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DEVELOPMENT OF TREE PLANTATION THROUGH MIYAWAKI METHOD AT SABARMATI RIVERFRONT DEVELOPMENT CORPORATION LIMITED - A RESEARCH

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ABSTRACT

The current paper deals with the progressive and sustainable approaches of development of tree plantation through Miyawaki method at Sabarmati Riverfront Development Corporation Limited. Miyawaki forests are one approach that has recently received a lot of attention. The Miyawaki method of reforestation, named after Japanese botanist and plant ecologist Akira Miyawaki, is a method of ecological engineering that advocates the growth of forests even in small areas by first treating the top layer of soil and then planting the local species that can thrive on their own. Ahmedabad's municipal corporation, which has Kobe, Japan as a sister city, is experimenting with this and hopes to develop such green spaces not only on land but also now on completely flowing Sabarmati River. 'We chose this fast-growing urban forestry method, as it has reported 15% faster growth rate per year compared to the other reforestation methods,' said Dr. Asif Memon, General Manager (Parks and Garden), and Sabarmati Riverfront Development, who is overseeing the reforestation initiatives. Moreover, for maintenance, all that a Miyawaki forest requires is good water supply and weeding for two years. Thereafter, it will be self-sustaining, need no external support. The current study gathers the strategic objectives for developing tree plantations using the Miyawaki method, as well as the benefits to nature and other ecosystems.

Keywords: *Tree Plantation, Miyawaki Method, Sabarmati Riverfront Development Corporation Limited (SRFDCL), Ahmedabad.*

INTRODUCTION

The removal of existing green cover in cities to make way for construction and other projects has been a major casualty of India's rapid urbanization. With people demanding that a good quality of life include not only conserving, but also adding to the city's green cover, Ahmedabad, like other cities, is experimenting with ways to create small green areas in an ever-expanding concrete urban landscape. Planting greater bushes enables to hold wholesome soils and humidity tiers within side the air across the world. It starts while timbers adjust the water cycle. Trees take in air and transpire it lower back into the atmosphere, successfully filtering and controlling the ranges of humidity anywhere they are. In the past 5-6 decades, scientists have gained new insights in the theories and practical actions of restoring and rebuilding natural ecosystems (Clewell and Aronson 2007; Falk et al., 2006; Jordan et al., 1981).

Restoration of ecological functions, expansion of individual habitats, and enhancement of biodiversity are all examples of natural restoration (Stature John and Madsen, 2004). Restoration is also described as "an deliberate activity that initiates or accelerates the recovery of an ecosystem in terms of its health, dignity, and sustainability" at the ecological level (Aronson et al., 2002). Plant populations that have been degraded are notoriously difficult, if not impossible, to rebuild (Van Diggelen and Marrs, 2003). Forest recovery takes a long time, and the results are often unsatisfactory, as shown by more than 200 years of reforestation practice. Plantations of various species are now possible, but the transition from a simple plantation to a forest population capable of evolving and sustaining itself according to natural successional patterns is still a rare occurrence (for Italy, cf. Bellarosa et al., 1996). The mere presence of vegetation regeneration, on the other hand, should be avoided. It is critical to restore natural vegetation using a mix of native species that adhere to the habitat's potential pattern, as well as to attempt to restore the region's entire unique ecosystem (Miyawaki, 1992).

We don't have the patience to wait several hundred years for forest restoration to be completed; because we live in a world where manufacturing and urbanization are rapidly evolving, developing an alternative reforestation technique that reduces these times may be a useful tool (Miyawaki, 1999). The “native forests by native trees" method, which is based on vegetation–ecological theories, is a reliable forest restoration method (Miyawaki 1993a, b, 1996, 1998b; Miyawaki and Golley 1993; Miyawaki et al., 1993; Padilla and Pugnaire, 2006). Prof. Akira Miyawaki suggested it, and it was the first to be implemented in Japan. Because of the simultaneous use of intermediate and late successional species in plantations, this approach allows for the restoration of native green habitats, multilayer forests, and natural biocoenosis, as well as the rapid establishment of well-developed ecosystems.

