Newsletter Hub of Talents on Air Pollution and Climate

HTAPC



Hilights

3rd year
ISSUE 5
August - September 2026

HTAPC Accomplished Activities

- Seminar on the Dissemination of the Action Plan for Pollution Reduction and Elimination in Bangkok's Pollution Control Zone (6/8/2569)
- Training on Provincial Air Pollutant Emission Inventories to Strengthen Bangkok's Clean Air Management Capacity (7/8/2569)
- Seminar "FROM SPACE TO SOLUTIONS" Harnessing Space Technology to Address Air Pollution (19/7/2569)
- Training on Odor Measurement and Control to Strengthen Bangkok's Air Quality Management Capacity (24/8/2569)

HTAPC Knowledge dissemination

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Seminar on the Dissemination of the Action Plan for Pollution Reduction and Elimination in Bangkok's Pollution Control Zone









SThe Hub of Talents on Air Pollution and Climate (HTAPC) organized a seminar to disseminate the Action Plan for Pollution Reduction and Elimination in Bangkok's Pollution Control Zone (2027–2032) on Thursday, 6 August 2026, from 9:00 a.m. to 12:00 p.m., at the Hydrangea 1 Meeting Room, 6th Floor, Grand Convention Building, TK Palace Hotel & Convention. The seminar aimed to present the key elements of the Action Plan to government agencies, the private sector, civil society organizations, academic institutions, and relevant experts, while providing a platform for exchanging views and recommendations on its implementation. The Action Plan was developed following the designation of Bangkok as a Pollution Control Zone under the Enhancement and Conservation of National Environmental Quality Act, B.E. 2535 (1992).

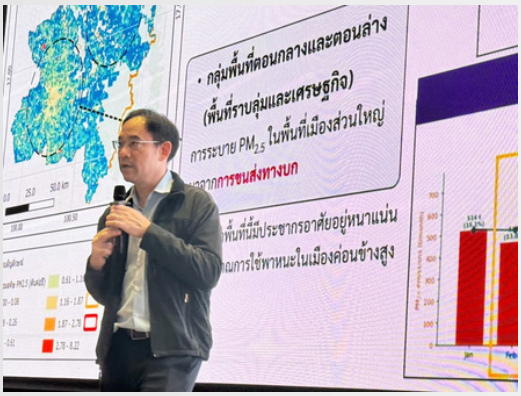
The seminar featured a presentation on the key elements of the Action Plan by Assoc. Prof. Dr. Savitri Garivait, a session on recommendations for implementing the Action Plan led by Assoc. Prof. Dr. Thongchai Khanabkeaw, and a presentation on the key provisions and progress of the Draft Clean Air Management Act by Dr. Achichaya Ottawong. A total of 119 participants registered for the seminar, including 63 on-site and 56 online participants. Attendees represented central government agencies, the Bangkok Metropolitan Administration, district offices, academic institutions, private sector organizations, and other stakeholders involved in air quality management.

The seminar provided an important platform for building a shared understanding of the Action Plan and gathering recommendations from relevant stakeholders. These contributions will support the systematic and effective implementation of pollution reduction and elimination measures in Bangkok, contributing to the long-term goal of restoring clean air and improving air quality for the city's residents.

Training on Provincial Air Pollutant Emission Inventories to Strengthen Bangkok's Clean Air Management Capacity









The Hub of Talents on Air Pollution and Climate (HTAPC) organized a training workshop on "Development of Provincial Air Pollutant Emission Inventories" on Friday, 7 August 2026, from 8:30 a.m. to 4:00 p.m., at the Barn Meeting Room, 1st Floor, Best Western Chatuchak Hotel. The workshop aimed to strengthen the knowledge and technical skills of Bangkok Metropolitan Administration (BMA) personnel in developing air pollutant emission inventories and preparing for the implementation of the Draft Clean Air Management Act, Section 45(10). This provision requires Provincial Clean Air Committees to submit air quality data, pollution source information, emission inventories, and other relevant information to the national clean air management database.

