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A growing city: agriculture and food security in the growing urban context

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Recycling the City

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Recycling the City

Chapter: 3

Replanting the Mind

"Unless..." This was the last word left by the Lorax when he left after the last truffula tree was felled. What he meant by it was that "unless someone like you cares a whole awful lot, nothing is going to get better. It's not." (Dr Seuss, 1971). And from there the story concludes with the last truffula seed being taken to be planted so that the forest can regrow and Thneed-ville can live in harmony with its natural surroundings. In a similar way, a city can grow in harmony with its natural surroundings, while at the same time allowing for people to grow and have access to the means to grow, and this means addressing food security in the city and encouraging developments that has positive effects on the social nature of humans.

It can now be seen how damaging the city can be on the physical environment, social networks, bodily health, and mental wellbeing. This comes largely through its disconnect from and competition with its context. As cities worldwide expand, the importance of green space in human health is an issue of common ground for all (Selhub et al., 2012: 5). In contrast to the city, I will now look at what the effect of the natural environment on these factors that make up urban life.

Humans are essentially social creatures, and there are many benefits to living in cities where there are lots of people in one area. For centuries people have lived together. History tells of our need to be in groups.

There are numerous psychological subfields that, to one degree or another, look at the interplay between human beings and their natural environment. The most prominent of these is known as ecopsychology, and embraces a revolutionary paradigm: just as Freud believed that neuroses were the consequences of dismissing our deep-rooted sexual and aggressive instincts, ecopsychologists believe that grief, despair and anxiety are the consequences of dismissing equally deep-rooted ecological instincts (Smith, 2010: 36). This may seem like quackery, but that is largely because mainstream psychology paradigms have limited the definition of mental health to the interpersonal context of urban-industrial society, according to Theadore Roszak (Smith, 2012: 36). Roszak refers to this as the "citified psyche". Again we see the natural environment shunned by the urban environment.

Recently, a number of psychiatrically inflected terms have sprung up to represent people's growing unease over the state of the planet — "nature-deficit disorder," "ecoanxiety," "ecoparalysis:" all mental-health issues attributable to the degraded state of one's physical surroundings (Smith, 2010:36). Ecopsychologists, many of whom are licensed clinicians, remain wary of attributing specific illnesses to environmental decline or of arguing that more-established disorders have exclusively environmental causes (Smith, 2010: 36). But what is clinically evident are the effects that the environment has in improving health and wellbe-

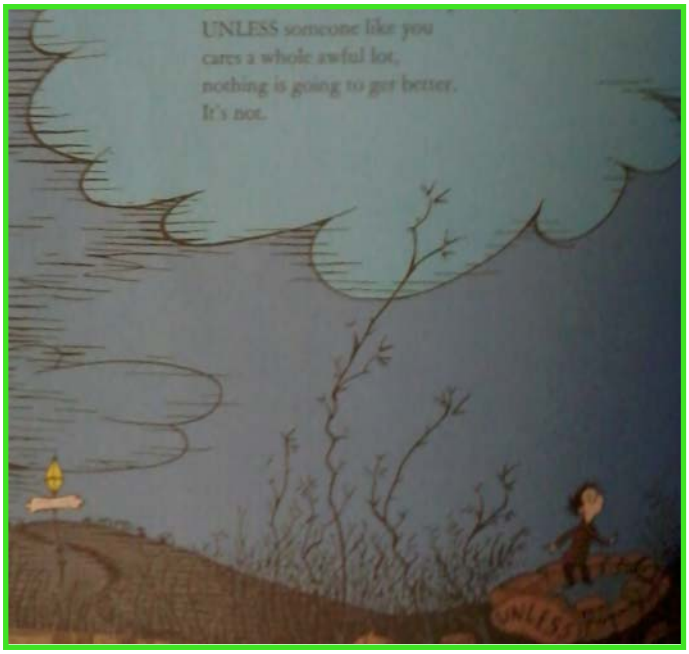


Fig. 3.1: Unless. (Source: Dr. Seuss, 1971)


Fig. 3.2: Wellbeing and the earth's systems. (Source: Drug Rehabilitation Today, 2010)

ing. Below is an example from Smith's article in The New York Times Sunday Magazine (2010: 36):

> In a recent study, Marc Berman, a researcher in cognitive psychology and industrial engineering at the University of Michigan, assigned 38 students to take a nearly three-mile walk — half in the Nichols Arboretum in Ann Arbor and half along a busy street. His purpose was to validate attention-restoration theory (A.R.T.), a 20-year-old idea that posits a stark difference in the ability of natural and urban settings to improve cognition. Nature, A.R.T. holds, increases focus and memory because it is filled with "soft fascinations" (rustling trees, bubbling water) that give those high-level functions the leisure to replenish, whereas urban life is filled with harsh stimuli (car horns, billboards) that can cause a kind of cognitive overload. In Berman's study, the nature-walkers showed a dramatic improvement while the city-walkers did not, demonstrating nature's significant restorative effects on cognition.

Biophilia, which I mentioned earlier, is the hypothesis that there is an instinctive bond between human beings and other living systems. The term directly translates to "love of life or living systems".

> Gregory Bateson, a major influence on eco-psychologists and something of a lost giant of 20th-century intellectual history, believed that the tendency to think of mind and nature as separate indicated a flaw at the core of human consciousness. Bateson argued that the essential environmental crisis of the modern age lay in the realm of ideas. Humankind suffered from an "epistemological fallacy": we believed, wrongly, that mind and nature operated independently of each other. In fact, nature was a recursive, mind-like system; its unit of exchange wasn't energy, as most ecologists argued, but information. (Smith, 2010: 36)

The above extract suggests a change of paradigms in how we look at nature. It shows that nature, in fact, thrives off feedback loops of information. And it shows that everything is connected in a single complex system. And this includes humans and cities.

> "When you narrow down your epistemology and act on the premise 'what interests me is me or my organization or my species,' you chop off consideration of other loops of the loop structure," Bateson wrote. "You decide that you want to get rid of the byproducts of human life and that Lake Erie will

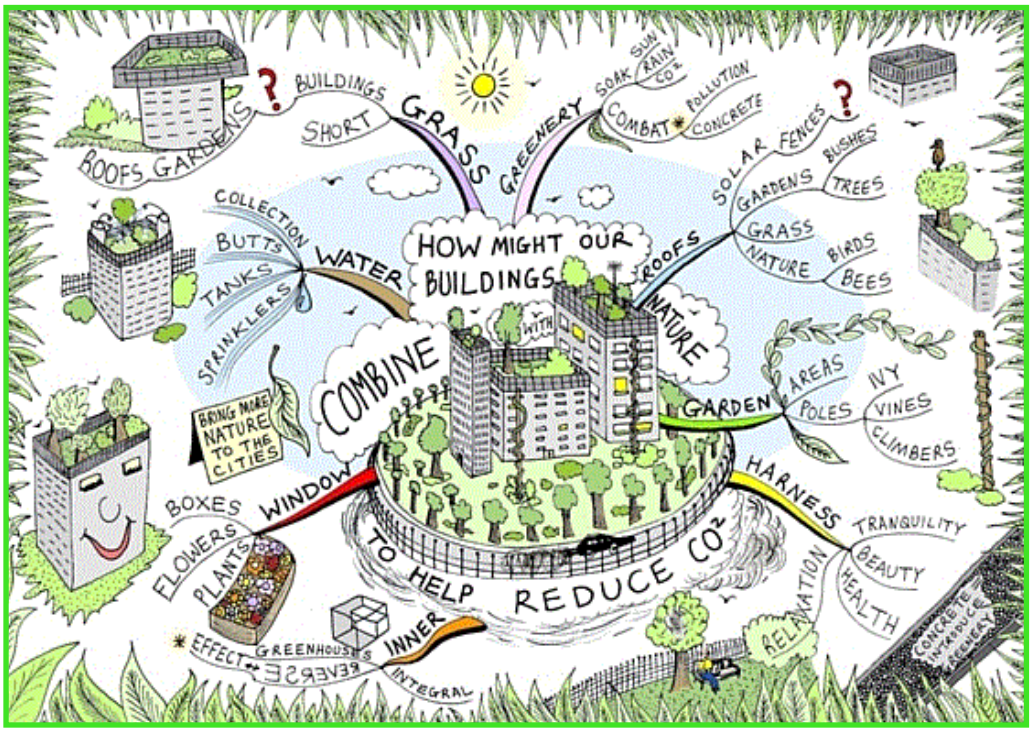


Fig. 3.3: Mind mapping how nature and cities are interconnected. (Source: Foreman, 2012)

be a good place to put them. You forget that the ecomental system called Lake Erie is a part of your wider ecomental system — and that if Lake Erie is driven insane, its insanity is incorporated in the larger system of your thought and experience." Human consciousness evolved to privilege "purposiveness" — to get us what we want, whether what we want is a steak dinner or sex. Expand that tendency on a mass scale, and it is inevitable that you're going to see some disturbing effects: red tides, vanishing forests, smog, global warming. (Smith, 2010: 36)

Stress hormones can compromise immune defense; in particular, the activities of frontline defenders, such as antiviral natural killer cells, are supressed by stress hormones. (Selhub et al., 2012: 21)

Nathan Gardels says in The 11th Hour (DiCaprio, 2007), "You have to change the idea behind expansion, in a phrase from well-having to well-being — it's a cultural transformation." This wellbeing is directly influenced by nature. Studies have confirmed that spending time within a forest setting can reduce psychological stress, depressive symptoms, and hostility, while at the same time improving sleep and increasing both vigour and a feeling of liveliness (Selhub et al., 2012: 19). Wellbeing is vital, and directly linked to health. Because green space provides a stress buffer, and so many aspects of human health and even longevity itself are negatively influenced by stress, it follows that green space is a promoter of human health, vitality and longevity (Selhub et al., 2012: 25).

Information overload, a by-product of the modern age, often leads to people becoming desensitised and narcissistic. This further affects work productivity in the workplace.

