

From sustainable production to the Green city

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Chiang Mai, Thailand, AGRIA, 4 December 2010



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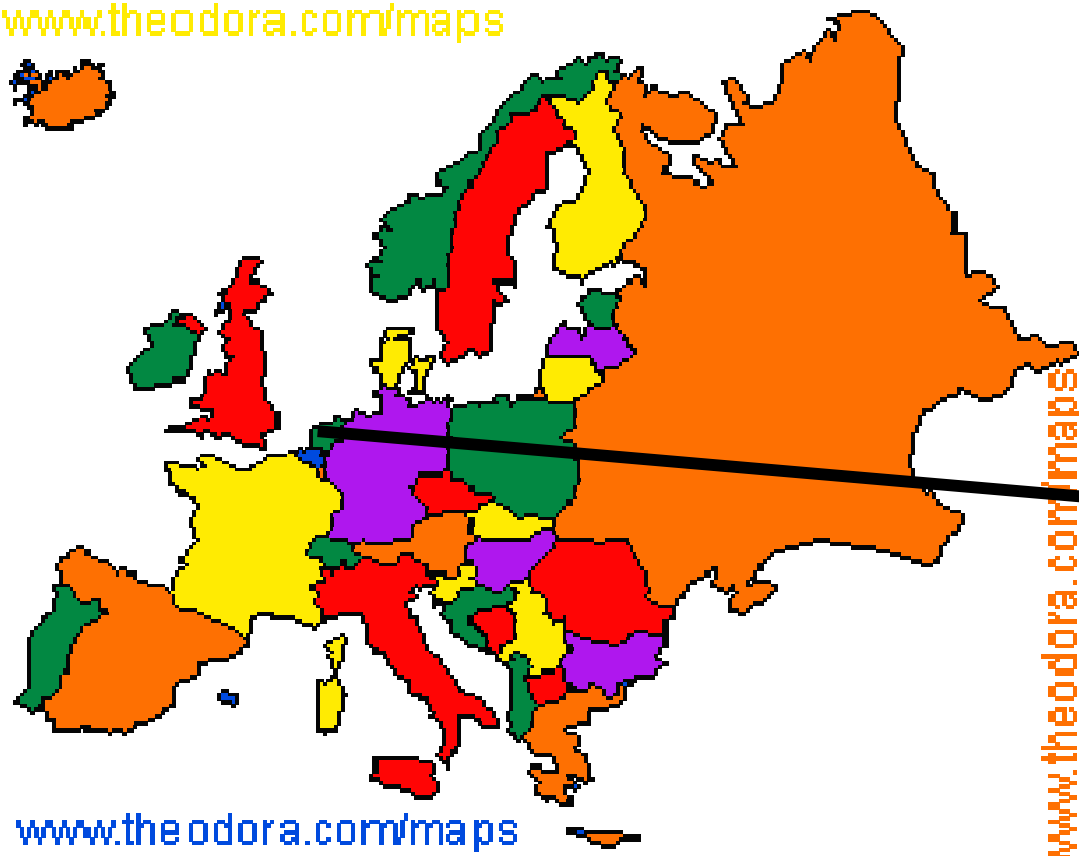
Outline

- Introduction
- Nursery stock production
- Green city concept
- Ornaments in Chiang Mai
- Eye catching trees
- Concluding remarks



The Netherlands

www.theodora.com/maps



www.theodora.com/maps

Landschappen

- Heuvelland
- Zandgebied
- Veenkolonien
- Rivierengebied
- Laagveengebied
- Zeekleigebied
- Droogmakerijen
- Kustzone
- Grote wateren
- Stedelijk gebied



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Nursery stock

Wide range of products



Nursery stock in the Netherlands

- Extent 17.000 ha
- Number of companies 3.000
- Number of workers 15.000
- Average farm size 5 ha
- Range 1 – 300 ha
- Production value 592 m€
- Production value/ha 34.500 € = 1.400.000 B
- Export >70%



Different seasons



Water



Sustainable production

High economic value

Constraints

People, Planet, Profit



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Sustainable production

Constraints

- People labour, availability, conditions
- Planet materials, water quality
- Profit competitive market, costs
family labour, succession