The training featured Assoc. Prof. Dr. Nares Chuersuwan from Suranaree University of Technology and Assoc. Prof. Dr. Ekbordin Winijkul from the Asian Institute of Technology as guest speakers. The sessions covered the importance of emission inventories in air quality management, the national emission inventory system, approaches to collecting activity data, and methods for estimating emissions from major pollution sources.

The workshop formed part of the development of Bangkok's emergency action plan and clean air management plan. It aimed to enhance the capacity of BMA personnel to develop and utilize emission inventories for identifying pollution sources, supporting air quality planning, and formulating effective emission reduction measures, while preparing for future data management responsibilities under the proposed clean air legislation.

Seminar "FROM SPACE TO SOLUTIONS"
Harnessing Space Technology to Address Air Pollution









The Hub of Talents on Air Pollution and Climate (HTAPC), in collaboration with the Geo-Informatics and Space Technology Development Agency (Public Organization) (GISTDA), organized a seminar titled "From Space to Solutions: Space Technology for Tackling Air Pollution" on Wednesday, 19 August 2026, at The Quarter Ari by UHG Hotel, Bangkok.

The seminar provided a platform for exchanging knowledge, perspectives, and recommendations among relevant stakeholders. It aimed to promote the integration of space technology, satellite observations, meteorological data, and geospatial information into Thailand's air pollution management strategies. The event also sought to strengthen collaboration among government agencies, academic institutions, the private sector, and other partners to support sustainable solutions to air pollution challenges.

The seminar featured presentations by experts from various fields, covering key topics such as the application of space-based data for air pollution management; the integration of satellite and meteorological data for air quality monitoring and forecasting; the use of geospatial information to support environmental laws and policies; research and innovation in satellite technologies for air pollution mitigation; and satellite-based approaches to forest fire fuel management.

The seminar marked an important step toward connecting data, technology, and multidisciplinary expertise to strengthen Thailand's capacity for air quality monitoring, forecasting, and management. These efforts aim to support more accurate, timely, and practical solutions to air pollution challenges at both national and local levels.

Training on Odor Measurement and Control to Strengthen Bangkok's Air Quality Management Capacity









The Hub of Talents on Air Pollution and Climate (HTAPC) organized a training workshop on "Odor Measurement and Control" on Monday, 24 August 2026, from 8:30 a.m. to 4:00 p.m., at The Twin Towers Hotel, Pathum Wan District, Bangkok.

The workshop was conducted as part of the development of Bangkok's ad hoc plan and clean air management plan. It aimed to strengthen the knowledge and practical skills of Bangkok Metropolitan Administration (BMA) personnel in odor measurement and control, an important component of urban air quality management. The target participants included personnel from the Environment Department, Health Department, and district offices.

The training featured presentations by representatives from relevant agencies, covering odor measurement and control in industrial facilities, businesses classified as hazardous to health, factories, and animal-rearing facilities. Representatives from the Pollution Control Department also provided a practical demonstration of odor measurement methods, enabling participants to gain a better understanding of fundamental principles, procedures, and the appropriate application of odor monitoring techniques.

The workshop represented another important step in strengthening the capacity of BMA personnel to address odor nuisance and urban air pollution. The knowledge gained will support pollution source control, regulatory oversight of relevant establishments, and the protection of public health and quality of life through more systematic and effective environmental management.

The Use of Trees for $PM_{2.5}$ Reduction Through Urban Dust-Reducing Garden Design

Fine particulate matter ($PM_{2.5}$) is a major environmental problem in urban areas of Thailand, particularly in areas affected by traffic, combustion activities, and the accumulation of atmospheric pollutants. Increasing green spaces has therefore received attention as a nature-based measure to mitigate pollution and improve urban environmental conditions. However, conventional tree planting may not always effectively reduce particulate matter concentrations in areas of human activity, as $PM_{2.5}$ can be transported by airflow and pass through gaps between vegetation. In response, the research team has continuously developed knowledge on the use of perennial trees for particulate matter reduction, ranging from investigations of plant characteristics associated with particle capture and wind tunnel experiments on vegetation arrangements to the establishment of prototype dust-reducing gardens and their application in urban green spaces. These efforts aim to develop a garden design approach that focuses not only on increasing the number of trees but also on vegetation structure and airflow within the area. This study aims to synthesize research findings on the $PM_{2.5}$ reduction potential of plant species, the effects of vegetation arrangements, and the effectiveness of dust-reducing gardens under real-world conditions, as well as to propose design guidelines for dust-reducing gardens that can be applied in urban areas.

