PATTERN ATLAS

Urban Arid Green - A sustainable approach to address population growth and urbanisation in arid areas, via a case study to Tamansourt

Rosa de Wolf, January 2023

COLOPHON

Urban Arid Green
A sustainable approach to address population growth and urbanisation in arid areas, via a case study to Tamansourt

Cover image: View on Tamansourt, photograph taken from roof of
                                     social housing complex, by author (May 2022).

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CONTENT

INTRODUCTION

1

A PATTERN LANGUAGE

In 'A pattern language: Towns, Buildings, Construction' (1977), Alexander explains the method of a pattern language.

The book describes a set of patterns, developed to be able to work together. The set is designed to be understandable for all, all stakeholders where a town, building or construction is involved.

The patterns are formulated in such a way that they can be used unlimitedly, without the spatial outcome being the same.

The patterns include a form of instruction. Every pattern can be used on a certain scale, such as the scale of the building or city.

Each pattern is connected to another pattern. This connection of patterns creates a pattern language.

The Urban Arid Green project searches for a sustainable approach to address population growth and urbanisation in arid areas. This is done via a case study of Tamansourt. To implement the systemic change proposed in the Urban Arid Green report, all relevant stakeholders must be involved from the start of the process.

Therefore, the issues that manifested themselves, and the solutions presented for these issues, must be understandable for all.

As the overall aim of the study is larger than Tamansourt only, a new pattern language is formulated to sustainably address population growth and urbanisation in arid regions. This is the Urban Arid Green language.

All stakeholders must be involved at the start of the transition process.

PATTERNS BY AL OMRANE

2

METHODOLOGY

The Al Omrane Development Holding Company formulated 41 design guidelines for the development of New Towns in 2010. These guidelines are shown on pages 8 and 9.

For this research, the guidelines are divided into the following categories:
- Urbanised Landscape (U)
- Infrastructure and Transport (T)
- Configuration (C)
- Buildings and Architecture (B)

Not all guidelines formulated by Al Omrane are equally important to the Urban Arid Green project. Therefore, for each guideline is determined whether they should be taken into account in this research project. As this project focuses on urban design and urban development, some guidelines, such as B.5 and B.10 on interior design, are not relevant to this research/design project.

RELEVANT	NOT RELEVANT
U.1 - Adapt to the relief	B.5 - Per level, 3 - 4 dwellings enclosed
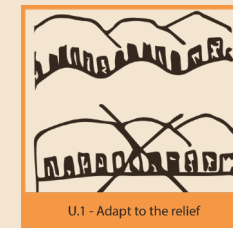
The urban morphology, design and amenities are studied via literature review and experience-based research during the site visit.

For each guideline is studied whether the urban morphology of Tamansourt now meets the aim behind the originally formulated guidelines. For each of these
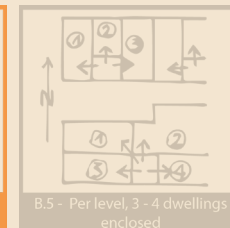
guidelines, a slider describes how close Tamansourt is to reaching these goals.

Tamansourt is not finished yet. It has not reached its target population and therefore is expected to grow further. Furthermore, the climate is changing. The effort Tamansourt has to make to reach and maintain this goal is therefore changing over time.

This methodology is explained via an example, *T.1: Tamansourt should be accessible by different modes of transport*. At the moment, Tamansourt is far from reaching this goal. Tamansourt's infrastructure and urban form are very car-oriented. There is lots of space to park and the fastest mode of transport from Marrakech to Tamansourt, due to the new highway, is by car. However, there are different modes of transport. There is one mode of public transport, bus 44, that connects Tamansourt to Marrakech. This bus goes once every 40 minutes and takes one hour. Therefore, the infrastructure might be there, however, the city is not accessible by different modes of transport yet. The current slider for T.1 looks as follows:


However, Tamansourt did not reach its target population yet. With the amount of transport increasing, the effort Tamansourt has to make to reach its goal to be accessible by different modes of transport is only increasing in the future scenario, forming this slider:
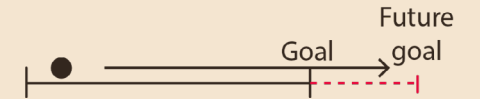
Fortunately, Al Omrane Tamansourt already aims to stimulate the use of public transport by creating a separate bus lane. In this way, public transport always has priority and because of a shorter travel time, they hope to stimulate its use.

The future scenario can also show an opposite effort. This is explained via the example *T.2: Parking in Tamansourt is integrated into the private plots*. Now, plots include private parking, and Tamansourt is close to reaching this goal. Considering climate change, the need for all private cars is not desired. In the future, the city should aim for less private and more shared cars. Therefore, the effort to reach the future goal is reverse from reaching this original formulated goal, as shown in this slider:
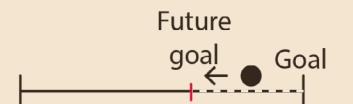
In this Urban Arid Green Pattern Atlas, every relevant patterns is explained more into detail. The effort Tamansourt has to make to reach the original goal behind every relevant guideline is studied and defined.

PATTERNS

Below, all 41 patterns formulated by Al Omrane in 2010 are visualised. Only the patterns relevant to this research are displayed in full opacity.

U.1 - Adapt to the relief

U.2 - Town integrated into a geographical and historical site
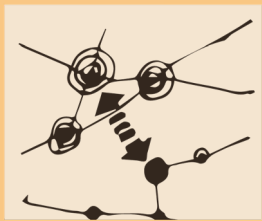
U.3 - Territory must be sufficiently large, to allow development
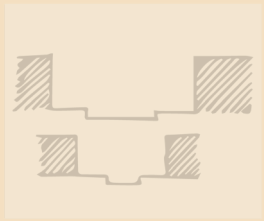
U.4 - Location New Town coherent to the functionalities

U.5 - The organisation of the city respons to indentified needs

T.1 - Accessible to different modes of transport
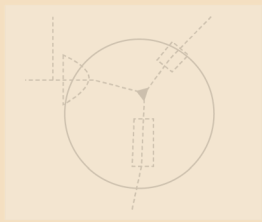
T.2 - Parking is integrated in private plots

T.3 - The greater the density of buildings, the wider the road

T.4 - A primair and secundair street network connects different districts

T.5 - Lanes for public transport only

T.6 - Network ensures access, crossings and allows urban area to grow

T.7 - Shops are located along main infrastructure

T.8 - Businesses without public facades located close to main road
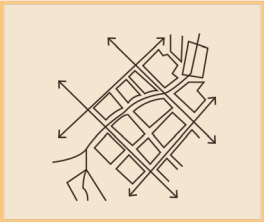
T.9 - Three 60 ha. neighbourhoods fit 200 ha. tranche