People



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Planet

Water quality - ground- and surface water

Leaching of nutrients and chemicals
Restricted use



Weed control

Restricted use of herbicides or mechanically



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No damage to the plants



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Crop protection

Restricted use of chemicals

Warning models



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Profit

Constraints

labour

soil bound diseases

quality

environment

Continuous innovation



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Profit



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Advantages

Advantages

- Labour
- Soil bound diseases
- Quality of products
- Fast growth
- Environment

Disadvantages

- Investment
- Sustainability



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From production to use



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Green city concept



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A photograph of a residential street. On the left, there is a brick house partially obscured by large, leafy green trees. A dark-colored car is parked on the street. A paved path runs down the center of the image, with a person riding a bicycle in the distance. On the right, another brick house is visible, also surrounded by trees and greenery. A tall, modern street lamp stands on the right side of the path. The overall scene is bright and sunny, with shadows cast by the trees onto the path and road.

The overall aim of the Green City concept

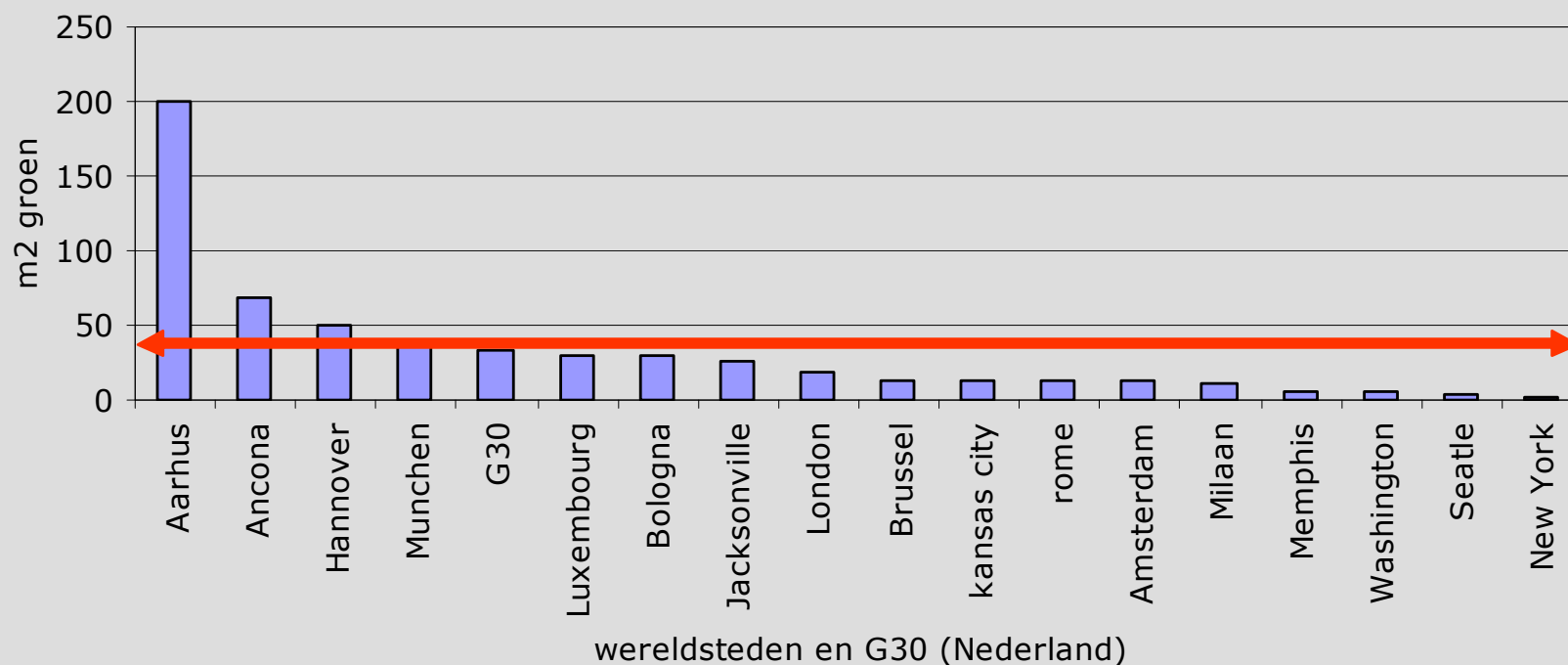
To improve the livability of urban surroundings and
to benefit the well-being of citizens living there

