

# URBAN GAPS

**Good Agricultural Practice for Urban Agriculture  
CAPE TOWN EDITION on vegetables**

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Federal Ministry of Food and Agriculture

## UFISAMO

Urban agriculture for Food Security and Income Generation in South Africa and Mozambique

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## Context

Since March 2016, the Federal Ministry of Food and Agriculture (BMEL) has supported a project on Urban Agriculture in Cape Town and Maputo: „UFISAMO - *Urban Agriculture for Food Security and Income Generation in South Africa and Mozambique*“. The objectives of the project are to research the contribution of urban agriculture to improving the food and nutrition security of the disadvantaged urban population and its impact on income through optimising production, processing and marketing of horticultural and livestock products.

Applicability of research results is in the foreground: all components of the project are expected to generate information that can be “translated” into good practice examples, extension material, demo-plots, capacity development etc. The project conducts research on a broad variety of topics:

- Urban agriculture value chains
- Opportunities & Challenges of urban agriculture
- Urban agriculture research and education networks
- Local capacity development and knowledge exchange through transferring research results into policies and practices

Research is being conducted by PhD students of HU and UEM, as well as students from all concerned universities and complemented in expertise by short term consultants.

The present guidelines show results of the workshop on URBANGAPs conducted in Cape Town from 6<sup>th</sup>-8<sup>th</sup> of March 2018 and have been further developed within UFISAMO and cooperation partners. The document is the base for a farmer manual and monitoring checklist for urban PGS farmers as well as for further policy recommendations.

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We thank in advance everyone who supports us to disseminate and diffuse the URBANGAPs within Cape Town and to other cities.

We strongly believe that a qualitative and healthier, environmentally friendly urban agriculture facilitates improved farming in cities and could lead to a safer and even more agroecological way of urban horticulture production.

The workshop and research was enabled through research funding provided within the UFISAMO project. We hereby acknowledge the support of our project leader Dr. Karin Fiege, our coordinator Erik Engel and our colleagues in Cape Town, Maputo, Coventry and Berlin.

Thank you, Dankie, Enkosi

Anja Kühn & Nicole Paganini

The present guidelines on URBANGAPs - Cape Town edition for vegetables, Version 1.0 are work in progress.

We will incorporate comments, feedback, and critic in the upcoming months and publish and print a second version by February 2019.

Do not hesitate to contact us; all feedback is highly appreciated and valuable.

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## List of abbreviations

BLE	Bundesanstalt für Landwirtschaft und Ernährung/Federal Agency for Agriculture and Food
BMEL	Bundesministerium für Ernährung und Landwirtschaft/Federal Ministry for Food and Agriculture
C/N	Carbon/Nitrogen
CO <sub>2</sub>	Carbon dioxide
CSA	<i>here</i> Climate Smart Agriculture
EU	European Union
GAP	Good Agriculture Practice
IFOAM	International Federation of Organic Agriculture Movement
IPM	Integrated Pest Management
GMO	Genetically Modified Organism
NGO	Non-Governmental Organisation
PGS	Participatory Guarantee System
SAOSA	South African Organic Sector Organisation
SLE	Seminar für Ländliche Entwicklung/Centre for Rural Development
UFISAMO	Urban Agriculture for Food Security and Income Generation in South Africa and Mozambique



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# 1 URBANGAPs - Version 1<sup>1</sup> (2018)

## 1.1 Background and Objectives

Sub-Saharan Africa is one of the most rapidly urbanising regions in the world. Achieving food and nutrition security is not only a rural challenge; the access to adequate - in terms of quantity and quality - healthy and affordable food is also a growing issue for cities. Especially in the rapidly expanding informal areas, the design and implementation of a sustainable urban food system plays a crucial role for cities and is one of the biggest challenges to address for policy makers, the population and civil society, city planners and, of course, urban farmers. A more environmentally-friendly urban agriculture in line with Good Agricultural Practices adapted to an urban context (URBANGAPs) has the potential to reduce the health and ecological risks associated with conventional urban agricultural production, provides more agrobiodiversity within the city and promotes a more sustainable urban food system.

Since March 2016, the Federal Ministry of Food and Agriculture (BMEL) through the Federal Office for Agriculture and Food (BLE) has supported UFISAMO (Urban Agriculture for Food Security and Income Generation in South Africa and Mozambique) on urban agriculture in Cape Town, South Africa and Maputo, Mozambique. The objectives of the project are to investigate how urban agriculture contributes to improved food and nutrition security of the small-scale urban farmers in informal and marginalised areas of the city - likewise, how to increase income by optimising production, processing and marketing of horticultural and livestock products.



Figure 1: Urban agriculture in Khayelitsha, Cape Town's biggest township. Source: Cipriani, Paganini 2018

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<sup>1</sup> Version 1 is published in July 2018 and will be tested, monitored and evaluated in the following months. URBANGAPs as newly developed guidelines are work in progress.

Research and observation in Cape Town have shown that the improvement of production in urban agriculture is necessary as:

- Farmers have little market access due to a lack of consistent produce and of quality, lack of knowledge and experience in marketing and administration, as well as the spatial layout and historical separation of the city which makes it difficult to transport produce.
- Farmers are challenged by theft and vandalism, poor soil quality and difficult production conditions like heavy winds, strong sun and water shortages.
- Farmers invest more in inputs (compost, seeds, mulching material) than they earn from produce sales.
- Farmers have little knowledge about pest and disease prevention and plant protection. Crop rotation is hardly applied in the fields.

URBANGAPs adapt Good Agricultural Practices in line with agroecology to urban conditions and provide the knowledge and practice base for more organic methods. Importantly, they also take into consideration challenges faced in a city environment, such as Cape Town's ongoing severe drought in 2018, thus focusing on water stewardship in horticultural production. URBANGAPs incorporate appropriate site and crop planning, soil building techniques and cover crops as well as the protection of food production sites from pollution through buffer zones, windbreaks and hedges. URBANGAPs should help city farmers to follow easily explained principles, such as field hygiene, to improve their production in terms of quantity, quality and reliability - as well as to assure safety and health of soil, crop and the consumer.

URBANGAPs are not only developed for enabling access to markets for small-scale farmers, they also aim to support home gardeners to grow healthier produce for their own consumption to increase urban agriculture's contribution to food and nutrition security.

The guidelines on URBANGAPs provide farmers with an informative base on the necessary inputs and recommendations on quantities to improve cost benefit calculations of farming activities.

The first URBANGAPs have been developed for the context of Cape Town. GAP-development is planned for Maputo with the aim to design a methodology to develop GAPs in general for cities and customise them for the local context.

## 1.2 About these Guidelines

A participatory process was initiated by UFISAMO to develop URBANGAPs with urban farmers, home food growers, retailers, NGOs, the Department of Agriculture and others involved in the urban vegetable value chain in Cape Town. URBANGAPs adapt Good Agricultural Practices for vegetable production to urban conditions and provide tools to evolve horticulture cultivation to a more sustainable production while considering Cape Town's severe drought and water stewardship in horticultural production.

This document begins by describing the relevant underlying principles of agriculture and production systems (Chapter 1). The following guidelines on URBANGAPs are in tables chronologically arranged from production planning to (post) harvest handling (Chapter 2). The primary target group for these guidelines is urban farmers who wish to improve the consistency and quality of their production. URBANGAPs aim to be a user guide and field manual for urban farmers to better understand their production cycle and to have simple, clear and helpful instructions for vegetable production. The guidelines explain the production steps, as well as different good practices at the respective stages of production and what to consider when applying these. In conjunction, the guidelines are being developed as a base for an example for a Participatory Guarantee System (PGS) by the Capetonian urban PGS farmers (Subgroup of Western Cape PGS) and include a monitoring and evaluation checklist (Chapter 3).

The guidelines are also useful for NGOs as training material (in conjunction with the farmer's manual), for customers as trustworthy quality control and for urban planners and research units as a base to build sustainable urban food planning upon.

As the first global quality guideline for urban agriculture production, it aims to contribute to a scientific and practitioner dialogue along with using guidelines to inform further trials and adaptation within their local contexts.

Urban agriculture provides both, challenges and opportunities, which URBANGAPs aim to employ and address in a sustainable and environmentally-friendly manner. Opportunities and benefits are justification for NGOs and policy makers to promote urban agriculture as a primary solution towards food and nutrition security, as can be seen in the City of Cape Town's Urban Agriculture Policy (2007), as well as through the existing work of several active NGOs.

During the workshop on URBANGAPs in Cape Town, stakeholders discussed additional benefits of urban agriculture. Aside from being a source for food, urban agriculture is a way to "green the city" and create a healthier urban environment, with the potential to reduce pollution and increase oxygen. Improving diets were also highlighted as subsistence farmers consume more vegetables than other people living in marginalised sectors of the city. Stakeholders also mentioned that the benefit of the short distance between consumers and producers (mainly important for perishable products) as well as niche markets, can create income opportunities for urban farmers and help support and build the local economy. Furthermore, the urban agricultural sector provides more job opportunities and upscaling possibilities due to direct trade of agro-processed food. The stakeholders highlighted community building, networking and knowledge sharing as well as the potential to de-stigmatise farming and to promote farming as an aspirational pursuit, as further key aspects of urban agriculture.

Challenges noted by stakeholders included access to sufficient land, the size of existing land and onerous conditions for land lease. Long term planning remains a challenge for several farmers as lease contracts are only for a few years. Access to markets, transport, finance, labour, inputs (mainly certified seeds and healthy planting material) are limited and create dependency on governmental or NGO

support. Production conditions depend strongly on the quality of soil and access to water, which are challenges in the urban environment. Climate change plays another crucial role and effects the production of urban farmers with drought, incalculable heavy rainfalls and increasing temperatures.

URBANGAPs address risks of urban agriculture such as soil and water contamination, i.e. through guidelines on site selection and crop management. Other risks are contamination through human settlements or proximity of livestock. In Cape Town, many farmers work on land that is above or near former dumpsites and heavy metals are known to remain in the soil for decades. Another risk of contamination in urban environments is caused by proximity to industrial areas; pollutants can affect soil and water sources.

The main users of URBANGAPs are Cape Town's urban farmers. Their immediate aim is not to achieve certification like SAOSA organic, EU Organic or GlobalG.A.P.; instead their primary aim is to improve cultivation practices to produce in a more sustainable, healthy, and profitable way and to gain access to markets.

Urban agriculture production sites in Cape Town have a size between 100 m<sup>2</sup> to maximum 1 ha. The majority of these urban farmers are small-scale producers. Hence, third-party certification is too expensive and the niche markets which require certification are hardly accessible for small-scale producers. Therefore, the focus of the guidelines is on improved and environmentally-friendly production/cultivation practices of the farmers. Issues common to certification schemes, like pesticide application, workers welfare, traceability etc. have thus not been considered for Cape Town. Nonetheless, URBANGAPs are developed to be the base for other certification schemes.



Figure 2: Monitoring urbanGAPs in Mitchells Plain. Source: Paganini 2018

## 1.3 Underlying Principles and Agricultural Systems

URBANGAPs combine different agricultural systems and principles of healthy, sustainable, economic and environmentally-friendly farming, namely agroecological principles and methods from organic agriculture, water stewardship/water smart agriculture (as one parameter of Climate Smart Agriculture - CSA) and (none chemical) methods used in Integrated Pest Management (IPM) - focusing on their application in the urban context.

These agricultural principles and systems recommend in many cases the same techniques and measures as shown in the following sub chapters. URBANGAPs combine them as the guideline for qualitatively and quantitatively improving urban agriculture.

### 1.3.1 Urban Context

What does it mean to farm in a city? The research conducted is based on Mougeot and Van Veenhuizen's definitions of urban agriculture: To Mougeot, urban agriculture are various forms of plant and livestock production in a variety of production systems in urban and peri-urban areas (Mougeot 2001). Veenhuizen adds that it complements rural agriculture and increases the efficiency of national food systems (van Veenhuizen in FAO 2017). Agricultural production in a city provides many opportunities, possibilities, networks, access to markets, inputs and knowledge. The closeness between actors can create short value chains or greater access to niche markets. Cities provide a dynamic surrounding that creates interaction between different actors and networking possibilities. This multidimensionality of urban agriculture shows that farming in cities is not only a source of food production or income generation; it includes also social interaction, connects people to their food source and is an opportunity to educate on food and ethical value chains. One crucial point of urban agriculture is also the use of (public) space for growing and greening urban environment. In many cities, agrobiodiversity is even higher than in monoculture rural areas. In addition, economic opportunities are to be considered: urban agriculture can be a catalyst for job creation, economic growth or increased exchange.

Urban agriculture is not a new phenomenon, especially in cities in the Global South. However, it is important to address its role within the food system and its contribution to sustainability. Within a sustainable urban food system, urban agriculture can be seen as the complementary city system to feed the population sufficiently and healthily. Such a system draws attention to a more organic and environmentally-friendly urban and peri-urban production, affordable and short local supply chains, strategic urban (food) planning to use appropriate space for food production, access to knowledge, and willingness by actors to adopt innovations. A sustainable urban food system is stable and strongly interlinked to peri-urban and nearby rural agriculture (Paganini, Schelchen 2018).

On the other hand, compared to rural conditions, there are additional considerations for urban agriculture: This starts with site selection and historic research on previous land use before converting it into agricultural land. The former land use needs to be considered (e.g. dumpsites, construction areas) but also its proximity to hazardous risks such as in industrial areas and roadways. A major risk of contamination in urban spaces is the presence of heavy metals. Residues can remain in the soil, even decades after contamination. Further risks of urban space are pollution due to industries, human settlements and traffic. Health risks related to urban agriculture are often a consequence of insufficient sanitation like polluted water, untreated greywater and wastewater resulting in possible pathogenic organisms, which could affect crops. In human settlements, especially in informal areas there are risks due to unhygienic handling of human latrines and human diseases (E.coli) as well as livestock close to horticultural production areas.



Another crucial issue is access to land. The urban area is of more economic interest than many rural areas. Urban agriculture is therefore widely seen as a temporary activity and in competition with housing or other urban development needs. In the long run, investment into soil health, (time consuming) production techniques and infrastructure for agriculture remain a risk for urban growers.

Particularly in small-scale urban agriculture, it might be a step towards independence from subsidies, if some farmers start to produce seedlings to sell them within the farmer community. This creates small micro-businesses, engages knowledge and creates horticulture expertise. Such small interactions are important social and economic benefits of small-scale urban agriculture.

It is important that urban farmers learn to value their important role as growers and as producers of healthy, local and fresh food. This starts with the appreciation of their own produce, with own consumption and with confidence in marketing their produce.

Taking all the above-mentioned risks in urban crop production into consideration is crucial for urban farmers before and during cultivation periods. One tool to support the handling of risks and dangers in the urban context is a hazard tree – presented below.

## **Hazard Tree**

The hazard tree (compare figure 3, following page) is a decision-making tool that identifies risks and supports a systematic process and analysis in identifying possible future steps. Using the hazard tree as a tool for decision-making helps urban farmers to assess their plot according to possible urban risks for food production.

Starting from the top-left side of the tree, with the overall goal to practice urban agriculture, one can follow the different branches with the two twigs 'yes' and 'no' leading to the conclusion. The left part of the hazard tree asks for different criteria which need to be in place to start with urban agriculture. These are 'access to land', 'access to market', 'having a plan or vision for the farm/ garden', 'access to funds', 'inputs' and 'water'. If these conditions are not in place, the urban farmer has to rethink his or her farm plan. The right half of the tree focuses on site selection. Possible urban risks are 'site history', 'contamination', 'latrines close to the plot', 'livestock close to the plot', 'pollution', 'theft and vandalism' and 'contaminated water'.

# HAZARD TREE

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**Let us look at an example:**  
I am a farmer. I want to do urban agriculture. I answered all the questions (farm plan or vision, access to land, market, funds, etc.) on the left branches with 'yes' and I accept the urban hazards I might be challenged with while farming in the city. I analysed the risk of contamination and because I know my plot used to be a dumping site, I assume the soil is contaminated, so my answer is 'yes'. That means I have different options; I can test my soil to have a final proof, I can detox my soil, I can do container farming, I can look for new land, or I can replace the contaminated soil with new soil. If my answer is 'no contamination', I move to the next branch of the tree and analyse the next risk, e.g. 'livestock' or 'pollution'.

Challenges of Urban Agriculture

Risks for urban production



### 1.3.2 Agroecology and Organic Agriculture

URBANGAPs aim to achieve a more organic urban agriculture in the context of agroecology to refer to the global movement of nature conservation, diversity and social justice in agriculture and agrarian transformation. Altieri, one of the main researchers in that field, describes agroecology as an approach that integrates ideas and methods of several subfields – from ecological movements to agricultural science and indigenous and traditional knowledge (Altieri: 1987). It is a research field, a set of principles and foremost a social movement. This movement goes beyond food and nutrition security and reclaims food as the right of every human being. Food is seen politically and not only considered in terms of availability or enough calories to survive, incorporating the freedom to choose the kind of food, variety, and origin. UrbanGAPs are a set of principles, techniques and methods, addressing the production challenges we found out within UFISAMO research. We emphasise the principles and philosophy of agroecology and we complemented specific good practices of other agriculture systems to these urbanGAPs. We are aware that the agricultural growing methods we are referring to apply partly conflicting techniques. Climate smart agriculture permits, for example, the use of mineral fertilisers and chemical inputs. This is not recommended in the URBANGAPs-guidelines.

The Southern African food system is mainly driven by capitalism, GMO, staple crops, processed foods, and dominant supermarkets. What we observed in the urban context is that small-scale agriculture was deeply rooted in communities, where people came mainly from rural areas. South Africa's apartheid history means that a lot of traditional agriculture knowledge was lost and access to agricultural science, subsidies, agricultural land and agricultural education were mainly provided to commercial white farmers. People who farm nowadays in cities receive direction from different NGOs, who follow a certain approach of agriculture and gardening or through the governmental extension service. We see agroecology as a philosophy, which can successfully be adapted to the context of urban agriculture while applying organic techniques and joining a movement that incorporates social justice in a conflict prone sector like agriculture.

The guidelines on URBANGAPs incorporate many techniques/measures from Organic Agriculture referring to the definition given by IFOAM: "Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved" (IFOAM, SAOSA). Based on the definition given by IFOAM, URBANGAPs include various principles set within the organic agriculture movement:

- The Principle of Health: Organic Agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible.
- The Principle of Ecology: Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.
- The Principle of Fairness: Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities.
- The Principle of Care: Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment.

Organic Agriculture provides a range of farming techniques, which are integrated into URBANGAPs with the aim to have guidelines that make agriculture in cities more sustainable and more environmentally-friendly. Generally, Organic Agriculture aims to have a production system with the least external input possible. High priority is given to soil building and to carbonising soil. This means in the long run, that

carbon is added to the soil by building up organic matter (mulching). To achieve a carbon-nitrogen-ratio, that enables the soil to be fertile, lively and healthy, it is inevitable to fix nitrogen in the soil. Pest and disease management inputs are referring to the local organic standards and recommend natural products like neem, oil emulsion, sulphur and copper as fungicides. Mineral fertiliser and chemical pesticides cause harm, especially on the urban small-scale production. Therefore, organic agriculture recommends a set of production techniques, which are soil building, and increase natural fertility and agrobiodiversity, such as:

- Mulching
- Green manure and fallow land
- Minimal tillage
- Manual weeding
- Composting
- Intercropping
- Crop rotation (four years)
- Legume planting to increase C/N
- Traditional and if possible organic seeds
- Manure to be composted, not from conventional livestock
- Hedges and buffer zones to prevent pesticide or pollution from conventional neighbours
- Attract insects for pollination and natural pest management

URBANGAPs are not equivalent to organic certification schemes but can be a base to set up further quality standards. As a participatory developed tool, it can be used as monitoring and evaluation guideline for PGS certification. A Participatory Guarantee System (PGS) is a bottom up system of quality assurance. Farmers, consumers, retailers meet once a year on each other's farm to assess farming practices. A PGS should ideally be championed by the farmer's peer to peer review and consumer interaction. It is built up on trust, community and shared knowledge, has a common vision of local farmers and enables local market access. URBANGAPs will be incorporated into the Western Cape PGS as a subgroup of the urban Capetonian farmers.



Figure 4: Organic Food Garden in Stellenbosch. Source: Paganini 2017

### 1.3.3 Water Stewardship (Climate Smart Agriculture)

Climate change has become a worldwide challenge. It has direct and indirect effects on agricultural productivity including changing rainfall patterns, drought, flooding and the geographic redistribution of pests and diseases (FAO, 2018). However, awareness and knowledge on adaptation of production methods to cope with increasing environmental challenges are often rather low.