> Distractions and information overload in work settings curb the likelihood that the overloaded individual will grant another a favour... Any tilt from empathy to narcissism has enormous consequences for society and the natural environment. Empathy is an essential ingredient in helping behaviour and social justice, while the costs of narcissism — exploitation, manipulation, aggression, shallow relationships and loss of emotional intimacy — are paid for by its victims... Narcissism is also associated with taking undue risk and impulsivity without regard to downstream consequences... In a study by a team of

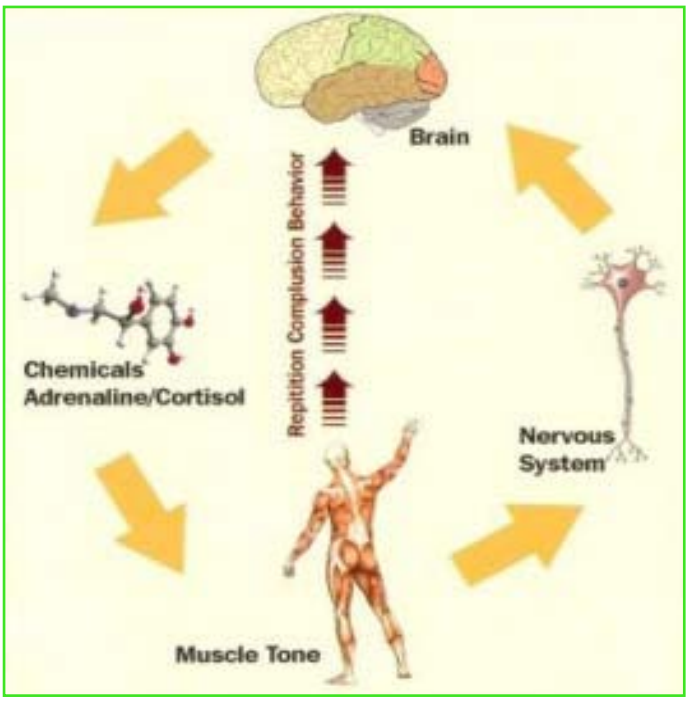


Fig. 3.4: The human nervous system. (Source: John, 2012)

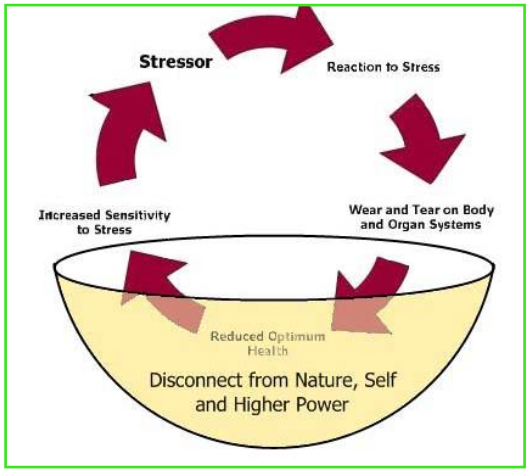


Fig. 3.5: Cycle of stress and health. (Source: Unknown, 2012)

> psychologists led by W. Keith Campbell, those with the narcissistic view were more likely to cut down a hypothetical forest with greedy intent, forgoing long-term gains and sustainability. Narcissists are no friends of nature. (Selhub et al., 2012:44)

A walk in the woods reduces the level of stress hormones in the body and increases natural killer cells in the immune system, which fight tumours and viruses (Robbins, 2012). The mere presence of four plants in a room, during a study, produced a robust and significant elevation of intrinsic aspirations (which could be described as prosocial aspirations). Further, the presence of natural vegetation mediated higher scores on feeling connected to nature and subsequent generosity compared with those who took the very same tests in a room without plants (Selhub et al., 2012:57).

The elements of green space that have influence on human physiology are more than merely visual. Trees and plants secrete aromatic chemicals that impact our cognition, mental state, and even our immunity (Selhub et al., 2012:83).

> Just as aromatic chemicals surround us in green space, human-made synthetic chemicals surround us in more urban areas, creating unnaturally polluted environments. And just as surely as miniscule levels of inhaled natural plant chemicals influence the brain, so too can synthetic chemicals. However, synthetic airborne chemicals and overt unpleasant odours typically have a negative influence on cognitive and emotional health. Exposure to indoor and outdoor airborne pollutants in residential and occupational settings has been linked to anxiety, depression, autism, aggression, irritability, pain, fatigue, frustration, short- and long-term cognitive decline, decreased altruism, and an overall downturn in individual helping behaviour. (Selhub et al., 2012: 86)

Sunlight even influences human health. Despite being pleasantly warm in Johannesburg in winter, sunlight plays a direct role in production of the mood-regulating chemical serotonin (Selhub et al., 2012: 92), which is what Prozac and other such drugs try to achieve.

Even the sounds of nature have an impact on us that is better than the din of urban sounds. In fact, urban sounds affect our perception of nature itself, as Selhub et al. say below (2012: 103, 104):

> Aircraft, traffic, chainsaw, landscaping equipment, motorboats or motorcycles — all detract from posi-



Fig. 3.6: Plants in a room increase the quality of the space. (Source: News Interior Design, 2010)

tive perceptions of natural settings. In contrast, the sounds of nature, birds chirping, and water flowing enhance the positive mental outlook associated with nature scenes. Therefore, we cannot assume that all the previously discussed benefits of green space are due to green per se – the contextual acoustics might just make or break the mental benefit... Cities are expanding and acoustic energy is increasing – some cities have doubled their acoustic energy levels since 1990. Given that trees, particularly evergreens, provide superb insulation against noise, we should consider expansion of greenbelts and urban forests as one of the many steps we must take to limit our metropolitan noise problem.

Green space is lacking in Johannesburg inner city, for that is the way the city has grown, and it is where very many of the people in poorest health dwell. The inner city has the highest number of stressors too, included among them high crime rates. There are a meagre few antidotes for the "diseases" born of urbanity. The majority of green space is located in the suburbs, much like the majority of access to food. Thus the suburban life creates an unequal divide in society in more ways than just one. It is a more costly and expensive life, requiring longer drives to the workplace, with an almost exclusive access to the necessities of health and wellbeing. It is well known that poor people suffer worse health than the wealthy, and this is not only linked to being able to afford healthcare.

However, Japanese and Scottish researchers showed that green space was reported to be a great equalizer – it could fill in, to a significant degree, the huge gap in health inequalities between the "have mores" and those struggling at the lower end of the economic spectrum (Selhub et al., 2012:27). The researchers concluded that green space was an independent variable capable of saving thousands of lives per year in lower-income populations.

If plants and greenery have such a profound effect on our health and well-being, the projection of urban growth is disconcerting. As the city grows in its current ways, green spaces diminish, and it is estimated that 71% of the population will be living in major urban areas within the next two decades. What will happen to stress levels and health? The importance of greening the city is obvious. It must be considered now already that future development must restore greenery to the cities. Plants also clean the

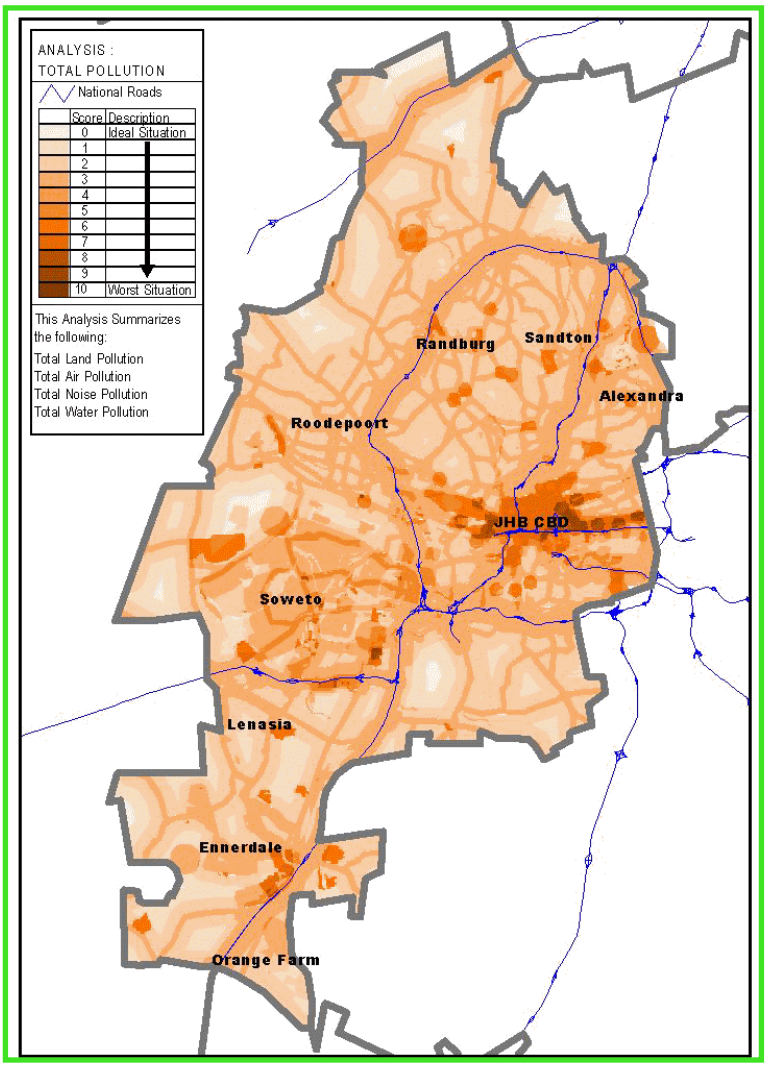


Fig. 3.7: A summary of pollution in Johannesburg. It includes land pollution, air pollution, water pollution and noise pollution. (Source: Greater Johannesburg, 1999)

air of pollutants, and it is a well-known fact that cities generate air pollution.

What does all this mean for architecture? Since the natural environment is crucial for human health and wellbeing, it is necessary to design an architecture that celebrates and respects nature, putting people in touch with it. Many of the systems we have in the city are open-ended and linear, generating waste products. It is better for them to become closed loops. We are part of the greater system. Our dwelling places need landscapes that provide trees, views that afford a vista, the presence of fresh water, and a rich variety of plants and animals (Selhub et al., 2012: 9). Our cities can begin to close their own loops and be a constructive link in the greater systems of our environment.

Lots of trees is a good thing, even in urban settings. But too many, too densely packed, can cause stress and fear. Similarly, lining walls with wood might be too much of a good thing. Japanese researchers have found just the right amount of wood on the floor and walls in an interior environment – between 30 and 40% of surface area (Selhub et al., 2012:20). This percentage has the highest rating of relaxation and is linked to lower physiological stress markers (blood pressure and pulse rate).