A photograph of a bustling outdoor market street. The scene is filled with vendors and customers. In the foreground, there are large displays of fresh produce, including bright orange citrus fruits and green mangoes. A woman in a white shirt is crouching down, looking at the fruit. To her right, a man in a blue shirt is sitting on a red stool, looking towards the camera. In the background, other vendors are visible, some sitting on stools and others standing. The market is covered by a series of awnings and umbrellas, providing shade for the vendors and customers. The overall atmosphere is one of a busy, traditional market.

50% of the entire population of the world lives in cities...

M² Green per inhabitant different cities

De hoeveelheid groen per inwoner in een aantal wereldsteden. Het gemiddelde voor de G30 steden in Nederland is eveneens aangegeven. De horizontale lijn komt overeen met het richtgetal uit de Nota Ruimte van 75 m² groen per woning



Green

Research data prove the positive effects of Green space

- Health and well-being
- Social harmony; neighborhood crime reduction & community development
- Property value & subsequent economic development
- Environmental benefits



Green and health

Danish study

- 93% believes greenery affects mood and health positively;
- Short distance to green reduces stress;
- Short distance encourages higher use frequencies.



Health and well-being

Complaints	Prevalence per 1000	
	10% green space	90% green space
Depression	32	24
Asthma / COPD	26	20
Diabetes Mellitus	10	8
Coronary heart disease	2	1.5
Total	70	53.5



Social harmony



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Property value



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Property value



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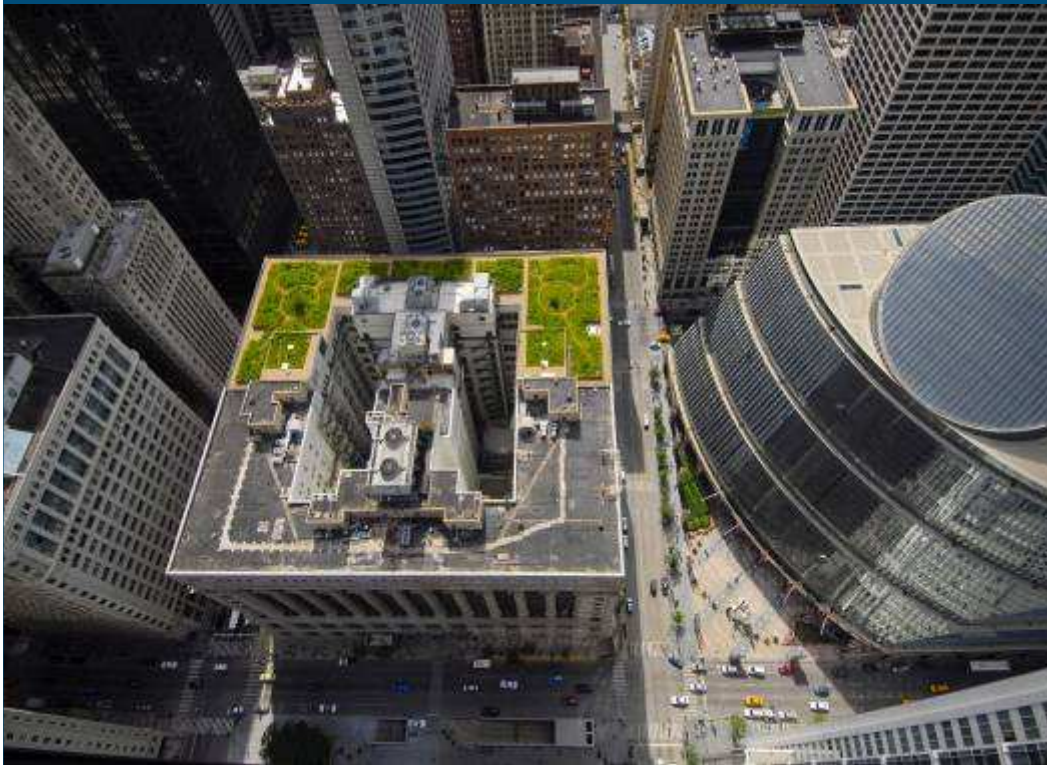