Climate Smart Agriculture (CSA) is an approach that helps to guide actions needed to transform and reorient agricultural systems to effectively support development and ensure food security in a changing climate. CSA aims to tackle three main objectives:

1. to sustainably increase productivity and incomes,
2. to adapt and build resilience to climate change from farm to national level, and
3. to mitigate climate change by reducing greenhouse gas emissions or, where possible, by increasing carbon sequestration in agriculture



Figure 5: Fezeka Garden in Gugulethu in 2016 and 2018. Source Paganini 2016/18

Although CSA differs from other agricultural development concepts by explicitly addressing climate change, it uses techniques and practices covered by other agricultural systems (i.e. Sustainable Land Management, Organic Agriculture etc.) - also on water wise production, as presented in the table on the next page:

<b>Techniques</b>	<b>When to use</b>	<b>Benefits</b>
<b>Agroforestry</b>	Little or late rain/dry-spells; heavy rain/floods; strong wind; hailstorms; high temperature	Prevents soil erosion, increases soil fertility, creates windbreaks, protects crops from heavy rain and hailstorms, provides shading from sunlight and heat, allows to keep bees to produce honey, tree leaves create beneficial mulch, provides fodder for livestock, attracts rainfall
<b>Certified seeds (drought tolerant varieties)</b>	Little or late rain/dry-spells	Early maturing, high rate of germination, bring yields and fodder even during persisting dry-spells, improve food security, tolerant to pests and diseases
<b>Compost, use of manure</b>	Little or late rain/dry-spells; heavy rain/floods; high temperature	Brings nutrients and microorganisms to the soil, makes crops look healthier and tolerant, retains soil moisture, makes food produce free from chemicals, reduces need for bought fertilisers, improves soil fertility and crop yields, increases income from selling surplus
<b>Conservation Agriculture</b>	Little or late rain/dry-spells; heavy rain/floods; strong wind; hailstorms; high temperature	Improves soil fertility and yields, soil remains in its natural state, makes work easier, reduces labour costs for ploughing, retains soil moisture during dry-spells, protects soil from heat, reduced logging as plant is growing from deeper holes that increase stability, controls soil erosion
<b>Crop rotation</b>		Diversifies and increases income, improves soil fertility and yields, reduces pests and diseases in crops, controls weeds, diversifies nutrition
<b>Improved fodder management (fodder bank, silage)</b>	Little or late rain/dry-spells; heavy rain/floods; strong wind; hailstorms; high temperature	Provides fodder during critical times/dry periods, controls soil erosion from wind and water, improved soil fertility from improved manure quality, cuttings can be sold or used as construction material, provides additional income
<b>Intercropping</b>		Improves soil fertility and yields, diversifies income, controls pests, stabilises main crop plants
<b>Mulching, cover crops</b>	Little or late rain/dry-spells; heavy rain/floods; strong wind; hailstorms; high temperature	Conserves soil moisture, protects the soil from high temperatures, produces yields even during persisting dry-spells, reduces labour requirement for weeding, conserves beneficial microorganisms in the soil, repels pests, prevents soil erosion, produces good humus layer, helps main crops to grow higher
<b>Soil testing and liming</b>		Provides knowledge about soil, improves soil fertility, improves crop yields
<b>Terracing</b>	Heavy rain/floods	Controls soil erosion, improves soil moisture retention, improves yields, maintains soil fertility
<b>Water harvesting</b>	Little or late rain/dry-spells; heavy rain/floods	Provides water during dry-spells and droughts, can be used for crop irrigation and livestock, allows production all year round, allows production for niche markets, reduces labour costs from water fetching

Figure 6: List of CSA techniques, uses and benefits in Western-Kenya (adapted from Schaller et al, 2017)

To measure positive changes arising from the implementation of CSA technologies, the World Bank in cooperation with CIAT (World Bank and CIAT, 2014) developed the following technical indicators:

- *Water smartness*: improved use efficiency, quality, conservation or capture,
- *Energy smartness*: reduced consumption or increase in use of renewable sources,
- *Carbon smartness*: higher CO<sub>2</sub> capture through increased biomass, increased soil organic matter, reduced soil disturbance or improved livestock management,
- *Nitrogen smartness*: reduced use of synthetic fertilisers, reduced nitrous oxide emissions,
- *Weather smartness*: reduced impacts of climate hazards, climate risk prevention, and
- *Knowledge smartness*: rescues and/or validates local knowledge or traditional practices.

Since 2015 Cape Town has been affected by a severe lack of regular rainfall, particularly in the catchment areas resulting in a growing water crisis, which has seriously affected agricultural production. In May 2017, ca. 37% of Cape Town's urban farmers mentioned that water restrictions decreased and hindered their production. From 2018, the use of municipal tap water for agriculture has been forbidden, but 30% of market gardens and 70% of backyard gardens use municipal tap water as a main source (own Baseline Survey 05/2017). Therefore, good water stewardship and using water-smart techniques are crucial for urban agriculture in Cape Town and these guidelines emphasis on water smartness and water-wise production.

An exchange of experiences with water saving techniques amongst the farmers was also an important focus of the discussions during the workshop on URBANGAPs-development. Effective water saving practices used by some farmers are presented below:

- Capturing of water/rainwater harvesting
- Drought-tolerant crops
- Dry-farming
- Drip and micro-sprinklers capturing (drip can reduce water use 20 - 50% and boost yields of crops)
- Irrigation scheduling and management practices
- Drainage systems
- Building soil organic matter
- Mulching
- Conservation Agriculture
- Permaculture
- Wicking beds

### 1.3.4 Integrated Pest Management - IPM<sup>2</sup>

IPM is a pest management approach that uses the best combination of pest and disease control measures to ensure a good crop harvest with minimum adverse effects to the environment. These include **cultural, physical/mechanical, biological** and, as the last resort, **chemical methods** as described below. URBANGAPs are developed to farm without mineral fertiliser and chemical pesticides. We strongly believe and good practice from all over the world, also in Cape Town, show that small-scale farming does not need application of chemical inputs.

**Cultural methods** include farming practices that prevent problems during the cultivation period by giving the plants the best circumstances for growing. Measures are e.g. crop rotation, planting schedules, plot selection and layout, associating crops, reasoned fertilisation, soil fertility, resistant varieties, soil tillage, use of trap crops, change in planting or harvesting time, intercropping with other crops or with varieties that repel pests and for sure weed control.

Field hygiene plays a crucial role before, during and after the crop cultivation. Measures to avoid infestation of crops with pests, diseases or contamination of soil and plants are, for example, destruction of crop residues (especially if infested), cleanliness of the crop zone and its environment, quality control of agricultural inputs and water, and the correct storage, use and treatment of manure, as well as the exclusion of animals.

**Mechanical and physical methods** are techniques which kill pests or prevent them from reaching the crops by physical means, i.e. hand removal of pests, collecting pests with traps, planting barrier plants on the edge of fields (maize acts as catch crop to pests), planting of windbreaks, covering crops with nets.

**Biological control** involves the use of microbial pathogens (e.g., bacterium, fungus, or virus) that attack a specific pest; or the release of natural enemies (predators and parasitoids) to control insect pests or weed species.

The use of **chemical methods** (pesticides) is the last option in Integrated Pest Management. Only if no other control measure has proven effective enough, pesticides are applied to prevent, destroy, repel or mitigate pests and diseases.

Urban agricultural farmers in Cape Town usually don't use chemical control methods for economic reasons and to achieve their objective to produce healthy and more environmentally-friendly.

Decision-making on pest and disease control measures is based on a regular monitoring of the field by farmers who are capable to identify the pests, diseases or (only) nutrient deficiency affecting their plants and to estimate the threshold of the infestation.

The guiding IPM principle is the production of healthy crops, meaning all cultivation practices should lead to good plant health at all stages. Hence, all cultural practices such as nutrient supply, irrigation, crop protection methods, environment, soil and climate in which the crops and pests and their natural enemies are interacting should be manipulated to ensure a healthy crop.

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<sup>2</sup> Source of chapter 1.3.4: adapted from Handbook of Crop Protection in Ghana: Volume 5; Good Agricultural Practices and Crop Protection Recommendations for selected vegetables (PPRSD/GTZ, 2005); mainly Blay, Ebenezer: Integrated Pest Management





Figure 7: Applying methods to avoid pests and diseases in Khayelitsha, Scagar Garden. Source: Paganini 2016

The main ways of ensuring a healthy crop production are as follows:

- Selecting fertile and suitable sites.
- Obtaining and planting in good, clean, healthy, disease free planting materials, giving a good head start to the crop.
- Adopting good nursery practices to ensure that healthy seedlings are planted on the field.
- Adopting appropriate planting distances and planting patterns to facilitate farm operations and avoid overcrowding that creates a conducive environment for fungal activity.
- Time cropping to escape periods of high pest pressure.
- Practicing crop rotation to prevent disease and pest build-up.
- Adopting good soil management practices to feed soil and therefore the crop better; and promote good sturdy growth.
- Adopting suitable water management practices to ensure suitable and balanced water supply to the crop, remove water stress and prevent water logging problems.
- Managing weeds regularly to remove competition with crop.
- Visiting fields regularly for monitoring plant growth, pest and natural enemy status and the environment for decision-making.
- Maintaining high levels of sanitation in fields to prevent the spread of pests and diseases over the farm.
- Enhancing the build-up of populations of natural enemies, beneficial to keep the pest population in check.
- Adopting good harvesting methods.
- Adopting good, clean, storage systems to ensure good produce after storage period.

Following these basic IPM principles (apart from use of chemicals) and general rules of field hygiene is a comparatively cheap and simple way for urban farmers in Cape Town to give plants favourable growing conditions during the cultivation period, to lower pest and disease pressure and thus to avoid crop and financial losses.



## 2 Overview of Good Agricultural Practices

### Introduction

All recommendations on good practices in these guidelines are based on the expertise and experiences of urban farmers and professionals/specialists from Cape Town who participated in the URBANGAPs-development workshop and in the following field trials and validation steps as well as in the peer review of this document.

Another very important knowledge base (see literature list) is built on the Good Agricultural Practices and crop protection recommendations from Ghana (PPRSD/GTZ 2005), the Good Agricultural Practice Handbook by FAO in Tanzania (Mushobozi, 2010) and the Soil for Life Training Manuals 'Grow your own vegetables' and 'Growing food in times of drought'.

It is also based on the knowledge shared in all participatory workshops conducted within the UFISAMO research and the group of research farmers.

This chapter describes all production stages chronologically from having a farm vision and site selection to harvesting and post-harvest handling referring to what practices are when, why and how to be applied. A collection and description of recommended Good Agricultural Practices (GAPs) which work in the context of urban agriculture follows. All GAPs have a reference to water stewardship (short water-wise) and apply organic, agroecological or environmentally-friendly techniques (short organic), as well as (none chemical) pest management and plant protection methods (IPM).

**The URBANGAPs consist out of the following stages of vegetable production:**

1. Farm Vision and Site Selection
2. Production and Crop Planning
3. Seeds and Seedlings – Nursery and Transplanting
4. Land and Soil Preparation
5. Soil Management and Soil Fertility
6. Fertilisation
7. Water Management and Irrigation
8. Pest and Disease Management, Field Hygiene and Weed Management
9. Harvesting and Post-Harvest Handling

## 2.1 Farm Vision and Site Selection

**FARM VISION** and **SITE SELECTION** are the very first steps of agriculture. Before starting, the producers need to have their own vision and simple business plan in mind. Site selection is a crucial factor for safe and healthy production which needs to be considered before starting any farming activity.

To have a **VISION** of their farm in mind helps farmers to stay focused and follow their own plan. Writing up the purpose and aims the farmer wants to achieve in the first year, after three years, after five years and in ten years, supports a visionary thinking and far-reaching, sustainable planning of the farm. During this step, the conditions of the farm (available land and length of lease etc.) and the farmer (available resources, time etc.) as well as the market situation (access and demand) need to be considered.

**SITE SELECTION** is the first step of starting farming activities. The farmer has to decide where the farmland will be located. Land is a challenging factor for urban agriculture as only a limited space is available for agriculture. Therefore, the ideal situation is self-owned land or a long-term lease on municipal land (e.g. schools, hospitals, churches) or other private land. The longer a farmer can stay on the land and plan with the land, the easier it is to invest in trees, windbreaks and hedges, as well as infrastructure i.e. containers, market and storage facilities etc.

Another crucial factor is access to water. The farmer needs to know the source of water (borehole, well point, municipal tap water) and the water quality. One main hazard occurring in urban agriculture is the risk of contamination due to polluted water. If affordable irrigation and water conservation methods are not feasible, the area is unsuitable for vegetable production and should not be selected.

There is a high risk of contamination of the plot in urban areas. It is necessary to identify possible sources of microbial and chemical contamination associated with the prior use of land (site history). The **HAZARD TREE** in chapter 1.3.1 (Figure 3) is a very helpful decision making tool for site selection, especially when starting urban agriculture from scratch.

Successful and economically viable production is also possible on a small piece of land if every part is used and properly maintained. A too large farm from the beginning could also be a hindering factor, as one is not always able to manage and cultivate the whole plot at once. It might be better to start with a small farm and to extend it later, maybe on a neighbouring plot or with a second farm.

To ensure that crops are grown under optimal conditions, it is important to choose the appropriate site for the variety to be sown or planted – the right exposure, soil type and structure, and slope. For example: healthy soils provide necessary plant nutrients, which are important for strong, healthy growths that help plants to resist pests and diseases.

A helpful tool for farm management is to draw a **FARM PLAN/MAP**. This can be a hand drawn design of the farmland, indicating the plots, paths, compost area, water sources and infrastructure. The plan could also include hazards or, in a further step, natural conditions like wind direction, shade or the course of the sun.



Figure 8: Production and Plot Plan at Beacon Organic Garden. Source: Paganini 2018

**RECORD KEEPING** supports the documentation of the farming activities and the income generated with urban agriculture. The farmer can compare data of previous years and note challenges and solutions to have a self-led and ongoing learning process. A farming diary can be a simple notebook, where the farmer writes down what was planted (quantity, how and why), what was used as inputs (fertiliser, pest management, how and why), and what was harvested and sold (quantities and prices). A simple cost calculation of inputs and outputs can show whether the production is profitable. It is recommended to also take notes on challenges, on solutions and on own consumption of the produce. This gives the farmer a clear picture on the impact of the farming activities.

A group of research farmers in Cape Town used a simple manual they filled in once a week on a Friday, a so-called FriDiary. The structure of the record keeping booklet is in the annex of these guidelines (5.4 FriDiary – Record Keeping Example).

1	<p style="text-align: center;"><b>URBANGAPS FOR FARM VISION AND SITE SELECTION</b></p>
1.1	<p><b>Farm vision and purpose</b> Before cultivating the land, farmers should reflect on resources, farm plan and vision as well as on possible constraints for farming.</p> <p>To be considered are:</p> <ul style="list-style-type: none"> <li>• Purpose and customer/market of farming: food garden, self-consumption, family and friends, community/neighbourhood or markets to sell the produce (to avoid production of food waste).</li> <li>• Existent and targeted market(s): high-end markets, such as supermarkets, restaurants or box schemes.</li> <li>• Food habits of clients for decision on crops to be cultivated.</li> <li>• Needed quantities and quality.</li> <li>• Acceptable prices for customers to avoid farming activity becoming an economical loss for the farmer.</li> <li>• Available time and labour resources to maintain the farm (farm size and cultivation techniques), full time job or casually.</li> <li>• Availability of sufficient start-up and investment funds to make the farm run and to maintain it until the first income from harvesting.</li> <li>• A holistic farm concept on the long run, i.e. feasibility to keep own livestock, chicken or rabbits for own manure production - separated from the production plot.</li> </ul>
1.2	<p><b>Plot assessment</b> A proper assessment of the production plot supports the further planning of the farming activities.</p> <p>To be considered are:</p> <ul style="list-style-type: none"> <li>• Size of the land.</li> <li>• Accessibility of the plot.</li> <li>• Access to water; source and quality of water (borehole, well point, municipal tap water).</li> <li>• Security of the land, consider fencing of the plot.</li> <li>• Wind direction - to plant trees, shrubs and hedges as windbreaks.</li> <li>• Course of the sun - to install, if necessary, nets or tunnels or to plant trees for shade.</li> <li>• Present vegetation on the land: some trees are heavy feeders and should be transplanted; indigenous plants can be included into the production.</li> <li>• Existing structures on the plot, like former beds or compost areas - effort has been done at these places to increase organic matter.</li> </ul>
1.3	<p><b>Logistics and equipment</b> Also logistical issues and the necessary equipment for the farm need to be planned. Consider to share/exchange equipment with other farmers in the neighbourhood.</p> <p>To be considered are:</p> <ul style="list-style-type: none"> <li>• Place/logistics for inputs i.e. manure and compost.</li> </ul>

	<ul style="list-style-type: none"> <li>• Transport facilities.</li> <li>• Equipment needed, like spade, rake, measuring stick, bucket, garden line, dibble (can be a piece of stick, old spoon), sharp knife, watering can, wheelbarrow, gloves, good shoes/boots etc.</li> </ul>
1.4	<p><b>Land history/cultivated land information</b></p> <p>It is necessary to identify possible sources of microbial and chemical contamination associated with the prior use of land for agricultural production.</p> <ul style="list-style-type: none"> <li>• Ask neighbours or former owner/user of the plot how it was used (site history).</li> <li>• Get in contact with city council on site history.</li> <li>• Use the hazard tree to take decision if the land is suitable for urban agriculture (compare figure 3).</li> <li>• Former use for animal feeding or domestic animal production might have affected ground water due to antibiotics. Small-scale livestock could have been beneficial to your soil.</li> <li>• Former use as garbage dump, toxic-waste disposal site, sanitary waste-management site, for mining activities, oil or gas extraction, for the disposal of incinerated material, industrial waste or mineral residues might have contaminated the soil.</li> <li>• Information should be obtained on former serious flooding of the plot or uncontrolled treatment with organic or inorganic fertilisers and/or pesticides.</li> </ul> <p>⇒ Contaminated soil threatens the safety of your crops - agricultural production should not take place at contaminated plots.</p>
1.5	<p><b>Soil testing/assessment</b></p> <p>Soil is fundamental for agriculture. In case of contamination, heavy metals or other residues can affect the safety of food.</p> <p>Another aspect is fertility and nutrients in the soil. Urban soils are considered as nutrient-poor due to the fact that almost all the organic matter has been removed.</p> <p>Farmers should monitor how the soil changes over time according to their management, such as changes in soil structure or in the soil profile (infrequently). Farmers shape the character of soil and determine whether it is productive or not in the long term. Even poor fertility soils like sands can produce the highest quality if managed according to URBANGAPs and associated sustainable methods.</p> <ul style="list-style-type: none"> <li>• If possible and affordable, take samples of soil for testing on contamination and nutrients every year, or as possible and as needed (as basis for a long-term strategy to build up the soil).</li> <li>• Test annually for: Total carbon (or organic matter); sodium (Na); pH; phosphorus (P); potassium (K); calcium (Ca); magnesium (Mg); sulphur (S). Most of these come from a single test and payment.</li> <li>• Micro-nutrients can be tested for infrequently as needed: Boron (B), Manganese (Mn); copper (Cu); zinc (Zn); iron (Fe).</li> <li>• Work with your extension agent (Department of Agriculture) or a specialist to interpret your results and to develop your soil management plan.</li> <li>• Develop a long-term plan on how to improve your soil: consider frequent mulching, building up of organic matter to create humus, implementation of compost heaps and</li> </ul>