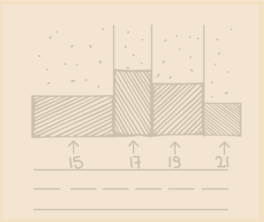**T.10 - Buildings on both sides on the entrance road interact**

T.11 - New town include centres, residental and business districts

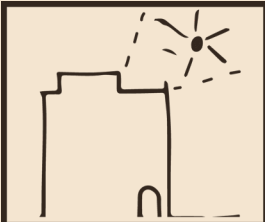T.12 - Household waste containers are accessible from main road

T.13 - Buildings must seek interaction, not necessarily symmetry

T.14 - Continuity of building addresses throughout the city

B.1 - Set back top floor allows more sunlight and sight

B.2 - Overhangs located on the rear side of the building

B.3 - Raised ground floor housing, doesn't effect safety
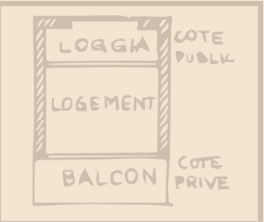
B.4 - Minimise external extensions on the public side
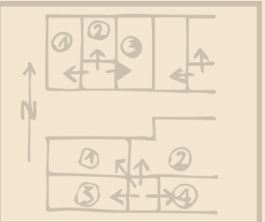
B.5 - Per level, 3 - 4 dwellings enclosed

B.6 - Shops' public facades have windows

B.7 - On the rear side, overhangs are aligned

B.8 - On the rear side, the rythm can be less strict

B.9 - The rear façade must look neat as well

B.10 - Interior of the entrance hall reflects on the building's function

B.11 - The crown

B.12 - Facades refer to local architecture in a modern way

B.13 - The body

B.14 - Plints carefully designed, to avoid maintenance
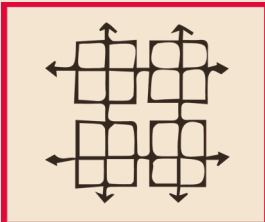
C.1 - Urban continuities between blocks

C.2 - Non-residential buildings more expressive architecture and location

C.3 - Private building blocks are surrounded by a public network

C.4 - Internal roadways in block distribute parcels
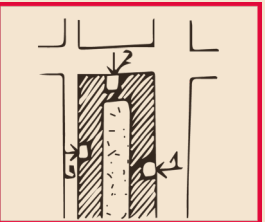
C.5 - Entrances stand out, in architecture and expression

C.6 - Entrance routes based on flows and sightlines
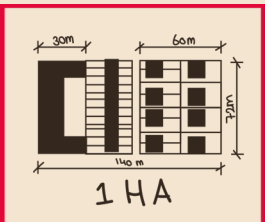
C.7 - Development of diverse architecture per 1 ha.

C.8 - Plots include private parking and building, they allow rear sides

U.1 - Adapt to the relief

U.1 - Adapt to the relief

Goal — Future goal

As shown in the image below, Tamansourt is located on the slope of the Jebilet. The city follows its slope and therefore adapts to its location. There is a maximum height difference of 36 m present in the city. The landscape of Tamansourt was not flattened down before construction started.

Due to snowmelt and rainfall in the Jebilet, and because of Tamansourts location on its slope, the city is enclosed by two natural wadis. It seems as if the city adapts very nicely to its relief.

However, the city could adapt to the relief better.

For example, the wadis were green linear structures before. This green vanished over time. Following the outline of the wadis is not enough to adapt to the relief.

Especially as in the future, the city should be more resilient to for example heavier rainfall or more extreme periods of drought. The location of Tamansourt, in between two wadis, should be seen as an opportunity for the city to restore the soil quality.

U.2 - Town integrated into a geographical and historical site

U.2 - Town integrated into a geographical and historical site

Goal — Future goal

The geographical and historical site is now mainly characterized by the nearby presence of Marrakech, as it used to be a more natural landscape surrounded by several smaller villages. Al Omrane formulated the aim for Tamansourt to resemble Marrakech. By this, it could integrate into the site.

In the urban form, this demonstrates in Tamansourt via the part of the city that must look like the old medina of Marrakech. The streets in this neighbourhood are all just as narrow as in Marrakech's medina. The housing types in this area include shops on the ground floor. As these are not in use yet, as shown on the photograph below, this

is only visible via the double plint in the back of the photograph.

On top of this, the city resembles Marrakech via its red-coloured façades.

Besides this medina, the look and feel of Tamansourt are very different from Marrakech's. The urban layout is wider, and it is quieter on the streets. The city feels less intense. However, together with the high level of urban continuity, this sometimes initiated a somewhat ghost-city feeling. This is not similar to Marrakech at all.

This can be explained by the little public and touristic places in Tamansourt.

U.3 - Territory must be sufficiently large to allow development

U.3 - Territory must be sufficiently large, to allow development

According to this pattern, the city must be sufficiently large to allow future development of the city. As Al Omrane has plans to expand further, this is somehow the case for Tamansourt.

However, with this expansion, the farmers operating in these locations must be relocated. Not all stakeholders have been included in this plan from the start. Therefore, the plan did not allow growth in a sustainable format.

In any plans for Tamansourt, all stakeholders must be integrated into the plan from the start. Everyone should be comfortable with their position in the current and future scenario.

U.5 - The organisation of the city responds to identified needs

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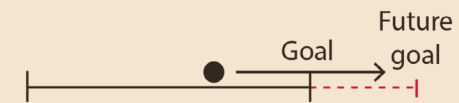
The organisation of the city responds to various needs. For example, there are parks and shops located in central locations along the main avenues. Most of these parks and shops are not in use yet. Therefore it can be questioned whether they are located in the right location or whether there is no need for these facilities yet.

On top of this, the city includes different typologies of housing for different social classes. There even are areas where inhabitants can build their own homes, according to their wishes but following the urban guidelines provided to them by Al Omrane.

The organisation does meet those diverse needs.
Al Omrane aims for the perfect harmonious mix amongst the inhabitants by adding the university campus, industrial site and extra residential area. The needs of the users will change along with this development.

To make sure Tamansourt's organisation responds to future needs, it should already take action. For instance by making sure the city's amenities respond to the need of the future students. Although they will partly overlap with the current families living there, new amenities could be added.

T.1 - Accessible to different modes of transport

T.1 - Accessible to different modes of transport

Goal | Future goal

Tamansourt is not accessible to different modes of transport yet.