Miyawaki is Japanese word and first introduced by Japanese botanists’ call "AKIRA MIYAWAKI" Internationally renowned botanist working at the institute of environment science and technology of the YOKOHAMA NATIONAL UNIVERSITY (YNU) (Miyawaki 1975, 1981).

This method can be used to grow an urban forest. The plantation density has increased by 30 times, and the growth rate has increased by 10 times. And it becomes maintenance-free within a time interval of 3 years, which is the smallest forest. This method used to grow an urban forest, within a short span of 20 -30 years, while natural forests grow in 200 to 300 years, in the Miyawaki method various species of plants are planted close to each other, so that the plants receive sunlight only from the, top and grow upwards instead of sideways, hence the plantation becomes 30 times denser, grows 10 times faster and becomes, maintenance free after a span of 3 years. The minimum size of the forest should be 4 by 3 meters; it should receive sunlight for at least 8 hours each day.

This approach is slowly gaining attraction in India. It is an effective way to increase green cover, especially in congested areas such as barren land, parks and hospitals. In urban areas where land and space are limited, this approach is a viable choice. Mini forests using the Miyawaki method in backyards are not feasible in highly urbanized Indian cities such as Ahmedabad, Delhi, Mumbai, Chennai, and Bengaluru since these cities are heavily populated and very few people have backyards in their homes. Mini forests, on the other hand, can be grown on government or community property. Allowing for optimal land optimization can be extremely satisfying.

Miyawaki Information of the Sabarmati Riverfront

There is a total of seven Miyawakis on the riverfront in Ahmedabad, each with its own unique field, tree, place, and watering system. They are all well maintained. SRFDCL currently has approximately 33,000 sq m (8.1 acres) of land, on which 1,04,400 trees have been planted, which is a significant figure. Taking care of such a large number of plants is difficult. The table-1 shows all Miyavaki areas, addresses, no. of variety, location everything.

No.	Addition Of miyawaki’s	No. of trees	No. of variety	Area in sq. m. (ac.)	Date of plantation (approx.)	Tree per sq. m. (approx.)	Location	Location co-ordinates
1	Between	3500	19	2000	04/2019	2	https://maps.app.goo.gl/gjxZvuabBUuScdZs7	23°02'11.9"N

	Gandhi bridge to Nehru bridge			(0.49)				72°34'16.3"E
2	Near sea plan	43,500	38	10,000 (2.47)	08/2019	4	https://maps.app.goo.gl/trVZhibxnxmdgxBx5	23°00'01.9"N 72°33'53.9"E
3	Gayatri shakti pith	3,500	31	6,200 (1.53)	09/2019	2.5	https://maps.app.goo.gl/ZajSDWKcwQp8N6i77	23°03'45.5"N 72°35'34.3"E
4	Back side of NID college	2900	17	1,100 (0.27)	05/2020	3	https://maps.app.goo.gl/qvN99cLXvR3SoEeg7	23°00'32.1"N 72°34'14.1"E
5	Opp. Sea plan	13,700	18	4,500 (1.11)	08/2020	3	https://maps.app.goo.gl/EqLS5r3E7QbQpJ3dA	23°00'01.9"N 72°33'53.9"E
6	Back on scout bungalow	9,000	21	2,200 (0.54)	11/2020	4	https://maps.app.goo.gl/t3ZXz9QqompAyCeo6	23°00'17.7"N 72°34'07.4"E
7	Dadhichi bridge	29,700	23	7,050	03/2021	4.2	https://maps.app.goo.gl/gD8YummsG8Bqgqa66	23°03'08"N 72°34'46"E

(TABLE NO-1 shows the number of Miyawakis, number of trees, varieties, area covered and locations)

Around 40 different indigenous tree species, including Drumstick, Mahuda, Jamun, Aamla, Mulberry, Kanjo, Kaju, Flame of the Forest, Sesam, Shami, Neem, Ramfal, Cordia species have been planted along with exotic varieties such as *Cassia* species, Peltophorum, Gulmohar, Spathodea, Largestonia, Saptaparni, Chini badam, and Rain tree. The exotic species selected are ones that have been flourishing for a long time in Ahmedabad. Figure-1 below shows all the Miyawaki locations on the Sabarmati Riverfront.