	<p>regular sowing of green manure suited to the season, like lupins or broad beans in winter, or cowpeas in summer.</p> <ul style="list-style-type: none"> <li>• Test for heavy metals: arsenic (As), lead (Pb), mercury (Hg), cadmium (Cd), and chromium (Cr). This test is only done once when you begin farming as it shouldn't change over time.</li> <li>• If the plot is heavy-metal contaminated: consider container gardening or change the soil and bring in new soil and compost (very expensive).</li> <li>• Think about changing your production site, if contamination is too high.</li> </ul>
1.6	<p><b>Environmental protection considerations</b></p> <p>Plots where intensive cultivation could cause soil erosion or contamination of water resources should be avoided. Areas that are important for retention of threatened plant or animal species or natural habitats should not be disturbed.</p> <ul style="list-style-type: none"> <li>• Collect information whether your plot is close to protected areas, if the land is suitable for urban agriculture and if protected areas are not harmed due to land use.</li> <li>• Implement barriers/buffer zones (like hedges) next to protected areas to allow nature to create a corridor between protected and used land. In addition it attracts useful insects and animals that help you in natural pest management and pollination.</li> </ul>
1.7	<p><b>Site Planning</b></p> <p>The farm needs to be well planned and designed to monitor the plot as efficiently as possible, as well as addressing risks related to the urban context.</p> <ul style="list-style-type: none"> <li>• Draw a simple farm map, including water streams, roads, distances to human settlements, human latrines etc.</li> <li>• When designing a plot from scratch: consider location of production plots, path ways, water installation, composting area, logistical centre (container) etc.</li> <li>• Consider edges and make efficient use of the plot size: use edges and buffer zones for fruit trees, hedges, and indigenous perennials.</li> <li>• Consider that urban areas attract theft and vandalism: safety is crucial, use a lockable container besides fencing.</li> <li>• Raise awareness within your neighbourhood, it brings the community closer to the garden and creates identification and ownership. An aware neighbourhood supports security.</li> </ul>
1.8	<p><b>Irrigation planning</b></p> <p>In case of regular insufficient rainfall, a reliable and affordable source of supplementary water for irrigation is necessary. Gravity flow or flood irrigation is usually more manageable for small-scale farmers than sprinkler or drip irrigation but the latter options might be necessary for saving water. Water conservation measures can reduce or even eliminate the need for supplementary irrigation. If the area is subject to flooding, drainage and flood control measures must be put in place.</p> <ul style="list-style-type: none"> <li>• Collect information on your water source(s) and quality (groundwater accessed with borehole, salty water).</li> <li>• Design a water system very carefully (location of water system and production sites).</li> <li>• Ensure sufficient funding to install an irrigation system.</li> <li>• Install water saving facilities like JoJo tanks, containers etc. to harvest rainwater and to</li> </ul>

	<p>avoid the use of municipality or groundwater.</p> <ul style="list-style-type: none"> <li>• Plan water intensive plants closer to the water source than trees or hedges.</li> </ul>
1.9	<p><b>Record keeping</b></p> <p>Record keeping supports the documentation of the farming activities and the income generated with urban agriculture. This ensures traceability but furthermore supports the farmer to compare data of previous years and note challenges and solutions to have a self-led and ongoing learning process.</p> <ul style="list-style-type: none"> <li>• Try to take notes regularly.</li> <li>• Take notes on inputs (seeds, seedlings, fertiliser and compost, pest management means).</li> <li>• Take notes on outputs and harvested amounts.</li> <li>• Have a simple input/output calculation to understand, if own farming activities are economically beneficial.</li> <li>• Try to note down also observation on climate, challenges regarding market access or support received.</li> </ul>



## 2.2. Production and Crop Planning

For the next step, **PRODUCTION AND CROP PLANNING**, it is essential to first consider for whom you are planting for: self-consumption, the local community or external markets. What are products people want to eat and what products could you easily produce for a local community market? Especially in food insecure areas like the Cape Flats and for poor small-scale farmers, it makes no sense to produce food for composting and wasting if there is no market or demand for it, as it could lead to loss of income for farmers. Food waste is also an ethical concern globally.

**PRODUCTION PLANNING** is especially relevant in the context of urban agriculture, as with good planning city farming can benefit from many opportunities: access to niche markets (produce something special that a chef needs and would directly buy from you), short value chains (directly supply a restaurant or store) or short distances (especially for fresh products like lettuce, herbs). Therefore, besides the season, the farmer also needs to consider its budget (simple business plan with input/output costs). Another crucial issue is time: How much time has a farmer available for the garden? Some plants require more attention than others. Thorough planning can strengthen the opportunities for urban agriculture to create closer links between consumer and farmer, the opportunity to trade directly and have short value chains and the chance to supply either fresh or high value/niche products to smaller shops, restaurants or individuals.

A limiting factor in urban agriculture is **SPACE**. Therefore, crops that need scale, such as grains, are impossible to produce on smaller plots.

**PRODUCTION PLANNING** considers different techniques and a **CROP ROTATION PLAN**. A crop rotation plan is recommended to plan for the next four years and goes hand-in-hand with a soil-building plan. This requires ongoing planning: what is planted first, what is harvested when, what is planted next? It also factors in which inputs for production are needed: manure/compost, fertilisers, water, seed/seedlings as well as the source for these inputs: buying, collecting, own production.

It is recommended to have a variety of crops as this supports **AGROBIODIVERSITY**, attracts pollinators and supports the natural pest management strategy of the farm. Depending on the size of a garden, it is useful to create expertise in crops and focus on few main crops. With record keeping season per season, knowledge and expertise is created about certain crops that could support the farmer to increase its harvest due to an ongoing learning and improving process.

Producing on a larger scale could increase productivity, compared to a huge variety on a small scale. Going for scale (dedicating 25% to 50% of the whole plot size to one crop) means that it is essential to have crop rotation in place. The plot can be partly intercropped.

2	<b>URBANGAPS FOR PRODUCTION AND CROP PLANNING</b>
2.1	<p><b>Production planning</b></p> <p>Production planning is the decision-making process about what will happen on the land. This considers the question of whether the garden is for self-sustenance or serves as a production food garden for marketing of vegetables. Calculate also the price you aim to achieve – incorporating costs for labour, transport, marketing time and if necessary packaging material.</p> <p>Take decisions on:</p> <ul style="list-style-type: none"> <li>• What is the purpose of the farming activity?</li> <li>• What is the production system applied?</li> <li>• Who are the users/consumers of the produce?</li> <li>• How much time and money can one invest to achieve marketing goals?</li> <li>• What are the necessary resources to invest, e.g. land, inputs?</li> </ul> <p>Take into consideration:</p> <ul style="list-style-type: none"> <li>• Seasonality</li> <li>• Expected yield</li> <li>• Expected marketable quantities</li> <li>• Harvesting times (schedule) and amounts: if consistent supply is required, plant in cycles to harvest frequently which can also supply a steady income.</li> <li>• Availability of sufficient land to transplant seedlings when they grow.</li> <li>• Companion planting from the beginning to optimise yield (compare figure 9 and annex 5.2).</li> </ul>
2.2	<p><b>Crop selection</b></p> <p>The main consideration in selecting the most suitable crops for production is of course the market demand – there is no point in producing something unless someone wants to buy it or the farmer wants to grow it for own consumption. Suitability of the crop for the farmer (type) and farming system (skills, resources – machines, labour, inputs, other income generating or household activities) are important considerations. The ideal solution for farmers would be to have a plant stock that is resistant or at least tolerant to disease and various pests. Although this resistance would not last forever, because pathogens and pests can overcome it with time, it gives the plants a better chance of thriving.</p> <ul style="list-style-type: none"> <li>• Ask your customers, community and family what they want to eat and what they could buy from you, consider quantities and seasonal produce.</li> <li>• Choose mainly crops you know to grow and you have expertise in. New trials are interesting, but avoid having a whole bed planted with un-known crops.</li> <li>• Choose local varieties, adapted to the climate and circumstances of your area.</li> <li>• Avoid water intense crops like tomatoes, cucumbers or cabbages during times of drought.</li> <li>• Adapt your crop selection to the season, compare the list of winter and summer crops in annex 5.1.</li> </ul>

2.3	<p><b>Crop rotation</b></p> <p>Crop rotation means to plant crops with different requirements in rotation, such as legumes and cereals, also intercropping deep-rooted crops with shallow-rooted ones. This practice contributes to improving soil fertility and increases yields, at the same time reducing pests and diseases in crops, controlling weeds and diversifying nutrition.</p> <p>Crop rotation offers various advantages in plant protection:</p> <p><b>Best use of topsoil:</b> Several seasons of monoculture tend to deplete the layer of soil from which the plant draws its mineral nutriment.</p> <p><b>Preventing the development of diseases and pests:</b> Pest and disease pressure will build up quickly with continual cultivation. Preventing build-up of pests by crop rotation and biological or integrated methods is therefore important. Hence, repeated cultivation of the same or related crops may allow such organisms to proliferate and epidemics to develop. Some soil borne pathogens and pests of crops can live for several years on dead planting material, ready to infect a new crop. The essence of crop rotation is to starve such pests/pathogens of their preferred host.</p> <p>URBANGAPs recommend a four-cycle rotation including root crops, brassicas, legumes and onions as well as fruit vegetables (night shades):</p> <ul style="list-style-type: none"> <li>• Change plants in every plot after the production cycle and don't grow the same crop again.</li> <li>• Start planning a 4-year crop sequence or rotation plan and let light feeders follow heavy and medium feeders, and plan to plant legumes and soil builders like peas and beans after heavy feeders.</li> <li>• Follow root crops by fruit crops by legumes by leafy crops.</li> <li>• Nightshades (brinjals, tomatoes, peppers, chilies, potatoes) should be grown after legumes. Never grow nightshades after nightshades.</li> <li>• Always grow legumes before heavy feeders.</li> <li>• Root crops are recommendable after heavy feeders.</li> <li>• Grow legumes first in every cycle either as soil builder/green manure or as production crop (beans, peas) – also consider planting legumes for intercropping.</li> <li>• Dig in or cut down legumes when their flowers are showing, and before pods form.</li> </ul>
	<p>Green Manure feeds the soil with energy and nutrients, i.e. lupins, cowpeas, different types of clover (white, red, violet), alfalfa, vetch, grains like oats and buckwheat</p>
	<p>Fruit and root crops are medium feeders. They use nutrients and energy from the soil - i.e. root crops like beetroot, carrots, swiss chard, spinach or all kind of fruit vegetables like brinjals, melons and pumpkins, tomatoes and peppers, sweetcorn.</p>
	<p>Legumes are easy to cultivate and are soil builders and nitrogen fixers. i.e. beans, peas, onions, garlic, spring onions, leaks.</p>
	<p>Leafy crops, so called heavy feeders, use a lot of nutrients and energy from the soil - i.e. brassicas like broccoli, cabbage, cauliflower, kale, kohlrabi, radish, turnip.</p>
2.4	<p><b>Intercropping</b></p> <p>Intercropping is a multiple cropping practice involving growing two or more crops on the same field. The most common goal of intercropping is to produce a greater yield on a given piece of land. It improves soil fertility and yields, diversifies income, controls pests and</p>

	<p>stabilises main crop plants. It supports the soil building process during the growing phase of the plants.</p> <p>Highly recommended is to intercrop with legumes, which are nitrogen fixing plants through their root nodules. Nitrogen is one of the macro plant nutrients- and thus increases soil fertility. After harvesting the legumes, the plant residues should be incorporated into the soil as green manure for succeeding crops.</p> <p>Intercropping also limits the impact and spread of diseases and pests because one pest/disease is mostly specialised on one crop and will leave a different crop (from another species) unharmed.</p> <ul style="list-style-type: none"> <li>• Plant crops in rows and in-between legumes like peas, beans, lupins.</li> <li>• Work legumes into the soil, at the height of flowering.</li> <li>• Use flowering plants, such as marigold, phacelia alyssum and coriander, to provide shelter and attract beneficial insects such as wasps and bees.</li> <li>• Marigold also attracts beneficial insects such as bees, butterflies and wasps.</li> <li>• Consider companion planting (compare list of companions in figure 9 and in annex 5.2).</li> </ul>
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Overview on good and bad companion plants		
Vegetables	Good companions	Bad companions
Bush beans	Beetroot, carrot, celery, mealies, leeks, potatoes, strawberry, radish, cauliflower, cucumber, lettuce	Onion, garlic, chives, fennel
Beetroot	Bush beans, onions, kohlrabi, lettuce	Climbing beans
Brinjal	Bush beans, peas, Potatoes, nasturtium	
Cabbage, Broccoli, Cauliflower, Kale, Kohlrabi	Beetroot, Celery, Lettuce, Onion, Potatoes, Tomatoes, Bush Beans, herbs	Climbing beans, strawberry, garlic
Carrots	Bush beans, lettuce, leek, onions, peas, radish, tomato, climbing beans, herbs	
Celery	Bush beans, cabbage family, cauliflower, leek, tomato	
Cucumber	Bush beans, Cabbage family, celery, lettuce, radish, sunflower, nasturtiums	Potatoes
Leeks	Beetroot, bush beans, carrots, celery, onion	
Lettuce	Carrots, radish, onion, spinach, strawberry	

Onion	Beetroot, Cabbage family, carrots, lettuce, leeks	Peas, beans
Parsley	Other herbs	
Peas	Carrots, radish, spinach, turnip	Potato, onion
Potato	Bush beans, cabbage family, peas, marigolds	Sunflower, tomatoe, rosemary, cucumber, pumpkin, squash
Squash and Pumpkin	Mealies and radish	Potatoe
Strawberries	Bush beans, onion, pea, spinach, lettuce, marigolds, borage	Cabbage family
Tomato	Basil, Celery, Onion, Cabbage family	Potatoes, fennel, strawberries

Figure 9: Overview on good and bad companion plants

## 2.3 Seeds and Seedlings - Nursery and Transplanting

**SELECTION OF ON-FARM SEEDS AND OTHER PROPAGATION MATERIAL** is a critical step in Good Agricultural Practices as the right selection obtains the crop quality and can generally contribute to higher yields, improved genetic quality and hyperlocal environmental adaptation which is particularly important in times such as the current drought Cape Town faces. Planting of clean, healthy and disease-free seeds and seedlings gives a good head start to the crops. Pure/untreated certified seed should be used to avoid diseases getting into production. Certified seeds are usually healthy seeds with a good germinating rate. In South Africa, it is difficult to get organic certified seeds. Large-scale commercial seeds are treated with fungicides (identifiable by the colourful coating in bright pink, blue and green), and are not permitted in organic certification standards.

It is a common strategy to share seeds, especially amongst small-scale farmers. **SEEDS** have a strong connection to culture and heritage and events like festivals and seed swaps are platforms for storytelling, knowledge sharing and awareness raising. Harvesting within the own farm or in the farmer community, as well as sharing own seeds is a crucial and political factor in the discussion of food sovereignty and independency of small-scale farmers from industrialised agriculture and monopoly of few global seed companies.

From the perspective of healthy plant production, shared and own harvested seeds might bring in diseases from infected mother plants. Therefore, it is necessary to know the source of seeds to avoid diseases in the garden. Good seeds come from healthy mother plants, are not treated with chemical pesticides, herbicides or fungicides and are GMO free. It is ideal to use local and traditional seeds, on the one hand, to keep natural heritage and variety; on the other hand, to be sure, the plant is adapted to the natural circumstances of the farming area.

In recent years, **SEED LAWS** have been passed in South Africa as in many other parts of the continent. These laws govern the Intellectual Property of registered seeds. One law in particular, the Plant Variety Protection law (PVP), governs the types of seeds that are available on a large-scale commercial market. As a result the seed market is dominated by patented and certified seeds, mostly hybrids and often genetically modified, coming from a few global seed companies. Certified seeds are often more expensive than seeds offered on the existing markets. This discourages farmer-saved seeds from entering the market or from garnering the same kind of government or economic support as patented seeds receive. Thus, only few alternative seed sources are left for small-scale farmers and it is imperative that farmers can access seeds outside of this large-scale market or save and breed own seeds. This is especially important with the revival of indigenous seeds and food.

If the farmer considers preparing own **SEEDLINGS** in an own nursery or raised bed, it is recommendable to dedicate time on the seedling cultivation to achieve a successful output. An own nursery or raise bed supports the planning all over the year and seedlings can directly be transplanted, intercropped or sold, if suitable. Furthermore, the farmer takes advantage of the land in summer as well as in winter times, while preparing the next season with seedling production. The annex 5.1 gives an overview on winter and summer crops and the ideal month, when to plant or sow them.

A sunny place for the seedling production is recommended. This might be on a smaller scale at home, even in a closed room with direct sunlight or in an own nursery in the garden. It is recommendable to cover the nursery with a net or shade cloth to prevent the young plants from burning by too strong sunlight. The nursery should also be located in a protected area of the garden to avoid too strong winds and disturbance of the young seedlings. It is ideal to have the nursery inside a tunnel with ample ventilation.

If seedlings are bought, the source of seedlings needs to be considered and records should be kept. Big seedling providers sell seedlings usually in trays. These seedlings are produced with high quantity of input compared to the urban farms. Bought seedlings are also a risk of disease entry as the source of the seed is not known. Different fellow farmers produce seedlings and can be considered as an alternative buying source. Especially in small-scale urban agriculture it might be a step towards independency of subsidies, if some farmers start to produce seedlings to sell them within their farmer community. This creates small micro-businesses, engages knowledge and creates horticulture expertise. Such small interactions are important social and economic benefits of small-scale urban agriculture. Closeness, short value chains and diverse interests, talents and knowledge are drivers.



3	<p style="text-align: center;"><b>URBANGAPs FOR SEEDS, SEEDLINGS, NURSERY AND TRANSPLANTING</b></p>
	<p style="text-align: center;"><b>SEED PRODUCTION AND NURSERY</b></p>
3.1	<p><b>Seed planning</b></p> <p>The choice of variety arises from a compromise between the expectations of producers, distributors and consumers. It takes into account such varied features as agronomic characteristics, tolerance/resistance to various pests, storage and transportation capability, sensory and visual qualities, market niche, etc.</p> <p>Planting of uncertified seeds should be avoided; they can be a source of diseases and pests. Also seed requirements should be considered to assure healthy production.</p> <p>If there is a choice between varieties with early and late planting and harvesting dates, the one that fits best into the small-scale farming system (i.e. does not compete with other crops for land or labour at planting, weeding and harvesting time) should be selected.</p> <ul style="list-style-type: none"> <li>• Choose seeds according to the production planning, the crops you want to plant for self-consumption or on your market demands.</li> <li>• Consider buying seeds from NGO's or other local and small suppliers.</li> <li>• If own seeds are harvested, the seeds have to be harvested from the healthiest plants of the plot.</li> <li>• If sharing seeds, the farmer needs to be aware that there is no assurance on the quality of the shared seeds, as the mother plant might have been infected.</li> </ul>
3.2	<p><b>Seed harvesting</b></p> <p>Seed harvesting is an important way to become independent of the big seed industry and from subsidies of NGO or the government. It allows also obtaining seeds which are not chemically treated or genetically modified.</p> <p>Consider collaborating with other farmers and maybe indicate someone who is an expert in seed saving to grow a variety of vegetables with the main purpose of seed harvesting.</p> <ul style="list-style-type: none"> <li>• Harvest only from the best and healthiest mother plants.</li> <li>• Let these plants flourish and take the seeds out for drying.</li> <li>• Store the seeds only if they are dry to avoid diseases or fungi.</li> </ul>
3.3	<p><b>Storage of seeds</b></p> <p>Building up a small seed library supports independence. It is a collection of different seed varieties with the aim to distribute, share and disseminate them.</p> <ul style="list-style-type: none"> <li>• Clean seeds with boiled water and dry them properly.</li> <li>• Store seeds in a dry and cool surrounding and use them within three years.</li> <li>• Store seeds ideally in a screw top glass jar.</li> <li>• Store seeds in a house as opposed to a shipping container since containers have more extreme temperatures.</li> <li>• Storing in closets or cabinets is preferable to storing in a refrigerator where humidity is too high.</li> </ul>