"As for feeding the world...'Maybe the better goal would be to enable the world to feed itself.'" (Benyus, 1997:51) The opportunity to experience nature through producing one's own sustenance could prove beneficial in ways beyond simply food security. Urban agriculture has the ability to provide a green space in the city which will aid in cognitive replenishment, provide food and assist in food security, provide employment for those who need it, and address the physical and mental health concerns linked to food insecurity and urban life.

Nature runs on sunlight. Nature uses only the energy it needs. Nature fits form to function. Nature recycles everything. Nature rewards cooperation. Nature banks on diversity. Nature demands local expertise. Nature curbs excesses from within. Nature taps the power of limits. (Benyus, 1997: 7)

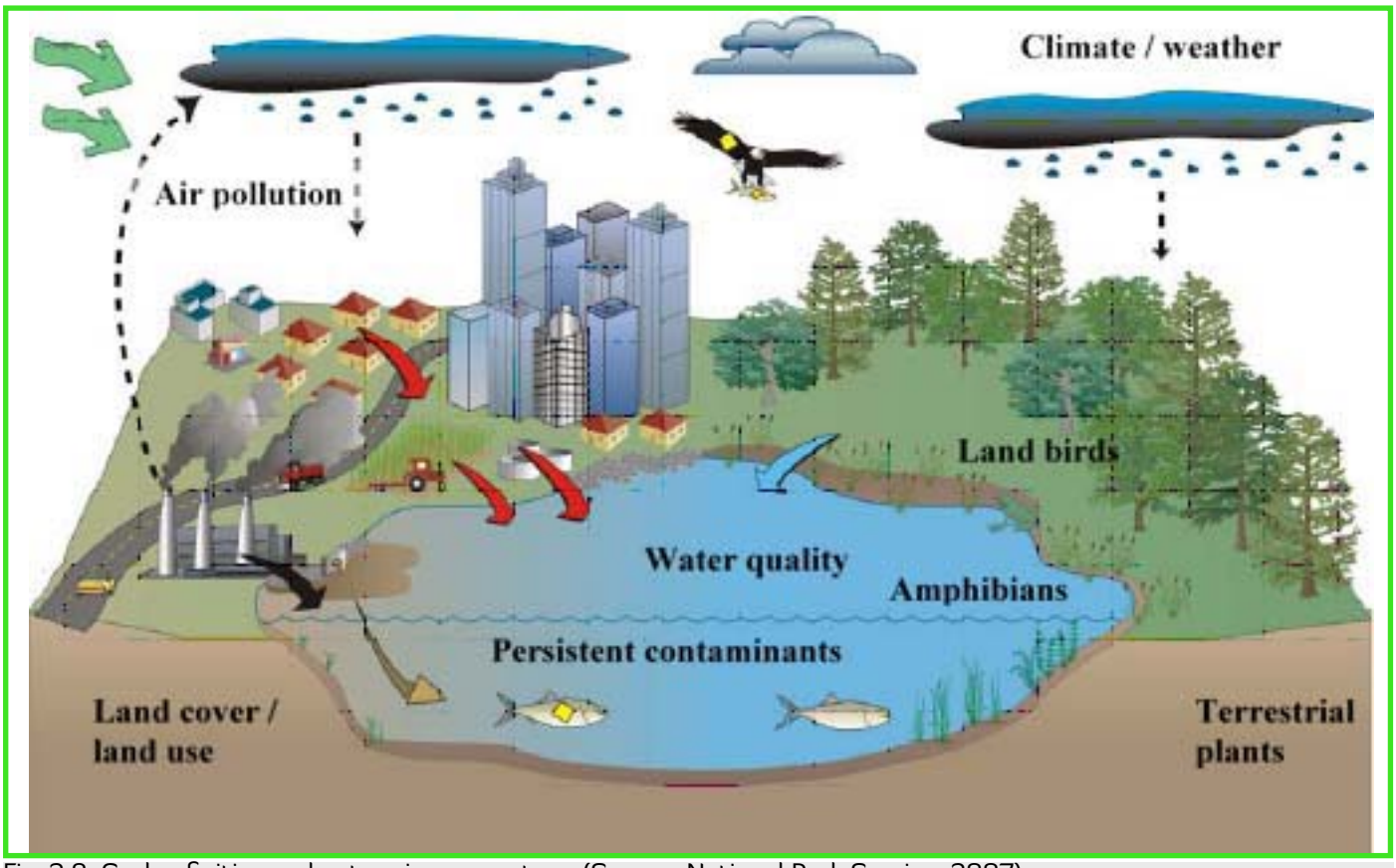


Fig. 3.8: Cycle of cities and nature in one system. (Source: National Park Service, 2007)

Reimagining the Future

The city keeps expanding and pushing food production further away from the centres where the majority of the population live. And all the while there is scant little initiative for growing food in the city. Thus we have a paradox where the people in greatest need of food and nutrition are those with the least access to food.

The irony is that the very thing which could be the solution to the concerns of the city, that is nature, is being banished further from the city. Flannery says (2009: 65) it is worth keeping in mind that we are facing several crises at once: declining oil reserves, ever more perilous food security, and, of course, climate change. He further says if we are to survive the twenty-first century, we must find ways forward that address these issues simultaneously.

All these issues of concern demonstrate how fragile the city is. Whether we like it or not we exist within the natural world and its order. We need ways of being able to live within the natural systems in a mutually beneficial manner. Biomimicry is one possible solution. The biomimics are discovering what works in the natural world, and more important, what lasts (Benyus, 1997: 3). In nature are already solutions to many of the problems we are facing.

> A striking characteristic of natural systems is that they tend to enhance their setting and, as they mature, create increasing opportunities for further organisms. By contrast, man-made developments are often destructive on a number of levels and even the concept of 'sustainability' implies merely maintaining a basic level of existence. The real challenge before us is to go beyond 'sustainable development' to achieve solutions that are actively restorative. (Pawlyn, 2011: 39)

Biomimicry means to imitate life. As described by Janine Benyus (1997), it means to take nature as a model to solve human problems; to take nature as our measure and ecological standard to judge the "rightness" of our innovations; and taking nature as mentor seeking what we can learn from it rather than what we can extract from it. Biomimicry can reintroduce nature to buildings. Yes, it can do so by directly bringing trees and plants into the building, but it can further do so at a deeper level of learning from nature and implementing the time-tested strategies that keep ecosystems alive while things are constantly changing. As Benyus says (1997: 2), "doing nature's way" has the potential to change the way we grow food, make materials, harness energy, heal ourselves, store information, and conduct business.

> Proponents of biomimicry contend that many of the solutions that we will need during the sustainability

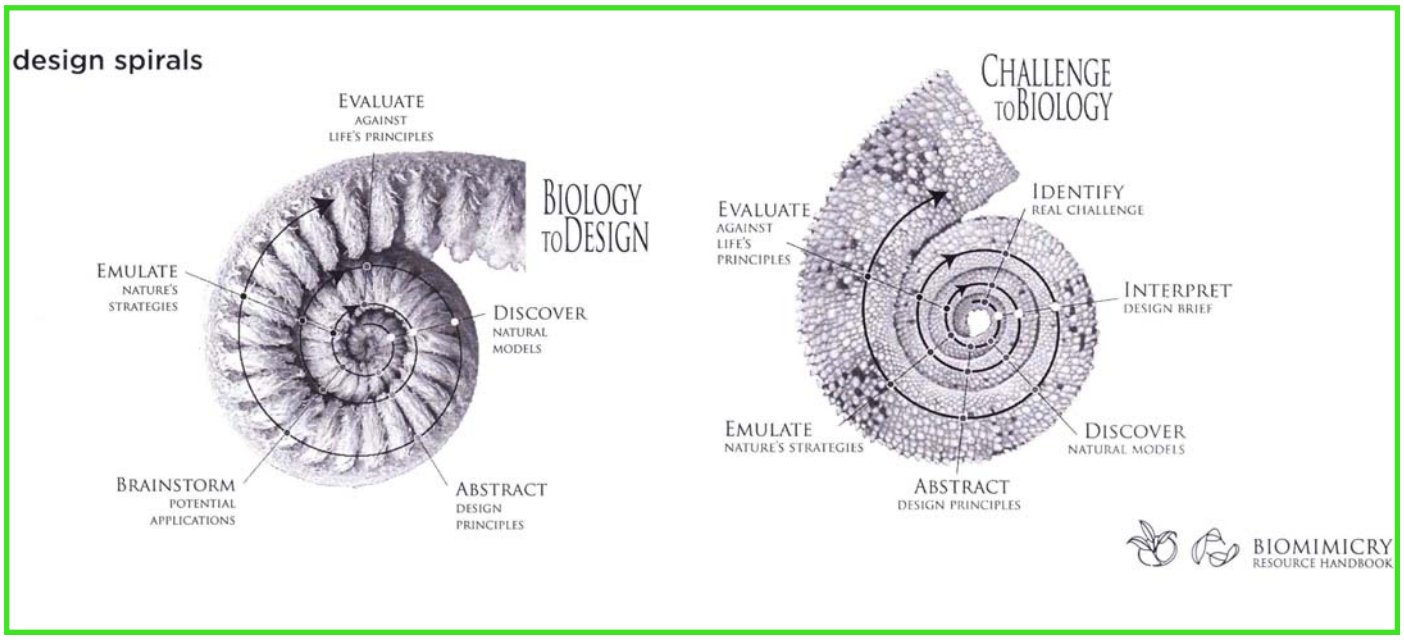


Fig. 3.9: Biomimicry design spirals. (Source: Biomimicry Institute, 2011)

> revolution are to be found in nature: super-efficient structures, high strength biodegradable composites, self-cleaning surfaces, zero waste systems, low energy ways of creating fresh water and many others. Typically man-made systems and products involve using resources in linear ways. Often the resource extraction is energy intensive, then used inefficiently and ultimately ends up as waste... it is worth remembering Einstein's maxim that problems are not solved by thinking within the same level of consciousness that created them. Biomimicry offers completely new ways of approaching design such that the whole system can be optimised and radical increases in resource-efficiency can be achieved. If future generations are to enjoy reasonable quality of life then we urgently need to redesign our buildings, our products and our systems to be completely closed loop and running off current solar income. (Pawlyn, 2011: 34)

Biomimicry can be implemented in three possible ways. The first is in form, where the building takes lessons from the form of a natural creature or object. Usually the form of a natural thing is optimised for its function. However, some buildings have taken the form of natural things while their function is different from that of the natural thing. This is merely biomorphism (copying the form). The second way nature can be imitated is in process, where the building copies the process of how something is achieved. And the third is in systems, where the building works in a closed loop system, together with many other components, creating conditions conducive to life.