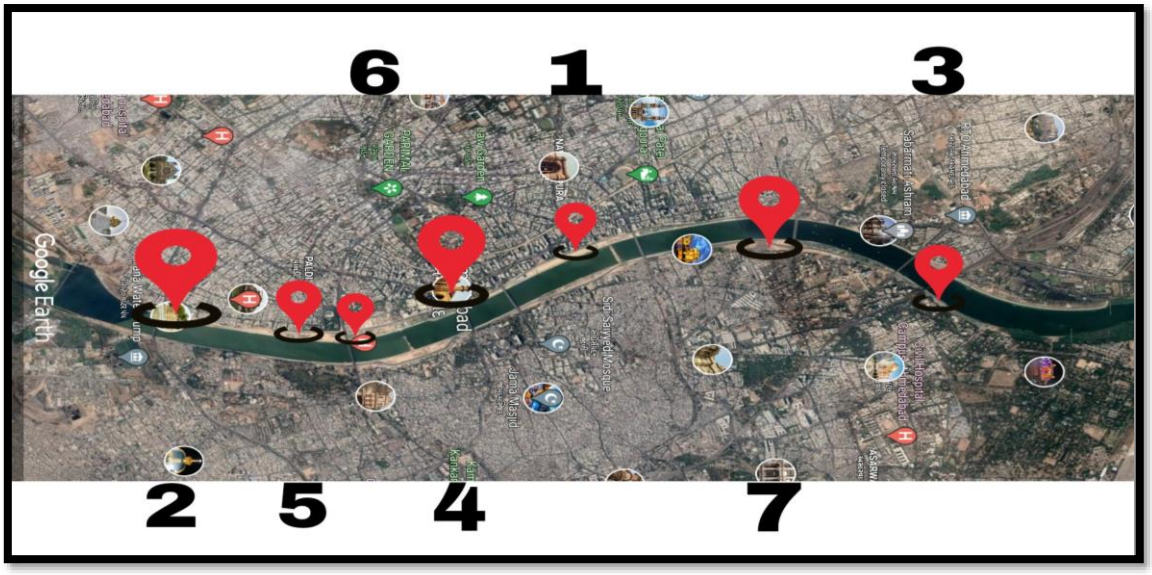


Figure-1 indicates the location of Miyawakis on the map

DEVELOPMENT OF MIYAWAKI:

STEP-1: DETERMINE THE SOIL TEXTURE AND QUALITY BIOMASS**:**

The land along the Sabarmati river was almost barren, it was very difficult to grow vegetation in all the coastal lands as it was bad that is why vegetation cannot grow there. That's why one meter of soil from above was extracted with JCB which was not at all fertile soil. Sabarmati river front have total seven Miyawaki plantations and is shown in figure-1 at different locations.

(Removing unfertile soil) (Land with productive soil)

All Miyawakis were developed with the same process with soil preparation after removing unproductive soil and replacing it with the fertile soil to 70% soil and 30% rice husk, farm yard and coco peat. After preparation of this soil, fill it in the hole of one meter through JCB and then the space is ground leveled. Soil texture helps determine water conserving capacity, water infiltration, root perforation capacity, nutrient retention and edibility. Check if the texture is sandy, loamy or clayey.

(Fill the Fertile Soil) (Leveled Ground)

What to add in soil:

Perforator substances aid in the improvement of perforation and the rapid development of roots. We can do this by using spongy and dry biomass found in nature. Husk is a by-product that can be used in grain mills and animal feed stores. Rice husk, wheat husk, corn husk, or groundnut shells are some other options.

(Rice husk)

Water retainer: Comparing to the herbal water retention ability, water retainer helps soil maintain extra moisture and water. Coco-peat or dry sugarcane stalk may be used as natural

materials. A good test is to soak the cloth in water for a few minutes before removing it and squeezing it. When water oozes out during the squeezing process, the material may be used as a water retainer.

Manure: For nourishment, organic fertilizer is needed. Depending on the environment and availability, different products may be used, such as cow manure, goat manure, or vermi compost. Manure is a nutrient-releasing plant fertilizer that releases nutrients gradually.