Development of Research-Based Knowledge into Urban Dust-Reducing Gardens

From Leaf Characteristics to the Selection of Plant Species for Particulate Matter Reduction

The initial phase of the research began by investigating which tree species could effectively reduce $PM_{2.5}$ and which plant characteristics influenced particulate matter capture efficiency. An evaluation of 20 plant species, combined with investigations of leaf morphology and wind tunnel experiments, revealed that perennial trees such as rain tree, pink shower tree, and Siamese rosewood, as well as shrubs such as water jasmine and yellow peacock flower, demonstrated potential for particulate matter reduction. Leaf trichomes, surface roughness, and canopy characteristics were associated with the capture and accumulation of particulate matter. These findings led to experiments examining the combined effects of different vegetation arrangements rather than evaluating the performance of individual plant species alone. The results indicated that planting low-growing shrubs together with medium-height shrubs and perennial trees could help reduce the transport of particulate matter through vegetation barriers.

The findings also demonstrated that plants with high $PM_{2.5}$ reduction efficiency do not necessarily have large leaves. Instead, they should possess leaf surface characteristics that promote particle adhesion, a large number of leaves, and canopy structures that facilitate contact between airborne particles and leaf surfaces. Investigations into the $PM_{2.5}$ reduction potential of plant species revealed that leaf morphological characteristics were important factors associated with the ability to capture and accumulate particulate matter. In particular, plants with leaf trichomes, rough leaf surfaces, numerous leaf veins, and large total leaf areas provide greater surface area and opportunities for contact between particulate matter and leaf surfaces. Examples of plants exhibiting these characteristics include lantana, purple false eranthemum, velvet plant, and Cuban oregano. Meanwhile, perennial trees and shrubs, such as pink shower tree, Siamese rosewood, and water jasmine, demonstrated potential for particulate matter reduction under controlled experimental conditions.

Correlation analyses of leaf characteristics further revealed that leaf number, stomatal density, and leaf vein number were positively associated with $PM_{2.5}$ reduction efficiency. In particular, trichome density on the lower leaf surface showed a strong association with particulate matter accumulation during nighttime. These findings suggest that the selection of plant species for dust-reducing gardens should consider leaf characteristics alongside canopy structure and vegetation arrangement to enhance particulate matter capture and reduce the dispersion of $PM_{2.5}$ into areas requiring protection.

Table: Synthesis of Leaf Characteristics and Plant Species Suitable for $PM_{2.5}$ Reduction

Leaf Characteristics	Example Plant Species	**Relationship with PM2.5 Reduction**
Leaf trichomes	Purple false eranthemum, velvet plant, coleus, Japanese carpet plant, lantana	Leaf trichomes provide additional sites for particle adhesion; trichome density on the lower leaf surface is associated with nighttime particulate matter accumulation.
Rough leaf surfaces	Cuban oregano, croton, lantana	Grooves and surface irregularities facilitate particulate matter accumulation.
Numerous leaf veins	Pink shower tree, water jasmine, Siamese rosewood, rain tree (examples of studied species)	Leaf vein number is generally associated with particulate matter capture, although high vein density has not been confirmed for every species.
High stomatal density and small stomatal size	Pink shower tree, water jasmine, Siamese rosewood, lantana (high-performing species included in the study)	Stomatal density is positively associated with PM2.5 reduction efficiency, whereas stomatal length and width show negative associations; these findings do not represent species-specific rankings.
Numerous leaflets / large total leaf area	Pink shower tree, rain tree, Siamese rosewood, water jasmine, Fukien tea tree	Increase the overall surface area and opportunities for contact with particle-laden air; canopy structure must also be considered.
Waxy leaf surfaces	Croton, bamboo palm, mondo grass, spider plant, Dracaena	Leaf wax may enhance particle adhesion and retention, depending on leaf surface properties and atmospheric conditions.
Large leaves / prominent leaf veins	Giant elephant ear, Homalomena	Provide greater surface area for particle deposition; however, larger leaves do not necessarily result in higher particulate matter capture efficiency.
Long, narrow leaves	Bamboo palm, lady palm, oyster plant, spider plant	Contribute to plant diversity in garden design; there is insufficient evidence that narrow leaves alone provide high PM2.5 reduction efficiency.