There are six different principles to learn from life that can be applied through these aforementioned ways of using biomimicry. The first point of these six is evolving to survive through continually incorporating information (BiomimicrySA, 2012). One of the most effective strategies for encouraging quality of life is through feedback loops. Feedback loops inform what is working or not working in a system and allow opportunity for adjusting the system accordingly.

Secondly the scheme should be resource efficient with materials and energy. This means largely taking advantage of local resources and opportunities, and multi-functional design while fitting form to function. It means to use low energy resources and recycle all materials.

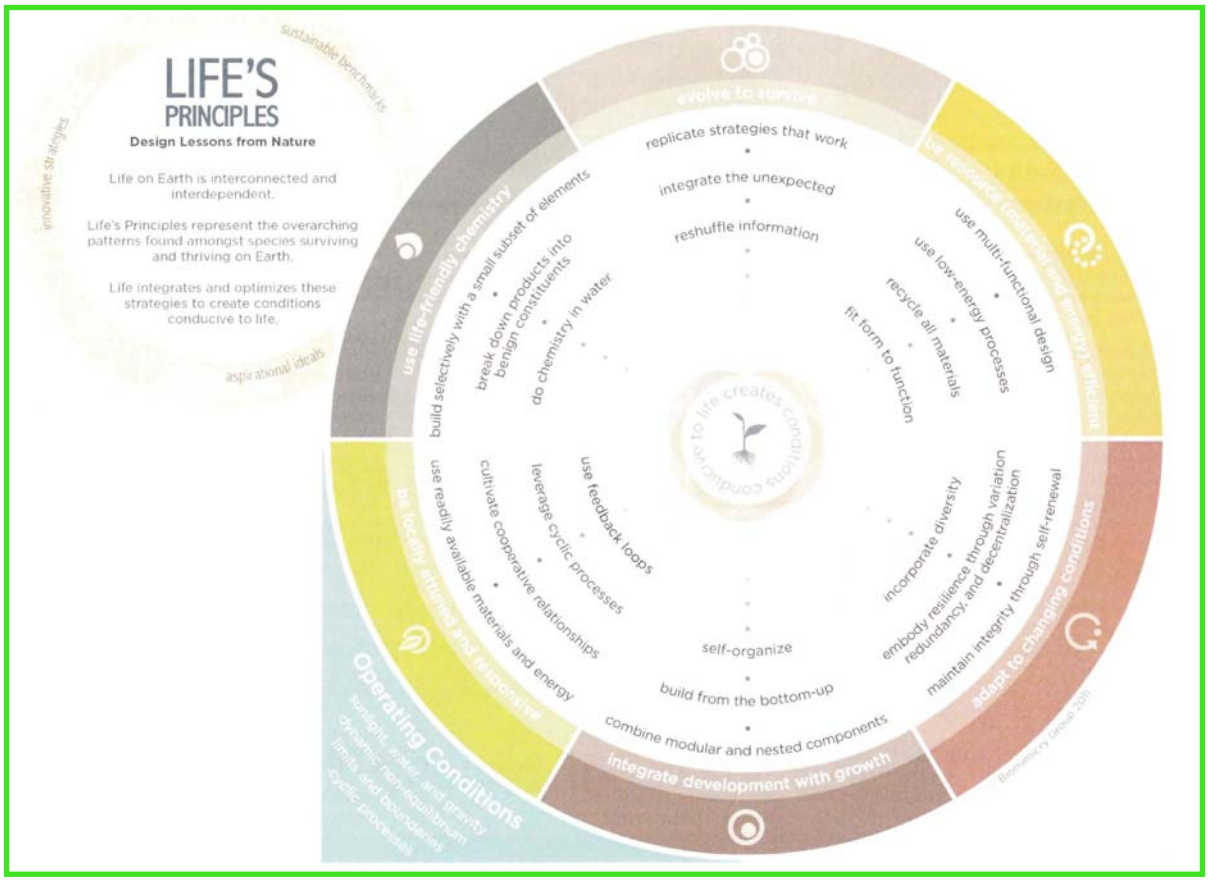


Fig. 3.10: Life's principles approach to biomimicry. (Source: Biomimicry Institute, 2011)

Thirdly it must adapt to changing conditions. Benyus says that one of the things that biomimicry might help with is moving towards designs and strategies that are better adaptive for life on Earth over the long haul (DiCaprio, 2007). Incorporating diversity and decentralisation meets a multi-functional need that allows for adaptability. This sounds quite contrary to the current way food is produced.

The fourth point is integrating development with growth. This means to create conditions which allow components to interact in concert as a whole system which self-organises. Combining modular and nested components is a good way to achieve this (BiomimicrySA, 2012). It means putting in place the necessary infrastructure that will then also allow for future growth.

The next point is to be locally attuned and responsive, fitting into and integrating with the surrounding environment. This requires using readily available materials and energy, cultivating cooperative relationships by finding value through win-win interactions, leveraging cyclic processes (taking advantage of repetitive processes), and using feedback loops to modify a reaction appropriately (BiomimicrySA, 2012).

The last point is to use life-friendly chemistry. This means building with a small subset of elements and using chemistry in which decomposition results in no harmful by-products. Each of these above points provide a matrix design framework for achieving biomimicry. They ultimately lead to good quality of life, and mutual benefit for all living organisms.

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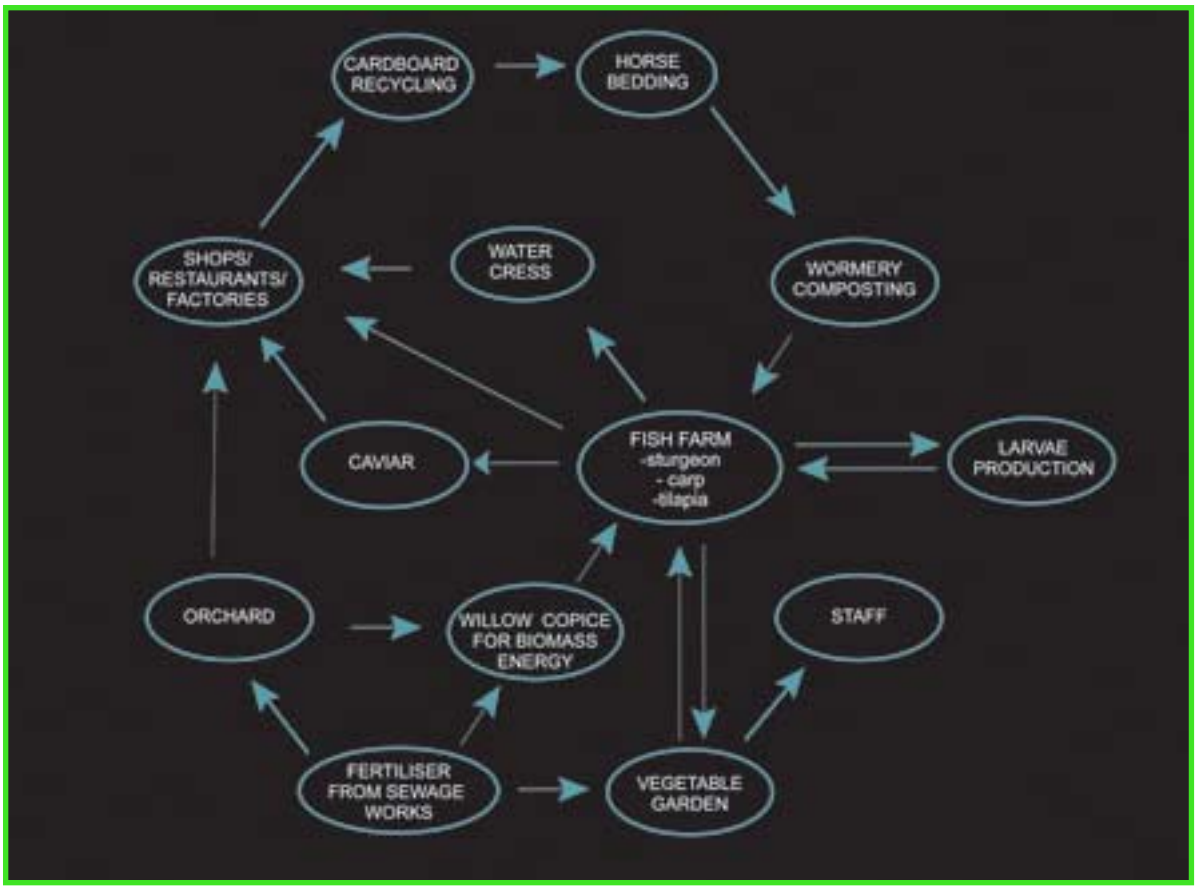


Fig. 3.11: The cardboard to caviar project imitates nature in the system of zero waste and large complex closed loops. (Source: Oppenheim, 2008)



Fig. 3.12: The Pax fan (top left) imitates the form of the pax lily, generating immense flow with very little energy input. On the right a shark tale has been mimicked in the efficient way in which it moves through water, generating lots of thrust with little movement. This has been made into a water turbine which moves with the tide, generating energy. (Source: Meredith, 2011)

