A rare view of urban forest in Dubai, everywhere could look like this.

TREES

ALONE CAN'T FIX CLIMATE CHANGE

Planting trees in paving or irrigated lawns won't mitigate climate change; we need to shift our design principles and practices to make a difference

By Mark Laurence

There is a growing awareness that trees help mitigate climate change, but the conversations are mostly limited to carbon sequestration, when that is only one of the benefits. We also know that trees add shade and transpiration, making streets cooler, yet even that is not the whole picture. It's time we understood trees as phytobiome generators, rather than just as shade/beauty structures spaced along a pavement.

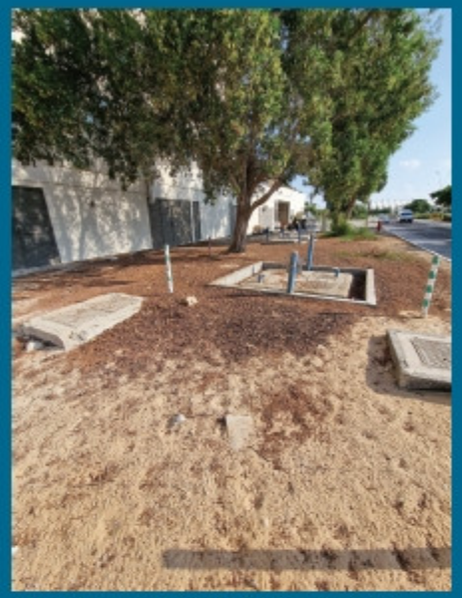
Over-irrigated ghaf trees are easily wind-thrown as they have few deep roots.

First, what is a phytobiome? A phytobiome consists of a plant (phyto) situated in its specific ecological area (biome), including its environment and the associated communities of organisms which inhabit it. These organisms include all macro- and micro-organisms living in, on, or around the plant including bacteria, archaea, fungi, protists, insects, animals, and other plants.

Trees often form the central pivot around which a phytobiome develops, so they are ecosystem generators. Yet modern landscape practice tends to put trees into sterile environments, bereft of sufficient soil, bacteria, fungi, nematodes, and insects needed for a healthy rhizosphere (soil microbiome). This is not helped by the constant tidying and removal of organic matter (leaves, seeds, fruit, decaying wood etc.) we do, as this is Nature's method of building soils. Standard landscape maintenance methods constantly thwart all efforts at phytobiome development, so tidy and neat maintenance must give way to ecosystem enhancing maintenance.

When trees like this sidr are paved around and have no open soil, it's no wonder they seek out drains.

Let's be clear: planting trees in paving or irrigated lawns is not the optimum way to mitigate climate change; we need much more, and we can have that if we shift our understanding and methodologies. This starts with design principles, but as just mentioned, only works if they are upheld by the correct long-term maintenance methods.



Self-generation of mulch and living soil under this Conocarpus. Maintenance has not tidied this away.

To understand this reasoning, we must acknowledge that the world has become fixated on carbon emissions as the driver of climate change, whilst ignoring the equally important impacts degradation of soil health and local water cycles have. For the past 12,000 years we have been removing trees, disrupting water cycles and dehydrating the land, which is increasing at an exponential rate.

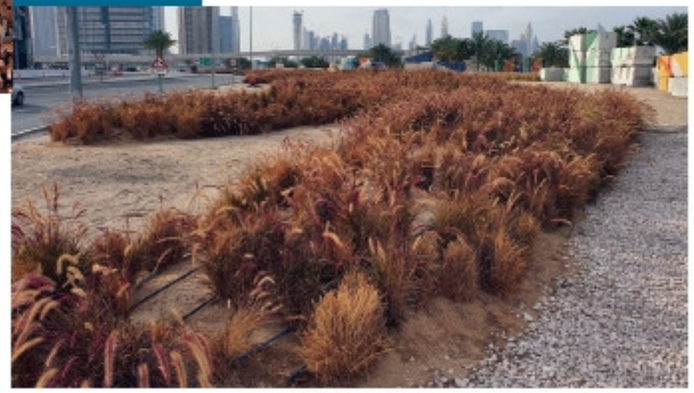
Perhaps this article should have been called 'designing with soils' rather than trees because that is what we need to do. Any tree planting is only going to be successful if we build up a healthy soil ecosystem. One of the benefits of doing this is that we would use far less water; most trees I've seen planted in the region survive by being massively over-watered. There is a price to pay for this approach: the cost of water, always a precious commodity, and the frequent irrigation means that trees remain shallow rooted – even ghaf – and become subject to wind-throw and are dependent upon water remaining forever available at that rate of supply. If you turned off all the irrigation tomorrow in, say, Dubai or Abu Dhabi, 95% of the trees would die. Those that would survive are the self-seeded pioneers, often found on neglected brownfield sites. I've studied these as they offer insight into tree resilience, but that's the subject for another article.

Trees will generate their own mulch from leaf litter. This is an essential part of soil-building.

If we need to not just plant trees, but create micro-phytobiomes, how do we do it? Ecosystems need a level of complexity and critical mass to survive and thrive, so it's our job as designers to set up the parameters that allow for natural systems to self-generate. Essentially, we must reverse the downward cycle of decline and desiccation, not by masking it (with irrigation) but by reversing it into a cycle of natural growth, life and complexity. Phytobiomes are complicated in ways we still don't understand but fortunately, we don't need to design and install every little microbe, we just need to create the conditions for them to thrive. Build it (soil) and they will come.