(Trolley of coco peat)

Direct sunlight dries out the soil, making it difficult for young saplings to meet their requirements.

(Manure)

This is especially important during the first 6-8 months, when the flowers are still developing. Mulch also plays an important role in preventing water from evaporating. Rice straw, wheat straw, corn stalk, or barley stalk are used in the process.

Step-2 Getting the Area Ready:

Site inspection: To assess the project's viability and scope, go to the site. Take photos of the site and confirm that fencing, preservation workers, and going for walks with water and sunshine are all accessible. Debris and weeds must be removed since they deplete the soil's nutrients and obstruct the flow of materials and citizens. As a result, they must be cleaned manually or with the aid of a machine. Ensure that the weeds that have been pulled are disposed of away from the site; otherwise, they will re-grow.

Manually Weed Cleaning

Making strategy to build roads to designated areas: Removing weeds, large stones, and boulders. The course can be made of any material, but trucks and tractors must be able to use it.

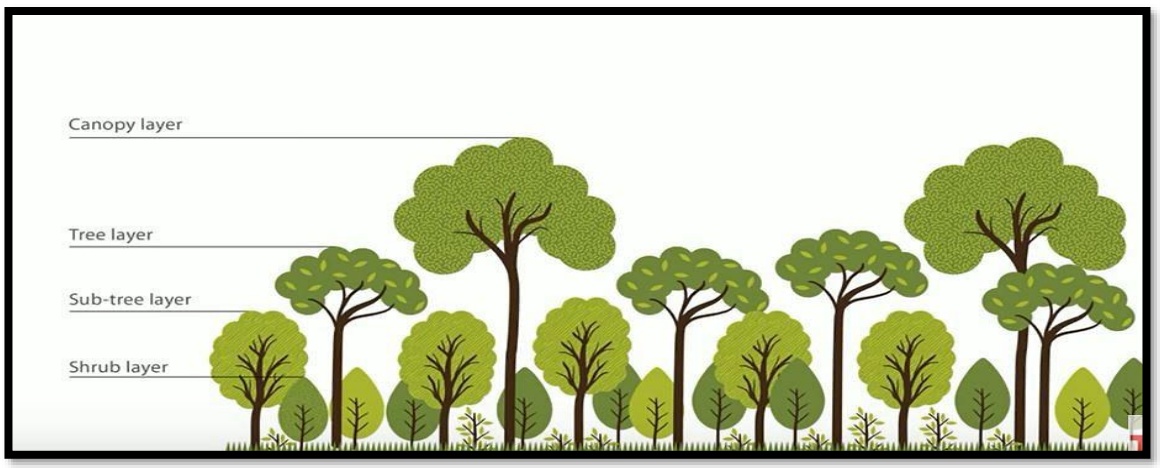
Inside glimpse of Miyawaki

Step-3 Choose the Right Tree Species for Plantation:

Make a list of all the native species of plants which are more visible in the respective temperature and atmosphere of your area. Then further categorize them into evergreen, deciduous and perennial plants.

(Native Species Saplings)

Before choosing a native tree, make a choice keeping in mind the atmosphere and weather of the place because the atmosphere and temperature of all the places are different, it will be difficult for the plants to survive, so we should try to plant as many plants as possible. Make a directory of all of your area's native organisms. Determine the form (evergreen, deciduous, or perennial), benefits, and top layer. Check the nursery for native species saplings, their age, and sapling height (ideal height is 60 to 80 Cm). This will account for 40-50 % of the forest's tree diversity.



(Figure-2)

Small and big trees should be planted according to their perimeter as shown in the given figure-2, So that all the trees get enough sunlight and grow upwards in the direction of sunlight. Miyawaki also has a rule that growing trees in a bunch gives less sunlight to the lower side so that its stem remains thin but also increases in height so in a short time the small forest is ready.

Step-4 Design the Forest:

Create a 4 layered plantation where shrub which grow up to 6 feet from the first layer, trees growing up to 25 feet from the second layer, trees growing up to 40 feet from the third layer and canopy trees from the fourth layer. Arrange the dense plantation with native plants so that they grow into different layers. All the species of plants should be arranged in a staggered manner so that similar species of plants are not planted together.