What one trees does

- Beech 100 years old
 - 600 000 leaves
 - 1200 m² surface of all leaves
- Uses CO₂
 - 18 kg/day
 - 36 000 m³ air
 - 400 liter H₂O
 - 18 kg O₂ = 10 people
- Replacement?
 - 2000 young trees
 - Costs > 100 000 €



Saving energy



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Noise reduction



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Environmental benefits



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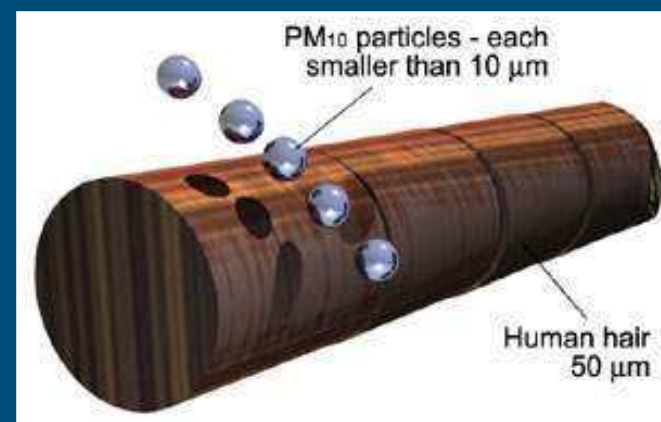
Environmental benefits

Air quality

PM10 / PM2.5

Nitrogen dioxide (NO₂)

Ozone (O₃)