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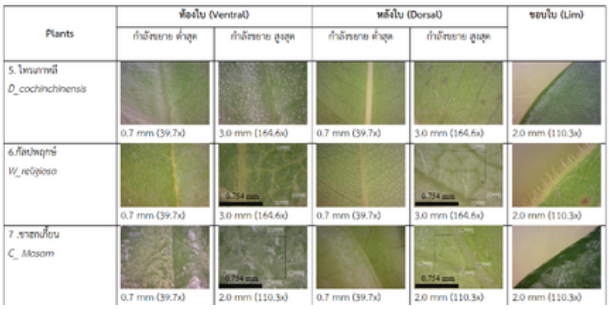


Figure 1. Leaf Morphological Characteristics Associated with $PM_{2.5}$ Capture Efficiency

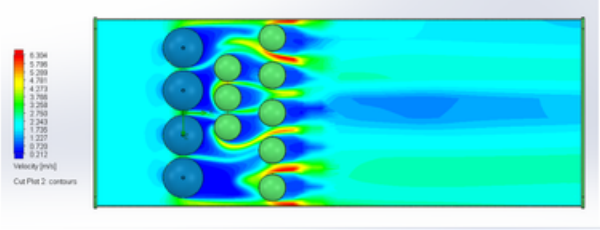


Figure 2. Simulation of Airflow Through Vegetation Barriers to Evaluate $PM_{2.5}$ Reduction Efficiency

Importance of Multilayered Vegetation Structure

A study of 22 plant species and a comparison of 14 vegetation arrangements revealed that leaf number, stomatal density, leaf vein number, and leaf trichomes were associated with particulate matter reduction efficiency. Wind tunnel experiments demonstrated that an arrangement combining 1.2-m-tall water jasmine shrubs with 3-m-tall pink shower trees achieved a maximum $PM_{2.5}$ reduction of 40.5 ± 5.0%, whereas some comparison vegetation barriers reduced $PM_{2.5}$ by only 6.2 ± 1.4%. These findings indicate that selecting plant species with suitable characteristics, together with appropriate vegetation barrier design, can substantially improve particulate matter reduction efficiency under experimental conditions.

Knowledge gained from the initial research phase was subsequently applied to the design of a prototype dust-reducing garden at the National Research Council of Thailand (NRCT). The garden was designed based on the ecological structure of urban forests, incorporating large trees, medium-height shrubs, low-growing shrubs, and ground-cover plants to perform different functions, including reducing wind speed, capturing particulate matter, and creating a microclimate. Air quality monitoring conducted in the garden during 2023–2024 revealed that, when $PM_{2.5}$ concentrations exceeded the air quality standard applied in the study, the garden reduced particulate matter concentrations by an average of 21.5% behind the garden and 4.5% in front of the building. Under certain conditions, when incoming $PM_{2.5}$ concentrations ranged from 70 to 80 µg/m³, a reduction of approximately 35% was observed at the downstream end of the garden.

The findings further demonstrated that garden performance was strongly influenced by wind direction and speed, with wind speeds of 1–3 m/s providing favorable particulate matter reduction under the study conditions. The garden also reduced temperatures within the area by approximately 1–2°C. These results highlight the potential of multilayered vegetation structures to create localized environmental conditions that differ from those of the surrounding areas.

