following locations

1. Public Gardens-1
2. Public Gardens-2
3. VBRI Vijayanagar Colony
4. Sanathnagar
5. Senor Valley (Filmnagar)
6. MLA Colony
7. Balreddy Nagar
8. Feroz Gandhi Park
9. New Science Colony

A questionnaire was prepared to evaluate different parameters in and outside of Miyawaki urban forests.

Parameters taken for the study were

1. Plant species planted
2. Survival of the plants
3. Plant growth

4. Physicochemical properties of soil samples collected inside and outside of Miyawaki urban forests area
5. Physicochemical properties of water samples collected inside and outside of Miyawaki urban forest area
6. Temperature in and around Miyawaki urban forest area
7. Noise in and around Miyawaki urban forest area
8. Particulate matter levels in and around Miyawaki urban forest area

Soil samples were collected as per the standard protocol given by Soil Testing lab, Department of Agriculture, Govt. of Telangana. One kg of soil sample was collected in a polythene bag from 5 different regions of selected area by removing pebbles and small stones (Fig 2). Collected soil was given for soil analysis to know the texture, pH, Organic Carbon, available Phosphorus, Potassium, Zinc, Iron, Manganese and Copper in the soil samples.

Fig 2: Students Collecting Soil Samples from Miyawaki Urban Forests Areas

Water samples were collected as per the standard protocol given by the Department of Ground water, Govt. of Telangana. Water sample was collected from the 9 different locations in one litre water can each without air gap (Fig 3). Water samples were analyzed for pH, Na^{+}, K^{+}, Ca^{+2}, Mg^{+2}, CO_3^{-2}, HCO_3^{-}, Cl^{-}, SO_4^{-2}, NO_3^{-}, F^{-}, Total Hardness (TH), Total Dissolved Salts (TDS).

To develop urban forests by adopting Miyawaki method by GHMC in Khairatabad zone the land was prepared by removing the top soil having pebbles and small stones, adding dry leaves and manure to the soil for enrichment (Fig 4). Then native varieties of saplings were planted in 3-4 per sq.mt.

Fig 3: Students Collecting Water Samples from Miyawaki Urban Forest Areas

To develop urban forests by adopting Miyawaki method by GHMC in Khairatabad zone the land was prepared by removing the top soil having pebbles and small stones, adding dry leaves and manure to the soil for enrichment (Fig 4). Then native varieties of saplings were planted in 3-4 per sq.mt.

Fig 4: Preparing of land for Miyawaki Urban Forest by GHMC

Results and Discussion

Plant species planted in Urban forests are *Pongamia*, Guava, Neem, Custard apple, Pomegranate. Among them *Pongamia* is a dominant species as it absorbs more CO_2 and releases O_2. Survival rate of the plants in all these forests is 99% (Fig 5). Dense plant growth was observed within a short period. Among all the soil samples tested, Miyawaki forest soils were rich in organic matter as they have high value of organic carbon compared to outside of Miyawaki urban forest area (Table 1). Available Phosphorus and Potassium were high in Miyawaki forest soils except in MLA colony and outside soil samples. Availability of Zinc, Iron and Copper were similar in all the soil samples tested. But the availability of Manganese was more in outside soil samples than inside of Miyawaki forest soils.

Fig 5: Miyawaki Urban Forests developed by GHMC in BalReddy Nagar and VBRI Areas under Khairatabad Zone

Table 1: Analysis Report of Soil Samples

Sample	Texture	pH	Organic Carbon	Available Phosphorus (P) Kg/acre	Available Potassium (K) Kg/acre	Available Zinc (Z) ppm	Available Iron (Fe) ppm	Available Manganese (Mn) ppm	Available Copper (Cu) ppm
MLA Colony	Sandy loam	Slightly Alkaline	Medium	32	150	1.250	2.296	1.407	0.651
Public Gardens	Sandy loam	Slightly Alkaline	High	73	252	0.991	2.569	1.196	0.526
Sanath nagar	Sandy loam	Slightly Alkaline	High	104	303	0.820	1.908	1.601	0.791
Outside Miyawaki	Sandy loam	Slightly Alkaline	Low	53	99	0.964	2.236	3.077	0.847