	<ul style="list-style-type: none"> <li>• Put the names of the seeds on the storage bin as well as the date when they have been harvested or bought.</li> </ul>
3.4	<p><b>Sowing facility</b></p> <p>The nursery or raised bed should be protected from direct sunlight, prevailing winds and livestock. The soil should ideally be healthy, rich and flat with appropriate structure for sowing.</p> <ul style="list-style-type: none"> <li>• Protect the nursery against insect pests, soil diseases and nematodes (disinfected/sterilised substrate), whitefly and other vectors of viruses (aphids and thrips).</li> <li>• Use substrate being high in nutrients; ideal is a mix of homemade compost and garden soil. Too much nitrogen (mineral fertiliser) negatively affects the health of the plants.</li> <li>• The nursery should be well established, including tables to work on for sowing and transplanting, access to water and equipment for gentle irrigation.</li> <li>• Label the new plantings with sowing date and name of specie and variety.</li> </ul>
3.5	<p><b>Sowing on prepared substrate</b></p> <p>Before sowing, the soil or substrate needs to be prepared for good growing conditions for the crops and avoid sowing in infested or exhausted soil.</p> <ul style="list-style-type: none"> <li>• Use soil blocks or pots: put one seed per block or container.</li> <li>• Make pots from newspapers to reduce costs.</li> <li>• Substrate used for sowing needs to be sterilised or constantly exchanged to avoid risk of diseases.</li> <li>• The substrates used must have: good porosity; rich organic content; low salinity; good moisture retention capacity; sterility with regard to pathogens and no weed seeds; balanced mineral content; they must be free of heavy metals (lead, mercury, cadmium, etc.) or toxic substances (chlorine, arsenic, etc.).</li> </ul>
3.6	<p><b>Sowing in the soil</b></p> <p>Some crops can be directly sown in the prepared beds. From an economic point of view sowing should be regular to obtain homogeneous, regular emergence of produce and continuous yields.</p> <p>Especially in urban agriculture, the quality of soil is essential for safe and healthy crop production. Before sowing, soil preparation as described in the following chapter is to be considered.</p> <ul style="list-style-type: none"> <li>• Prepare, loosen and pre-water the soil before sowing. Water with watering cans with roses with small holes or gentle sprinklers. Avoid the use of hosepipes.</li> <li>• Sow in moist but not too wet soil and maintain the moisture content throughout the duration of the nursery.</li> <li>• Sow the seeds at a depth of 0.5 - 1 cm in heavy soil and 1 - 1.5 cm in light soil. The size of the seeds indicates how deep seeds should be sown: generally double-size of the seed is the recommended depth of the seed in the soil (small seeds are closer to the top of the soil than big ones).</li> <li>• Germination depends on the seed, soil moisture, and the soil temperature: usually 6 to 14 days after sowing. It is normal, that not all seeds germinate.</li> </ul>

	<ul style="list-style-type: none"> <li>• Irrigate continuously to keep the soil moist and support the germination process.</li> <li>• Avoid flooding the bed, as this flushes the seeds away. Drip irrigation or soft sprinklers are recommended.</li> <li>• Watering doses and frequency must be adapted. Sow seeds in rows at 20 cm intervals at right angles to the axis of the bed. Mark out and make straight furrows. Carefully refill the furrows with fine, loose soil and tamp lightly.</li> <li>• Cover young plants with a shade net, especially during hot and sunny days, to avoid burning out by the sun.</li> <li>• During winter days, a net or soil cover like mulching keeps the temperature of the soil warm.</li> <li>• Anything that carries a risk of asphyxia (heavy soil, excess water, compacted soil, sowing too deep, etc.) will lead to irregular emergence and collar and root diseases.</li> <li>• Sowing is recommended in furrows for radish, carrots, beetroot, rocket, coriander and basil.</li> <li>• Sowing distance of peas and beans for intercropping depends on the main crop of the bed and of space, so sowing can be irregular.</li> <li>• Take a stick and write the name of the sown crops to indicate what is planted.</li> </ul>
3.7	<p><b>Sowing dates</b></p> <p>The scheduling of sowing dates must consider the duration of the crop cycle (i.e. 22 to 25 weeks for cherry tomato), conditions during harvesting and crop protection. Sowing at a certain date is often necessary, so that a given stage in the development of the host plant (seedlings, for example) no longer coincides with the stage of disease contamination or pest infestation.</p> <ul style="list-style-type: none"> <li>• To determine the best sowing date, the crop growth and development cycle must be compared with the crop plan and the possible market.</li> <li>• It is also useful to consider the pest population building cycle.</li> <li>• Compare crop specific overview on ideal and recommended sowing dates in annex 5.1.</li> </ul>
3.8	<p><b>Management of young plants</b></p> <p>Ideally, small, young plants can be observed a few days after sowing.</p> <ul style="list-style-type: none"> <li>• Take young plants out, if they are growing too densely (mainly carrots).</li> <li>• Thinning the smallest seedlings out allows the other plants to grow strongly instead of staying small as too many plants are taking away each other's nutrients and space.</li> </ul>
<b>TRANSPLANTING &amp; PLANTING OUT OF SEEDLINGS</b>	
3.9	<p><b>Transplanting and planting out of the nursery</b></p> <p>In ideal circumstances seedlings are healthy and vigorous, less susceptible to subsequent stress and ready for planting out in a short time.</p> <p>The seedlings sown directly in the soil are planted with bare roots, and re-growth is less successful than sowing in prepared substrate, especially when the weather conditions are unfavorable for establishment.</p> <p>A major issue in Cape Town is the wind during planting out of seedlings which must be protected as much as possible from the wind (with windbreaks like rosemary, dune spinach,</p>

	<p>granadilla, lemongrass etc.).</p> <p>Certain plants need support during transplanting and growing. A stick is helpful for: tomatoes, peas and beans, broad beans, asparagus and grapes.</p> <ul style="list-style-type: none"> <li>• Plant out the seedlings when they have reached the 5–6 real leaf stage.</li> <li>• Sort seedlings at planting: prefer short, stocky plants with large collars that are vigorous and turgid.</li> <li>• Before planting, ensure the seedlings are fully turgid (holding water at maximum capacity) by watering the nursery sufficiently.</li> <li>• Observe ideal planting densities depending on: type of crop, development of the variety, planned pruning method, yields sought, temperature and light.</li> <li>• Plant out the seedlings at the end of the afternoon or when the sky is overcast to reduce stress to the plant.</li> <li>• Prepare small holes to plant in the seedlings.</li> <li>• Water the planting holes before planting.</li> <li>• Add liquid organic fertiliser (i.e. home-made teas) to the substrate before transplanting to strengthen the growing of the seedlings.</li> <li>• Take the seedlings with soil out of tray to settle it quickly, without cutting the roots or the stem.</li> <li>• Place the seedlings in the ground in such a way that the first real leaf is about 5 - 10 cm above the surface (if the soil is loose and not liable to water logging).</li> <li>• Avoid open roots and cover them with soil to avoid exposure to the sun. Take 2 - 3 cm of the lower stem into the planting whole to assure, that the plant is well settled.</li> <li>• Firm the soil around the seedling, with moderate pressure applied around the stem but without wounding or crushing it.</li> <li>• Water moderately after planting. Avoid excess water in the first days after transplantation to avoid the development of soil diseases (especially bacterial wilt) and to enhance root growth.</li> <li>• Avoid transplanting of already settled plants to other beds or other areas of the garden, as this causes stress to the crops and limits a good growing stage.</li> </ul>
3.10	<p><b>Spacing</b></p> <p>All crops have different needs considering space what is essential for a healthy plant. That means providing enough space for the roots to settle, having enough soil, also for keeping water around the root system as well as enough nutrients.</p> <p>Consider crop specific spacing while transplanting:</p> <ul style="list-style-type: none"> <li>• pumpkin: 1 m</li> <li>• butternut/melons/cucumber: 50 cm</li> <li>• head lettuce, celery: 30 cm</li> <li>• spinach, lettuce, kohlrabi, onion: 20 cm</li> <li>• beetroot, turnip: 15 cm</li> <li>• carrots in rows: 15 cm</li> <li>• spring onion: 10 cm</li> <li>• leek: 10 cm</li> </ul> <p>Use free space in-between crops for intercropping.</p>

## 2.4 Land and Soil Preparation

**LAND AND SOIL PREPARATION** are essential production stages for farmers and crucial in the context of urban agriculture, as many urban risks are related to the land used for farming and the availability of fertile and uncontaminated soil.

**LAND PREPARATION** considers in a first step to put the farm plan into practice and to divide the plot into different sections like nursery, production section and composting area. In addition, a container provides space for storage of garden tools, seeds and fresh produce.

As soon as the overall structure is set up, the farmer decides on the **TYPES OF BEDS**, i.e. trench bed, container gardening, high bed, hugel bed. This decision is based on the availability of money, time, wo(men) power but foremost on the requirements of the chosen crops. Essential is also, that the farmer can reach the plants easily in the beds for ongoing cultivation practices and for harvesting, that means not to have too wide beds. It is recommended to have the soil level a bit higher than the rest of the garden to support drainage of water. A possibility to keep the soil protected, avoid water drainage and damage due to heavy winds are frames (wood, stones, plastic bottles filled with sand or water) around the beds.

During land preparation, it is recommended to disturb the soil as little as possible. If tillage is considered, zero and conservation tillage are alternative solutions in land preparation to maintain soil fertility. Excessive disturbance of the existing soil layers should be avoided due to the surface of the poorer layers of the sandy soil of the Cape Flats. Especially in the urban context, much attention should be given to soil and organic matter building as urban soils are generally poor in nutrients and very compact due to human activities such as walking on the soil.

**SOIL PREPARATION** requires input, energy and work, especially if the plot is on a newly developed urban farm. It should enable the root system to spread to a depth of 40 to 60 cm for shallow root crops to ensure good water and mineral supply to the plant (loose, fine soil). This requires an uncompacted soil structure. Depending on the scale, consider tillage or digging.

The use of manure needs to be carefully considered, as raw manure is too hot and toxic for plants. Fresh manure can burn roots and leaves of the plants. Therefore it is generally recommended to compost raw manure instead of adding it directly onto and/or into the soil. Risks which may occur are contamination with bacteria, pathogens or residues of medicines applied in conventional livestock agriculture (especially when the source of manure is from conventional livestock farms).

4	<p style="text-align: center;"><b>URBANGAPS FOR LAND AND SOIL PREPARATION</b></p>
4.1	<p><b>Site preparation</b></p> <p>Before planting, it is necessary to put the farm plan into practice and transfer the plot design into the garden. That means, first create beds, paths, patterns, open spaces and infrastructure on the plot.</p> <p>Urban agriculture requires the protection of cultivated land from urban pollution like traffic pollution, waste and dump sites. With increasing salt levels in the soils of the Cape Flats, gardens might need some sort of trench system to improve leaching.</p> <p>Theft and vandalism are very high in Cape Town's urban gardens and farms. Basic safety measures need to be implemented to assure the security of farmers and visitors as well as protecting the harvest from theft.</p> <ul style="list-style-type: none"> <li>• Clear and clean the site, removing all the weeds, big rocks, waste and residues.</li> <li>• Level the plot - that includes digging a drainage system (during winter production).</li> <li>• Consider buffer zones (thick hedges or even nets, wood, bamboo poles or corrugated sheets) to the street to prevent the plot from traffic pollution.</li> <li>• Fence the fields to prevent livestock from entering. Livestock should not be allowed to graze the crop residues; they can bring in weed seeds or spread nematodes.</li> <li>• Besides fencing, lock the garden gate and your container to prevent theft. Keep all belongings locked and avoid opportunities and attraction for thefts.</li> <li>• Raise awareness for your urban agriculture activity within your neighbourhood to establish a solidarity security system.</li> </ul>
4.2	<p><b>Wind protection and anti-erosion measures</b></p> <p>These measures protect the soil from strong rains and summer winds which blow nutrients and organic matter away. Wind also dries out the soil, and will damage crop leaves by propelling sand across them. Hence, the land use system should be designed to strengthen the structure of the soil and to avoid leaving the surface exposed to wind and rain.</p> <p>Anti-erosion measures are physical anti-erosion structures or practices that can help to protect against soil erosion and minimise the loss of topsoil. Such measures are: planting bunch grasses or grass strips, planting tree hedges and shelter belts; planting perennial crops such as fruit trees with cover crops, bunds, windbreaks. They should be put in place on steep or exposed terrain and on soils liable to erosion.</p> <p>Another technique is terracing, which contributes to prevent or control soil erosion on slopes but also improves soil moisture retention and maintains soil fertility. Terracing might be too challenging for the Cape Flats and most useful around dune and mountain slopes.</p> <ul style="list-style-type: none"> <li>• Consider a drainage system, especially after times of drought with very dry soils. Rain can flood your beds, as the soil is too dry to absorb it. Too much water can cause serious damage to the soil and plants. Applying mulching, adding humus to the soil and ridging can help to prevent water logging.</li> <li>• Windbreaks are essential in Cape Town, as the summer months are characterised by heavy winds causing erosion, crop damage, and soil moisture loss.</li> <li>• Ideal windbreaks are nets or even tunnels. They also protect from strong sun and heat.</li> <li>• Natural windbreaks are trees, hedges, scrubs. Plant granadilla, pomegranate or dune</li> </ul>



	<p>spinach as windbreaks along the fence. Small windbreaks are shrubs or hedges along the beds, like rosemary, spekboom, also leafy garlic or lemon grass.</p> <ul style="list-style-type: none"> <li>• Add thick mulching to support organic matter and prevent top soil erosion.</li> <li>• Use cover crops to cover the soil: their roots keep water and the leaves cover the soil from drying out and from winds.</li> <li>• Use dune spinach as climbing plant to create a natural fence, as it grows thick and fast.</li> </ul>
<b>4-3</b>	<p><b>Urban soil</b></p> <p>Urban soils are extensively influenced by human activities and settlements, found mostly but not only in urban areas. Urban soils are furthermore very compact, with few nutrients and a human shaped consistency, also including residues of industry, buildings, streets or former agriculture. This needs to be considered for the soil management and its fertilisation while doing urban agriculture. A big risk for the health of the soil is contamination. Former dump sites, close industrial areas or mining activities are risks and contamination sources for urban farms.</p> <ul style="list-style-type: none"> <li>• If possible, make a soil test and compare heavy metal residues with allowed minimum residues (WHO). These are: <ul style="list-style-type: none"> <li>- Cadmium: 1 - 3 mg/kg</li> <li>- Copper: 50 - 140 mg/kg</li> <li>- Nickel: 30 - 75 mg/kg</li> <li>- Lead: 50 - 300 mg/kg</li> <li>- Zinc: 150 - 300 mg/kg</li> <li>- Silver: 1 – 1.5 mg/kg</li> </ul> </li> <li>• Consider, that your soil might be salty and/or sodic (high sodium), due to closeness to the ocean, salt intrusion in ground water used for irrigation, use of fertilisers and manures, and frequently dried out soils. This has a direct impact on your crop production: yellow leaves; white coatings on leaves; poor plant growth and poor yields.</li> <li>• Consider the quality of your irrigation water as this is the most frequent source of salinization. Test your water source before investing your resources into a site.</li> <li>• Urban soils are generally poorly permeable to air due to its compact structure. Continuous soil building and hoeing support soil aeration.</li> <li>• Urban soils require a lot of work to convert them into fertile and productive soils, i.e. fertilisation and building up of organic matter.</li> </ul>
<b>4-4</b>	<p><b>Soil organic carbon</b></p> <p>An essential tool in sustainable and organic agriculture and the basis of soil fertility is soil organic carbon. Increasing soil organic carbon augments soil fertility and is a mitigation step against global warming: The principle is simple, the more carbon is stored in the soil, the less carbon heads into the atmosphere.</p> <p>Especially in cities, where temperature is usually higher than in rural areas, it is essential to increase soil organic carbon to mitigate urban warming. Concepts like greening the city are a step towards a climate friendly urban surrounding. If the green areas of the cities will be used for agriculture or even fruit production, urban green will increase.</p> <ul style="list-style-type: none"> <li>• Apply methods of Conservation Agriculture, i.e. minimum tillage and thick mulching.</li> </ul>

	<ul style="list-style-type: none"> <li>• Implement agroforestry systems and plant fruit trees.</li> <li>• Add compost and animal manures to the soil and support building up organic matter.</li> </ul>
4.5	<p><b>Preparation of beds</b> As soon as the land is prepared, the plots can be designed or redesigned at the farm. That means to set barriers and create space for paths to walk through the garden. In a next step prepare the beds to get planted.</p> <ul style="list-style-type: none"> <li>• Decide on location and size of your beds; an ideal width is between 1 and 1.5 m to make the bed accessible from every side, without entering/stepping on it. It helps the daily work, when you can reach the bed easily from the paths.</li> <li>• Install a water system and distribute the irrigation system (drip irrigation or sprinkler etc.) to make the plots ready for planting.</li> </ul>
4.6	<p><b>Types of beds</b> Preparing the beds starts with decision making on the appropriate type and location of the beds:</p> <p><b>Seed Bed:</b> used for sowing.</p> <ul style="list-style-type: none"> <li>• Prepare horizontal beds, between 1 - 1.20 m wide. Raise the beds by 15 cm during rainy periods to improve drainage. A maximum length of 10 m makes access and moving around easier.</li> </ul> <p><b>Trench Bed:</b> recommendable in sandy soils, especially for heavy feeders. This type of bed requires labour, input and effort, but it is worthwhile. Especially in the poor soils of the Cape Flats, it is recommendable to do trench beds once a year.</p> <ul style="list-style-type: none"> <li>• Dig some of your soil out and separate the top soil. Digg out the bed at least for 30 cm.</li> <li>• Fill it with organic material, compost, (dry, not fresh, no pig manure), cardboard and water it. Add the top soil and mulch on top. The bed is full of not yet composted organic material, what will enrich the soil very much.</li> <li>• Do some trench beds per season and rotate it through the garden.</li> </ul> <p><b>Double-digged Bed:</b> A recommended technique for the poor Cape Flats soils and an easier version of the Trench Bed. Also a good method where drainage is a problem.</p> <ul style="list-style-type: none"> <li>• Dig the soil to a depth of 30 cm and take the topsoil aside, add 10 cm of compost or organic matter in the bottom of the bed and mix it with the subsoil</li> <li>• Add the topsoil and shape the bed</li> </ul> <p><b>Hugel Bed:</b> is variation of trench beds, recommended during droughts and to build up huge space of healthy soil.</p> <ul style="list-style-type: none"> <li>• Use wood, organic matter, branches, compost and top soil to create a small hillock to keep water inside.</li> <li>• A dense, intercropped, companion planting makes this type of bed very fertile and productive.</li> </ul> <p><b>Wicked Bed:</b> is soil free but low-tech intense, as irrigation system is under gravel. Recommendable if no healthy soil is available and for water shortages, as the systems requires less water. Input costs are high and knowledge on fertilisation is essential.</p>

	<p>A wicked bed requires some more technical input and a good irrigation system. Further information needs to be collected by experts. PEDI in Cape Town is working successfully with wicked beds.</p> <p>Other <b>substrate-free alternatives</b> like aquaponic or hydroponic systems are very cost-intensive. URBANGAPs have not worked out these alternatives, but especially in cities and especially with lack of fertile soil and water, this might be a way towards a more technical but in a long run sustainable urban agriculture. Many cities world-wide experiment with high-tech agriculture, vertical gardening or aquaponic systems.</p>
4.7	<p><b>Container gardening</b></p> <p>Container gardening is recommendable for small spaces but could be done also on a larger scale. It is recommendable if you have an industrial area around, or if you farm on a former dumpsite or close to an urban livestock farm.</p> <p>Container gardening is fairly popular in the small backyards of the Cape Flats. Gardeners use pots, bottles, buckets and even old toilets, bathtubs, old shoes, baskets or tires as containers.</p> <ul style="list-style-type: none"> <li>• Fill the container properly with rich soil. Add mulch only on the last 2 cm.</li> <li>• Place the plants outside or at the kitchen window to ensure enough light.</li> <li>• Irrigate regularly as soil is drying out quickly compared to the soil in beds. Ensure drainage in the container allowing water to run out.</li> <li>• Small space requires more nutrients: feed soil and plant frequently with organic liquid fertiliser and microorganisms (inoculants, effective microorganisms, Bokashi, etc.).</li> </ul>
4.8	<p><b>Preparation for planting</b></p> <p>Good soil levelling prevents the accumulation of water that could asphyxiate the plants or cause the spread of diseases. The field should be perfectly leveled and not too stony.</p> <ul style="list-style-type: none"> <li>• Remove weeds, stones, crop residues and waste from the plot and clean it.</li> <li>• Dig minimally with a fork spade to get air into the soil.</li> <li>• Take a rake and level the soil.</li> <li>• Consider letting the soil rest after 3 to 5 production cycles and take advantage (i.e. in winter times) to sow green manure cover crops.</li> </ul> <p>The “false sowing technique” can be used to reduce the number of weed seeds in the soil before planting. This consists of full preparation of the soil as for sowing and then watering to cause weed seeds to germinate. The weeds are then eliminated by hoeing or taking them out by hand.</p>

## 2.5 Soil Management and Soil Fertility

Working on soil is an ongoing process, starting with soil preparation (see chapter before) and continuing during the entire growing period of the plant with ongoing soil management measures. Farmers named poor soil fertility as one major challenge in the Cape Flats.