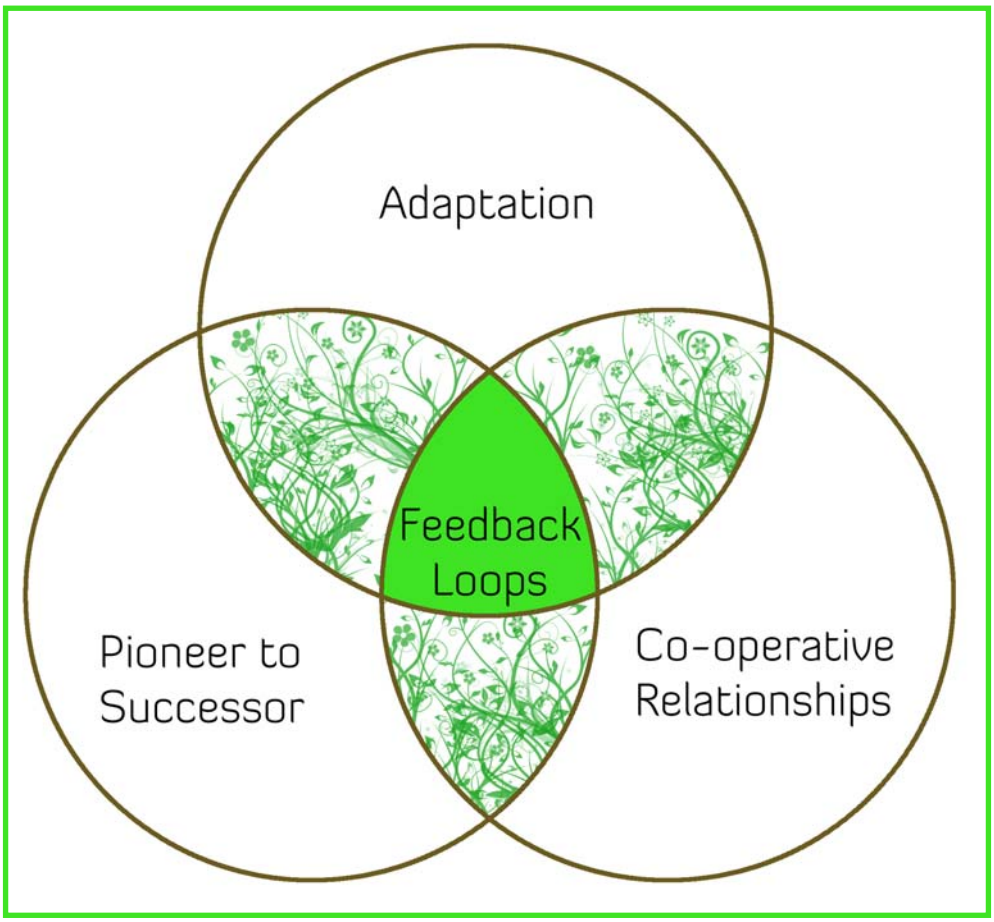


Fig. 3.13: This diagram shows the three governing principles in biomimicry which I feel relate to food security in the inner city. These three principles come together at the point of feedback loops. (Source: author, 2012)

Cultivating the City

Urban agriculture has the potential to address multiple concerns of urban life. It provides a green space where people can be immersed in nature, benefitting from how it cleans the air, from the sounds and fragrances, benefitting from the shear greenness of nature, of the systems of life. It provides opportunity for people to delve into the soil and keep stress at bay, as Max E. Witte said (Selhub et al., 2012: 62).

John Todd says, "If we combine our housing, and our waste treatment, and our food production, and our energy generation, all integrated in single whole systems, we can live beautifully on the planet with one tenth or less of the resources that our current civilisation uses." (DiCaprio, 2007)

Currently, the average meal (globally) travels 1200 km from the farm to plate (Suzuki, 2012). Food that is grown closer to where people live will therefore have fewer transportation emissions associated with it, and also be fresher and support local farmers. And as the distance food travels decreases, so does the need for processing and refrigeration to reduce spoilage (Suzuki, 2012).

In a healthy town every family can grow vegetables for itself. The time is past to think of this as a hobby for enthusiasts; it is a fundamental part of human life. (Alexander et al., 1977: 819)

It merges urbanity and nature in a mutually beneficial, I dare even say biomimietic, way. It helps to diversify the production of food, making distribution more equal, as well as loss of crops less disastrous. Indeed, urban agriculture allows the city to keep growing, in numerous ways, towards the end goal of quality of life.

Therefore, I will now look at the different ways food can be grown in cities. There are different techniques and technologies to study concerning urban agriculture. I will now look at how the city can be cultivated for food production.

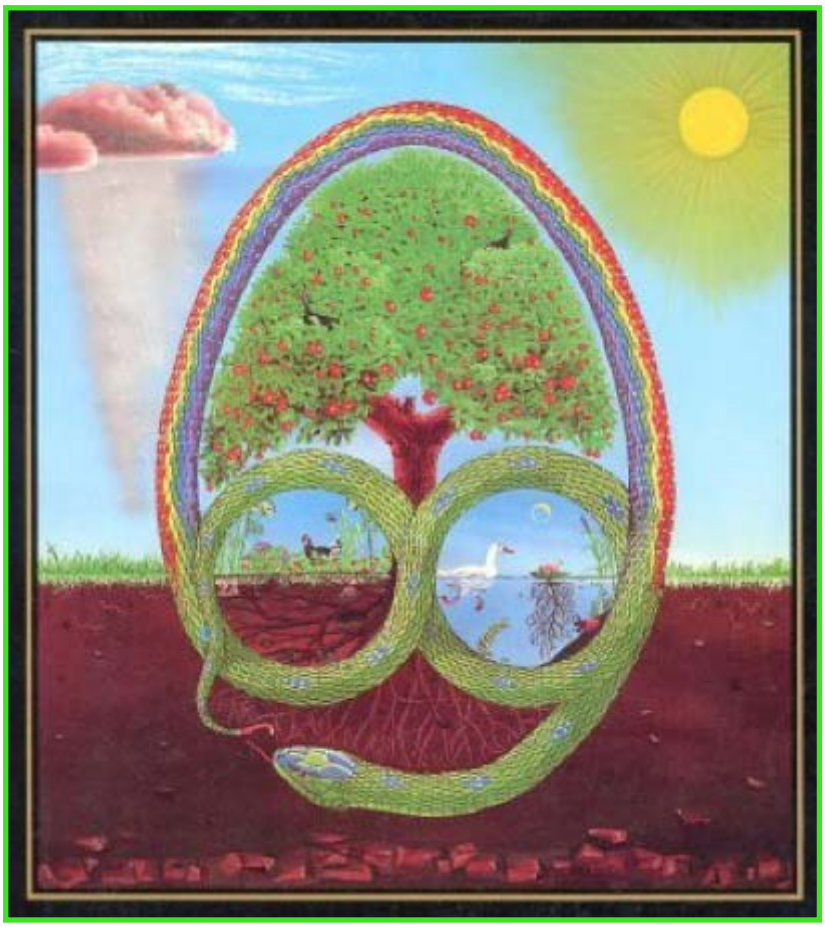


Fig. 3.14: Permaculture logo. The oval represents the egg of life. The rainbow snake is the Earth-shaper of Australian and American aboriginal people. Within the snake is the tree of life. The elemental forces shown external to the snake represent the physical environment, the sun, and the matter of the universe. (Source: Mollison, 1988)

The first method of agriculture I will look at is permaculture. This is not limited to the city but can be practiced in rural farms and commercial farming. What makes it suitable to urban conditions is it produces higher yields in smaller areas of land.

Permaculture means permanent agriculture – that is, agriculture that can sustain itself. Permaculture is an ethical approach to designing land use and community systems, to provide food, ecological habitats, and other essentials needed for human survival (Permaculture SA, 2012). There are certain design principles that go with permaculture and these can be described in three brief points.

Firstly, one must care for the earth by using renewable resources, recycling, minimising waste, building up soils rather than depleting them, conserving water and so on (Permaculture SA, 2012). It means to work with nature rather than against it. "The problem is the solution... If the wind blows cold, let us use both its strength and its coolness to advantage (for example funneling wind to a wind generator, or directing cold winter wind to a cool cupboard in a heated house)." (Mollison, 1988: 15) A corollary of this principle, as Mollison continues, is that everything is a positive resource; it is up to us to work out how we may use it as such. This is a good step towards avoiding the Thneed-ville conundrum.

Secondly, one must care for the people. This means simply to look after yourself and others. Health and wellbeing are important as are learning, a sense of belonging, communication, trust and respect. All people should have access to what they need to live a safe and healthy life (Permaculture SA, 2012).

The third principle is that everyone gets their fair share – take only what you need and share the rest. This Permaculture ethic focuses on cooperation, networking, contributing to the community and on distributing resources and wealth (Permaculture SA, 2012).

Permaculture is a design system. It encourages use of appropriate and rehabilitative technology, design of energy-efficient structures, recycling at the highest level, creation of very durable systems and objects, storage of run-off water for extended use, and making harmonious connections between components and sub-systems (Mollison, 1988: 19). It encourages every component of a design to function in at least two or more ways. It attempts to integrate fabricated, natural, spatial, temporal, social, and ethical parts to achieve a whole. To do so, it concentrates not on the components themselves, but on the relationships between them, and on how they function to assist each other (Mollison, 1988: 36). For example, we can arrange any set of parts and design a system which may be self-destructive or which needs energy support, but by using the same parts in a different way, we can equally well create a harmonious system which nourishes life (Mollison, 1988: 36). A flexible and conceptual design can accept progressive contributions from any direction, and be modified in the light of experience (Mollison, 1988: 55). These are principles that Mollison applies to farming as well as lifestyle, and it can apply to buildings too.

Local examples of permaculture can be seen at Joubert Park, and Siyakhana in the Bezuidenhout Valley. Both of these are social projects involving communities, but aside from the facilities at Joubert Park they have few notable



Fig. 3.15: Permaculture principles. (Source: Permaculture and Sustainability, 2011)


Fig. 3.16: Joubert Park permaculture gardens (Source: author, 2012)

buildings.

Joubert Park Clinic treats mostly T.B. patients while at the same time providing them with fresh food and medicinal herbs, and knowledge of healthy food, which further aids in their recovery from T.B. (Inner-City Gazette, 2011). It was started in 2009. Thembelihle Mxotwa a health promoter at the Joubert Park Clinic explains the main objectives for starting the food garden: "Our main purpose for starting the food garden was to help make people understand the importance of eating nutrients, in particular, the T.B patients. Eating nutrients helps to boost their immune system." Inner-City Gazette, 2011) The community also benefit significantly in the food garden as a portion of the plot was given to the old-age home in the Wolmarans Street as part of engaging people to be active in eating healthy food (Inner-City Gazette, 2011). The garden is not only a place for vegetables, but it also encourages the culture of healthy eating for the people, making it their habit to have fresh vegetables.

There are a few buildings on the grounds for the gardens. One is the old conservatory which is being renovated. Another, the main building, is currently being built and was designed by Nicholas Whitcutt. The development is called the Greenhouse and makes extensive use of recycled materials. It is a two story building which incorporates many innovative passive design techniques. It is a great example of resource efficiency and designing with low embodied energy.

The structure is made from gumpoles and timber trusses, with interspersed rammed earth walls. Some of the walls are a composite of clay, straw, and chicken mesh wire. This demonstrates how, if reclaimed and salvaged materials cannot be used, readily available materials can be. These are materials that can be bought from any hardware store.