All the water samples collected are alkaline with pH ranging from 6.99 to 7.67 (Table 2). All the water samples have Chlorine, and Sulphates content below the permissible limits. Except Chinthal basti water sample all other samples have nitrates within the permissible limits. Calcium levels are low in Khairatabad sample than others. Sodium, Potassium, Bicarbonates, Fluorine levels, Total Hardness (TH) and Total Dissolved Salts (TDS) are within permissible limits in all water samples. Magnesium levels are low in 4 Miyawaki forest water samples. Temperatures ranged between 22-24ºC inside Miyawaki forests and outside was 25-28ºC. Noise levels noted inside Miyawaki forests was 31 – 46 dbs and outside of Miyawaki forest area was 60 – 75 dbs. Particulate Matter (PM2.5) inside Miyawaki forests was 46-57µg/m^3 and outside of Miyawaki forest was 80-118µg/m^3.

Table 2: Analysis report of Water Samples

Name of the location	**Type of water**	**pH**	**Na^+ mg/L**	**K^+ mg/L**	**Ca^{+2} mg/L**	**Mg^{+2} mg/L**	**CO_3^{-2} as CaCO3 mg/L**	**HCO_3^- mg/L**	**Cl^- mg/L**	**SO_4^{-2} mg/L**	**NO_3^- mg/L**	**F^- mg/L**	**TH mg/L**	**TDS mg/L**
Public Gardens-1	Bore water	7.28	150	5	88	58	0	410	150	115	44	1.20	460	870
Public Gardens-2	Pond water	7.29	171	7	104	29	0	410	120	155	18	1.11	380	858
Senor Valley	Bore water	7.00	88	2	136	24	0	300	90	175	23	0.88	440	705
MLA colony	Bore water	7.15	113	5	114	49	0	400	180	120	31	0.53	560	954
VBRI	Bore water	7.40	104	6	80	5	0	230	100	74	3	0.51	220	557
Feroz Gandhi Park	Bore water	7.47	105	1	136	15	0	300	110	160	10	1.14	400	719
Khairatabad	Bore water	7.67	112	1	32	131	0	500	130	145	43	0.70	620	1032
Chinthal	Bore	6.99	114	3	144	39	0	420	130	120	50	0.46	520	883

Basthi	water													

Hyderabad's growing green space: city now hosts country's largest Miyawaki forest