Tamansourt's infrastructure and urban form are very car-oriented. There are lots of private and public parking spaces. To resolve urban congestion, the highway between Marrakech and Tamansourt was widened over twelve kilometres. Therefore, the fastest mode of transport from Marrakech to Tamansourt is by car.

However, there are different modes of transport. There is one mode of public transport, bus 44, that connects Tamansourt to Marrakech. This bus goes once every 40 minutes and takes one hour. Therefore, the infrastructure might be there, however, the city is not greatly accessible

by different modes of transport yet. On top of this, Tamansourt did not reach its target population yet. With the amount of transport increasing, the effort Tamansourt has to make to reach its goal to be accessible by different modes of transport is only increasing in the future scenario.

Fortunately, Al Omrane Tamansourt already aims to stimulate the use of public transport by creating a separate bus lane. In this way, public transport always has priority and because of a shorter travel time, they hope to stimulate its use.

T.7 - Shops are located along the main infrastructure

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(Future) Goal
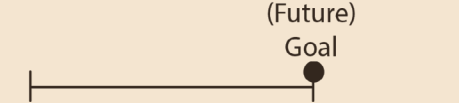
In many locations throughout the city, space for retail is reserved on the ground floor of buildings. On the upper floors, housing is located, as was the case for the medina (pattern U.2).

This pattern also shows the hierarchy in the urban form. The public facilities are located on the main infrastructure. And the infrastructure occupies most of the public facilities. Infrastructure is therefore very important to the visitors of Tamansourt, the users that don't have a private area to interact with people.

However, many of the shops there are either closed or have not moved in yet. The location of these shops is quite

rational.

It can be concluded that in the organisation, Tamansourt already reached this goal. In the future, this should be continued.

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T.10 - Buildings on both sides on the entrance road interact

T.10 - Buildings on both sides on the entrance road interact

(Future)
Goal

All entrance roads are accentuated by a line of trees on both sides of the road. When entering the city or neighbourhood, buildings on both sides of the road interact in colour, height and form.

It can be concluded that in the organisation, Tamansourt already reached this goal. In the future, this should be continued when this interaction is desired.

T.11 - New town include centres, residental and business districts

T.11 - New town include centres, residental and business districts

Future
goal   Goal

During the site visit, I did not visit any business district. There are centres, with a bit more public facilities and districts with residential buildings only. It would be quite hard to achieve this goal in the current format of Tamansourt.

However, Al Omrane wants to achieve this goal by adding the university campus and industrial area to Tamansourt. By just adding these extra districts outside the city's borders, the goal is achieved more easily than trying to fit this within.

T.13 - Buildings must seek interaction, not necessarily symmetry

T.13 - Buildings must seek interac-
tion, not necessarily symmetry

Future
goal   Goal
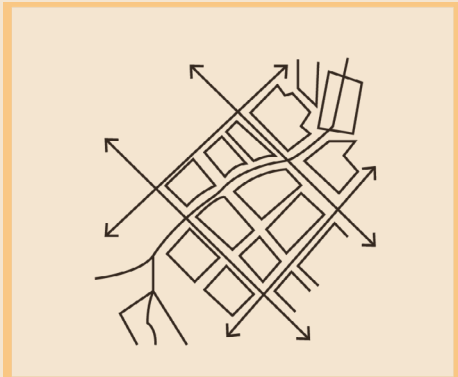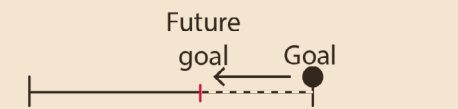
Although the buildings do not have to seek symmetry, most of the forms are quite identical, as visualised in the photograph below.

The image shows a smaller avenue within a neighbourhood, instead of one in between. Within neighbourhoods, the architecture looks copy-pasted. A bit more diversity could resemble a more human dimension.

The pattern's goal is achieved. In the future, it would be okay for the urban form to allow a bit more individuality.

B.1 - Set back top floor allows more sunlight and sight

B.1 - Set back top floor allows
more sunlight and sight

Future
Goal   goal
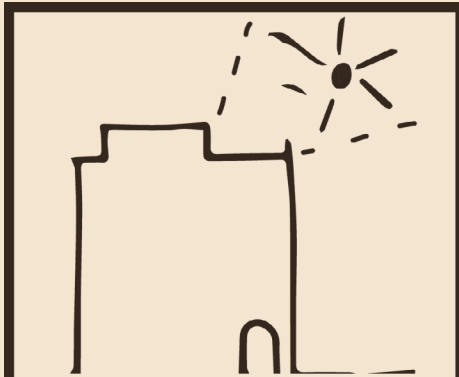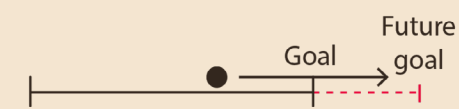
On the crown of many buildings, there is a setback.

The photograph below is taken on top of one of the rental housing flats, from the one on the opposite side of the street. As can be seen in the photograph below, there are PV panels located on the roofs of these building typologies.

The setback ensures that the PV panels remain unseen.

Of course, this is not the case for every typology, which can also be seen in the photograph, on the low-rise buildings.

B.2 - Overhangs located on the rear side of the building, the rear side can be less strict, however must remain uncluttered

B.2 - Overhangs located on the rear side of the building

Future goal ← Goal

The photograph below shows the front façade of a social housing building. As can be seen, this façade is very strict and clean. Therefore, the goal is achieved. However, allowing overhangs or less strict façade design could create more human dimension.

B.12 - Façades refer to local architecture in a modern way

B.12 - Facades refer to local architecture in a modern way

(Future) Goal
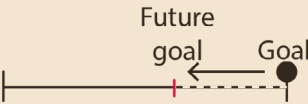
The Moroccan architecture is influenced by the Islamic traditions, Arab neighbours, European colonizers and African tribes from the other side of the Sahara Desert. This creates a very beautiful and unique architectural style. The strongest influence still present in modern Moroccan architecture is Moorish architecture.

Moroccan architecture includes geometric patterns, ornamental Islamic calligraphy of Quranic verses, and colourful zellij. In the centre of classic Moroccan residential buildings, open courtyards with luxurious gardens can be found. These were constructed as places of privacy and relaxation while providing shelter to different weather conditions.

The photograph below shows a beautiful example of how this classic Moroccan architecture can be translated to 2023, with the geometric patterns, modern zellij and stucco façades. In my opinion, this is one of the most beautiful ways of referring to local architecture in Tamansourt. Unfortunately, the image is not visualising the Tamansourt standard.