**SOIL MANAGEMENT** is the application of operations, practices, and treatments to protect the soil and enhance its performance and soil fertility. **SOIL FERTILITY** refers to the ability of a soil to sustain agricultural plant growth, i.e. to provide plant habitat and result in sustained and consistent yields of high quality. A fertile soil is characterised by the absence of toxic substances which may inhibit plant growth and the ability to supply water and essential plant nutrients in adequate amounts and proportions for plant growth and reproduction. The goal of soil management is thus to protect the soil and to enhance its productivity for profitable farming - as a healthy soil is the base for safe and organic crop production, and a healthy environment.

Soil management techniques like intercropping, mulching or crop rotation with legumes (see above) are therefore at the same time techniques of soil fertilisation. Application of compost or manure contributes to soil building but are at the same time a main component of organic fertilisation in the following chapter. Inoculating soil with beneficial microorganisms ensures that plants obtain more soil nutrients, which might be otherwise locked up.

5	<p style="text-align: center;"><b>URBANGAPs FOR SOIL MANAGEMENT AND SOIL FERTILITY</b></p>
5.1	<p><b>Mulching</b></p> <p>Mulching is the protective layer of material that is spread on top of the soil. Mulching materials is e.g. grass cutting, green weed, newspapers, cardboards, organic residues, straws, woodchips, rotten manure or compost. Mulching aims to maintain soil organic matter and allows plant stalks to rot in the field.</p> <p>Mulching has many benefits:</p> <ul style="list-style-type: none"> <li>• It increases organic matter and beneficial organisms in the soil and creates porous soil and improves the aeration.</li> <li>• Soil organic matter acts as buffer against adverse environmental effects such as higher temperature and drought. In summer it keeps soil cooler, in winter it keeps it warmer.</li> <li>• Mulch protects the soil from erosion and wind.</li> <li>• Mulching encourages growth of diverse soil fauna and aerobic microorganisms.</li> <li>• Mulching assists in the development of an absolutely critical soil component – humus.</li> <li>• It conserves moisture, reducing the needs of irrigation.</li> <li>• Mulch prevents weed growth, maintains soil temperature and keeps fruits and vegetables clean.</li> </ul> <ul style="list-style-type: none"> <li>• Chop all weeds and cut grass.</li> <li>• Put cardboard and newspapers on the bed.</li> <li>• Add a layer of organic material, dry brown material (10 cm).</li> <li>• Add a little bit of manure, compost, i.e. comfrey leaves, water, organic fertiliser.</li> <li>• Best mulch in dryer seasons, to retain soil moisture.</li> <li>• Use comfrey as an ideal fast-growing plant for mulching material.</li> </ul>
5.2	<p><b>Intercropping</b></p> <p>Intercropping is a multiple cropping practice involving growing two or more crops on the same field. It supports soil building processes during the growing phase of the plants. Highly recommended is to intercrop with legumes (which are nitrogen fixing plants) to increase the fertility.</p> <p>The main goal of intercropping is to produce a greater yield on a given piece of land. It improves soil fertility and yields, diversifies income and stabilises the main crop plants. Intercropping also limits the impact and spread of diseases and pests, which are mostly specialised on one crop and leaves a different crop (from another species) unharmed.</p> <ul style="list-style-type: none"> <li>• Plant crops in rows and in-between legumes like peas, beans, and lupins.</li> <li>• Work legumes into the soil, at the height of flowering.</li> <li>• Use flowering plants, such as marigold, phacelia alyssum and coriander, to provide shelter and food for beneficial insects such as wasps.</li> <li>• Marigold also attracts thrips and makes them moving out of the cultivated crops.</li> <li>• Consider companion planting, compare list of companions in figure 9 and in annex 5.2.</li> </ul>
5.3	<p><b>Cover crops</b></p> <p>Cover crops are crops grown for the protection and enrichment of the soil. They conserve soil moisture, protect the soil from high temperatures, reduce labour requirement for weeding, conserve beneficial microorganisms in the soil, repel pests, prevent soil erosion</p>

	<p>and produce good humus layer.</p> <p>Examples for cover crops are:</p> <ul style="list-style-type: none"> <li>• spinach or rocket</li> <li>• sweet potato</li> <li>• dune spinach or sour figs</li> <li>• rape or mustard greens (in winter)</li> <li>• nasturtium (can be difficult to remove)</li> <li>• grains like oats and buckwheat</li> </ul>
5.4	<p><b>Green manure</b></p> <p>Green manure is a fertiliser consisting of growing plants that are ploughed back into the soil or cut and used as a nitrogen source in compost making. Used are fast growing legumes producing a lot of biomass that is incorporated into the soil while green. Green manuring materials consists of green, not woody plants, plant parts or comes from a shade plant.</p> <p>Examples for green manure are:</p> <ul style="list-style-type: none"> <li>• lupins</li> <li>• cowpeas</li> <li>• different types of clover (white, red, violet)</li> <li>• alfalfa</li> <li>• vetch</li> <li>• serredella</li> </ul>
5.5	<p><b>Hoeing and aerating the soil</b></p> <p>At a certain time of plant growth, hoeing may be required for aerating the soil and for weed management. Aeration, adequate ground cover and mulching - provides both, soil microorganisms and plant roots with much-needed oxygen to breathe.</p> <ul style="list-style-type: none"> <li>• Hoe very shallow to avoid damaging roots near the surface. Hoeing doesn't mean digging.</li> <li>• Use clean tools.</li> <li>• Don't destroy organic matter.</li> <li>• Combine hoeing with weeding.</li> <li>• Avoid walking through the beds to compact the soil again.</li> </ul>
5.6	<p><b>Optimising Soil pH</b></p> <p>pH is the balance of acids and bases in the soil. Liming is the application of calcium- and magnesium-rich materials to the soil in various forms, including marl, chalk, limestone, or hydrated lime. In acid soils, these materials react as a base and neutralise soil acidity. Lime is mainly recommended for soils low in calcium and with pHs below 5.5 which need to be raised between pH 5.5 and 6.5 for optimum crop growth. If your soil is above 6.5, sulphuric acid or elemental sulphur is used to make the soil more acidic to improve crop yields. If soil is also too high in sodium, gypsum can be used. In the Cape Flats, pHs are between 7 and 8.5. Lime would not be recommended alone unless mixed with gypsum so that pH would remain unchanged. This would increase calcium and sulphur in the soil for crop use. Application amounts need to be calculated based on the results of your soil test.</p>

	<ul style="list-style-type: none"> <li>• Work lime and an equal amount of gypsum into soil once a year before the rainy season.</li> <li>• Use one gloved hand and mix it with one wheelbarrow of soil.</li> </ul>
5-7	<p><b>Managing Sodium and Salts</b></p> <p>This is an increasing challenge in many coastal areas and can be the result of normal crop production, from poor irrigation water quality, less and unpredictable rains, and a warming drier climate from global warming. Salts and sodium are present naturally in all soils, but they can accumulate to toxic levels for many crops. When there is too much, crop growth is poor (yellowing leaves, leaves die and fall off), crop yields decrease, soil becomes impermeable, soil looks flooded, plants wilt and die, and soil structure can be completely destroyed.</p> <p>Sodium and salt toxicity can be separate or simultaneous issues, and have different solutions. Applying gypsum will leach sodium out of the soil. Improving drainage in the garden by digging deep pits will leach salts out. To improve sodic irrigation water, acid injectors are a costly solution. New boreholes or depths may need to be used for cleaner water. Municipal fresh water is the cleanest option when the city is not under water restrictions, though hefty tariffs can apply. Greywater and water run-off from roofs can also offset and dilute salty/sodic irrigation water. Improving irrigation scheduling and amounts can also leach salts and stop salt precipitation when managed properly.</p> <ul style="list-style-type: none"> <li>• Retest your soil once a year to see how the soil has changed.</li> <li>• If sodium is at toxic levels, gypsum must be applied to leach sodium out of the soil.</li> <li>• Work gypsum into soil once a year before the rainy season.</li> <li>• Use one gloved hand and mix it with one wheelbarrow of soil.</li> <li>• If salts are at toxic levels, drainage ditches around the garden must be installed to a 1 m depth.</li> <li>• Grow more salt tolerant crops like asparagus, beetroot, broccoli, cabbage, cucumber, squashes, and tomatoes. Crops that grow poorly in salty soil are beans, carrots, lettuce, onions and peppers.</li> <li>• If both sodium and salts are a problem, sodium must first be leached out of the soil. Only then salts can be leached.</li> <li>• Dilute salty/sodic irrigation water with greywater, harvested rain water, or fresh water. Use these alternative water sources as much as possible to assist in leaching salts.</li> </ul>



## 2.6 Fertilisation

**FERTILISERS** are natural or synthetic materials that are applied to soils or to plant tissues to supply nutrients essential to the growth of plants. The application of organic (compost, manure) and inorganic fertiliser in correct amounts and timing, and by methods that are appropriate to agronomic and environmental requirements are essential for fertilisation. Ideally and if URBANGAPs are applied accordingly, this leads to the production of healthy crops which can better tolerate pests and diseases.

Productive soil needs large amounts of nitrogen (N), phosphorous (P), and potassium (K), the so called **MACRO NUTRIENTS (NPK)**. Cultivating and harvesting crops always removes these nutrients from the soil and farm - they must hence be regularly replaced. Nitrogen is usually absorbed with the roots of the plants and the most essential nutrient element for plants. Nitrogen fixing plants like legumes are essential to keep nitrogen in the soil. Nitrogen is needed to make chlorophyll in plant cells, which allows plants to create sugars for plant growth. Phosphorous is crucial for the plant health and strength, strong roots and the production of healthy seeds. Especially in urban soils, which are generally compact and with low organic matter, phosphorous is a limiting element. Soil erosion is one cause of phosphorus loss, and measures to reduce erosion should be taken. Potassium gives crops their quality as it is used during photosynthesis and for making proteins. Because potassium is not a mobile nutrient, plant roots must grow freely to intercept it in the soil. Properly preparing soil beds assists crop roots reaching potassium.

URBANGAPs recommend using **ORGANIC FERTILISER** and home-made products. Good crop yields are the results of fertile soils and a proper crop management. Usually, input of mineral fertilisers is not essential if all production stages are well in place. Different organic fertilisers are helpful to strengthen the plant growth or the resistance against pests and diseases. Healthy plants are healthy foods.

The poor conditions of the Cape Flats demand ongoing soil management by building up organic matter to increase soil health and functioning. Soil building is therefore a fundamental task of an urban farmer and their own compost production supports this efficiently, economically and naturally. An essential duty for every production site is therefore making one's own **COMPOST**. It brings nutrients and microorganisms to the soil, makes crops healthier and tolerant, retains soil moisture, reduces need for bought fertilisers, improves soil fertility, increases crop yields and makes food free from chemicals.

There are interlinkages between fertilisation and crop protection. Whether applied on the ground or in the form of a nutritive solution, the type of fertiliser must be balanced. Excessive use of nitrogen should be avoided. Overly vegetative, vigorous growth facilitates the development of various diseases, predatory insects and weeds. Rational use of fertilisers is important when farmers are facing economic constraints and try to limit production costs.

6	<p style="text-align: center;"><b>URBANGAPs FOR FERTILISATION</b></p>
	<p style="text-align: center;"><b>ORGANIC FERTILISATION</b></p> <p style="text-align: center;">To feed the soil - apply compost in Autumn. To feed the plants - apply compost in Spring.</p>
6.1	<p><b>Composting</b></p> <p>Compost is natural fertilisation and plant nutrition. Composting is a biological process by which organic material is broken down and decomposed to plant available nutrients. The heat produced by the microorganisms during the composting process not only contributes to their own growth, but also speeds up the decomposition process and helps in killing pathogens and weed seeds. In addition, it helps to hold water in the sandy soils for longer. Start to have your own compost or earthworm farms by using all the organic waste from the farm and also the kitchen. Farmers can work with their neighbours and customers to get even more organic waste for making higher amounts of compost.</p> <p>A specific urban risk is microbiological contamination. Human and animal fecal materials are important sources of contamination of produce. Organisms linked to these sources include <i>Salmonella</i>, anaerobes such as <i>Enterococcus</i>, and other intestinal bacteria. One of the most infectious organisms prevalent in animal manure is <i>Escherichia coli</i> O157:H7 (E. Coli) that usually derives from the faecal material of ruminants such as cows, sheep and pigs, but also human waste.</p> <p><b>How to create a compost heap:</b></p> <ul style="list-style-type: none"> <li>• Build it in a sheltered place if possible, e.g. next to a wall or fence and in the shade.</li> <li>• Loosen the ground with a fork and mark out the area with a spade (at least 1 m wide and 1 m long).</li> <li>• Lay down the first layer of rough material, e.g. branches, mielie stalks, cabbage stalks and hedge cuttings.</li> <li>• Next put a layer of brown material e.g. dead leaves, dead plants and dry grass cuttings.</li> <li>• Add a layer of green material, e.g. grass cuttings, green leaves and kitchen waste. Take care, that kitchen waste doesn't attract mice and rats and keep it covered or closed.</li> <li>• Next add a layer of manure. After manure, add 2 cups of bone meal and handfuls of gypsum, wood ash, mature compost or healthy soil.</li> <li>• Water each layer well as you go.</li> <li>• Keep on repeating these layers until the heap is 1 to 1.5 m high.</li> <li>• Water your pile regularly, turn it over with a fork every 2 to 4 weeks.</li> <li>• It will take about 6 months until it is ready. The compost should be dark brown and crumbly.</li> <li>• Keep the heap covered with a breathable material like shade cloth.</li> <li>• In winter, cover with plastic to protect it from rain and from leaching.</li> </ul> <p><b>Application of compost in the garden:</b></p> <p>The soil quality and the respective crop requirements specify the amount of compost to be applied.</p> <p>For very poor and sandy soils, when beds are newly prepared, use:</p>

	<ul style="list-style-type: none"> <li>• 30 kg compost / m<sup>2</sup> for heavy feeders</li> <li>• 20 kg compost / m<sup>2</sup> for medium feeders</li> <li>• 10 kg compost / m<sup>2</sup> for light feeders</li> </ul> <p>For already existing, well-maintained beds, that have been mulched regularly, less compost is necessary:</p> <ul style="list-style-type: none"> <li>• Mix the compost with top soil, work it in with clean tools to 15 cm depth.</li> </ul>
6.2	<p><b>Vermicomposting</b></p> <p>A very productive and small-scale opportunity for composting is vermicomposting. Earthworms easily and quickly de-compost kitchen residues, leaves, newspaper, coffee grounds, and egg shales.</p> <p>The liquid coming out of the composting process – the so called earth worm tea - serves as liquid fertiliser (1:10 ratio mix with water), especially as growing booster.</p> <ul style="list-style-type: none"> <li>• Use a dark container, basin or box for the worms with some vent holes.</li> <li>• The box has ideally a double bottom, that compost can trickle down and the worms are with kitchen waste, newspaper, coffee ground in the second “floor” of the box.</li> <li>• The box can alternatively have two sections with a coarse screen in the middle. In this type, add wastes to one side at a time until it is full, then add waste to the other side. Remove the mature compost from the full side and put anything not decomposed into the new side. The worms will move through the screen to the fresh waste in the new side.</li> <li>• Look for worms weekly to assess how the system is working. Make sure it is draining freely and water never builds up. It should always be moist, never soaked.</li> <li>• Remove mature compost monthly and work into the soil before a bed planting.</li> <li>• Add new worms once a year if you see they have died or the compost isn’t properly working.</li> </ul>
6.3	<p><b>Use of manure</b></p> <p>When animal manure is used as fertiliser without proper treatment, there is danger of contamination of fruits and vegetables with pathogenic bacteria. These bacteria can cause gastrointestinal and other illnesses to humans.</p> <p>Human and animal faecal materials are important sources of microbiological contamination of produce. Organisms linked to these sources include <i>Salmonella</i>, anaerobes such as <i>Enterococcus</i>, and other intestinal bacteria. One of the most infectious organisms prevalent in animal manure is <i>E. coli</i> O157:H7 that usually derives from the faecal material of ruminants such as cows, sheep and pigs. Other significant hazards found in human and animal faecal material includes <i>Cryptosporidium</i>.</p> <ul style="list-style-type: none"> <li>• Compost/break down raw manure before applying on the beds to avoid health risks.</li> <li>• Best use manure coming from small-scale organic farmers.</li> <li>• Manure from pigs is very acidic, so only use it if your soil’s pH is over 6.5. Chicken and duck manure can be mixed with soil in small portions. Manure from cows and horses needs to be composted before applying.</li> <li>• Don’t use manure from human beings or household animals.</li> <li>• Consider pellets instead of raw manure, if you are not sure, about the source of the manure.</li> </ul>

	<ul style="list-style-type: none"> <li>• Don't put manure on top of your plant, as this could infect the plant.</li> <li>• The safest way to apply manure is to mix it into the upper 15 cm of soil before (not after) planting. Don't leave manure on top of the soil as this doesn't help the plant or the soil and can infect crops.</li> <li>• Don't use too fresh manure, as high nitrogen and ammonium levels could burn the roots.</li> </ul>				
6.4	<p><b>Home-made liquid fertilisers</b></p> <p>A good way to feed your vegetable seedlings is by making liquid fertilisers - like home-made teas made from different herbs, comfrey, nettle, manure, earth worm compost and mixed with water. Liquid fertilisers support plant strength and soil nutrients as nitrogen is put into the soil.</p> <p>Preparation of homemade liquid fertiliser:</p> <ul style="list-style-type: none"> <li>• Fill a bucket one third with nettle or comfrey leaves and fill it up with water.</li> <li>• Put about 1.5 wheelbarrows of fresh manure (chicken, cattle, and rabbit) in a 200 litre drum. Mix well.</li> <li>• Cover the bucket or drum with a lid. Let the mixture stand for 1 week.</li> <li>• Stir well once or twice a day.</li> <li>• When it is ready, strain it through a woven plastic bag or screen to get the pieces of manure and leaves out.</li> </ul> <p>Application of homemade liquid fertiliser:</p> <ul style="list-style-type: none"> <li>• Mix the liquid fertilisers with water (1:10) before applying.</li> <li>• Use a watering can or bucket and gently pour it on the ground around the plants. Do not pour it on the leaves or they may burn.</li> <li>• Water the soil around the crops with liquid fertiliser every 2 weeks.</li> </ul>				
	<table> <tr> <td> <p><b>Manure tea</b></p> <p>When: For young plants as a booster.</p> <p>How: Use a hessian sack of manure and hang the bag into a bucket filled with water. Let it rest for two weeks. 10 Litre of manure tea are sufficient for one square meter.</p> <p>Application to roots.</p> </td><td> <p><b>Compost tea</b></p> <p>When: Seedling production as it contains many nutrients.</p> <p>How: Use a hessian sack of compost and soak for one night.</p> <p>Use it 1:2 ration with water.</p> <p>Application to roots.</p> </td></tr> <tr> <td> <p><b>Seaweed tea</b></p> <p>When: To strengthen the root system, it contains many minerals.</p> <p>How: Soak one bag of seaweed in a bucket of water for two weeks.</p> <p>Use it 1:2 ration with water.</p> <p>Application to roots.</p> </td><td> <p><b>Comfrey tea</b></p> <p>When: To supply nitrogen to the plants.</p> <p>How: Soak one quarter of bucket with comfrey leaves for one or two days.</p> <p>Use it 1:1 ration with water.</p> <p>Application to roots.</p> </td></tr> </table>	<p><b>Manure tea</b></p> <p>When: For young plants as a booster.</p> <p>How: Use a hessian sack of manure and hang the bag into a bucket filled with water. Let it rest for two weeks. 10 Litre of manure tea are sufficient for one square meter.</p> <p>Application to roots.</p>	<p><b>Compost tea</b></p> <p>When: Seedling production as it contains many nutrients.</p> <p>How: Use a hessian sack of compost and soak for one night.</p> <p>Use it 1:2 ration with water.</p> <p>Application to roots.</p>	<p><b>Seaweed tea</b></p> <p>When: To strengthen the root system, it contains many minerals.</p> <p>How: Soak one bag of seaweed in a bucket of water for two weeks.</p> <p>Use it 1:2 ration with water.</p> <p>Application to roots.</p>	<p><b>Comfrey tea</b></p> <p>When: To supply nitrogen to the plants.</p> <p>How: Soak one quarter of bucket with comfrey leaves for one or two days.</p> <p>Use it 1:1 ration with water.</p> <p>Application to roots.</p>
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6.5	<p><b>Use of other organic fertilisers</b></p> <p>Certified fertilisers like pellets and Bio-Ocean might be accepted during fruiting time.</p> <ul style="list-style-type: none"> <li>• Consider recommended quantities and timing, follow instructions on the label.</li> </ul>				