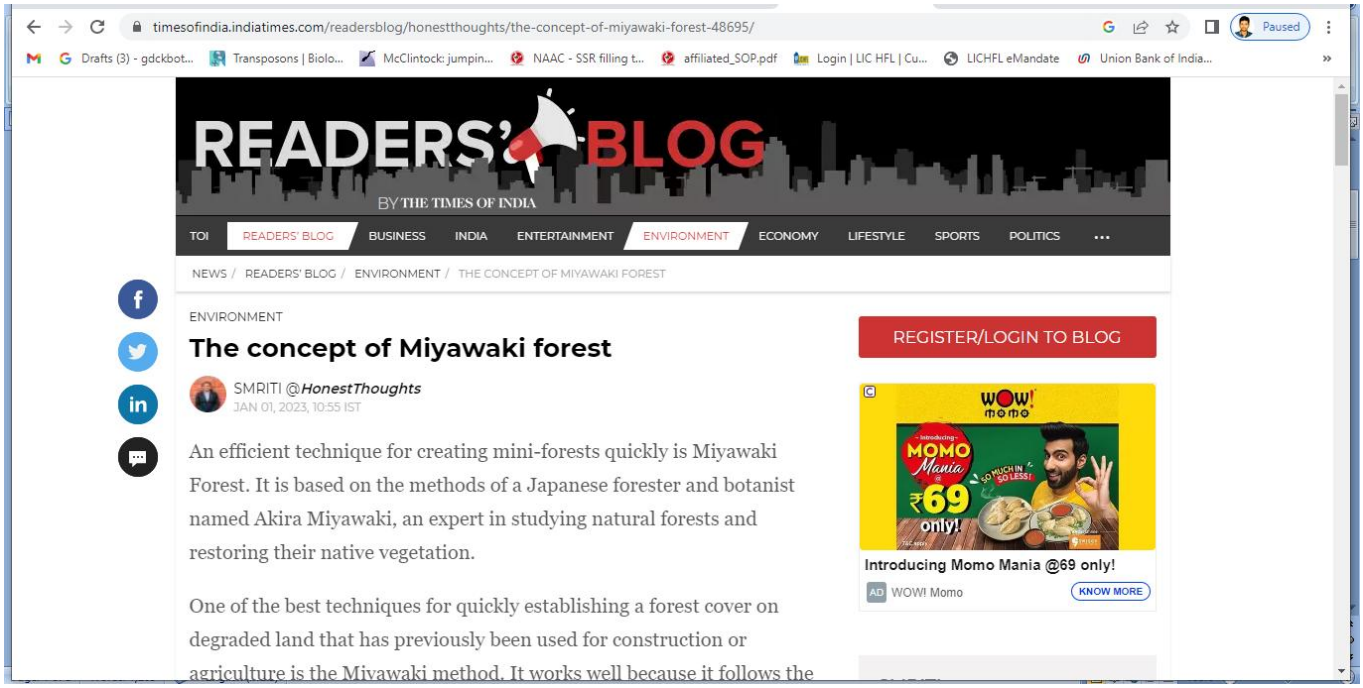
Spread over 18 acres in Kavaguda near the airport, the forest has 126 species of native fruit and flowering trees and is a birds' paradise

When bird photographer Sriram Reddy reached a village in Kavaguda, eight kilometres from the Shamshabad airport, at the crack of dawn, he was stepping into a Miyawaki forest, not expecting to capture much. However, when he sighted more than 10 species of birds within a short span. Spread over 18 acres, this is the country's largest Miyawaki forest, followed by one in Gujarat, spread over 14 acres. Sriram, who has documented 1,013 (out of the 1,350) bird species in India, says "In three days, I spotted over 50 species of birds. Apart from the resident birds like the Tickell's blue flycatcher, barn owl, red-collared dove and barred buttonquail, I spotted winter visitors like the rosy starling and lesser whitethroat.

Miyawaki makeover: Urban forests to dot city landscape

Japanese plantation technique to help grow denser mini-forests at a faster rate to improve tree cover in Hyderabad; KTR explains 'Haritha' budget

Miyawaki Parks or mini forests will now dot all Urban Local Bodies (ULBs) in Telangana, including six under Greater Hyderabad Municipal Corporation (GHMC) limits. The parks will be the first of its kind to come up in the ULBs during the proposed Telangana Ku Haritha Haram (TKHH). Chief Secretary Somesh Kumar issued instructions to ULBs to start Miyawaki parks. According to GHMC officials, the State government has proposed that every ULB have at least one such park.



13.44 Lakh acres of Degraded Forest rejuvenated and 109 Urban Parks are created in Telangana. The Yadadri model of plantation is a modified, high-density afforestation technique used in Telangana, based on the Japanese Miyawaki method to create dense, fast-growing native forests in small spaces (Fig 6). It focuses on soil enrichment using cow dung and organic fertilizers, supporting 3-tier vegetation (shrubs, trees, canopy) to increase green cover rapidly, often utilized for urban parks and rural nature parks.