Reclaimed floor boards have been used for the floors as well as wall cladding. This timber adds to the insulation R-value of the building, as does the clay used in the walls. Other innovative use of reclaimed materials includes hexagonal floor tile blocks used as walls. The windows and doors, wherever possible, are also reclaimed, but this can be harder to match the desired design since these items are usually quite specific in shape and size. Solar panels line the roof to harvest solar energy.

This project can be well learnt from in its reuse of salvaged materials and use of low energy construction, that befits the South African context.

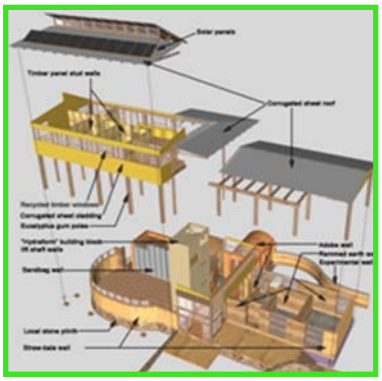


Fig. 3.17: The Greenhouse Project in Joubert Park. (Source: Whitcutt, 2012)





Fig. 3.18: (above) The conservatory in Joubert Park. (Source: author, 2012)

Fig. 3.19: (left) Sunken growing trays are part of the existing infrastructure at Joubert Park. (Source: author, 2012)



Fig. 3.20: Straw, wire mesh, and clay wall construction (Source: author, 2012)



Fig. 3.21: Reclaimed boards for the ceiling, with timber beam construction. (Source: author, 2012)



Fig. 3.22: Gumpole structure with rammed earth wall and recycled windows (Source: author, 2012)



Fig. 3.23: The interior of the building showing reclaimed floor boards as wall cladding. (Source: author, 2012)



Fig. 3.24: Workmen shaping salvaged materials on site (Source: author, 2012)

Siyakhana, headed by Moira Beery, works to improve food security through growing a vegetable garden, increase access to nutritious and sustainably grown foods, and raise awareness of the impact of ecological health promotion (Siyakhana, 2011). Siyakhana's work seeks to eliminate the social and environmental barriers that prevent people from accessing nutritious foods and leading an active healthy lifestyle (Syakhana, 2011). The Siyakhana Permaculture Food Garden has been operational since 2005 and is a 2ha garden on what was once a patch of ugly inner city ground which has been vividly transformed with permaculture gardening techniques (Siyakhana, 2011).

The Siyakhana project serves not as an architectural precedent but rather a social one. It demonstrates how a community can be successfully educated and involved in growing food through a sustainable model - a model which essentially aims at improving quality of life through the simplest and most accessible means. While the people at Siyakhana are involved in urban planning and in particular sustainable urban design, their food garden It does not appeal to high class development such as will be seen in the Plantagon Plantscraper, but rather it addresses the particular context in which Johannesburg denizens live, appealing to those who need it and making food accessible.

They work closely with urban planning and urban design firms, government agencies, NGOs and universities to help reshape how people interact with the environment that surrounds them and ensure sustainable urban development (Siyakhana, 2011). They also build up the skills level of the communities in which they are involved. It successfully involves NGO's and communities in uplifting and addressing food security.

As an implemented social model it serves as a good precedent on how urban agriculture can be incorporated in a particular society and have an impact on it.

In Chicago there is a project called Mobile City Farm. It is a farm which, in contrast to Siyakhana and Joubert Park, moves around among vacant plots in the city as they become available or occupied. It does not have only one site, and its sites are constantly changing.

Vegetables are grown in the plots using permaculture techniques. It presents an exemplary process for using vacant sites in the city during the inevitable urban cycle of demolition and development (Cumberlidge et al., 2007: 174). It contributes to an intensive and efficient use of urban land by ensuring that a site can be used productively even while 'derelict' or awaiting construction (Cumberlidge et al., 2007: 174). The City Farm offers more than city beautification and provision of public green space; by



Fig. 3.25: The permaculture garden at Siyakhana. (Source: Google Maps, 2012)



Fig. 3.26: Children being educated at Siyakhana. (Source: Siyakhana, 2011)



Fig. 3.27: Siyakhana also produce and sell organic salts and sun-dried herbs. (Source: Siyakhana, 2011)

producing a significant amount of organic produce that is sold to local residents, many of whom have little or no access to cheap, nutritious food, it also provides job training and employment for homeless and poor people (Cumberlidge et al., 2007: 182). This is noteworthy in how it helps poor people to get back on their feet and equips them with a new set of skills. This self-improvement of individual people ultimately has a benefit on the city as a whole. Thus it demonstrates a principle found in nature of mutual benefit.

It takes into account that often urban land is damaged and unfit for farming due to oil spills and urban waste, but it overcomes this hurdle by laying down a carpet of clay before putting the soil down for farming. The clay then serves as a protective barrier between the food and the floor. The land is farmed, then the compost moved and reused elsewhere as lots are developed and communities grow. In addition to simply creating more green space and beautifying the urban landscape, the City Farm program strives to build a community-sustained operation while also providing highly nutritious products to people in diverse neighbourhoods (Resource Centre, 2012).

Again, this is a social project which does not house the growing within a building. It makes use of the unused land in the city. It shows a good use of vacant sites, and demonstrates the flexibility of farming to suit the urban environment. Since Johannesburg is a city with many vacant lots and unused buildings, this project shows a model that can be applied to Johannesburg, adapting it for context, and then making profitable use of otherwise unproductive and unsightly land. It shows how the left over spaces and forgotten corners of urban neighbourhoods become valuable and meaningful.



Fig. 3.28: Mobile City Farm, Chicago. (Source: Cumberlidge et al., 2007: 183)



Fig. 3.29: An aerial view of the main site for the city farm in Chicago. (Source: City Farmer News, 2009)

Fig. 3.30: The City Farm provides an interesting juxtaposition between the urban fabric and agricultural productivity. (Source: Roseman, 2011)



Another method of growing food within urban spatial constraints is hydroponics, which involves growing food without soil and usually in a water solution that provides the plants with the nutrients they need (Thiyagarajan et al., 2007: 1). The plant roots are exposed to the nutrient solution, without any type of growing medium (e.g. soil), and the solution is recirculated and reused (Thiyagarajan et al., 2007: 2). This system allows for dense growing in artificial conditions. The plants are healthier and less likely to become diseased.

Hydroponics forms a closed-loop system for growing plants, where the water is reused multiple times. It is very water and space efficient. This is often called the Nutrient Film Technique (NFT). This method provides a thin film of nutrient solution that flows through either black or white-on-black polyethylene film liners supported on wooden channels or some form of PVC piping which contains the plant roots (Thiyagarajan et al., 2007: 2). The walls of the polyethylene film liners are flexible, permitting them to be drawn together around the base of each plant, which excludes light and prevents evaporation (Thiyagarajan et al., 2007: 2). The nutrient solution is pumped to the higher end of each channel and flows by gravity past the plant roots to catchment pipes and a sump. The solution is monitored to determine the need for replenishment of salts and water before it is recycled.

There is currently a 'vertical farm' skyscraper under construction in Linkoping, Sweden, which uses hydroponics. It is a project piloted by Plantagon. It provides scientists with a new place for testing new path-breaking technologies for optimum urban farming methods (Ecofriend, 2010). The original proposal design was of a spherical building, but later this was changed to a more triangulated tower-like building.

Inside it will be numerous pots planted with vegetables. These pots would be placed in large trays that will be taken up a 'tray elevator' to the central helix for giving them the perfect growing environment. The plants grow as the trays slowly move downwards from the helix to the basement for harvesting (Inhabitat, 2012). After harvesting,

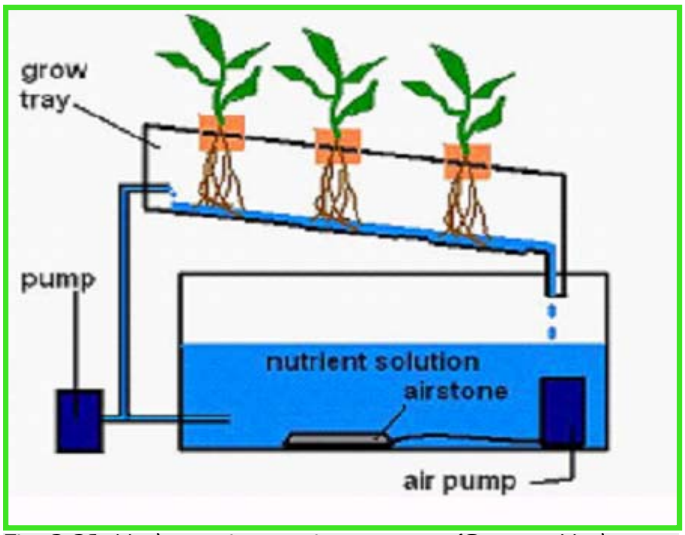


Fig. 3.31: Hydroponic growing system. (Source: Hydroponics Systems, 2011)


Fig. 3.32: The original proposal design for the Plantscraper. (Source: Inhabitat, 2012)

the empty pots and trays are disinfected and separated for replanting them with new seeds. Along the way, local manure and plant residue would be collected for production of biogas in an anaerobic digester. The biogas that is generated would be used to power the cooling and heating mechanisms of the greenhouse such as the chillers and boilers for dehumidification, and heating inside the Plantscraper (Ecofriend, 2010). This self-production of biogas makes the entire building sustainable and cost effective. The smallest model proposed for this project will be able to feed about 10 000 people and will cost about $10 to $20 million (Georgieva, 2012).



Fig. 3.33: The Plantagon skyscraper with a market in the surrounding plaza. (Source: Georgieva, 2012)



Fig. 3.34: The later triangulated design to be built in Sweden. (Source: Inhabitat, 2012)

This design is a tall skyscraper, suitable for the dense context of the city. It is suited to the context of Sweden, but such a design would perhaps be out of context for Johannesburg at such a large scale and cost.