However, the mix amongst architecture is good and should be kept in the future scenarios as well.
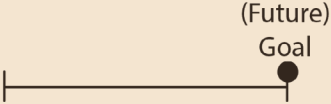
B.14 - Plints are carefully designed to avoid maintenance

B.14 - Plints carefully designed, to avoid maintenance

Future
goal   Goal
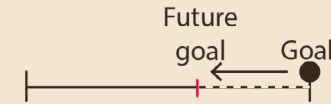
In most scenarios, the plints are designed in such a way that maintenance is avoided. In most cases, only one material is used, mostly stucco. This is easily fixable when there is any damage. There also are little to no ornaments on the plint.

This creates a very monotonous image. Especially because there are also little overhangs and every building is in the same colour tone. Only the neighbourhoods with private housing and villages show some more characteristics.

Although it's a matter of taste, in the future this pattern could be followed a bit less strict. Different materials and rythms in the façade could form a more interesting architectural composition. This would add a bit more human dimension.

C.1 - Urban continuities between blocks

C.1 - Urban continuities between blocks

(Future)
Goal
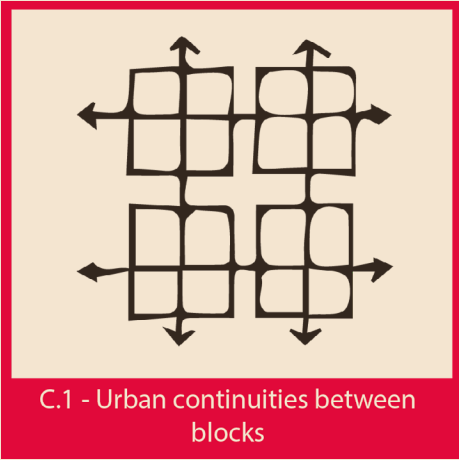
As can be seen in the photograph below, within blocks/neighbourhoods there is a very strict continuity in architecture, form and appearance. Therefore, the goal is achieved.

C.2 - Non-residential buildings are more expressive in architecture and location

(Future)
Goal

You can distinct non-residential buildings easily, as can be seen in the photograph below.

As the image shows, the café differs from its surrounding residential buildings in form, colour and appearance. It provides a very clear urban structure. This goal is achieved in Tamansourt.

C.5 - Entrances stand out, in architecture and expression

Future
goal   Goal
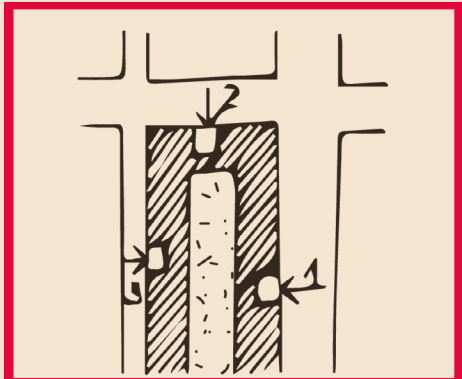
The public facilities that are opened do stand out in architecture and expression.

As visualised via the photograph below, plints including café and restaurants are more brightly coloured. The plints are extended and therefore they stand out in both architecture and expression.

This is not always done in the most delicate way.
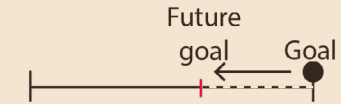
C.6 - Entrance routes based on flows and sightlines

C.6 - Entrance routes based on flows and sightlines
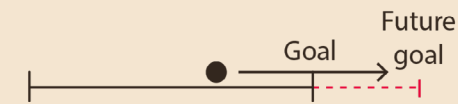
The main entrance route of Tamansourt by car is via the highway. The highway goes through the core of the city. This sightline is not blocked. In Morocco, it is common that the highest building of a city are the mosques, for its visibility to religious people.

From a distance, there is no catchy building or sightline that identifies Tamansourt. The main avenues cross at a roundabout, where the main park is located. From this location, all city 'centres' are visible.

The entrance routes are now mainly based on flows, as it follows the highway and thus car traffic. It could explore a bit more with interesting sights.

Goal — Future goal

C.7 - Development of diverse architecture per 1 ha.
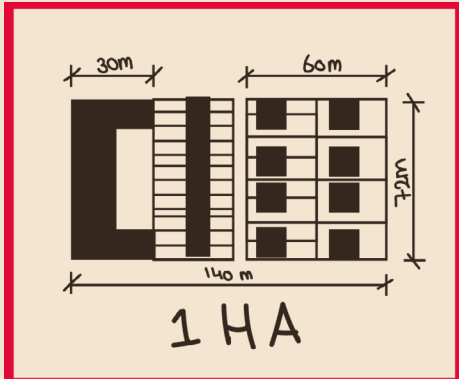
C.7 - Development of diverse architecture per 1 ha.

The urban layout ensures you can easily distinct neighbourhoods. Every neighbourhood has its own architectural style, there is a very strict architectural continuity within those neighbourhoods.

(Future) Goal

U.1	Goal → Future goal
U.2	Goal → Future goal
U.3	Goal → Future goal
U.4	not relevant
U.5	Goal → Future goal
T.1	Goal → Future goal
T.2	not relevant
T.3	not relevant
T.4	not relevant
T.5	not relevant
T.6	not relevant
T.7	(Future) Goal
T.8	not relevant
T.9	not relevant
T.10	(Future) Goal
T.11	Future goal → Goal
T.12	not relevant
T.13	Future goal → Goal
T.14	not relevant
B.1	Goal → Future goal
B.2	Future goal → Goal
B.3	not relevant
B.4	merged B.2.
B.5	not relevant
B.6	not relevant
B.7	merged B.2.
B.8	merged B.2.
B.9	merged B.2.
B.10	not relevant
B.11	not relevant
B.12	(Future) Goal
B.13	not relevant
B.14	Future goal → Goal
C.1	(Future) Goal
C.2	(Future) Goal
C.4	not relevant
C.5	Future goal → Goal
C.6	Goal → Future goal
C.7	(Future) Goal
C.8	not relevant