Fig 6: Miyawaki/Yadadri Model Plantation in Karimnagar District


4 months old plantation
Venkateshwara colony Yadadri model

Conclusions

Without a healthy ecosystem and green environment no economy can sustain for a very long time. In this hour of global warming and extreme climate change we have to adopt a solution based approach. The greatest way to achieve this is Urban Afforestation by adopting Miyawaki method. We conclude that we have observed reduction in temperature, noise levels, particulate matter, increase in oxygen levels, organic carbon and potassium levels in urban forest developed by Miyawaki method by GHMC.

Regarding water analysis the elements in water are within permissible limits in and outside the Miyawaki forest areas except Chlorine, Sulphates, Magnesium and Nitrates.

Because of *Pongamia* species plantation the O_2 levels increased in Miyawaki forest areas.

Because of dense vegetation in Miyawaki forest areas the temperatures, noise levels and particulate matter have decreased. Because of high organic carbon and potassium levels in the Miyawaki forest soils the fertility of the soil have increased. Exposure to high noise levels damages our ear and causes hearing problems. Exposure to fine particles in the air causes infections in eyes, nose, asthama, bronchitis, lung infections and other respiratory problems.

We conclude that urban forests developed by GHMC adopting Miyawaki method were providing healthy environment to live with less pollution and we also suggest developing more such urban forests in the city.

Future Scope

Through our study we suggest to develop more urban forests in the city by adopting Miyawaki method which reduces pollution, increases soil fertility and maintains a conducive environment for the people to live. It is our responsibility to preserve and protect environment for our future generations.

References

1. Balderas Torres, A., MacMillan, D. C., Skutsch, M., & Lovett, J. C. (2015). 'Yes-in-my-backyard': Spatial differences in the valuation of forest services and local co-benefits for carbon markets in México. Ecological economics, *109*, 130–141. https://doi.org/10.1016/j.ecolecon.2014.11.008
2. Chiarucci, A., Araújo, M. B., Decocq, G., Beierkuhnlein, C., & Fernández-Palacios, J. M. (2010). The concept of potential natural vegetation: An epitaph: The concept of potential natural vegetation. Journal of vegetable science, 21(6), 1172–1178. https://doi.org/10.1111/j.1654- 1103.2010.01218.x
3. European Commission. (2022). Forests [WWW document]. Retrieved March 14, 2023, from https:// environment.ec.europa.eu/topics/forestsen
4. GHMC brochure on Parks
5. Hanyu Qi, Nicola Dempsey & Ross Cameron (2024). Seeing the forest for the trees? An exploration of the Miyawaki forest method in the UK, Arboricultural Journal, 46:4, 292-304. DOI: 10.1080/03071375.2024.2394355. https://doi.org/10.1080/03071375.2024.2394355
6. Hyderabad's Gachibowli to go Miyawaki in attempt to boost green space in New Indian Express - https://www.newindianexpress.com/good-news/2019/jul/18/hyderabads-gachibowli-to-go-miyawaki-in-attempt-to-boost-green-space-2005743.html
7. Keenan, R. J. (2015). Climate change impacts and adaptation in forest management: A review. Annals for science, 72, 145–167. https://doi.org/10.1007/s13595-014-0446-5
8. Kump, L. R. (2004). The earth system. Upper Saddle River, N.J. Pearson Prentice Hall.
9. Lewis, H. (2022). Mini-forest revolution: Using the Miyawaki method to rapidly rewild the world (1st ed.). Chelsea Green Publishing.
10. Miyawaki forests a welcome addition to 'heat islands' **https://www.thehansindia.com/news/cities/hyderabad/miyawaki-forests-a-welcome-addition-to-heat-islands-663845**
11. Miyawaki forests to bring pristine green glory to city

https://www.thehansindia.com/telangana/miyawaki-forests-to-bring-pristine-green-glory-to-city-631844