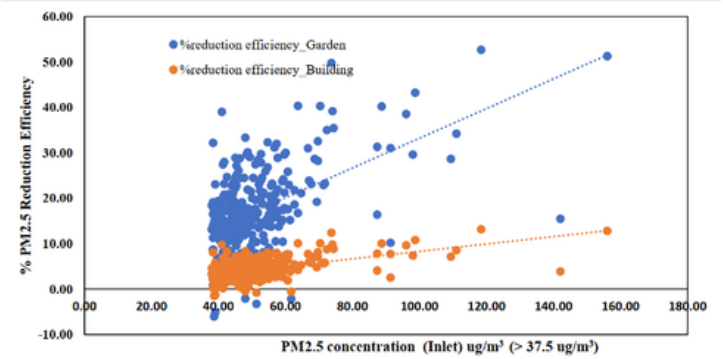


Figure 3. Relationship Between $PM_{2.5}$ Concentrations and Particulate Matter Reduction Efficiency of the Prototype Dust-Reducing Garden

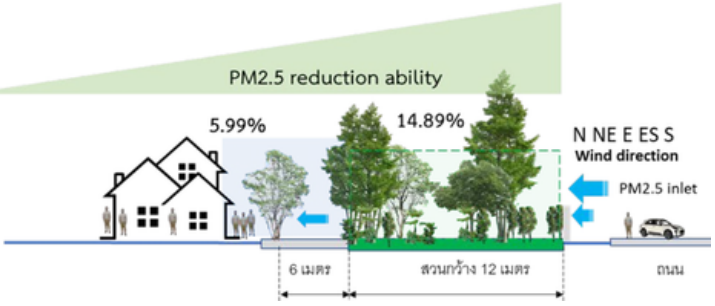


Figure 4. Home Garden Design for Particulate Matter Reduction Using Plants of Different Heights

From Prototype Gardens to Wider Implementation in Urban Areas

The subsequent phase of the research expanded the dust-reducing garden concept to the Ministry of Higher Education, Science, Research and Innovation and the Ministry of Foreign Affairs. The study examined existing site conditions, wind direction, road-related particulate matter sources, and vegetation arrangements, together with airflow simulations and air quality measurements before and after air passed through the vegetation barriers. Monitoring results showed that the improved gardens reduced $PM_{2.5}$ concentrations by approximately 3–5% at the Ministry of Higher Education, Science, Research and Innovation and 1–3% at the Ministry of Foreign Affairs. Meanwhile, temperatures within the gardens were approximately 1–2°C lower than those in the surrounding areas. Although particulate matter reduction efficiency differed from that of the initial prototype garden, these findings demonstrate that the effectiveness of dust-reducing gardens depends on site-specific conditions, including garden size, vegetation density, surrounding buildings, and wind direction. Therefore, a single garden design cannot be directly applied to all locations.

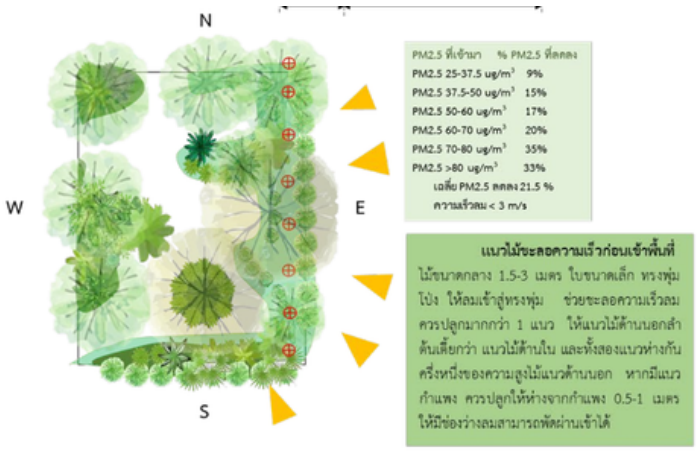


Figure 5. Planting Layout and Direction of $PM_{2.5}$ Transport Within a Residential Dust-Reducing Garden

Conclusion: What Should a Home Dust-Reducing Garden Look Like?

For homes with sufficient space, a dust-reducing garden can be established in an area approximately 6 meters wide and 6–10 meters long. The garden should incorporate low-growing shrubs measuring 0.5–0.8 meters in height, medium-height shrubs measuring 1.2–2 meters, and appropriately sized trees, complemented by ground-cover plants. The vegetation should be arranged on the side of the property exposed to incoming particulate matter. The key consideration is not to maximize planting density, but rather to select plant species with effective particulate matter capture characteristics, provide appropriate planting distances to accommodate plant growth, and maintain adequate airflow. **"Understand the direction of particulate matter transport, select suitable plant species, establish multilayered vegetation, maintain appropriate planting distances, and ensure continuous maintenance."** These principles provide practical guidance for establishing dust-reducing gardens around residential properties. Nevertheless, dust-reducing gardens serve as a supplementary measure for mitigating air pollution and cannot guarantee completely particle-free air. On days with elevated $PM_{2.5}$ concentrations, indoor protective measures and efforts to reduce particulate matter exposure remain necessary.