Conclusion status design guidelines Tamansourt.
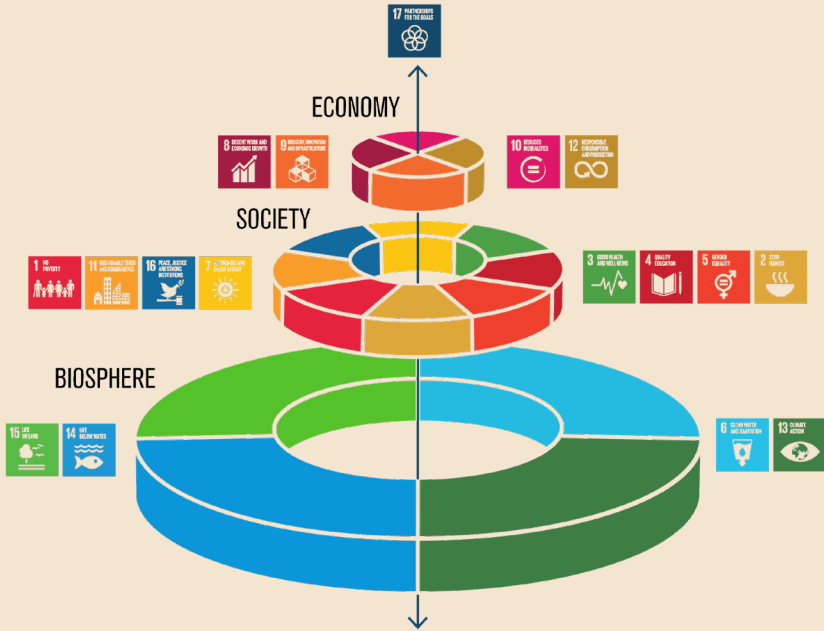
Integrated Sustainable Development Goals. (Stockholm Resilience Centre, 2016)

ECONOMY

SOCIETY

BIOSPHERE

The table to the right shows the current status of each relevant pattern based on this Atlas. Not all guidelines are followed yet. Additionally, some goals might need to be adjusted or reformulated.

The Figure above shows how the Stockholm Resilience Centre (2016) integrated the Sustainable Development Goals of the United Nations.

As visualised, the biosphere includes the Sustainable Development Goals concerning life on land, life below water, clean water and sanitation and climate action. In this integrated model, the biosphere functions as a foundation for the social and economic layer, and for global sustainability (Stockholm Resilience Centre, 2016).

The analysis of the guidelines by Al Omrane shows that none of them focuses on the Biosphere. Therefore, the foundation of Tamansourt, and the other Moroccan new towns following these guidelines, is unsteady to start with.

Therefore, additional design guidelines that focus on the biosphere should be formulated. This contributes to global sustainability and to the original goal to create a green city, via an integral approach.

URBAN ARID GREEN

3

URBAN ARID GREEN PATHWAYS

The Al Omrane Development Holding Company formulated 41 design guidelines for the development of new towns in 2010, as mentioned in the Analysis (chapter 3.2). The analysis concluded that the guidelines were not focused on the biosphere. To transition Tamansourt into an ecocity, socio-spatial design guidelines focused on the biosphere are formulated. These guidelines are presented in this paragraph.

The Urban Arid Green patterns are all based on the spatial analysis, interviews, vision and systemic change presented in this report. The patterns touch upon several scales:
- Organism
- Building
- District
- City
- Region
- Multi-scalar

The patterns form four pathways:
- Al Omrane
- Circularity & Ecology
- Supportive lifestyles
- Facillitating Fabric.

Pattern B.2 to the right is used to illustrate the method of the Pattern Language. In the title of the pattern, the first letter resembles the scale, followed by a number to specify the pattern. The colour indicates the pathway the pattern belongs to.

Al Omrane pathway
The guidelines by Al Omrane are reformulated into four patterns, together forming the Al Omrane pathway. The pathway ensures that the urban fabric remains clean and Moroccan. The pathway stimulates interaction between buildings and emphasizes a clear structure. The town is integrated into its context. As this pathway is based on the design guidelines for Moroccan new towns, this pathway is useful for other Moroccan new towns as well. The pathway must be altered when used in other countries.
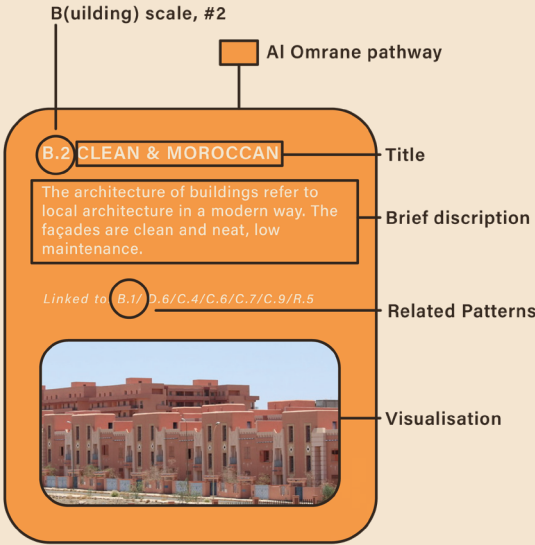
B(uilding) scale, #2

Al Omrane pathway

B.2 CLEAN & MOROCCAN — Title

The architecture of buildings refer to local architecture in a modern way. The façades are clean and neat, low maintenance. — Brief discription

Linked to: B.1/ D.6/C.4/C.6/C.7/C.9/R.5 — Related Patterns

Visualisation

Figure 70: Examplary pattern

B.2 CLEAN & MOROCCAN

Urban, landscape and architectural design refer to local architecture in a modern way. High maintenance is avoided.

Linked to: B.1/ D.6/C.4/C.6/C.7/C.9/R.5

D.6 INTERACTION

Buildings interact without seeking symmetry. There is a diversity in architecture between blocks, but unity within blocks.

Linked to: B.2/B.1/C.2/C.4

C.9 CLEAR STRUCTURE

The hierarchy in routes is clear and expandable. Different functions in different districts. Non-residential buildings are more expressive.

Linked to: B.1/B.2/D.3/D.6/C.2/C.3/C.4/C.5 /C.7

R.5 INTEGRATED

The new towns are linked to other cities. They adapt to the relief and are integrated to the geographical and historical site. Their territory allows further development.