	<ul style="list-style-type: none"> <li>• Don't apply the products when the fruit or vegetable is nearing maturity or harvest.</li> <li>• Rather use less than too much of the products.</li> <li>• Apply products near the roots and cover it with soil.</li> </ul>
6.6	<b>Storage of organic fertilisers</b> <ul style="list-style-type: none"> <li>• Keep the location for storage and treatment of animal manure away from the production areas.</li> <li>• Cover manure piles with plastic or other materials and/or store it under a shed to avoid runoff of organic material containing pathogenic bacteria during rain (contaminating fields, equipment, etc.).</li> <li>• Use barriers or some type of physical containment as part of the manure storage areas to prevent contamination of produce or production areas by pathogens spread by rain wash, subterranean water flow or wind spread from the stored manure.</li> <li>• Store small amounts in plastic bags.</li> <li>• Minimise contamination of groundwater supplies by storing animal manure on a cement floor or in special holes lined with clay.</li> </ul>
<b>INORGANIC FERTILISATION</b>	
6.7	<b>Management of inorganic fertilisers</b> <p>Inorganic fertilisers are obtained via commercial chemical processes. Although the products themselves are generally not a source of microbial contamination, care should be taken to assure that contamination is not introduced using contaminated water to mix the products or unclean equipment during application.</p> <p>The dosage of each nutrient must be appropriate to actual conditions in each field (this requires a soil analysis every three years).</p> <p>If applying mineral fertiliser, follow instructions and don't over-fertilise your soil.</p> <p>Mineral fertilisers are not recommended for small-scale production. They reduce soil organic matter, harm soil structure, and impair its microorganisms. In case the farmer wants to apply them, an extension officer or NGO trainer should be consulted to avoid over-fertilisation.</p> <p><b>Application time:</b></p> <ul style="list-style-type: none"> <li>• Apply basal dressings, where required, at seed bed preparation time.</li> <li>• Apply top dressings only when the plant can take them up.</li> <li>• Don't apply fertilisers during periods of heavy rain, waterlogging or unusual climatic conditions when the danger of leaching is high.</li> </ul> <p><b>Application method:</b></p> <ul style="list-style-type: none"> <li>• Small-scale farmers: apply fertilisers by hand close to the take-up point of the roots.</li> <li>• Work fertilisers into the soil to avoid leaching or runoff.</li> <li>• Avoid large single doses as uptake is generally improved and leaching reduced when smaller doses are applied at intervals. Try micro-dosing with bottle caps, one cap for each plant.</li> <li>• Wear gloves during the application of fertilisers and remember to wash hands after application.</li> </ul>

	<ul style="list-style-type: none"> <li>• Avoid inappropriate use of fertiliser; the application should be done by an aware farmer.</li> </ul>
6.8	<p><b>Storage of inorganic fertiliser</b></p> <p>Storing the fertiliser out of the public avoids misuse. People who are not farmers can misuse these substances, and children may be harmed if they play with them or ingest them. Hence, they must be secured away from open or common areas.</p> <ul style="list-style-type: none"> <li>• Store fertiliser (especially mineral fertiliser) separately from food, seeds, pesticides and animal feeds.</li> <li>• Store fertiliser in a dry place with a solid floor (metal container, concrete, etc.) and secure it by padlock.</li> <li>• Position fertiliser store away from water sources to reduce the risk of contamination.</li> </ul>

## 2.7 Water Management and Irrigation

**IRRIGATION** is one of the key activities in the garden since water is one of the main inputs for plant growth. The ongoing and severe drought in Cape Town lets farmers face more and new challenges.

To guarantee reliable and economically viable crop yields, application of irrigation water to supplement natural rainfall is frequently needed. However, water is a costly input, often in short supply and not always of the desired quality. Hence, particularly for resource-poor small farmers, it is essential that sustainable and cost-effective methods of applying and **MANAGING WATER** are adopted, and that the quality of the water applied and its impact on soil and crop water balances is carefully monitored.

- **Water quantity:** application of only the quantity required for optimal crop growth. Many irrigation systems apply more water than the plant or the soil can absorb, leading to waste of a scarce resource, drainage problems and unnecessary expense.
- **Water quality:** ensuring that the chemical content of the water applied does not lead to soil salinity or affect the quality of the irrigated crop.
- **Application method:** choice of a method of applying water to the crop that is low cost and easily managed by small-scale growers.
- **Drainage method:** avoiding risks of water-logging and, wherever feasible, recycling the use of excess irrigation water.

Usually, water for agricultural use comes from surface sources such as rivers, streams, and reservoirs; groundwater from wells (open or capped); public water systems, such as those provided by towns or other municipalities.

Surface water can be exposed to temporary or intermittent contamination. This contamination can come from raw human and animal wastes, sewage water discharges, and water coming from adjacent lots dedicated to animal production, or other contamination.



7	<b>URBANGAPS FOR WATER MANAGEMENT AND IRRIGATION</b>
7.1	<p><b>Irrigation planning</b>  Mainly in case of regular insufficient rainfall, a reliable and affordable source of supplementary water for irrigation is necessary. There are three mayor water sources in Cape Town: ground water accessed with boreholes or well points, municipality water accessed at public points or private taps, and harvested rain water.  Water conservation measures can reduce or even eliminate the need for supplementary irrigation.</p> <p>To be considered is:</p> <p><b>Water sources</b></p> <ul style="list-style-type: none"> <li>• Decide on the best water source(s) for you farm.</li> </ul> <p><b>Water requirement</b></p> <ul style="list-style-type: none"> <li>• Consider the water requirement of your soil type: on sandy soils, irrigation should be more frequent than on heavier soils.</li> </ul> <p><b>Water quality</b></p> <ul style="list-style-type: none"> <li>• Test irrigation water once a year to monitor salt, iron, chlorine, and lime levels, and assess biological risks (e.g. E.Coli).</li> <li>• Avoid saline water, which will cause an immediate drop in yield and poison the soil.</li> <li>• Avoid irrigating directly with chlorinated water.</li> </ul> <p><b>Watering regularity</b></p> <ul style="list-style-type: none"> <li>• From the moment of emergence, the plant must never be subjected to water stress. The emergence and flowering/pod formation stages are particularly sensitive.</li> </ul>
7.2	<p><b>Scheduling of irrigation/watering</b></p> <p>To be considered is:</p> <p><b>Frequency of irrigation</b></p> <ul style="list-style-type: none"> <li>• Do not water too often until the crop has begun to put down roots to encourage the establishment of the root system and deeper rooting.</li> <li>• Avoid excessive watering to prevent root collar diseases.</li> <li>• Based on annual rainfall and soil salt levels, some soils may need a well-managed, consistent irrigation schedule that allows salts to leach out.</li> </ul> <p><b>Timing of watering</b></p> <ul style="list-style-type: none"> <li>• Water early morning and late afternoon, not during the day - between 10 am and 5 pm the soil and sun are hot: The water will burn your crop, causing diseases, bacteria problems, dying of plants and it attracts aphids.</li> <li>• Watering in the morning allows you to use the moisture from mulching material.</li> <li>• Even if it is hard to be early in the morning in the garden, you save water if you irrigate as early as possible and you avoid crop damages.</li> <li>• If affordable, an automatic irrigation system between 4.30 and 8.30 am in the morning</li> </ul>

	and 6 to 8 pm in the evening during summer times is recommended.	
7-3	<p><b>Irrigation practices</b></p> <p>The common methods used in irrigation are: surface (furrow or flood); overhead (sprinklers); trickle (drip or buried) and micro-sprinklers.</p> <p>The use of water saving irrigation systems is very important during the drought in Cape Town.</p> <p>The type of irrigation system chosen is important for the crop safety because it determines the amount of contact between the irrigation water and the produce. Where water quality is unknown or cannot be controlled, growers are advised to consider irrigation practices that minimise contact between water and the edible portion of the crop.</p> <ul style="list-style-type: none"> <li>• Maximise water infiltration and minimise unproductive efflux of surface water from watersheds.</li> <li>• Drip irrigation is water saving and better than sprinklers as wind blows water away and doesn't reach every corner of your garden.</li> <li>• Using drip irrigation systems depends on the plot size – it can be an expensive investment and drip irrigation is difficult with crop rotation and intercropping due to fix pipes.</li> <li>• Planting bags combined with drip irrigation (container planting) – save water and soil can easily be changed, also when plants are infested.</li> <li>• Micro-jet sprinklers also save water.</li> <li>• Both drip lines and micro-jet sprinklers need regular maintenance such as cleaning or washing out to prevent lime and iron from clogging pores and lines.</li> <li>• For small plots: Burying 2 litre bottles to water as drip irrigation (start small) – goes together with indigenous crops, which don't need too much water.</li> <li>• The use of horse pipes is very common, but they wash soil away and need a lot of water.</li> </ul>	
	Water tomatoes and other fruit vegetables to the base and not on the leaves.	Water pumpkins and melons only in the morning to avoid moist leaves during the night.
7-4	<p><b>Water harvesting techniques</b></p> <p>In times of drought it is essential to take advantage on every rain and save as much water as possible.</p> <ul style="list-style-type: none"> <li>• Install a JoJo tank to save rain water from the roofs of houses and shacks.</li> <li>• Use buckets and watering cans to fill up, when you know there will be rain.</li> </ul>	
7-5	<p><b>Other water saving techniques</b></p> <p>Improving soil structure and increasing soil organic matter content supports efficient water usage.</p> <ul style="list-style-type: none"> <li>• Directly water to the plant roots instead of watering surroundings, plant leaves, or unplanted ground.</li> <li>• Mulching is part of water management to keep in moisture and water less.</li> <li>• Soil improvement helps saving water (add a lot of organic material to your soil), conserving soil – good soil absorbs water better and longer.</li> <li>• Tunnel production saves water.</li> </ul>	

	<ul style="list-style-type: none"> <li>• Water at the right times: early morning or evening.</li> </ul>
7.6	<b>Water wise plants</b> <ul style="list-style-type: none"> <li>• Companion planting saves water, i.e. water plants, indigenous plants – sweet potatoes, dune spinach.</li> <li>• Succulents, i.e. spekboom, keep water in the soil.</li> <li>• Don't plant water intense plants during drought like cabbage, tomatoes, cucumbers, butterhead, lettuce, carrots and beetroot.</li> <li>• Crops, tolerating dry spells are swiss chard, beans and most herbs.</li> <li>• Crops with low water requirement are onion, turnip, squash, potato and sweet potato, sugar bean and most indigenous crops.</li> </ul>
7.7	<b>Farming during drought</b> <ul style="list-style-type: none"> <li>• Respect water restriction and do not use municipality water.</li> <li>• Avoid moving the soil too much, digging and hoeing supports evaporation.</li> <li>• Build up a resilience plan and water harvesting strategies.</li> <li>• Consider stopping farming during hot summer month if water restrictions are put in place to avoid that plants die due to water shortage.</li> <li>• Use this time to rework the garden structure and to prepare for cooler months and end of the summer, or plant green manure cover crops before the dry season to protect the soil and its moisture.</li> <li>• Stop farming completely during severe droughts if you do not have alternative water sources.</li> </ul>
7.8	<b>Use of grey water</b> Grey water is one alternative source of irrigation during times of water restriction. <ul style="list-style-type: none"> <li>• Avoid, that grey water touches leaves.</li> <li>• Use grey water only if the plant is well established.</li> <li>• Consider to mix grey water with tap water.</li> <li>• Don't use grey water for root vegetables.</li> </ul>

## 2.8 Pest and Disease Management, Field Hygiene and Weed Management

Pest and disease pressure will build up quickly with continual cultivation. Crop losses due to pest and disease problems are usually very high. The main goal of plant protection is ensuring economic and sustainable production of healthy crops. All practices undertaken in the growing of a crop should thus lead to **GOOD PLANT HEALTH** at all production stages.

A good beginning is an important step in the fight against pests and diseases. A lot of field problems can be avoided, minimised or managed by selecting the right production site and manipulating and guiding the **CULTURAL PRACTICES** (i.e. crop rotation, nutrient supply, irrigation) or conditions and habitat (environment, soil, climate) to favour the crop - and not their pests and diseases.

It is better to grow and protect healthy plants by **PREVENTING** attack rather than attempting to cure symptoms. In many cases diseased plants cannot be cured and constitute a source of infection for surrounding healthy plants. Conditions which promote the spread and activity of pests and diseases should thus be avoided. Here, the role of **HYGIENIC OR SANITARY MEASURES** (i.e. rogueing, burying of infested crop residues, clean growing zones) cannot be overemphasised.

Since weeds can serve as alternate hosts, a regular **WEED CONTROL** is inevitable.

When it becomes necessary, and economic losses are mounting, the **CURATIVE CONTROL** of pests and diseases can be approached from various angles: mechanical/physical measures, biological control, or chemical control as the last solution and not recommended for small-scale farming oriented towards an environmental friendly/organic production in Cape Town.

Pest and disease problems are site specific and dynamic. Control strategies therefore differ from farm to farm and must be worked out as individual problems in each location. **REGULAR MONITORING AND ANALYSIS** of the crops and knowledge on pests and disease symptoms and their causes (conducive conditions/environment, host) enable the farmer to decide on appropriate prevention or control measures in the farm.

Steps to implement effective crop protection can be summed up as follows:

1. Monitor and identify diseases, pests and weeds.
2. Define intervention threshold/economic damage threshold (i.e. pest densities, harmfulness and extent of crop infestation) and decide if an intervention is needed.
3. Decide on type of intervention.
4. Monitor and assess impacts and effectiveness of intervention.
5. Implement appropriate preventions for the next season using lessons learned.

The main pests and diseases observed in the gardens by the farmers in Cape Town are aphids and butterflies (eggs, worm-caterpillar, cut worms) on brassicas, rust on leaves of celery and spring onions, mildew on leaves, leaf minors, snails, fruit flies (tomatoes), spider mites and fungi (peppers). Other pests or means of transport for pests and diseases in urban areas are mice, rats, pigeons, moles, but also cats and dogs.

8	<p style="text-align: center;"><b>URBANGAPs FOR PEST &amp; DISEASE MANAGEMENT (INCL. FIELD HYGIENE AND WEED CONTROL)</b></p>
	<p style="text-align: center;"><b>PREVENTIVE PEST AND DISEASE MANAGEMENT</b></p> <p>Avoid the build-up of pests and diseases through good cultural practices, appropriate plant fertilisation field hygiene/sanitation and weed control.</p>
8.1	<p><b>Identification of pests, diseases and nutrient deficiencies</b></p> <p>Most important is a regular monitoring of the field. A basic requirement to prevent attacks is a good knowledge of the diseases or pests, their hosts and conducive environments. It is crucial to know, if the plant is affected by a pest, a disease or a nutrient deficiency to decide on the right preventive or control measure.</p> <ul style="list-style-type: none"> <li>• Consider and implement preventive methods first, before using curative methods.</li> <li>• Monitor the garden every day: the better a farmer knows the plants, the better the farmer can prevent pests and diseases. <ul style="list-style-type: none"> <li>- <b>Pest:</b> Animals damaging the crops are namely caterpillars, insects, worms, and snails, but also birds, cats, dogs, and livestock.</li> <li>- <b>Disease:</b> Fungal, viral, protozoal, or bacterial diseases causing damages to plants.</li> <li>- <b>Nutrient deficiencies:</b> When plants are not sufficiently and suitably provided with nutrients like nitrogen, phosphorous or potassium. This is obvious, when plants don't grow; leaves are pale green or yellowish. Nutrient deficiencies provide an opportunity for pests and diseases to easily attack the plants.</li> </ul> </li> <li>• When pests or diseases are identified, make a record of it, and decide on the right control measure (see below) by seeking guidance.</li> <li>• In case of nutrient deficiency, apply the right fertiliser in appropriate amounts.</li> <li>• Organic methods work out, if they are followed accordingly and with patience. An organic technique of pest management always needs more time, than conventional ones. But the result for plant and soil health is worth it to choose the organic way.</li> </ul>
8.2	<p><b>Preventive cultural methods</b></p> <p>Cultural methods include farming practices that prevent problems during the cultivation period by giving the plants the best circumstances for growing. The application of good cultivation practices throughout the whole crop cycle is the best way to avoid pest and disease manifestation in the farm.</p> <p>Appropriate cultural methods to avoid pests and diseases are:</p> <ul style="list-style-type: none"> <li>• Visit fields regularly to monitor pests, diseases and natural enemy status for decision making.</li> <li>• Use suitable sites and soils for production (avoid heavy/too sandy or badly eroded soils etc.).</li> <li>• Practice crop rotation to disrupt build-up of soil borne pests in particular. The essence of rotation is to starve pests/pathogens of their preferred host. The duration of rotation depends on the type of pathogen – a crop other than the susceptible crop or related</li> </ul>

	<p>species is planted for a defined period of time. That means i.e., do not plant a nightshade after another nightshade (planting brinjals after tomatoes) to avoid disease build-up.</p> <ul style="list-style-type: none"> <li>• Change time of planting to be after or well before the predictable emergence of some pests.</li> <li>• Practice planned intercropping to boost the development of predators and to reduce spread of pests and diseases from plant to plant.</li> <li>• Practice mulching to prevent disease spores splashing up on to the crop and to break the cycle of some pests that pupate in the bare soil, for example leaf miners.</li> <li>• Mulching also helps to reduce water stress of crops and thus reduces the effects of certain pests like spider mites.</li> <li>• Sterilise soil as needed to kill fungal overgrowth and weed seeds. Solarisation is easy to use in seed beds and can also be achievable in small-scale farms.</li> <li>• Create habitats that are conducive for natural enemies of pests (strips of flowering plants, sites with bushes near the fields, herbs) – i.e. aphids do not like marigold, mosquitos do not like basil or rosemary.</li> <li>• Use clean and healthy seeds and planting material to avoid diseases coming with the seeds directly into the soil.</li> <li>• Adopt good nursery practices and transplant healthy seedlings on the fields.</li> <li>• Adopt appropriate planting distances and avoid overcrowding that creates a conducive environment for fungal activity.</li> <li>• Adopt good soil management practices to feed the crop better and promote good sturdy growth. Improve the nutrient status/build a healthy soil through application of organic/green manure, compost or fertiliser (ideally organic or homemade products, respectively in line with recommendation and instruction, if mineral fertilisers are applied).</li> <li>• Apply appropriate and balanced fertilisation (avoid too much nitrogen).</li> <li>• Adopt suitable water management practices to ensure balanced water supply and avoid water stress (avoid wrong irrigation time, and over- or under-watering, follow correct irrigation schedule, avoid use of contaminated water or greywater on top of leafy vegetables).</li> <li>• Stay out of the fields when plants are wet to avoid carrying inoculum from diseased to healthy plants.</li> <li>• Avoid injury to plants to prevent entry points for pathogens and insect pests.</li> <li>• Control weeds which could serve as alternate hosts (see below).</li> </ul>		
8.3	<p><b>Associating/companion and repellent plants</b></p> <ul style="list-style-type: none"> <li>• Use associating crops which have a positive impact on pest dynamics (promoting insect development or diverting them from primary crops), i.e. marigold attracts thrips to move out of cultivated crop.</li> <li>• Repellent plants are plants containing a substance that deters insects or other pests from approaching or settling.</li> <li>• Plant herbs etc. to repel unwanted pests and diseases from your crops.</li> </ul>		
<table> <tr> <td>Basil attracts pollinating insects to cucumber, prevents fungal diseases on baby marrow and improves the taste of tomatoes, lettuce and</td><td>The smell from garlic protects strawberries, cucumbers, carrots, lettuce and tomatoes from</td></tr> </table>		Basil attracts pollinating insects to cucumber, prevents fungal diseases on baby marrow and improves the taste of tomatoes, lettuce and	The smell from garlic protects strawberries, cucumbers, carrots, lettuce and tomatoes from
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parsley.	insects and mice.
Marigold planted under fruit trees and in the vegetable patch, especially near broccoli plants, will draw aphids away from fruits and vegetables.	Peppermint repels ants, white cabbage moths, aphids, and flea beetles.
Rue repels parasites and keeps the bugs away.	Rosemary and sage repel cabbage moths, bean beetles, and carrot flies.
<b>8.4</b>	<p><b>Field hygiene/Crop sanitation</b></p> <p>High levels of sanitation in the fields prevent the build-up and spread of pests and diseases over the farm and are hence one important component of preventive pest and disease management.</p> <p>Field hygiene/crop sanitation plays a crucial role before, during and after the crop cultivation: All measures to avoid infestation of crops with pests or diseases or contamination of soil and plants contribute to good field hygiene by depriving pest organisms of their food base which is critical for proliferation and development.</p> <p>Recommended field hygiene measures are:</p> <ul style="list-style-type: none"> <li>• Keep your cropping zone and its environment clean of weeds and diseased/infested plants/crop residues.</li> <li>• Practice rogueing: removing of infested or diseased plant parts or whole plants to prevent the spread of pests and diseases to healthy crops.</li> <li>• Pull out and destroy any plants that are badly affected by pests to prevent pests from moving to another crop.</li> <li>• Take care not to spread infested soil in the field while transporting rogued plants.</li> <li>• Destroy crop residues by ploughing/deep burying before sowing, burying, composting or feeding them to livestock. If these are not options, place residues in an isolated location with barriers between them and your crops.</li> <li>• Don't use infested material for mulch and don't add it to your compost.</li> <li>• Do regular quality control of agricultural inputs before using them to avoid contamination, also check water before irrigating and avoid using contaminated water.</li> <li>• Produce, store and use the manure as recommended to avoid bringing in pests and diseases.</li> <li>• Avoid animals on the horticulture planting site of your farm, they contribute to the spread of pests/diseases or weeds.</li> <li>• Do not allow people to use open spaces or fences on the farm as toilet. People should always use proper toilets for human waste to avoid polluting the soil and spreading diseases.</li> <li>• Clean tools of excess soil after use, and store tools in a dry, clean place to prevent harbouring and spreading diseases.</li> </ul>
<b>8.5</b>	<p><b>Weed control</b></p> <p>A regular weed management is important because weeds compete with the cultivated plants on nutrients and water and they host many pests and harmful diseases.</p> <p>Whenever possible, growing and spread of weeds should be prevented to avoid the often</p>