The last form of urban farming I will look at for this essay is aquaponics. Aquaponics is a wonderful mixture of aquaculture (farming fish) and hydroponics. It is not a new concept. The origins of aquaponics can be traced to ancient Egyptian and Aztec cultures (Winkler, 2011). Aztecs

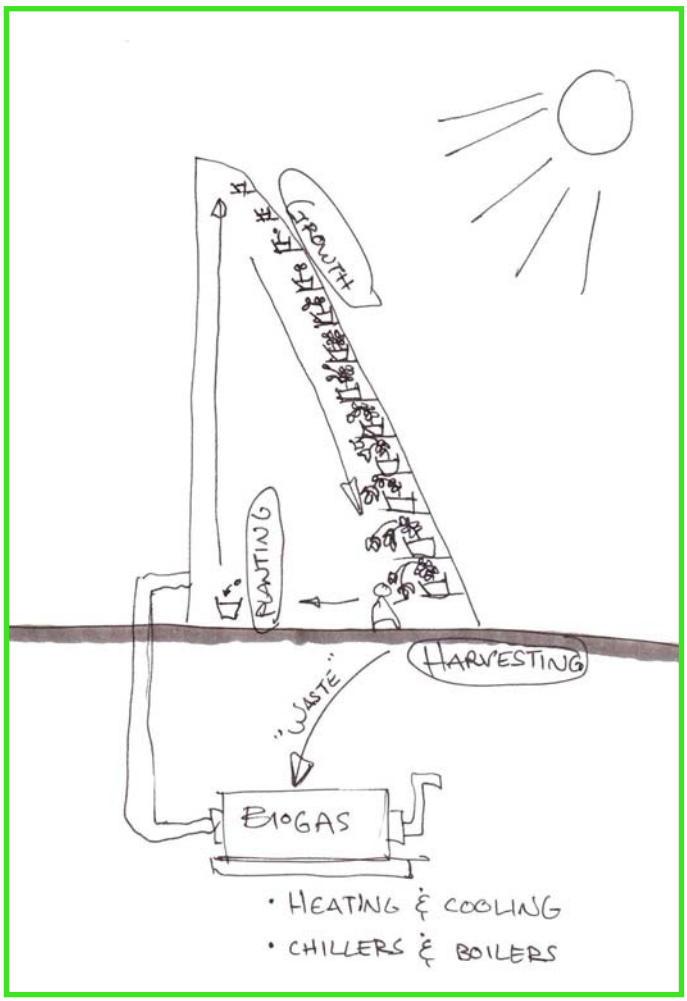


Fig. 3.35: The cycle of the plants in the Plantscraper. (Source: author, 2012)

cultivated maize, squas¬h and other plants on chinampas (man-made floating islands) and fish in the canals surrounding them (Winkler, 2011). The fish waste settled on the bottom of the canals, and the Aztecs collected the waste to use as fertilizer. The two methods are combined in a closed loop mutually beneficial system. In nature, what one group sheds as waste, another takes in as nourishment Winkler, 2011).

The systems are closed – that is, once they've been filled with water, only a small amount is introduced into the system thereafter to replace evaporated water (Winkler, 2011). The waste from fish produces natural bacteria that convert waste like ammonia into nitrate. This nitrate is then absorbed by plants as a source of nutrients. Fish excrete waste and respirate ammonia into water. Ammonia is toxic to fish in high concentrations, so it has to be removed from the fish tanks for fish to remain healthy (Winkler, 2011). Ammonia-laden water is processed to harvest helpful types of bacteria such as Nitrosomonas and Nitrobacter. Nitrosomonas turns ammonia into nitrate, while nitrobacter converts into nitrate (Winkler, 2011). Nitrate-rich water is introduced to the plants and provides the nutrients they need. The roots of the plants absorb nitrates, which come from fish manure, algae and decomposing fish feed (Winkler, 2011). The roots function as a biofilter – they strip ammonia, nitrates, nitrites and phosphorus from the water (Winkler, 2011). Then, that clean water is circulated back into the fish tanks.

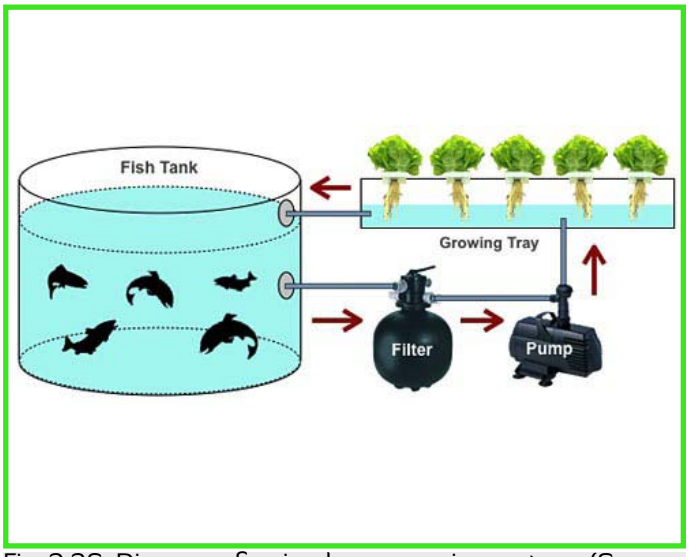


Fig. 3.36: Diagram of a simple aquaponics system. (Source: Aquaponic Gardening, 2011)



Fig. 3.37: Aquaponics shed (Source: Aquaponics Backyard, 2012)

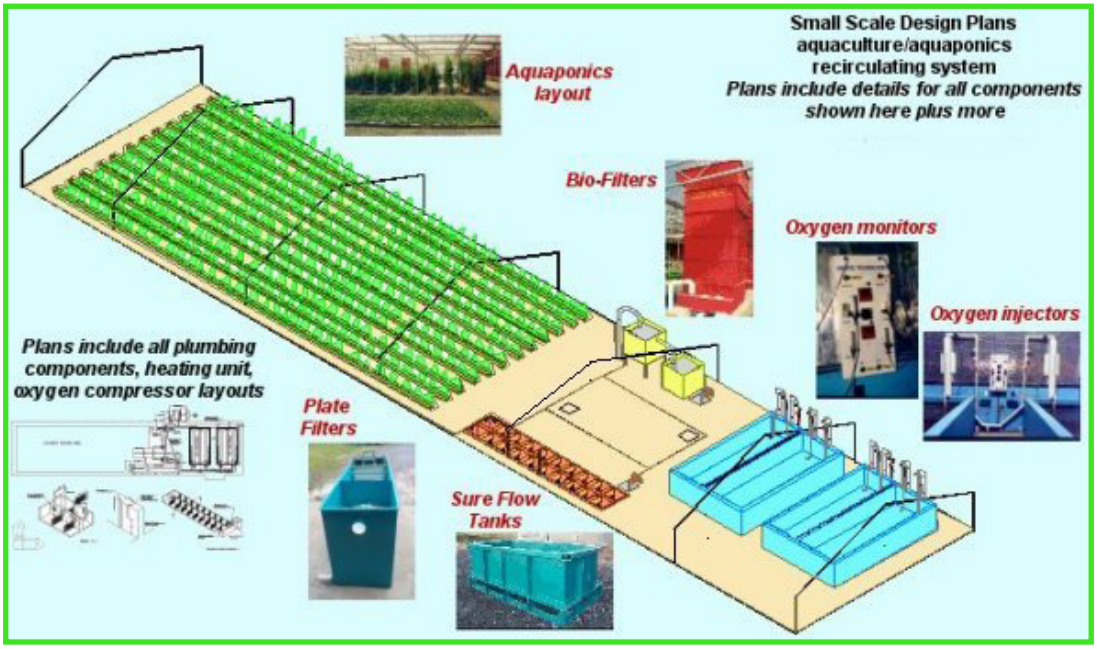


Fig. 3.38: Design of the aquaponics shed (Source: Aquaponics Backyard, 2012)

The most commonly cultivated fish in aquaponics systems are tilapia, cod, trout, perch, Arctic char and bass. But out of all of these, tilapia thrives best (Winkler, 2011). Tilapia are very tolerant of fluctuating water conditions, such as changes in pH, temperature, oxygen and dissolved solids. They also are in high demand as they are frequently sold in markets and restaurants.

In general, the best plants to cultivate in an aquaponics system are leafy greens and herbs. Lettuce, herbs and greens like spinach, chives, bok choy, basil, and watercress usually do well in aquaponics systems (Winkler, 2011). Vegetables like bell peppers, cucumbers and tomatoes can be cultivated in these types of aquaponics systems. The only plants that don't seem to respond as well are root crops like potatoes and carrots. Without soil, these crops wind up misshapen, and they're hard to harvest properly (Winkler, 2011). Additionally, aquaponically farmed vegetables grow much faster that those grown in a conventional garden.

All that is needed to house this system is a shed which allows sufficient light in. Greenhouses are perfect for this. The size is dependent on the demand.

Each of these methods and precedents show briefly how agriculture can and has been successfully incorporated into the urban context with all its constraints and hostility. Joubert Park specifically addresses T.B. patients in the inner city and has only a small growing area. Siyakhana has a larger growing area which does not directly deal with inner city restrictions. These two local examples are of limited scale and location. The City Farm example in Chicago shows how derelict corners of the city can be recycled until they are redeveloped, and the farm keeps changing and adapting organically in the shadow of the city's own mutations. This allows it to reach people from all corners of the city, as well as creating urban green spaces which beautify the site until a new building can be built. The Plantagon development demonstrates high density vertical farming which fits its socio-economic context in a first world setting.

Since adaptability is an important factor in biomimicry and food growth, I would like to briefly look at an inspiring example of adaptable architecture. This is the Coral Reef Matrix, a housing project in Haiti by Vincent Callebaut. It is a carbon neutral eco-village concept which includes placing entire modular housing communities on top of massive earthquake-resistant concrete piers (Design Buzz, 2011). This design followed a magnitude 7.0 earthquake in Haiti. Each house on the Coral Reef would have its own garden plot in order to grow food. Also there are aquaculture farms and fishing pools for the residents. Power would be generated from thermal energy conversion under the pier, marine currents, vertical axis wind turbines, and solar photovoltaics (Architecture Exposed, 2011).



Fig. 3.39: The Coral Reef Matrix. (Source: Vincent Callebaut Architectures, 2012)

All of the village would employ wind, solar and tidal power to generate electricity in a very natural way and hence help in reduction of carbon emissions (Design Buzz, 2011). Modular duplexes can be added into the housing matrix as funds and time allow, and eventually extend over the entire pier (Design Buzz, 2011). These duplexes are standardised and prefabricated (Vincent Callebaut Architectures, 2011). This basic module is simply made of two passive houses (with metallic structure and tropical wood facades) interlocked in duplex around a transversal horizontal circulation linking every unit (Vincent Callebaut Architectures, 2011). Thus the design is one of adaptability with development followed by growth. The master plan can evolve and extend itself according to the plug-in principle (Vincent Callebaut Architectures, 2011).