Linked to: R.4/R.3/C.4/C.5/C.7/C.9/D.6/B.2

Circularity & Ecology pathway
By transitioning into an ecocity, the city will lower its usage and produce renewably. It will reduce waste by reusing as much as possible. A self-sustaining, resilient system is established, that can adapt to a changing climate and does not take natural resources for granted.
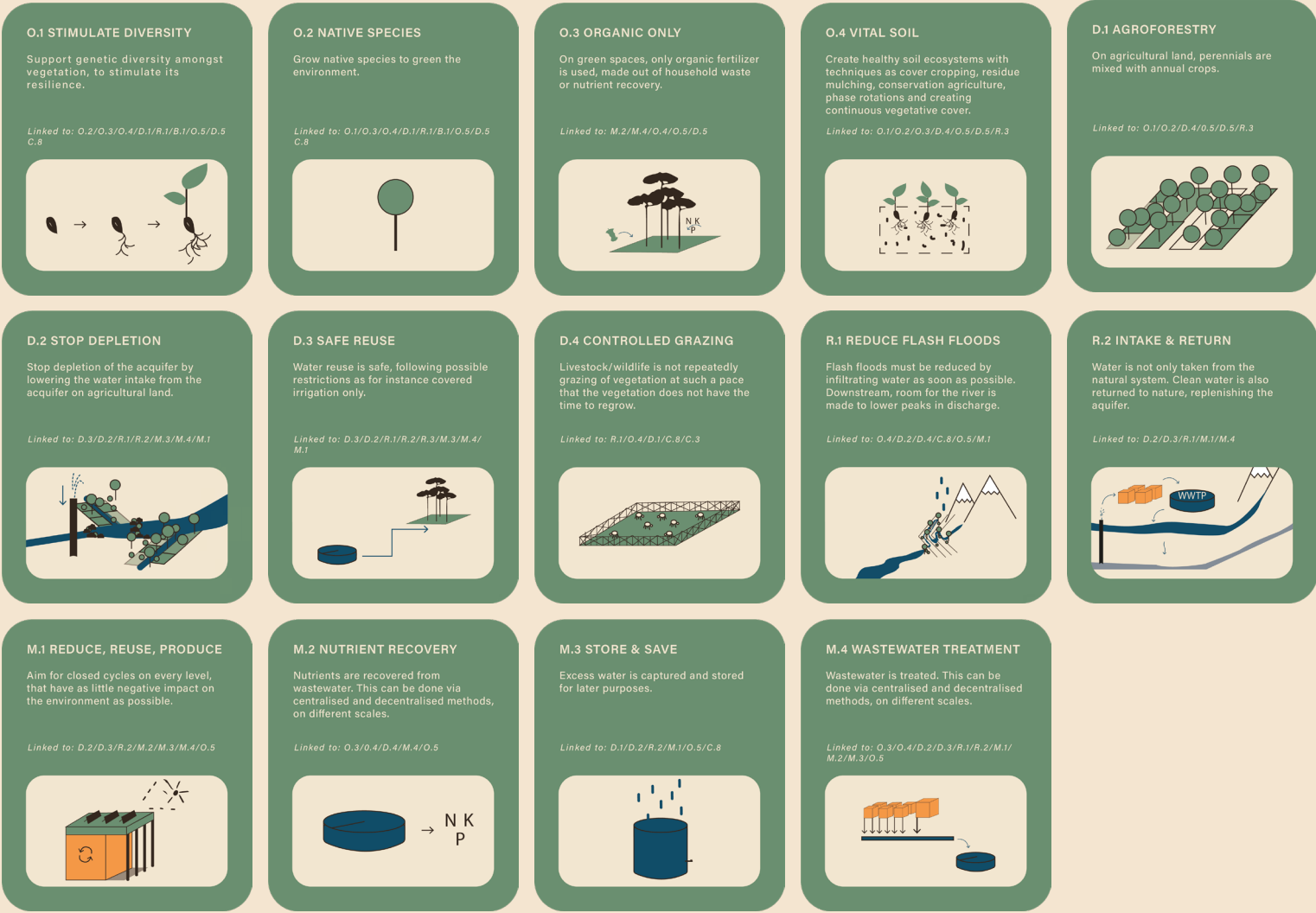
O.1 STIMULATE DIVERSITY

Support genetic diversity amongst vegetation, to stimulate its resilience.

Linked to: O.2/O.3/O.4/D.1/R.1/B.1/O.5/D.5 C.8

O.2 NATIVE SPECIES

Grow native species to green the environment.

Linked to: O.1/O.3/O.4/D.1/R.1/B.1/O.5/D.5 C.8

O.3 ORGANIC ONLY

On green spaces, only organic fertilizer is used, made out of household waste or nutrient recovery.

Linked to: M.2/M.4/O.4/O.5/D.5

O.4 VITAL SOIL

Create healthy soil ecosystems with techniques as cover cropping, residue mulching, conservation agriculture, phase rotations and creating continuous vegetative cover.

Linked to: O.1/O.2/O.3/D.4/O.5/D.5/R.3

D.1 AGROFORESTRY

On agricultural land, perennials are mixed with annual crops.

Linked to: O.1/O.2/D.4/O.5/D.5/R.3

D.2 STOP DEPLETION

Stop depletion of the acquifer by lowering the water intake from the acquifer on agricultural land.

Linked to: D.3/D.2/R.1/R.2/M.3/M.4/M.1

D.3 SAFE REUSE

Water reuse is safe, following possible restrictions as for instance covered irrigation only.

Linked to: D.3/D.2/R.1/R.2/R.3/M.3/M.4/ M.1

D.4 CONTROLLED GRAZING

Livestock/wildlife is not repeatedly grazing of vegetation at such a pace that the vegetation does not have the time to regrow.

Linked to: R.1/O.4/D.1/C.8/C.3

R.1 REDUCE FLASH FLOODS

Flash floods must be reduced by infiltrating water as soon as possible. Downstream, room for the river is made to lower peaks in discharge.

Linked to: O.4/D.2/D.4/C.8/O.5/M.1

R.2 INTAKE & RETURN

Water is not only taken from the natural system. Clean water is also returned to nature, replenishing the aquifer.

Linked to: D.2/D.3/R.1/M.1/M.4

M.1 REDUCE, REUSE, PRODUCE

Aim for closed cycles on every level, that have as little negative impact on the environment as possible.

Linked to: D.2/D.3/R.2/M.2/M.3/M.4/O.5

M.2 NUTRIENT RECOVERY

Nutrients are recovered from wastewater. This can be done via centralised and decentralised methods, on different scales.

Linked to: O.3/O.4/D.4/M.4/O.5

M.3 STORE & SAVE

Excess water is captured and stored for later purposes.

Linked to: D.1/D.2/R.2/M.1/O.5/C.8

M.4 WASTEWATER TREATMENT

Wastewater is treated. This can be done via centralised and decentralised methods, on different scales.