Steps to Transform Unused Space Around a Home into a Dust-Reducing Garden

Planting trees around a home not only provides shade and greenery but, when suitable plant species are selected and appropriately arranged, can also help capture $PM_{2.5}$ transported by wind from roads or areas outside the property. Research has shown that gardens incorporating trees, shrubs, and ground-cover plants at different heights can help reduce wind speed, increase opportunities for airborne particles to come into contact with and adhere to leaf surfaces, and improve environmental conditions within the garden. For homes with sufficient space, a dust-reducing garden approximately 6 meters wide and 6–10 meters long is recommended as a starting point, incorporating three vegetation layers of different heights together with ground-cover plants. For homes with limited space, the garden dimensions can be adjusted accordingly, without the need to fill the entire area with vegetation.

Step 1: Identify Where Particulate Matter Enters the Property

Before planting, identify the locations of potential particulate matter sources around the home, such as nearby roads, parking areas, or areas where combustion activities occur. Observe the prevailing wind direction that transports particulate matter toward the property, particularly during winter and the dry season, when elevated $PM_{2.5}$ concentrations are common in many areas.

For homes located near roads, priority should be given to establishing a garden on the side exposed to road-related particulate matter. This allows the vegetation barrier to capture particles before the air reaches residential areas. However, the garden should not completely obstruct airflow and ventilation.

Step 2: Determine the Size of the Dust-Reducing Garden

The garden size depends on the available outdoor space. Findings from research on the wider implementation of dust-reducing gardens suggest a vegetation barrier approximately 6 meters wide or more to accommodate multilayered planting. A length of 6–10 meters is provided as an example for residential gardens, rather than an experimentally established minimum length.

Step 3: Select Plant Species with Particulate Matter Capture Characteristics

Plant species should be selected based on characteristics associated with $PM_{2.5}$ capture and accumulation, including numerous leaves, leaf trichomes, rough leaf surfaces, and numerous leaf veins. Examples of plant species suitable for garden arrangements include:

- Trees: Pink shower tree, Siamese rosewood, rain tree, bullet wood, and Burmese rosewood. These should be planted in areas with sufficient space to accommodate their growth.
- Medium-height shrubs: Water jasmine and yellow peacock flower, which help increase particulate matter capture surfaces at heights close to the human breathing zone.
- Low-growing shrubs: Fukien tea tree and purple false eranthemum, which help capture particulate matter near ground level.
- Ground-cover plants: Ferns and other ground-cover species suited to local conditions, which help reduce the resuspension of dust from the ground.

Priority should be given to plants that maintain continuous foliage coverage during periods of elevated particulate matter concentrations and are relatively easy to maintain.

S**tep 4: Establish Three Vegetation Layers with Appropriate Heights and Planting Distances**

The key principle of a dust-reducing garden is to establish vegetation at multiple heights, allowing each layer to contribute to particulate matter capture. Plants should be arranged from the side exposed to incoming particulate matter toward the interior of the garden.

Recommended spacing between vegetation layers:

- First to second vegetation layer: Maintain a gap of approximately 0.25–0.50 meters between canopy edges.
- Second to third vegetation layer: Begin with a planting space of approximately 1.5–2.5 meters, adjusting the distance according to the mature canopy size of the trees.
- Trees to the house: Determine the appropriate distance based on mature canopy size, root system development, and building safety. A single planting distance should not be applied to all tree species.

These distances are preliminary recommendations for residential garden design. They are based on experimental findings indicating that arranging two shrub barriers with a spacing of approximately half the height of the front shrub layer can effectively reduce particulate matter under experimental conditions.