Step-5 Fence around for protection:

Those grown trees are also needed to be protected. Because if there is no fence around, any pet (like cow, dog, bull and humans) will come inside. And if it gets inside, it will cause a lot of damage to the vegetation. The first few months require extra care as the trees are small. Therefore, it is necessary to fence around to pay more attention to all this.

(Fencing by Grill of Iron)

Step-6 Plant the Trees:

Mixing materials: Perforator, water retainer, and fertilizer should be mixed together without clumps. They must be mixed in the exact ratio that was calculated at the outset for each mound.

✓ **Choosing trees for the plantation**: Arrange plants on the mound to create a perfect, multi-layered forest. In each square meter, try to group plants that grow in different layers – shrub, sub tree, tree, and canopy. Avoid planting two trees of the same species next to each other, and avoid following a trend while planting the trees. Maintain a 60-centimeter gap between saplings. The aim is to create a dense plantation of native tree species in a random pattern.

✓ **Plantation:** To plant the tree, use a trowel to dig a small pit on the ground, remove the root bag from the plant, and gently position the plant in the pit. Outside, gently level the soil around the plant's stem, but do not press or pack it.

(Tree Plantation)

Step-7 Help the plants with sticks:

Saplings need support during their first few months to avoid drooping or bending. Insert sticks into the soil near the plant's roots without destroying them. Use 1 metre bamboo sticks for plants shorter than 1 metre. Use slightly thicker 2-2.5-metre-long bamboo sticks for taller plants. Use thin jute cords, tie the sticks to the plant stems. At least one alternative plant may need support sticks.

(Supporting the plants with sticks)

Step-8 Watering plan:

The water pipeline layout can be designed via an architect, based on the daily water requirement for the area, backed by using bore wells, overhead water tanks and also pumped directly from the river by electric motor. There are seven Miyawaki among which one Miyawaki is supplied with water directly from the river by a single electric motor and one have bore-well so water is sprinkled with the help of sprinkler. In the other five Miyawaki, water is given from the water tanker two to three times in a week.

(Water Tanker) (Electric Motor Pump)

Step-9 Monitor the plantation

- ✓ The forest should be watered at least one or two day in first year.
- ✓ There should be no weeds for the first one year.
- ✓ Pesticides and inorganic fertilizer should not be used in first few months of plantation.
- ✓ Monitor the forest after every one month to check the growth of all plants.
- ✓ Do not cut or prune the forest.

(Final view of Miyavaki after following all the steps)

RESULT

During the study, a total of 50 plants belonging to 24 families, 38 genera were documented from the study area (Table 2). Plantation from Miyawaki method grows very well. The tree can reach a height of 2 to 3 meters in around three years and after 3 years, the sunlight in the lower part also stops coming in. The photo below shows the length of the trees that grow in two years.

Table-2 List of plants grown in Miyawaki

NO.	LOCAL NAME	SCIENTIFIC NAME	FAMILY	HABIT	HOW TO GROW
1	Aambali	Tamarindus indica	Fabaceae	Tree	Seed
2	Sonmohar	Peltophorum pterocarpum	Fabaceae	Tree	Seed
3	Kher	Senegalia catechu	Legumes	Medium Tree	Seed or cutting
4	Saragvo	Moringa oleifera	Moringaceae	Tree	seed or cuttings
5	Kanji	Holoptela integrifolia	Ulmaceae	Tree	Seed or stem cutting
6	Kanjo	Pongamia pinnata	Legumes	Tree	Seed
7	Shirish	Albizia lebbeck	Legumes	Tree	Seed
8	Jamfal	Psidium guajava	Myrtaceae	Tree	seed, air layering, grafting, cuttings or T.S culture