Linked to: O.3/O.4/D.2/D.3/R.1/R.2/M.1/ M.2/M.3/O.5

Figure 70: Circularity & Ecology Pathway

Supportive Lifestyles pathway

Following the ecocity definition of the Ecocity Builders (2010), the social order of the city reflects on fundamental principles of fairness, justice and reasonable equity.
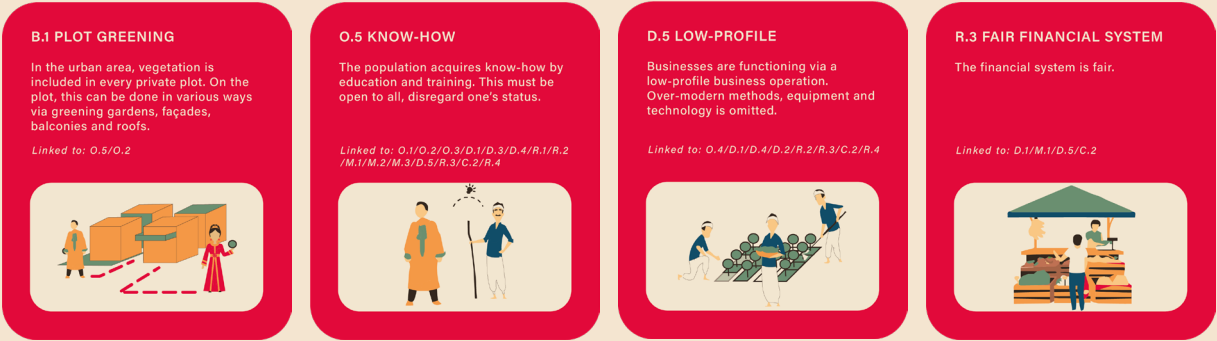
B.1 PLOT GREENING

In the urban area, vegetation is included in every private plot. On the plot, this can be done in various ways via greening gardens, façades, balconies and roofs.

Linked to: O.5/O.2

O.5 KNOW-HOW

The population acquires know-how by education and training. This must be open to all, disregard one's status.

Linked to: O.1/O.2/O.3/D.1/D.3/D.4/R.1/R.2 /M.1/M.2/M.3/D.5/R.3/C.2/R.4

D.5 LOW-PROFILE

Businesses are functioning via a low-profile business operation. Over-modern methods, equipment and technology is omitted.

Linked to: O.4/D.1/D.4/D.2/R.2/R.3/C.2/R.4

R.3 FAIR FINANCIAL SYSTEM

The financial system is fair.

Linked to: D.1/M.1/D.5/C.2

Figure 69:

Facilitating Fabric pathway

The urban structure forms a clear spatial framework and a safe and comfortable place to live. It provides the city with room to exceed the target population, to a certain limit. The urban fabric facilitates a sustainable interaction between human and natural systems.

C.1 LIFE CYCLE DURABILITY

The urban form of the city allows inhabitants to grow through different stages of life.

Linked to: D.6/R.5/C.2/C.3/C.4

C.2 COMMON INTERESTS

Spaces for common interest around the city are available to everyone.

Linked to: O.3/D.1/M.1/B.1/D.5/R.3

C.3 GATHERING SPACES

Safe & comfortable spaces allow people to come together in public space.

Linked to: O.1/O.2/O.4/C.8/D.5/C.9/B.2

C.4 EASY TO EXPLORE

The urban form is super clear. It is easy and safe to explore areas one does not necessarily has to go to.

Linked to: C.9/C.2

C.5 BREAK THE BARRIER

Within the city, there are no barriers in form of obstacles. The human settlement is not defined by a clear border.

Linked to:C.4/D.1/R.1/D.2/R.4

C.6 ALLOW INDIVIDUALITY

Identity must be created. Although a city must look as one whole, the city allows individuality.

Linked to: B.2/D.6

C.7 CREATE ENTITIES

Entities are created throughout the city.

Linked to: B.2/D.6/C.2

C.8 IMPROVE QUALITY OF SPACE

Development must ensure an improvement of the quality of space.

Linked to: B.2/D.6

R.4 LIFTING THE ECOCITY

The idea of the Ecocity is lifted to the regional scale.

Linked to: R.5/O.5/D.5/R.3/D.1/O.4/D.2/R.1 R.2

Figure 72: Facilitating Fabric Pathway

All stakeholders speak the same language, they understand each other and work together on the transition towards an ecocity.

ORGANISM SCALE PATTERNS

O.1 - Stimulate Diversity

Support genetic diversity amongst vegetation, to stimulate its resilience.

The create more resilient vegetation, diversity amongst vegetation should be stimulated, as explained by Roeland Lelieveld in the Urban Arid Green report, chapter 4.2.1.

Amongst one species, aim for diversity by growing vegetation from seeds in stead of from cuttings. Also aim for diversity in species, so no mono-cultures.

More genetic diversity amongst vegetation creates resilience to for instance plagues.

By formulating a species catalogue, the stakeholders are provided with a tool to easily create a diverse vegetation cover.

Translating this pattern to a urban and landscape design: the vegetation cover will look less neat and plant nurseries are needed.
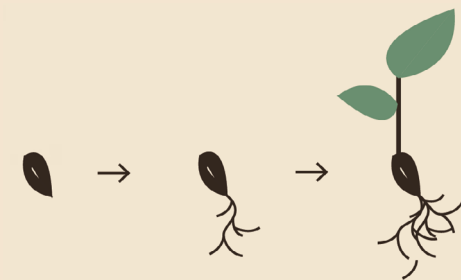
Linked to: O.2/O.3/O.4/D.1/R.1/B.1/O.5/D.5C.8

O.2 - Native Species

Grow native species to green the environment.

The biological diversity is experiencing a rapid loss[1]. In chapter 4.2.1. of the Urban Arid Green report, Roeland Lelieveld explained that prioritising native species over alien species enhances biodiversity, as they fit in the local ecosystems. On top of this, they are more resilient to potential hazards and disruptions.

By formulating a species catalogue, the stakeholders are provided with a tool to easily create a diverse vegetation cover.

Linked to: O.1/O.3/O.4/D.1/R.1/B.1/O.5/D.5C.8

1. Chan, S., Bauer, S., Betsill, M. M., Biermann, F., Boran, I., Bridgewater, P., ... & Pettorelli, N. (2022). The global biodiversity framework needs a robust action agenda. *Nature Ecology & Evolution*, 1-2.

Circularity & Ecology pathway

Circularity & Ecology pathway

O.3 - Organic Only

On green spaces, only organic fertilizer is used, made out of household waste or nutrient recovery.
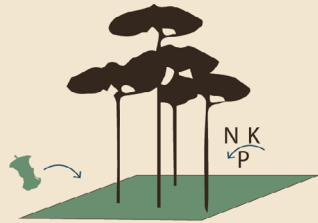
This pattern concerns several actors:
1. The community must carefully seperate its household waste.
2. The municipality must facilitate the community with a place to dump the household waste, or they must collect the waste at their homes. In case of nutrient recovery, centralised or decentralised treatment sites are needed.
The waste or recovered nutrients must be collected and transported to the nurseries or green spaces.
3. The farmers and landscape workers must gain knowledge on working with the organic fertilizer, how to compose household waste to cultivate organically.