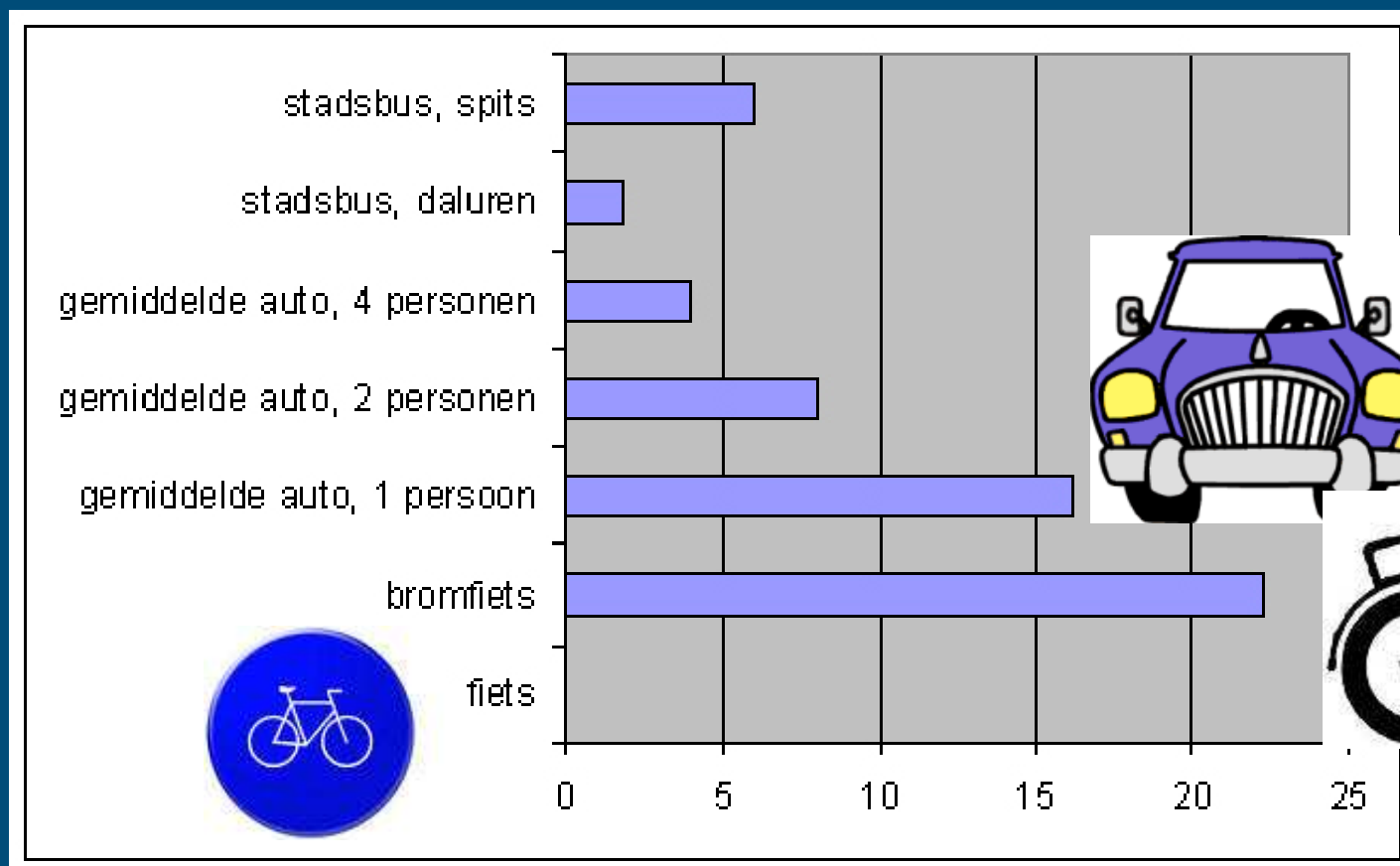


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Pollution per transported person (4 km)



Design

- Integrated approach
- Identification of main source
- Aesthetic values
- Ecological conditions
- Right plant on the right place

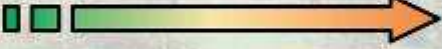
Urban tree air quality score

To rank the ability of the different tree species to affect air quality, we compared the concentrations of pollutants with each new tree population against those produced by the current one. We used a simple equation that takes into account the effect of changing tree species on pollutant formation and deposition, using ozone to represent all the relevant pollutants. The change in ozone concentration with each tree population was compared to the air quality standard for ozone* to estimate the significance of the change.

$$UTAQS = \frac{\text{Change in ozone concentration}}{\text{Air Quality Standard for ozone}}$$

We grouped the tree species according to their effect on air quality. They are grouped below as

- trees that have the greatest capacity to improve air quality
- trees that have a smaller capacity to improve air quality
- trees that have the potential to worsen air quality.

Best  Worst

Ash
Common alder
Field maple
Larch
Norway maple
Scots pine
Silver birch

Apple
Cherry laurel
Common elm
Common lime
Elder
Grey alder
Hawthorn
Hazel
Holly
Italian alder
Lawson cypress
Leyland cypress
Lilac
Mountain ash
Sycamore
Wild cherry

Crack willow
English oak
Goat willow
Poplar
Red oak
Sessile oak
White willow

* The air quality standard for ozone in the UK is an 8-hour running mean of 50 ppb not to be exceeded on more than 10 days in one year. This is set as part of the government's National Air Quality Strategy. Details are found at www.aeat.co.uk/netcen/airqual/index.html.