	<p>labour-intensive weed control measures.</p> <p>Weeding can be done manually during the daily monitoring walk through the garden; then it doesn't become too intense and gets into an easy daily routine.</p> <p><b>Prevention of weeds:</b></p> <ul style="list-style-type: none"> <li>• Use cover crops, canopy planting or (thick) mulch to avoid growing of weeds (removed young weeds without seeds can also be used as mulch).</li> <li>• Water directly on plants, not in the surrounding areas where weeds grow, especially in times of water shortage it is twice as important.</li> <li>• Use only manure, which has properly decomposed, because fresh manure is a means of weed seed dispersal.</li> <li>• Use properly sorted and clean seeds since poorly sorted seeds can contain weed seeds.</li> <li>• Don't allow animals in the cultivated fields because they also contribute to seed multiplication. They carry seeds or flowers attached to their body surfaces or by eliminating them in their dung.</li> <li>• Practice container gardening where appropriate to easier control weeds.</li> </ul> <p><b>Weed control measures are:</b></p> <ul style="list-style-type: none"> <li>• Monitor your fields regularly to avoid spreading of weeds.</li> <li>• Do regular mechanical weeding - removal by hand or hoe, at an early stage and in dry weather. In dry soil, cut weeds cannot root again.</li> <li>• Remove small/young weeds - necessarily before they produce seeds to avoid spreading of the weed seeds. Small weeds can be cut easily, and shallow hoeing does not damage the crop roots.</li> <li>• Plant crops in rows, it makes removal of weeds easier.</li> <li>• The use of herbicides for weed control is not recommended for environmentally-friendly production.</li> </ul>
	<p style="text-align: center;"><b>(CURATIVE) CONTROL OF PESTS AND DISEASES</b></p> <p>After build-up of pests and diseases, control with mechanical/physical, biological or chemical measures (as the last solution and not recommended for small-scale urban farming in Cape Town), becomes necessary.</p> <p>Most important is a regular monitoring of the field. The identification of the pests and diseases affecting your fields is a precondition for applying the appropriate control method.</p> <p>If you are not sure what is affecting your crop, ask your fellow farmers, an NGO trainer or the extension service rather than applying a product/method you are not sure what the consequence is.</p>
8.6	<p><b>Mechanical and physical control</b></p> <p>methods are techniques which kill pests or prevent them from reaching the crops by physical means.</p> <ul style="list-style-type: none"> <li>• Fence off your farm to keep out animals and livestock which can cause crop losses.</li> <li>• Remove pests and snails by hand-picking/collecting - feasible on small plots only.</li> <li>• Cover crops with nets to avoid pest infestation (expensive technique, only recommendable for high value crops or nurseries).</li> <li>• Plant windbreaks (growing in line of tall, resistant plants) which act as catch crops,</li> </ul>

	<p>preventing pests from moving to the cultivated crop.</p> <ul style="list-style-type: none"> <li>• Plant trap/catch crops as barrier plants on the edge of fields as catch crop to pests - i.e. bush or broad beans on the edge of brassicas (kale, cabbage) act as trap crop by confusing pests in search of cultivated crops.</li> <li>• Use soap solutions to wash off pests. Mix curd soap with water and apply it with a small hand distributor or with a rag and wash pests off. You may have to repeat it over a few days, especially if there have been eggs or grubs on the leaves.</li> <li>• Bag fruits to protect them from insects.</li> </ul>	
8.7	<p><b>Biological pest and disease control</b> is a method for controlling a pest by using or promoting microbial pathogens that attack a specific pest and the release of natural enemies (predators and parasitoids) to control insect pests (insects, mites and nematodes). Any predatory, parasitoid or infectious organisms that limit the frequency and severity of eruptions are considered natural enemies of crop pests. Planting and maintaining conservation buffers of native plants can be reservoirs for beneficial animals and insects. In other words, the main approach is to promote beneficial insects that eat or parasitize target pests.</p> <p>Within the URBANGAPS- guidelines naturally occurring extracts from plants such as nicotine, neem and pyrethrum are also considered as biological control measure.</p> <p><b>Predators</b>, like bats, birds, praying mantis, lady bird beetle, wasps, spiders and carnivorous mites, attack and consume the crop pests (i.e. use of predator mites against red spider mites).</p> <p><b>Parasitoids</b> are insects (i.e. certain flies and wasps) laying their eggs on or in the body of an insect from another species. Their larvae consume the host's tissues and kill it.</p> <p><b>Pathogenic agents</b> are microorganisms that infect the cells and tissue of a host and multiply. There are certain entomo-pathogenic species amongst fungi, viruses and bacteria.</p> <ul style="list-style-type: none"> <li>• Release of predators or bringing in of parasitoids and pathogenic agents is certainly a recommendable biological pest control method – pre-conditions are the availability and affordability of such biological products.</li> <li>• Enhance the build-up of populations of natural enemies (predators/beneficials) by using associating plants: Flowering plants (marigold, phacelia, coriander) provide shelter and are food for beneficials (wasps).</li> <li>• Pheromone trapping and mating disruption can be useful for farmers with tunnels to control fruit flies.</li> <li>• While bees are not predators, they are agitators to many pests, thus keeping pest populations lower than they would be otherwise.</li> </ul> <p>Other <b>natural means or natural plant extracts</b> can also be used to avoid or control pests and diseases – see examples.</p>	
	Crushed eggshells around plants help against snails.	Curd soap, chili and garlic in water, standing for 24 hours, can be sprayed against insects.
	Mix milk and water to a spray helping against red spider mites, caterpillars or	Flower heads of pyrethrum and a bit of curd soap as spray can be used against aphids, caterpillars, mites.

mildews.	
Use a mix of chili, water and neem leaves. Mix 1 liter of water, a handful of chilies and a handful of neem leaves and boil it. Spray it on the leaves.	Mix nettles with water and leave it for two weeks. Use the liquid to spray against snails.
8.8	<p><b>Chemical control</b></p> <p>is the use of chemical methods (pesticides) to prevent, destroy, repel or mitigate pests and diseases.</p> <p>The application of synthetic pesticides is not reasonable on small plots (cost intensive) and not recommended for environmentally friendly and not allowed for organic production of vegetables. But if chemicals are used, the application should be done by an aware farmer and safe rules of pesticide application and storage should be followed.</p> <p>If used:</p> <ul style="list-style-type: none"> <li>• Use naturally derived products before resorting to synthetic pesticides.</li> <li>• Minimise the application of chemicals – use them only when absolutely needed.</li> <li>• Use the appropriate chemical for the identified pest or disease.</li> <li>• Read and understand the labels, including how to use, warnings, expiration dates, and waiting periods before going back to the field</li> <li>• Apply the pesticide at the right time and the right dosage (to avoid the killing of beneficials).</li> <li>• Follow rules of safe pesticide application to not endanger your health.</li> <li>• Spray chemical controls while wearing personal protection equipment like plastic overalls, jacket, gloves, eye and mouth masks, and boots.</li> <li>• To avoid misuse or contamination, store the pesticides out of the public.</li> <li>• Store pesticides separately from food, seeds, fertilisers and animal feeds.</li> <li>• Store pesticides in a dry place and secure it by padlock.</li> <li>• Position pesticide store away from water sources to reduce the risk of contamination.</li> <li>• When finished, cut the bottle open so no one reuses it for drinking water.</li> <li>• Dispose of empty bottles and expired products with the pesticide store or salesman to avoid polluting the farm or soil.</li> </ul>

## 2.9 Harvesting and Post-Harvest Handling

At the end of the production cycle stands harvesting and preparing the produce for **MARKETING, SELLING, SHARING OR CONSUMING**. Harvest and post-harvest activities include harvesting, handling, cleaning, sorting, storage/cooling, processing, packaging, transportation and marketing of the harvested crops.

Losses of horticultural produce due to spoilage, shrinkage or contamination are a major problem in the post-harvest chain. It is therefore crucial to follow certain rules and to adapt **GOOD HANDLING PRACTICES** to ensure harvested produce of good quality and to avoid food waste and economic loss for the farmer during this stage.

Just as the production of crops, **HARVESTING AND POST-HARVEST HANDLING** have thus to be properly planned: How much of the produce do I need for own consumption to ensure a diversified and healthy alimentation of my family? How much produce, in what quantity and quality, do I need for which markets? To minimise the risk of food waste and loss of income for the farmers, it is recommended to have several marketing options. Produce that cannot be sold in the markets will spoil on the field or after harvest in containers.

**FOOD WASTE** is a crucial issue in Cape Town's urban agriculture. One reason is that food is not harvested at the right time and it got rotten on the field. Another aspect leading to food waste is the provision of subsidised seedlings of many crops which are not eaten within the communities. A breakdown of the external markets for these crops can cause surpluses in the farms.

Manual **HARVESTING** is the most used and appropriate harvesting method for urban small-scale farmers. Selective picking ensures that vegetables are harvested at the right, crop specific time and the quality required by the client (required size, maturity, colour, free from defects and diseases). Harvesting depends on the customer's needs and requirements (stage of ripeness, with/without roots or leaves etc.).

**RECORD KEEPING** during harvesting and marketing is very important for the farmers to have an overview on harvested quantities, qualities, current prices and income, the outputs of the farming activities. In comparison to the farming inputs gives this calculation an overview on the outcome of the urban food garden.

9	<b>URBANGAPs FOR HARVEST AND POST-HARVEST HANDLING</b>	
9.1	<p><b>Harvesting</b></p> <p>Crops, especially vegetables, need to be harvested and handled with care to avoid damages (cuts, bruises) or loss of produce at the end of the cultivation period. Hygiene and quality standards are important during the harvesting and throughout the post-harvest chain, mainly to avoid contamination.</p> <p>Follow some basic principles during harvesting:</p> <ul style="list-style-type: none"> <li>• Consider the right harvesting time and weather conditions: best during the coolest part of the day – early morning or late evening and under light conditions.</li> <li>• Use selective harvesting (harvest at the right maturity and harvest only the quantity needed for consuming or selling).</li> <li>• Use appropriate, crop specific harvesting techniques: harvesting methods vary with plant parts harvested; either the whole or a part of vegetative growth can be harvested by hands only or sharp knives.</li> </ul>	
<p><u>Leaves only (spinach, curly kale):</u></p> <p>The stem is snapped off by hand or a sharp knife.</p> <p>Herbs can be cut by stem (rosemary, thyme) or whole groups of leaves are picked (basil).</p>		<p><u>Above-ground part of the plant (cabbage, lettuce):</u></p> <p>The main stem is cut through with a heavy knife, and trimming is done in the field (the cut stem must not be placed on the soil).</p> <p>Leave outer leaves with cabbage to keep it fresh.</p>
<p><u>Bulbs and roots:</u></p> <p>Leeks, garlic and mature bulb onions are loosened by using a digging fork as for root crops (such as carrots) and lifted by hand. Immature green onions can be pulled from the soil by hand.</p>		<p><u>Fruits (tomato, brinjal, pepper):</u></p> <p>Fruits are cut off at the stem, around 2 cm above the fruit (brinjal, pepper). Tomatoes are cut also with the stem to avoid infection in the fruit. Tomatoes can mature after harvesting; brinjals need to be ripe (shiny peel, strong pulp) for harvest.</p>
9.2	<p><b>Harvesting tools</b></p> <ul style="list-style-type: none"> <li>• Use correct and clean equipment for harvesting: knives must be kept sharp and clean to prevent spreading (virus) diseases from plant to plant.</li> <li>• Use clean and correct containers (smooth, with no sharp edges or projections to damage the produce).</li> <li>• Prevent overfilling of the containers/bins.</li> <li>• Prevent damaging the fruit, dropping the fruit in to the containers at a distance and rough handling.</li> </ul>	
9.3	<p><b>Post-Harvest Handling</b></p> <ul style="list-style-type: none"> <li>• Transfer, if necessary, the produce gently into bigger collection bins.</li> <li>• Protect the harvested produce from rain, dust or sun by keeping it in a shaded environment or in a cool temporary storage area. It is best to pre-cool the produce within</li> </ul>	

	<p>the shortest period to remove the field heat.</p> <ul style="list-style-type: none"> <li>• If washing of very dirty produce is necessary, use clean tap water, because borehole water might be salty. Not all legumes can be washed; some have to be kept dry - e.g. soft herbs and potatoes.</li> <li>• Avoid contact between the harvested produce with the soil or contaminated surfaces, e.g. with dirt, oil or chemicals.</li> <li>• Transport must also happen with care to prevent damage. Avoid unnecessary delays. Basic hygiene practices must still be followed. The cleanliness of the equipment is vital. Loading a product can be deteriorated by smells, residues of toxic chemical products; insects living in the equipment; remains of rotting agricultural products; debris blocking the openings for evacuating the air circulating along the floor.</li> </ul>
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### 3 URBANGAPs Monitoring and Evaluation

A Participatory Guarantee System (PGS) is a tool, which allows farmers to assure their production quality in a mutual learning process. "The grass root movement allows producers to work on their own quality assurance standard and building up their production on trust, participation, and sovereignty from global and national food markets. Farmers visit the members of the PGS group frequently and carry out an assurance check on their own PGS criteria" (Paganini, Schelchen 2018).

The visits are also a platform for farmers to exchange, interact and learn from each other. The annual visits are based on transparency and trust. The Western Cape Farmer PGS which is active in the whole province of the Western Cape is open to include the urban farmers of Cape Town and the application of URBANGAPs as subgroup.

The following monitoring and evaluation checklist can be used by farmers to assess their production cycle according to the criteria set by URBANGAPs. PGS is a learning process and this checklist should help the farmer to understand, where he or she stands.

#### **How to use?**

This checklist corresponds with the main guidelines on URBANGAPs (tables in chapter 2). All subchapters and points are transferred to the monitoring and evaluation checklist below.

The rows on the right side indicate if the respective aspect is applied (a), not applied (n), in conversion (c) or in the case of the farmer not applicable (n/a).

Mark the column based on the assessment and observation during the field visit and based on the conversation with the farmer.

Note, a PGS visit is not a control by a third party. It allows a horizontal learning and offers opportunities for discussion and exchange during a farm visit.



## Monitoring and evaluation of URBANGAPs

	URBANGAPs	APPLIED OR IMPLEMENTED (A)	IN CONVERSION / TRANSITION (C)	NOT APPLIED (N)	NOT APPLICABLE (N/A)
	<b>1 FARM VISION AND SITE SELECTION</b>				
	<b>1.1 FARM VISION AND PURPOSE</b> The farmer has a vision for the farm and a long-term plan (in mind). Purpose of farming is in line with farmers' available resources, e.g. labour, time, money.	A	C	N	N/A
Remarks and notes					
	<b>1.2 PLOT ASSESSMENT</b> The farmer assessed the plot before starting farming activities. The farmer is aware of conditions of the land and natural resources.	A	C	N	N/A
Remarks and notes					
	<b>1.3 LOGISTICS AND EQUIPMENT</b> Logistics are planned and the farmer is equipped with the necessary equipment.	A	C	N	N/A

Remarks and notes					
	<b>1.4 LAND HISTORY (CULTIVATED LAND INFORMATION)</b> The farmer has information on the former land use and is aware on possible risks.	A	C	N	N/A
Remarks and notes					
	<b>1.5 SOIL TESTING/ASSESSMENT</b> The farmer assessed the soil of the land, regarding possible contamination (soil test) and fertility to set up a soil-building plan.	A	C	N	N/A
Remarks and notes					
	<b>1.6 ENVIRONMENTAL PROTECTION CONSIDERATIONS</b> The farmer considered close environmental protection zones before starting agriculture. In case of risk for a protection zone, the farmer reconsidered location.	A	C	N	N/A
Remarks and notes					
	<b>1.7 SITE PLANNING</b> The farmer has a farm plan and map in place. The map includes planting sections, nursery (if available), composting area, water source and storage facilities, including farm boundaries and potential sources of contamination (streets or close housing).	A	C	N	N/A
Remarks and notes					
	<b>1.8 IRRIGATION PLANNING</b> The farmer has an irrigation plan in place.	A	C	N	N/A

Remarks and notes					
	<b>1.9 RECORD KEEPING</b> The farmer takes regularly notes on farming activities, basically input and output.	A	C	N	N/A
Remarks and notes					
	<b>2 PRODUCTION AND CROP PLANNING</b>				
	<b>2.1 PRODUCTION PLANNING</b> The farmer has a production plan in place going in line with farm the purpose.	A	C	N	N/A
Remarks and notes					
	<b>2.2 CROP SELECTION</b> The crops are selected in a suitable way, considering market demand and self-consumption.	A	C	N	N/A
Remarks and notes					
	<b>2.3 CROP ROTATION</b> A crop rotation plan is in place and implemented in the farming activities. The farmer documented planting activities and kept records.	A	C	N	N/A
Remarks and notes					

	<b>2.4 INTERCROPPING</b> The farmer applied intercropping in the cultivation system and used adequate companion plants to optimise yield and to take advantage on space.	A	C	N	N/A
Remarks and notes					
	<h3>3 SEEDS, SEEDLINGS, NURSERY AND TRANSPLANTING</h3>				
	<b>3.1 SEED PLANNING</b> The farmer chose certified, untreated, GMO free seeds, preferably local varieties.	A	C	N	N/A
Remarks and notes					
	<b>3.2 SEED HARVESTING</b> The farmer harvested seeds from healthy mother plants at the right time. The farmer is aware on possible risks related to diseases.	A	C	N	N/A
Remarks and notes					
	<b>3.3 STORAGE OF SEEDS</b> Seeds are stored in a dry and cool place. A label indicates variety and harvesting/buying date of the seeds.	A	C	N	N/A
Remarks and notes					
	<b>3.4 SOWING FACILITY</b> Nursery or raised bed are integrated in the farming activities and good practices are implemented.	A	C	N	N/A

Remarks and notes					
	<b>3.5 SOWING ON PREPARED SUBSTRATE</b> Before sowing, the farmer prepared the substrate and chose good quality soil.	A	C	N	N/A
Remarks and notes					
	<b>3.6 SOWING IN THE SOIL</b> The farmer prepared the soil before sowing, using good and nutritious soil. Sowing techniques are applied to assure proper start of cultivation cycle.	A	C	N	N/A
Remarks and notes					
	<b>3.7 SOWING DATES</b> Sowing dates are adapted to the crop plan and consumption/market demands.	A	C	N	N/A
Remarks and notes					
	<b>3.8 MANAGEMENT OF YOUNG PLANTS</b> The farmer is aware when to plant out and when to thin out young plants.	A	C	N	N/A
Remarks and notes					
	<b>3.9 TRANSPLANTING AND PLANTING OUT OF THE NURSERY</b> Transplanting is in line with good practices to assure healthy growing of the plant.	A	C	N	N/A
Remarks and notes					