Fig. 3.40: Housing units. (Source: Vincent Callebaut Architectures, 2012)

The housing units are placed in two rows with a canyon between them that is filled with a tropical ecosystem for the local fauna and the flora (Design Buzz, 2011). Coral reefs with fluid and organic shapes are one of the most biologically diverse ecosystems on earth and these inspired the Vincent Callebaut architects to build the carbon neutral complex in a biomimetic manner.

So from each of these precedents a basic idea of contextual responses can be derived, and upon reviewing the context of food security in Johannesburg, as well as the organic and daily mutations that it takes on, a good understanding can be gained for what sort of response can properly address the socio-economic cast of the inner city. This can determine the correct technologies feasible



Fig. 3.41: The Coral Reef Matrix plans of housing units. (Source: Vincent Callebaut Architectures, 2012)

for our city, leading to the planting of a seed destined for healthy growth that can benefit those who need it most.

Based on the above research it stands to reason that any urban agricultural intervention that wishes to address food security needs to bear in my the mental and physiological aspects of firstly the urban context, and secondly the natural environment. It also needs to be optimised for high yields of crops in a small area. This means that it would be beneficial to use aquaponics which will allow high yields of vegetable to be grown with fish, providing a huge portion of good nutrition to the people who benefit from it.

In order to address the mental and physiological aspects permaculture allows people to be directly involved in nature and at the same time produce higher yields than modern monoculture farming. It is also beneficial to the soil, maintaining high levels of nutrients without the need for petro-chemical fertilisers or pesticides.

Therefore a combination of permaculture and aquaponics provides the necessary aspects to feed a city (in a greater sense than only food), allowing for community involvement leading to skills development of social repair.

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Fig. 3.42: Perspective showing wind turbines and the tropical plants in the canyon between each side of the matrix. (Source: Vincent Callebaut Architectures, 2012)

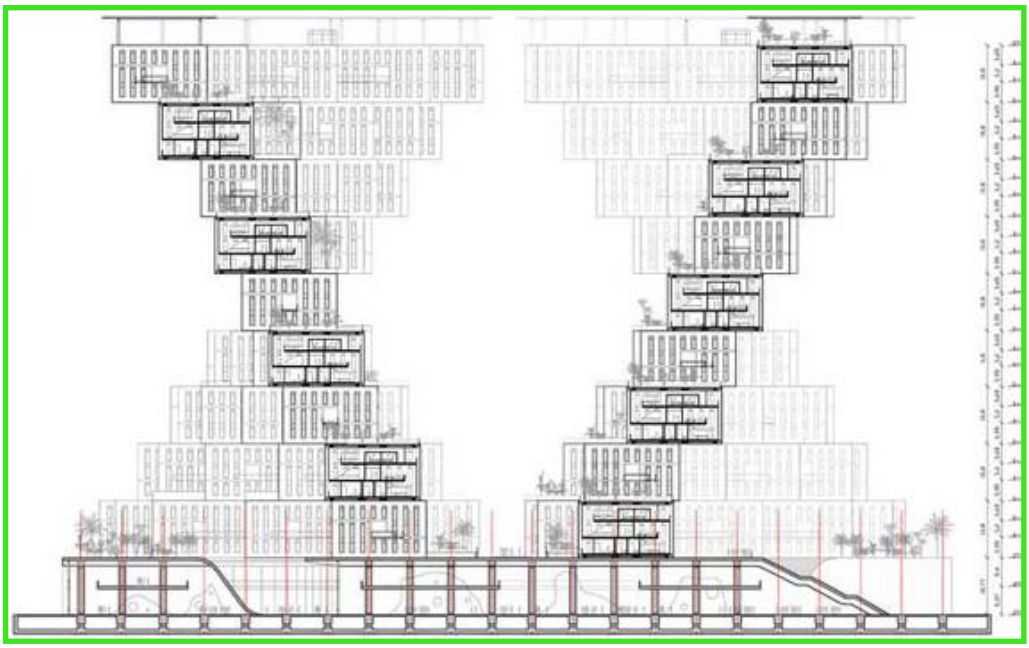


Fig. 3.43: Section. (Source: Vincent Callebaut Architectures, 2011)

Recycling the City

In a metaphorical sense, urban agriculture is the reclaiming of land in the urban context for the production of food – that is, recycling the city. It does not need to be in broad open fields, but can even happen in the left-over corners of the city. As we well know, all cities are fraught with dump sites and forgotten corners. Sometimes they may have once been buildings which have since been raised, other times the space simply never got addressed but rather ignored or buried in denial. Whether we like it or not, these spaces are a reality and form part of the city. They are typically seen as eyesores and health hazards. But to some people they are foraging grounds; to some people they are home.

It is these very places which are thought to be the degraded and dead places of the city. As stated previously, in nature there is no death, only life. The "death" of these spaces can become the fuel for new life. This is where the Lorax's last word releases its power.

Real solutions to household food insecurity lie in growth and structural change. The future growth and development trajectory depends on effective human development. Access to sufficient nutritious food and clean water underpins human development (Altman et al. 2009: 9). Food security is a complex sustainable development issue, linked to health through malnutrition, but also to sustainable economic development, environment, and trade (WHO, 2012). Sustainability is "living in such a way as to not detract from the potential quality of life of future generations" (Flannery, 2009: 3).

Since it is the poor who are first affected by food insecurity they should become the focus of an intervention. What is needed, then, is food production in the city which will provide food directly to those who have no food at lower-than-market prices; employment opportunities in cultivating the food, as well as through creating a market for selling the food, allowing those without employment or income the opportunity to change their economic situation. This draws from the Mobile CIty Farm in Chicago and creates a direct link to the informal market sector.

Also needed is a community network for people with AIDS (who are the ones at greatest risk of food insecurity), which will give them aid, food and income when they need it. This can be achieved with counselling and employment so that they can meet other people in similar scenarios, and have employment opportunities and nutrition which can be achieved through their labour in food gardens. It also addresses an inner city community which is different to that addressed by the Joubert Park garden.



Fig. 3.44: A beggar at a traffic light is a common sight in Johannesburg. (Source: author, 2012)



Fig. 3.45: A billboard in Johannesburg making people aware of climate change. (Source: author, 2012)

Through all of this it is vital that the people addressed are educated in nutrition, farming, and food so that they become knowledgeable enough to care for their own needs. This knowledge can be spread through the city like a seed, expanding the need and demand for urban agricultural interventions, as well as providing increasing food infrastructure in an affordable way, growing as the city grows.

The informal market is an ideal leverage point for intervening in the food supply system. The majority of the population buy their food through the informal market (Beery, 2012), and there are no policies in place governing the distribution of the food through agents or supermarkets (both of which ultimately increase the price of and decrease the access to food).

But what is the viability of the informal market and is it enough to warrant a development that could feed many people? Here are a few simple calculations. The De Villiers Agency at the Fresh Produce Market said that they their client base is about 30% informal traders. They also said that they themselves are a small agency bringing in only R5 million per month, while the bigger agencies bring in around R20 million a month. With an estimated twenty agents at the Fresh Produce Market the monthly turnover could be approximately R250 million. 30% of this as informal traders is R75million per month. This is a large potential market to intervene in! If an urban agricultural intervention could supply food to even as little as 10% of the informal traders and sell it at 60% of the price that the Market would (due to no expenses for chemical fertilisers or transport) its monthly income could be R4½ million. This suggests it is a viable project, not to mention the food would be of higher quality without the chemicals, and that the social benefits are great too.

Exploding, shrinking, swelled by migration and suffering environmental destruction, cities have always been and always will be in a state of flux. Change is the key experience of urbanism (Cumberlidge et al., 2007: 174). Change and growth are inseparable, and therefore the correct form of change is essential for a healthy quality of life. This thesis briefly shows how a city grows physically, socially and economically, and some of the effects these forms of growth have, particularly on the potential for future growth. Since the city is constantly growing and changing, as are people, an adaptive architecture seems suitable in order to facilitate this growth. Yet while buildings — architecture — in Johannesburg have been changing through demolition and redevelopment, the buildings themselves seem to be rather static. They do not change or allow for change unless they are demolished or completely redeveloped.



Fig. 3.46: The Kerk Street informal market where a large amount of food is sold. (Source: author, 2012)



Fig. 3.47: Fake Disneyland in China which is essentially abandoned. This is an example of how plants can adapt to the forgotten parts of the city. (Source: Ratcliff, 2011)

It is natural to change and adapt. Nature adapts. This is seen in the millions of plant and animal species adapted to their specific contexts and climates, which has led to many biodiversity systems being able to perpetuate their existence. People are natural too and have adapted over the years. Janine Benyus says in The 11th Hour (DiCaprio, 2007), "Life relies on diversity. Our technologies are natural, because we are living organisms. For example, our cars and aeroplanes are natural. The question is how well adapted are they?" Can our buildings learn from nature to be able to adapt and provide what their contexts need and live off what their contexts provide? It seems that with our current infrastructure and urban model we are unable to do that. Food insecurity, pollution, harsh social conditions and the many poor bring to question just how well adapted Johannesburg is.

Andy Lipkis says in The 11th Hour (DiCaprio, 2007):

> "Our mission is to challenge and to inspire the people of the city, after informing them, to participate in healing the city, participate in making it sustainable. How we do that: we literally start to break up the concrete, the asphalt, and put the forest back in place. We take all those things that the trees can do – the water capture, the energy and nutrient cycling, the waste recycling... So we take all the things the forest can do and we literally overlay that onto the city."

Our cities can adapt to produce food. This can be seen in the Mobile City Farm in Chicago. This project adapts as the city adapts, and at the same time it helps the city through beautification as well as helping people to adapt to have better chances for survival in the social and economic situations they face. This creates a closed system of change where one aspect of the city is in decline while another aspect recycles that which is in decline as food for improving the very same city.

Benyus further says, in The 11th Hour (DiCaprio, 2007), that the definition of success is to keep yourself alive and keep your offspring alive. Citizens of Johannesburg need food to keep growing, and Johannesburg has the capabilities for providing that food. But it needs to be able to thrive more than just grow sustainably in order to provide a suitable environment for future generations to grow. Can there be found in Johannesburg an architecture that adapts to accommodate what people need for growth; an architecture that can change as the city changes; an architecture that can turn the current waste into future food? What a wonderful opportunity of growth there is in recycling the city!

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