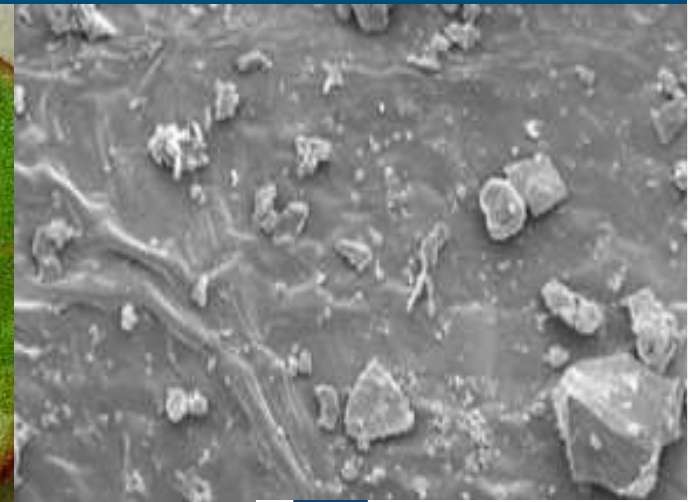
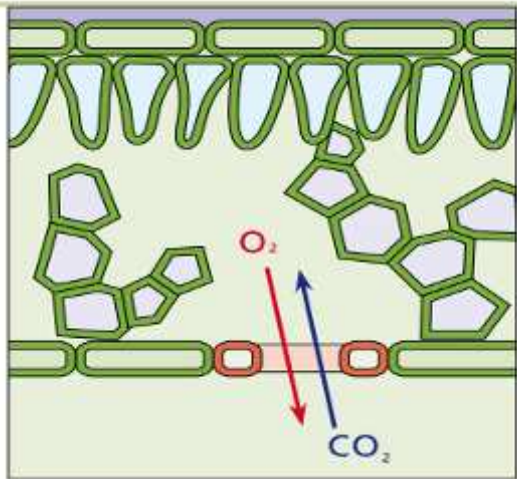
How to reduce air-pollution

- Reducing pollution from the source
- Stimulate methods that are friendly to environment
- Plants to filter pollutants (additional method)



How do plants remove pollutants?

- Absorption via stomata - inside leaves NO_x and ozone
- Via wax layer (cuticle) - VOC
- On surface - PM_{10}



How much pollutants can be removed?

- Depends on species and concentration
- Much research has to be done (only few sources)
- Decrease of concentration seems limited to few %
- An adult tree can remove 300 g PM₁₀ per year



Plant characteristics for air-cleaning

- Criteria for reduction NO_x
- Criteria for reduction PM₁₀ (and PM_{2.5})
- Effect depending on species
- Only few measurements of certain species available



Criteria for reduction PM 10

- Plant- or crown volume
- Leaf volume throughout the year (evergreen or not)
- Leaf area index (small leaves)
- Leaf structure (needles positive)
- Hairs (hairs catch PM10)



Criteria for reduction NO_x

- Plant- or crown volume
- Leaf volume throughout the year (evergreen)
- Flat big leaves
- Glabrous (no hairs)



Ornamentals in Chiang Mai

- Trees
- Shrubs and climbers
- Herbs



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เมืองสีเขียว Urban green

การบรรเทาผลกระทบทางอากาศ
สำหรับเมืองเชียงใหม่

*Relief for the city
With focus on Chiang Mai,
Thailand*



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Qualitative evaluation

- Air-cleaning effect of ca. 130 species
- Based on model in The Netherlands
- Classification based on plant characteristics and expert judgement

			PM	NOx
Scientific name	English name	Main Group		
<i>Acacia auriculiformis</i>	Black Wattle	Tree	++	+++
<i>Acalypha hispida</i>	Red Hot Cat's Tail	Shrub	+	++
<i>Acalypha wilkesiana</i>	Painted copper leaf	Shrub	+	++
<i>Adenium obesum</i>	Mock Azalea	Shrub	+	+
<i>Allamanda cathartica</i>	Yellow allamanda	Shrub / Climber	+	+++
<i>Alstonia scholaris</i>	Devil tree	Tree	+	++++
<i>Antigonon leptopus</i>	Mexican creeper	Climber	+	++
<i>Araucaria heterophylla</i>	Norfolk Island pine	Tree-Conifer	++++	++
<i>Artocarpus heterophyllus</i>	Jackfruit	Tree	+	++++

- Examples of good species for air-cleaning PM10



Casuarina equisetifolia (Australian pine)



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Many other Legumes



Samanea saman (Rain tree)