	<b>3.10 SPACING</b> Appropriate space is considered in between plants to avoid pest and diseases and assure healthy growing.	A	C	N	N/A
Remarks and notes					
	<b>4 LAND AND SOIL PREPARATION</b>				
	<b>4.1 SITE PREPARATION</b> Farmland is prepared for cultivation according to the farm plan. Buffer zones and fencing prevent the land from drift pollution and vandalism.	A	C	N	N/A
Remarks and notes					
	<b>4.2 WIND PROTECTION AND ANTI-EROSION MEASURES</b> Windbreaks are planted and anti-erosion measures are implemented into the farm.	A	C	N	N/A
Remarks and notes					
	<b>4.3 URBAN SOIL</b> Urban risks concerning soil health are considered and countermeasures are implemented. A soil sample was taken and tested (optionally).	A	C	N	N/A
Remarks and notes					
	<b>4.4 SOIL ORGANIC CARBON</b> Organic matter is constantly built and conservation techniques are in place.	A	C	N	N/A

Remarks and notes				
	<b>4.5 PREPARATION OF BEDS</b> Beds are prepared and connected to the irrigation system.	A	C	N N/A
Remarks and notes				
	<b>4.6 TYPES OF BEDS</b> The farmer decided wisely which types of beds are suitable for the farmland and crop planning.	A	C	N N/A
Remarks and notes				
	<b>4.7 CONTAINER GARDENING</b> If containers are used for farming, good practices are implemented.	A	C	N N/A
Remarks and notes				
	<b>4.8 PREPARATION FOR PLANTING</b> Before planting, the farmer prepared and cleaned beds to assure healthy growing.	A	C	N N/A
Remarks and notes				
	<b>5 SOIL MANAGEMENT AND SOIL FERTILITY</b>			
	<b>5.1 MULCHING</b> The farmer used mulch to support soil building and fertility.	A	C	N N/A

Remarks and notes					
	<b>5.2 INTERCROPPING</b> The farmer applied intercropping methods to support soil fertility.	A	C	N	N/A
Remarks and notes					
	<b>5.3 COVER CROPS</b> The farmer planted cover crops to support soil fertility.	A	C	N	N/A
Remarks and notes					
	<b>5.4 GREEN MANURE</b> The farmer included green manure in the crop rotation plan and used green manure frequently.	A	C	N	N/A
Remarks and notes					
	<b>5.5 HOEING AND AERATING THE SOIL</b> The farmer applied low tech practices to aerate the soil.	A	C	N	N/A
Remarks and notes					
	<b>5.6 OPTIMISING SOIL PH</b> On the basis of a soil test, the farmer put measures in place to optimise the soil pH (e.g. liming/calcium-magnesium or gypsum).	A	C	N	N/A
Remarks and notes					



	<b>5.7 MANAGING SODIUM AND SALT</b> On the basis of a soil test, the farmer put measures in place to manage the sodium and salt content of the soil.	A	C	N	N/A
Remarks and notes					
	<b>6 FERTILISATION</b>				
	<b>6.1 COMPOSTING</b> The farmer has a compost heap and works on home-made compost production to increase fertility. The farmer used the compost in an adequate manner.	A	C	N	N/A
Remarks and notes					
	<b>6.2 VERMICOMPOSTING</b> Additionally, the farmer used vermicomposting (ideally, but not compulsory) for soil fertilisation.	A	C	N	N/A
Remarks and notes					
	<b>6.3 USE OF MANURE</b> The farmer applied only composted and broke down manure. Raw manure was not used directly to avoid health risks and damage to leaves and roots.	A	C	N	N/A
Remarks and notes					
	<b>6.4 HOME-MADE LIQUID FERTILISERS</b> The farmer used home-made organic fertilisers to enrich soil and plants with nutrients and minerals to build up strong and healthy crops.	A	C	N	N/A

Remarks and notes					
	<b>6.5 USE OF OTHER ORGANIC FERTILISERS</b> In case certified fertilisers like pellets or Bio-Ocean are used, they are applied in an appropriate manner and in right amounts (optionally).	A	C	N	N/A
Remarks and notes					
	<b>6.6 STORAGE OF ORGANIC FERTILISERS</b> Organic fertilisers are safely stored without risk of contamination.	A	C	N	N/A
Remarks and notes					
	<b>6.7 MANAGEMENT OF INORGANIC FERTILISERS</b> In case, the farmer uses inorganic fertilisers, the appropriate application time and method are considered.	A	C	N	N/A
Remarks and notes					
	<b>6.8 STORAGE OF INORGANIC FERTILISERS</b> Inorganic fertilisers are safely stored without risk of contamination.	A	C	N	N/A
Remarks and notes					
	<b>7 WATER MANAGEMENT AND IRRIGATION</b>				
	<b>7.1 IRRIGATION PLANNING</b> The farmer planned an irrigation system, which is adapted to local water availability and quality.	A	C	N	N/A

Remarks and notes					
	<b>7.2 SCHEDULING OF IRRIGATION/WATERING</b> The farmer irrigated during an appropriate time, with the right frequencies.	A	C	N	N/A
Remarks and notes					
	<b>7.3 IRRIGATION PRACTICES</b> The farmer wisely selected the irrigation practice to maximise water infiltration and minimise water efflux.	A	C	N	N/A
Remarks and notes					
	<b>7.4 WATER HARVESTING TECHNIQUES</b> The farmer saved rain water and has water harvesting facilities implemented in the farm design.	A	C	N	N/A
Remarks and notes					
	<b>7.5 OTHER WATER SAVING TECHNIQUES</b> The farmer applied water saving techniques across the whole cultivation cycle.	A	C	N	N/A
Remarks and notes					
	<b>7.6 WATER WISE PLANTS</b> The farmer used water wise crops during drought, preferably local varieties.	A	C	N	N/A
Remarks and notes					

	<b>7.7 FARMING DURING DROUGHT</b> The farmer respected water restrictions and considered to stop farming during drought.	A	C	N	N/A
Remarks and notes					
	<b>7.8 USE OF GREY WATER</b> The farmer used grey water to save tap water, and applied it in an adequate manner to avoid health hazards.	A	C	N	N/A
Remarks and notes					
	<b>8 PEST AND DISEASE MANAGEMENT, FIELD HYGIENE &amp; WEED CONTROL</b>				
	<b>8.1 IDENTIFICATION OF PESTS, DISEASES AND NUTRIENT DEFICIENCIES</b> The farmer is aware of differences between pests, diseases and nutrition deficiencies and has the knowledge to identify pest or disease.	A	C	N	N/A
Remarks and notes					
	<b>8.2 PREVENTIVE CULTURAL METHODS</b> The farmer applied cultural methods to prevent pest and diseases, based on a regular monitoring.	A	C	N	N/A
Remarks and notes					
	<b>8.3 ASSOCIATING/COMPANION AND REPELLENT PLANTS</b> The farmer planted companion and repellent plants to build a strong crop system.	A	C	N	N/A

Remarks and notes					
	<b>8.4 FIELD HYGIENE/CROP SANITATION</b> Field hygiene has a crucial role in the farmers' daily activities and rotten vegetables are taken out of the field.	A	C	N	N/A
Remarks and notes					
	<b>8.5 WEED CONTROL</b> The farmer prevented weeds as much as possible and controls weeds regularly - only manually and/or mechanically.	A	C	N	N/A
Remarks and notes					
	<b>8.6 MECHANICAL AND PHYSICAL CONTROL</b> The farmer applied techniques for mechanical and physical control against pests, i.e. traps or manual picking of snails.	A	C	N	N/A
Remarks and notes					
	<b>8.7 BIOLOGICAL PEST AND DISEASE CONTROL</b> The farmer applied biological methods or organic pest and disease management products on infected crops.	A	C	N	N/A
Remarks and notes					
	<b>8.8 CHEMICAL CONTROL</b> In case the farmer uses pesticides, the appropriate product (best according to organic regulations), application time and method are considered. Minimum residue levels and rules of safe handling and storage are observed.	A	C	N	N/A

Remarks and notes					
	<b>9 HARVESTING AND POST-HARVEST HANDLING</b>				
	<b>9.1 HARVESTING</b> The farmer used good harvesting practices, according to specific crop demands.	A	C	N	N/A
Remarks and notes					
	<b>9.2 HARVESTING TOOLS</b> The farmer used clean harvesting tools in an appropriate manner.	A	C	N	N/A
Remarks and notes					
	<b>9.3 POST-HARVEST HANDLING</b> The farmer harvested crops in the right time and kept produce clean and fresh, before marketing.	A	C	N	N/A
Remarks and notes					

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## 5 Annex

### 5.1 Winter and summer crops

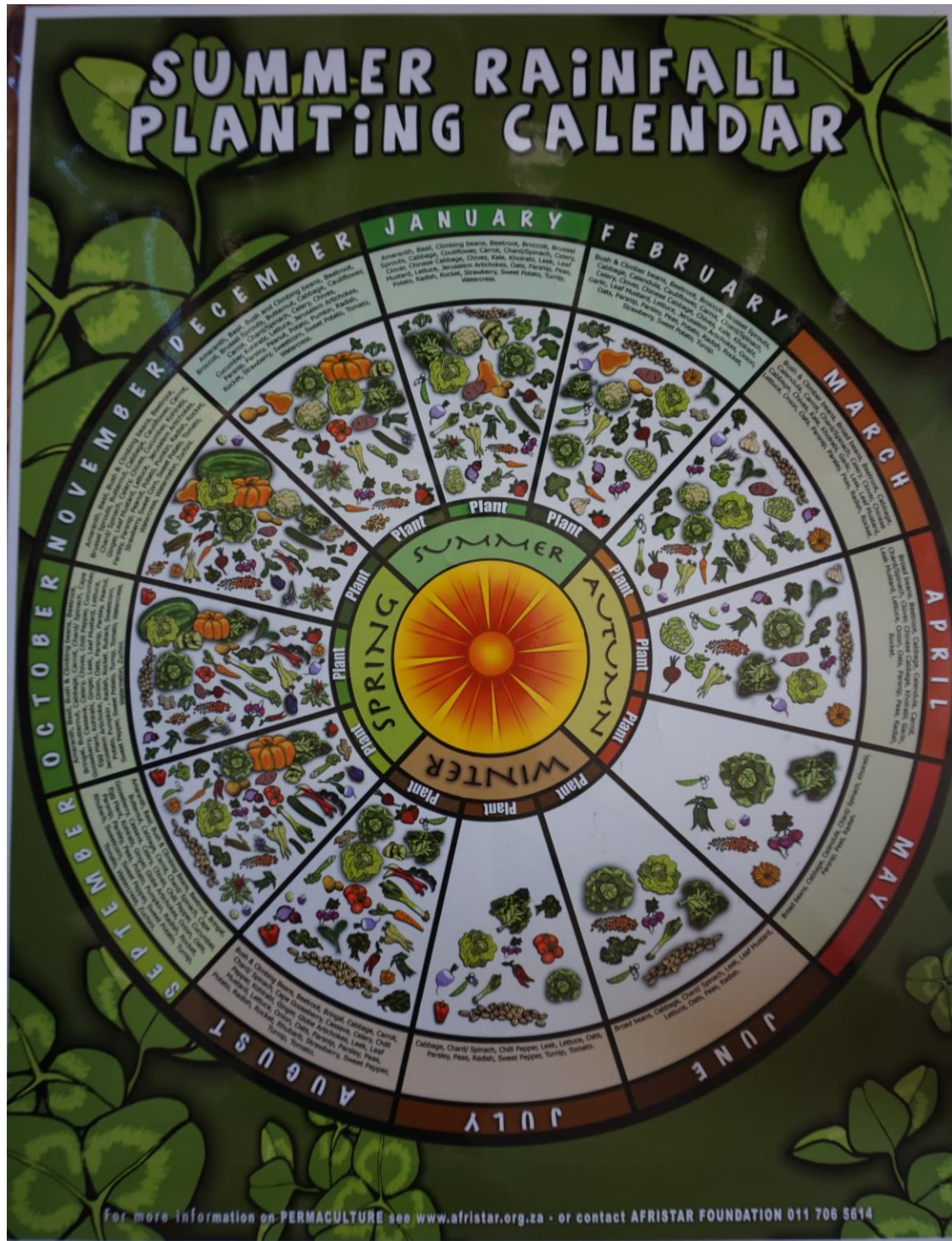


Figure 10: Summer Rainfall Planting. Source: SEED





Figure 3: Winter Rainfall Planting. Source: SEED



## 5.2 Companion Plants

COMPAÑION PLANTING		
IN NATURAL ECOSYSTEMS, PLANTS PERFORM FUNCTIONS THAT CAN EITHER HELP OR PREVENT OTHER PLANTS TO GROW. THE SAME IS TRUE IN OUR GARDENS. THIS CHART WILL HELP YOU UNDERSTAND WHICH PLANTS GROW WELL TOGETHER AND WHICH TO PLANT FAR APART!		
PLANT	GOOD COMPANIONS	BAD COMPANIONS
BEANS	MAIZE, SUNFLOWERS, LAVENDER, CABBAGE, CUCUMBER, STRAWBERRIES, BRINJAL	ONION, GARLIC, FENNEL
BEETROOT	BEANS, ONIONS, GARLIC, LETTUCE, CABBAGE	NO BAD COMPANIONS
BRINJAL	CALENDULA, MARIGOLDS, MINT, PEAS	NO BAD COMPANIONS
BROCCOLI, CABBAGE, CAULIFLOWER, KALE	AROMATIC PLANTS, DILL, SAGE, ROSEMARY, POTATOES, BEETROOT, CELERY, GARLIC, ONIONS, GERANIUM	TOMATOES, POLE & RUNNER BEANS, PEPPERS
CARROTS	LETTUCE, CHIVES, LEEKS, ROSEMARY, SAGE, PEAS, WORMWOOD	STRAWBERRIES, FENNEL, CABBAGE
LETTUCE	CARROTS, RADISH, STRAWBERRIES, CUCUMBER, BEANS	CELERY, PARSLEY
MAIZE	SUNFLOWERS, AMARANTH, BEANS, PEAS & OTHER LEGUMES, PUMPKIN, SQUASH, CUCUMBER, MELONS & OTHER CUCURBITS, PARSLEY	CABBAGE, TOMATO, CELERY
ONION/GARLIC	CARROTS, BEETROOT, STRAWBERRIES, TOMATOES, LETTUCE, CABBAGE	PEAS, BEANS, PARSLEY, LEEKS
PEAS	LAVENDER, CARROT, TURNIP, RADISH, CUCUMBER, MAIZE, BEANS, GROWS WELL WITH MOST VEGETABLES & HERBS	ONION, GARLIC
PEPPERS	TOMATOES, GERANIUM, BASIL, CARROT, ONION	BEANS, KALE, CABBAGE FAMILY
POTATOES	CORIANDER, MARIGOLD, BEANS, MAIZE, CABBAGE FAMILY, BRINJAL	PUMPKIN, CUCUMBER, SQUASH, MELONS, SUNFLOWERS, TOMATOES
SPINACH	STRAWBERRIES, BROAD BEANS, PEAS	NO BAD COMPANIONS
TOMATOES	BASIL, OREGANO, PARSLEY, CHIVES, NASTURTIUM, ONIONS, CARROTS, CELERY, CALENDULA, GERANIUM, BORAGE	POTATOES, FENNEL, CABBAGE FAMILY
CALENDULA	TOMATOES - REPELS TOMATO WORM!	GENERAL PEST DETERRANT, PLANT THROUGHOUT GARDEN
COMFREY	FAST-GROWING NUTRIENT ACCUMULATOR, PLANT ALONG EDGES & USE LEAVES FOR MULCH	COMPOST ACTIVATOR, USE LEAVES TO MAKE COMFREY TEA FERTILIZER!
CHILE PEPPER	CABBAGE, MAIZE	REPELS CABBAGE MOTH, PLANT ON BORDERS TO KEEP FLYING PESTS AWAY!
MARIGOLD	PLANT FREELY THROUGHOUT THE GARDEN - REPELS SOIL NEMATODES, APHIDS, BEAN BEETLES & MANY MORE.	USE MARIGOLD LEAVES TO MAKE AN ORGANIC GENERAL INSECTICIDE SPRAY!
NASTURTIUM	TOMATOES - IMPROVES FLAVOR	REPELS WHITE FLIES & SPIDER MITES
THYME	CABBAGE	DETERS CABBAGE WORM
ROSEMARY	CARROTS, CABBAGE, SAGE, BEANS	DETERS CABBAGE MOTH, BEAN BEETLES & CARROT FLY!
WORMWOOD/ARTEMESIA	AROUND GARDEN EDGES	KEEPS ANIMALS OUT! ALSO REPELS WHITE FLY
YARROW	PLANT FREELY THROUGHOUT THE GARDEN, REPELS SOIL NEMATODES, BEAN BEETLES, AND MANY MORE!	PLANT NEAR AROMATIC HERBS TO ENHANCE ESSENTIAL OIL PRODUCTION
A DIVERSE GARDEN IS AN ABUNDANT GARDEN. HAPPY PLANTING!		

Figure 12: Companion Planting. Source: SEED

### **5.3 Preliminary recommendations for a more Sustainable Urban Food System and the impact of Urban Agriculture related to a more sustainable production based on research results<sup>3</sup>**

- Support urban farmers in improving production in terms of quality and quantity towards a healthier, more water wise and environmentally friendly Urban Agriculture. Promote urbanGAPs as first qualitative guideline for urban horticulture production, researched, developed and tested in Cape Town.
- Adaptation of well running Food Gardens to low tech small-scale farms and implement techniques like wicking bed and tunnel production to increase production.
- Especially in times of a drought, a few well-run and productive low-tech Food Gardens are more sustainable, than an array of micro-farms, where producers are challenged on a daily base with access to water
- Promote the contribution of backyard gardens to a healthier diet, as it is one central benefit of Cape Town's Urban Agriculture. Backyard gardeners need an initiative support for tools, soils and compost as well as seeds and seedlings. Many backyard gardeners started very small with recycling and very creative ideas and highlight the benefits of a more diverse and nutritious diet.
- Few well running Food Gardens could work as AgriHub, producing seedlings and act as demonstration gardens but as well as meeting points, community centres and space of social interaction, knowledge exchange and transversal learning
- Support on topics such as administration skills/ business development skills with trainings and workshops as well as micro-credits could empower farmers to become independent from long-term support by NGOs or DoA. Main challenge of farmers is access to market, on the one hand caused by the long dependency on one supporting entity, on the other hand caused by to lack of education / administration skills/ business development skills/ access to finance and transport.
- Support on topics such as plant protection (pest and disease monitoring, identification, prevention and control. As a high knowledge lack and need for information and constant monitoring is necessary what couldn't have been done by the NGOs
- Support by DoA should also include monitoring of farms and an ongoing assessment of the impact and production achieved to accompany the farmer in an learning and improving process.
- Support farmers in access to land and long term lease possibilities to make it attractive for investment in infrastructure and trees / hedges or intensive soil building.
- Link especially the productive gardens in schools with the school feeding program to create direct value chains, raise awareness in early ages and support directly small-scale farmers.
- Creating and supporting a system of procurement for national or regional institutions like hospitals, jails and public institutions to promote local economy, food sovereignty and independency of global food players. Linking Food Gardens and small-scale farmers with these other players.

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<sup>3</sup> This policy recommendations have been elaborated together with the group of Urban Research Farmers and were sent to the City of Cape Town in April 2018

## 5.4 Fridiary – Record Keeping Example<sup>4</sup>

### Planting and Sowing

What?	How much was planted?	Why and how?	Costs?

### Inputs used for fertility and pest management?

What?	How much was applied?	Why?	Costs?

### Harvesting and marketing

What?	How much was harvested?	How much was sold?	What was consumed by me and my family?	What is my weekly income with my garden?

What was my production challenge this week?

What have I done to implement urbanGAPs?

What and how much was sold to the community?

What was my weekly income with the garden?

Have I received new information? If yes - By whom and on what?

How was the weather?

Other relevant observations:

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<sup>4</sup> The FriDiary was created as a self-assessment tool for urban farmers. From November 2017 onwards, the group of Urban Research Farmers filled in the records once a week (Friday).



## 5.5 Training Manual

Based on these guidelines and the content of the URBANGAPs - Cape Town edition on vegetables, a farmer training manual was developed and distributed amongst Capetonian urban farmers. The manual describes every stage of the production cycle much shorter than the guidelines and includes graphical indications to help farmers implement the good practices in their gardens.