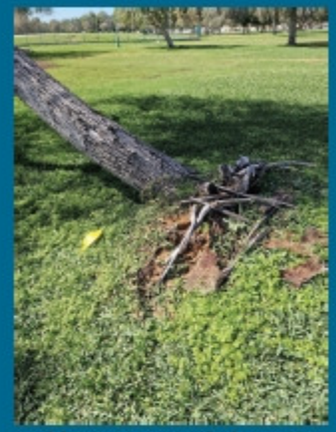
Current practice in the region is to replace the site soil in planting areas with 'sweet soil', as that has lower salt content. But transplanting red desert soil potentially destroys whatever microbial life it has, which also may not be well suited to the (typically coastal white psamment) regions where it is used. Perhaps it would be better to look at enhancing the existing site soil, bringing that to life and selecting plants that work with the site. Using the correct irrigation methods is also important in managing salinity, and we should look at deep watering at intervals, rather than smaller surface waterings every day. Using water absorbing elements mixed into the top 500mm, such as zeolites is a good practice as that provides some of the missing microporous structure, which retains water and nutrients. Biochar might be a better option, as this can be continuously produced from local organic waste – palm fronds (a current disposal problem) being a good source.

We need to mulch beds with woodchip, preferably Ramial Chipped Wood (produced from small branches with a higher nitrogen and cambial content). This again can be made from local green waste and arisings, even from the landscaped areas themselves, especially if a coppice-landscape approach is used (the subject of another article). Mulches oxidize quickly in the heat, so need regular top-up, but they keep moisture in the soil and feed microbial activity; no mulch, no soil life. Ornamental stone mulches of the wavy black/white areas so often seen, should be relegated to past mistakes, though natural stone mulching may be appropriate in some xerophytic plantings. The aim is to reverse the excess of transpiration over infiltration.



Monoplanting of species does little for ecosystem generation

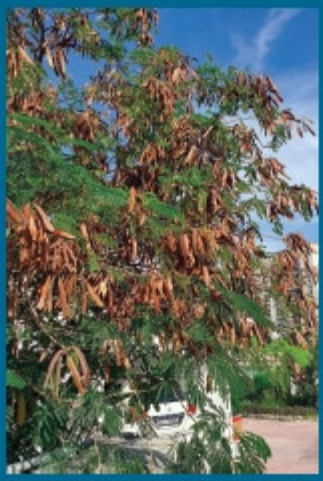
Over 90% of trees have root associations with mycorrhizal fungi (many of them are obligate – essential to survival), and this is true even in the desert. There is limited research on this, but wild plantings of regional natives and date palms have been shown to have these active relationships. For landscape plants, creating the soil conditions mentioned above will allow mycorrhizae to thrive but we may have to inoculate the area with local strains taken from healthy soils. A tree will give these



Over-irrigated ghaf trees are easily wind-thrown as they have few deep roots.

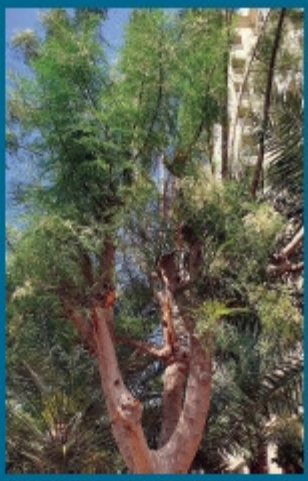
What happens when trees are irrigated, then it is switched off, roots have no resilience.

Tecomella undulata is a rarely planted UAE native



Trees like Leucaena leucocephala are considered invasive, but they are adaptive and pioneering trees.

Leucaena leucocephala attracts wildlife, such as this carpenter bee.



Moringa oliifera – a tree of multiple uses, which adds to urban ecosystem creation.

fungi up to 20% of their photosynthate, in return for water and nutrients which the mycorrhizae find, often far beyond the reach of tree roots. This is the main reason why we should NOT add fertilizer to soils, for it bypasses this symbiosis and diminishes the fungal relationship, especially for phosphorous accumulation.

Once we've sorted our soil, we can turn to the plants and selection. We need to build up an ecosystem, so we must think about things far wider than just aesthetics. We use the principle of layering, where we build planting in discrete layers – main canopy, mid-layer canopy, understory, shrub layer, ground cover, bulbs and herbaceous (not all will be necessary or possible in any given situation). The second aspect is to plant mixed species in large groups, where soils can self-generate as described and plant roots collectively benefit from a healthy rhizosphere. Where trees must be planted in isolation through paved areas, underground connectivity of soil, using crating systems should be used. This though, is a poor substitute for healthy, mulched soils that are open to the air, so ribbon-planting design should be considered as the best approach in urban streets.

Should all planting be native? No, because we don't know what changes climate will bring and ecosystems everywhere will need to adapt to survive. Plants suited to existing and future conditions should be used, and understood in the context of disruption, pioneering, and necessary change. From these design principles, a new aesthetic can emerge, of equal, if not greater beauty, than the traditional plantings we are used to. And there is still room for some of our favourite exotics, for who can resist the charms of trees such as the flamboyant (Delonix)? Context and complexity are everything.

Climatic change is coming to a street near you; let's learn to design ecosystems and use the complex web of life that trees generate to adapt to what's coming. ■

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