9	Paras pipal	Thespesia populnea	Malvaceae	Tree	Seed, root cuttings or air-layering
10	Rain tree	Samanea saman	Leguminosae	Tree	Seed, stem and root cutting
11	Gulmohar	Delonix regia	Fabaceae	Tree	Seed
12	Khakhra	Butea monosperma	Fabaceae	Tree	Seed
13	Setur	Morus alba L	Moraceae	Mmedium-sized	seeds, cuttings, or gratings
14	Spataparni	Alstonia scholaris	Dogbanes	Eevergreen tree	Seed
15	Kachnar	Bauhinia Variegata	Legumes	Tree	Seed or cutting
16	Jambu	Syzygium samarangense	Myrtaceae	Tree	Cutting
17	Pink poui	Tabebuia rosea	Bignoniaceae	Tree	Seed
18	Mahudo	Madhuca longifolia	Sapotaceae	Tree	Seed
19	Gondi	Cordia sinensis	Ctenodactylidae	Tree	Seed
20	Baka Limbdo	Melia azedarach	Meliaceae	Tree	Seed
21	Neem	Azadirecta indica	Meliaceae	Tree	Seed, root shoot & cutting
22	Mango	Mangifera Indica	Anacardiaceae	Tree	Seed, grafting or budding
23	Gundo	Cordia dichotoma	Boraginaceae	Tree	Seed, cutting
24	Kailashpati	Couroupita guianensis	Lecythidaceae	Tree	Seed
25	Aritha	Sapindus Mukorossi	Sapindeae	Deciduous Tree	Seed
26	Arduso	Ailanthus excels Roxb	Simaroubaceae	Tree	Seed
27	Badam	Terminalia catappa	Rosaceae	Tree	Seed
28	Tilak tulsi	Ocimum tenuiflorum	Lamiaceae	Shrub	Seed
29	Kadvi Mendi	Lawsonia inermis	Lythraceae	Tree	Seed
30	Sharu	Casuarina equisetifolia	Casuarinaceae	Tree	Seed
31	Piplo	Ficus religiosa	Moraceae	Tree	cuttings. Air layering and TSC, seed
32	Borsalli	Mimiosops elengi	Sapotaceae	Tree	Seed or cutting
33	Jambu	Syzygium samarangense	Myrtaceae	Tree	Cutting
34	Sisam	Dalbergia sissoo	Fabaceae	Tree	Root Suckers,Seed
35	Nilgiri	Eucalyptus	Myrtaceae	Tree	Seed
36	Mahogany	Swietenia mahagoni	Meliaceae	Tree	Seed
37	Baval	Vachellia nilotica	Fabaceae	Tree	Seed

38	Paras Jambu	Syzygium samarangense	Myrtaceae	Tree	Cuttings And Layered
39	Vad	Ficus Benghalensis	Moraceae	Large tree	Seed
40	Pilkhan	Ficus Virens	Moraceae	Large tree	Seed
41	Sevan	Gmelina Arborea	Lamiaceae	Tree	Seed
42	Ice cream vel	Antigonon Leptopus	Polygonaceae	Creeper	Seed
43	Conocarpus	Conocarpus Lancifolius	Myrtales	Tree	Seed and Cutting
44	Pangaro	Erythrina suberosa Roxb	Papilionaceae	Tree	Seed
45	Kanak Champa	Pterospermum acerifolium	Malvaceae	Tree	Seed, cutting
46	Cassia sp.	Cassia javanica	Caesalpiniaceae	Small Tree	Seed
47	Piludi	Salvadora persica	Salvadoraceae	Shrub or small tree	Seed
48	Karen, yellow oleander	Cascabela thevetia	Apocynaceae	Shrub	Cutting
49	Yellow trumpetbush	Tecoma stan	Bignoniaceae	Large Shrub	Seed, Cutting
50	Australian baval	Vachellia nilotica	Fabaceae	Evergreen Tree	Seed

CONCLUSION

Miyawaki is a good way to plant trees. This allows a lot of trees to be grown in less space with less hard work, after two to three years the maintenance is done at zero. This method can be used to grow a large number of trees which has brought many benefits to humans and the environment. Trees reduce noise in cities, prevent temperatures from rising, purify the air and a good place to live and eat for small animals and birds. It is suggested that Miyawaki should be in all the big cities where there is less land to plant trees and more pollution in states like Delhi, Noida, Kanpur, Gurugram etc. In such cities, more trees can be grown in less land just like in Miyawaki method. However, having such a small forest near the city is a matter of pride and destiny for people of that city.

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