12. Miyawaki makeover: Urban forests to dot city landscape-Japanese plantation technique to help grow denser mini-forests at a faster rate to improve tree cover in Hyderabad; KTR explains 'Haritha' budget - https://www.newindianexpress.com/cities/hyderabad/2020/jun/14/miyawaki-makeover-urban-forests-to-dot-city-landscape-2156332.html
13. Miyawaki, A. (1993). Native forest by native trees. - restoration of indigenous forest ecosystem. Bull institute Environmental Science and Technology, 19, 73–107.
14. Miyawaki, A. (1998). Restoration of urban green environments based on the theories of vegetation ecology. Ecological Engineering, 11, 157–165. https://doi.org/10.1016/S0925-8574(98)00033-0
15. Pan, Y., Birdsey, R. A., Fang, J., Houghton, R., Kauppi, P. E., Kurz, W. A., Phillips, O. L., Shvidenko, A., Lewis, S. L., Canadell, J. G., Ciais, P., Jackson, R. B., Pacala, S. W., McGuire, A. D., Piao, S., Rautiainen, A., Sitch, S., & Hayes, D. (2011). A large and persistent carbon sink in the World's forests. Science, 333, 988–993. https://doi.org/10.1126/science.1201609
16. Pan, Y., Birdsey, R. A., Fang, J., Houghton, R., Kauppi, P. E., Kurz, W. A., Phillips, O. L., Shvidenko, A., Lewis, S. L., Canadell, J. G., Ciais, P., Jackson, R. B., Pacala, S. W., McGuire, A. D., Piao, S., Rautiainen, A., Sitch, S., & Hayes, D. (2011). A large and persistent carbon sink in the World's forests. Science, 333, 988–993. https://doi.org/10.1126/science.1201609
17. Ritchie, H., & Roser, M. (2021). Forests and deforestation. Our World in Data.
18. Riyas, A. F. (2022). Miyawaki Technique: Creating mini forests in urban areas. ClearIAS. Retrieved March 25, 2023, from https://www.clearias.com/miyawaki-technique/
19. Rots, A. P. (2015). Sacred forests, sacred nation: The Shinto environmentalist paradigm and the rediscovery of "Chinju no Mori". Japanese Journal of Religious Studies, 42, 205–233.
20. Rots, A. P. (2015). Sacred forests, sacred nation: The Shinto environmentalist paradigm and the rediscovery of "Chinju no Mori". Japanese Journal of Religious Studies, 42, 205–233.
21. Stanturf, J. A., Palik, B. J., & Dumroese, R. K. (2014). Contemporary forest restoration: A review emphasizing function. Forest Ecology and Management, 331, 292–323. https://doi.org/10.1016/j.foreco.2014. 07.029
22. The Concept of Miyawaki concept in Reader's blog by Times of India - https://timesofindia.indiatimes.com/readersblog/honestthoughts/the-concept-of-miyawaki-forest-48695/
23. They grow fast and easy but do Miyawaki forests meet the fundamental principles of ecological restoration? in The Hindu - https://www.thehindu.com/sci-tech/energy-and-environment/they-grow-fast-and-easy-but-do-miyawaki-forests-meet-the-fundamental-principles-of-ecological-restoration/article65258901.ece
24. Tüxen, R. (1956). Die huetige potentielle naturliche Vegetation als Gegestand der Vegetationskarierung. Angew Pflanzensozioligie, 13, 5–42.
25. Wang, R., Kauze, F., & You, H. (2002). Theory and practices for forest vegetation restoration: Native forest with native trees - introduction of the Miyawaki's method for reconstruction of "environmental protection forest (ecological method to reforestation)." Chinese Journal of Plant Ecology, 26, 133. https://www.plant-ecology.com/EN/Y2002/V26/I增刊/133
26. Webber, S. (2022). The miyawaki method for creating forests - creating Tomorrow's forests | restoring biodiversity by creating habitats and planting trees [WWW Document]. Retrieved March 13, 2023, from https://www.creatingtomorrowsforests.co.uk/blog/the-miyawaki-method-for-creating- forests