Caesalpinia pulcherima



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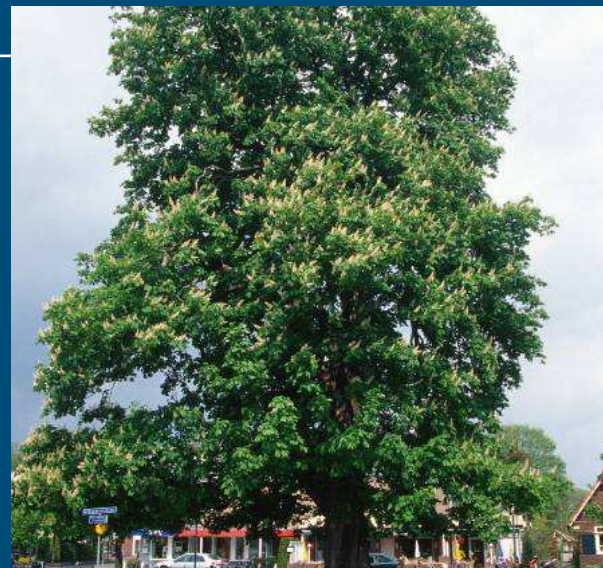
Effective for reduction NO_x



Big leaves

Big crown

Glabrous
leaves



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City conditions difficult for plants

- Often poor soil conditions
- Surrounded by pavement
- Pollution by traffic and industry
- Damage and vandalism
- Competition with cables, piping, foundations, etc.



Roots need space



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Not only roots need space



What be done?

Good design

Right plant for the right place

- Improve soil
- Enough space underground (tree container)
- Protection against vandalism, storm, etc.
- Good maintenance



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Inventory of eye catching trees in Chiang Mai

In cooperation with Dr. Yaowanit of Maejo University



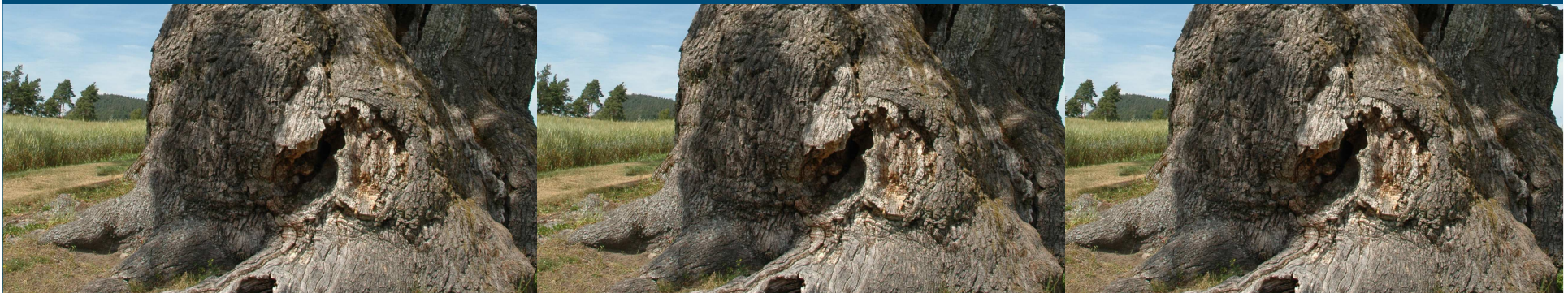
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Criteria in the Netherlands

- Age of the tree more than 80 years

And one or more of the following criteria

- Important cultural heritage
- Valuable species
- Rarity because of age, size, etc.



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BIG TREE MAP IN CHIANG MAI, THAILAND



LEGEND

- START POINT
- BIG TREE SITE
- ▲ MEASURE THE IMPORTANCE OF HISTORY
- TOURISM AUTHORITY OF THAILAND
- ⬢ BREAKPOINT
- + HOSPITAL



- WALK WAY
- BIKE WAY
- CAR WAY



SCALE 1:7500





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Possibilities for follow up

- Choice of ca. 25 most characteristic trees
- Making brochure for education and promotion
- Possibilities for tourism



What kind of information

- Descriptions of the species
- Botanical data of the tree: place, species, age, height, outline of the stem
- Cultural data and other characteristics of the tree (owner, goal of planting, damaged by storm, etc.)



Concluding remarks

- Nursery stock can be profitable
- On-farm experiments
- Continuous innovation
- Green has many effects
- Trees can improve the living conditions in cities but cannot solve all problems
- Fight pollution at the source
- Eye catching trees are worth protection
- Right plant at the right place



Thank you for your attention



Biodegradable pots and containers

■ Advantages

- No waste
- Easy planting
- Reduction of labour costs

■ Disadvantages

- Price
- Life-time