Step 5: Arrange Vegetation to Capture Particulate Matter While Maintaining Airflow

Once plant species and planting distances have been determined, vegetation should be arranged according to the direction of particulate matter transport: **Road or particulate matter source → Low-growing shrubs → Medium-height shrubs → Trees → Residential area**. The front shrub layer should provide relatively continuous foliage coverage to help slow wind speed and increase opportunities for particulate matter capture. Trees should have appropriately structured canopies that do not become excessively dense or obstruct airflow, particularly in residential areas surrounded by buildings. Ground-cover plants should also be established beneath trees to minimize exposed soil surfaces, which may contribute to dust resuspension under windy conditions.

Step 6: Position Recreational Areas Behind the Vegetation Barrier

If the garden includes seating areas, walkways, or recreational spaces, these should be positioned behind the vegetation barrier in well-ventilated locations away from direct particulate matter sources.

For gardens approximately 6 meters wide, multilayered vegetation should be arranged according to the available space. Consideration should also be given to the future growth of tree canopies and root systems to prevent potential impacts on surrounding buildings.

For smaller properties, it is not necessary to include trees in every vegetation layer. Appropriately maintained shrub barriers may be used as an alternative, recognizing that their particulate matter reduction efficiency may differ from that of larger multilayered gardens.

Step 7: Maintain and Monitor Garden Effectiveness
After establishing the garden, regular maintenance is essential to ensure that plants remain healthy and maintain consistent foliage coverage. Maintenance activities should include appropriate watering, cleaning leaves when particulate matter accumulation becomes excessive, pruning canopies to maintain suitable airflow, and replacing dead plants or filling gaps in vegetation.

If a $PM_{2.5}$ monitoring device is available, measurements can be conducted before and after the vegetation barrier at approximately the same time, as well as in areas requiring protection, to assess potential differences in particulate matter concentrations. However, measurements should be repeated across multiple periods, with consideration given to wind direction, as differences in particulate matter concentrations may be influenced by factors other than vegetation alone.

Conclusion: What Should a Residential Dust-Reducing Garden Look Like?
For homes with sufficient space, a dust-reducing garden can be established in an area approximately **6 meters wide and 6–10 meters long,** incorporating low-growing shrubs measuring 0.5–0.8 meters in height, medium-height shrubs measuring 1.2–2 meters, and appropriately sized trees, complemented by ground-cover plants. The vegetation barrier should be positioned on the side of the property exposed to incoming particulate matter.

The key consideration is not to maximize planting density, but rather to select plant species with effective particulate matter capture characteristics, provide appropriate planting distances to accommodate plant growth, and maintain adequate airflow.

"Understand the direction of particulate matter transport, select suitable plant species, establish multilayered vegetation, maintain appropriate planting distances, and ensure continuous maintenance." These principles provide practical guidance for establishing residential dust-reducing gardens.

Nevertheless, dust-reducing gardens serve as a supplementary measure for mitigating air pollution and cannot guarantee completely particle-free air. On days with elevated $PM_{2.5}$ concentrations, indoor protective measures and efforts to reduce particulate matter exposure remain necessary.

Recommendations
Findings from ongoing research demonstrate that **the development of urban dust-reducing gardens requires the integration of knowledge concerning plant species, leaf morphology, canopy structure, and airflow dynamics.** The key principles include arranging vegetation barriers according to particulate matter sources and prevailing wind directions, incorporating plants of different heights to increase contact between airborne particles and vegetation, and maintaining adequate ventilation pathways to prevent pollutant accumulation in areas of human activity.

Garden design should begin with a site assessment and airflow analysis before determining the locations of vegetation barriers and areas requiring protection. Effectiveness should be evaluated through actual air quality measurements, with garden arrangements adjusted according to site-specific conditions.

This approach represents an application of nature-based solutions to address environmental problems and can be adapted to develop green spaces in schools, healthcare facilities, government institutions, communities, and public parks. However, dust-reducing gardens should be regarded as a supplementary measure to pollution control at the source, rather than a replacement for emission reduction strategies. Long-term monitoring of garden effectiveness is also recommended to ensure sustainable environmental benefits.

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Hub of Talents on Air Pollution and Climate (HTAPC)



This newsletter is part of the project for the Hub of Talents on Air Pollution and Climate, under research funding support from the National Research Council of Thailand (NRCT).

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