This provides jobs and healthy soils, contributing to the ecocity.

The urban design must also facilitate this proces, by for instance including compost collection points in the street layout.

The pattern emphasizes the exclusion of chemical fertilizers.

Linked to: M.2/M.4/O.4/O.5/D.5

O.4 - Vital Soil

Create healthy soil ecosystems with techniques as cover cropping, residue mulching, conservation agriculture, phase rotations and creating continuous vegetative cover.

As explained in chapter 3.3 of the Urban Arid Green report, soil ecosystems are disrupted by construction. In urban areas, the land cover is mostly sealed, harming the soil structure and biodiversity.

Sustainable urban development should focus on land conservation and soil restoration.

Techniques related to restoring soil quality are controlling grazing, cover cropping, residue mulching, conservation agriculture and creating a continuous vegetative cover [1].

Mixing perennials with annuals protects against soil erosion, conserves water and nutrients, stores more carbon below ground, and builds better pest tolerance [2].

Crop and phase rotations are important to make sure the soil remains healthy and productive [3].

Linked to: O.1/O.2/O.3/D.4/O.5/D.5/R.3

1. Lal, R. (2015). Restoring soil quality to mitigate soil degradation. *Sustainability*, 7(5), 5875-5895.
2. Zhang, Y., Li, Y., Jiang, L., Tian, C., Li, J., & Xiao, Z. (2011). Potential of perennial crop on environmental sustainability of agriculture. *Procedia Environmental Sciences*, 10, 1141-1147.
3. Batello, C., Wade, L., Cox, S., Pogna, N., Bozzini, A., & Choptiany, J. (2014). Perennial crops for food security. In *FAO Expert Workshop on Perennial Crops for Food Security Rome (Italy)* 28-30 Aug 2013.

Circularity & Ecology pathway

stimulate safe and public transport

Arbutus unedo, native smaller tree, 3-5 m

compost collecting

RESIDENTIAL

RESIDENTIAL

RESIDENTIAL / COMMERCIAL

STOP PARK

3 m two way sport

3,5 m one way traffic

3,5 m one way traffic

7 m pedestrian
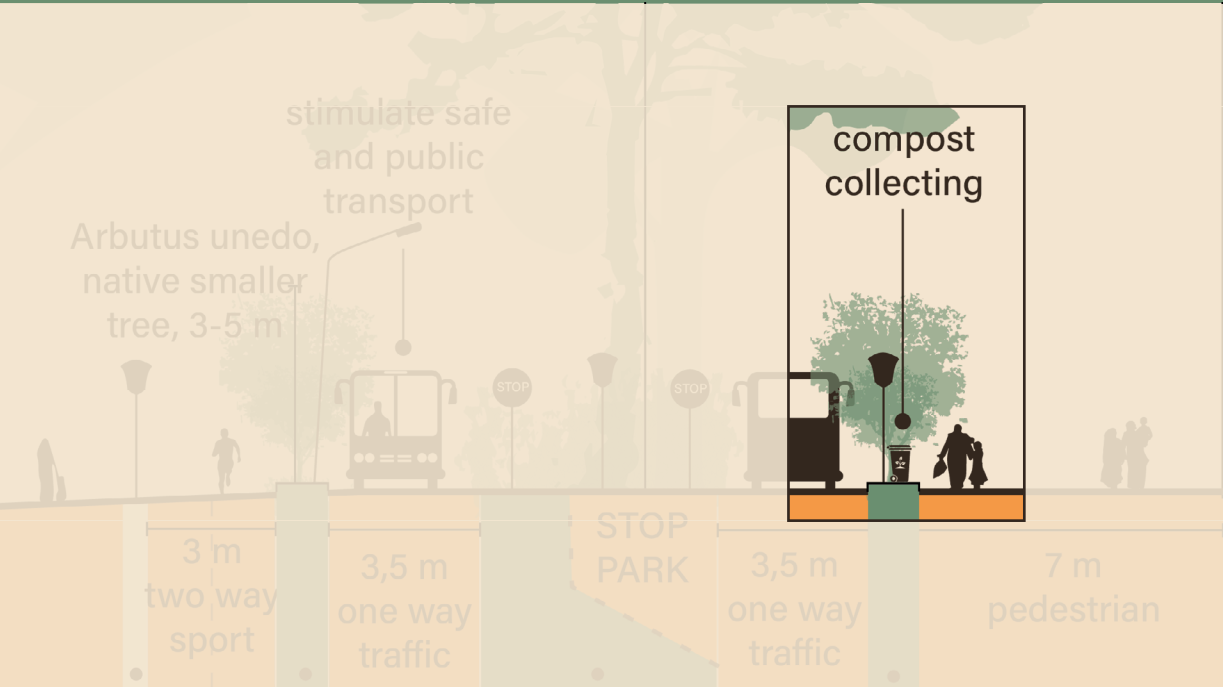
The population acquires know-how by education and training. This must be open to all, disregard one's status.

As explained by Tom Wilms in chapter 4.2.2 of the Urban Arid Green report, all stakeholders must be involved in sustainable urban development. The vision must fit all parties, including nomads, farmers, residents, tourists, investors, the government, etc.

These actors must go through a behavioural change to support the Ecocity vision. For behavioural changes know-how is needed and this requires education.

By educating, training and employing locals, they can participate in the activities undertaken in the ecocity.

Linked to: O.1/O.2/O.3/D.1/D.3/D.4/R.1/R.2 /M.1/M.2/M.3/D.5/R.3/C.2/R.4

BUILDING SCALE PATTERNS

Supportive Lifestyles pathway

B.1 - Plot Greening

In the urban area, vegetation is included in every private plot. On the plot, this can be done in various ways via greening gardens, façades, balconies and roofs.

As described in chapter 4.3 of the Urban Arid Green report, in the case of Tamansourt, the municipality takes care of green maintenance, in city parks and along avenues. The community can green the urban area further, from the bottom-up, by including green in every plot.

The residents of villas and appartment buildings with shared courtyards can maximise the amount of ground bounded green.

Residents living in buildings with balconies can maximise the amount of green in pots.

All other typologies without (suitable) outdoor space can include wall and roof greening.

By this, everyone is able to contribute to the ecocity. The system must allow this regreening proces, the community must be stimulated to do this.
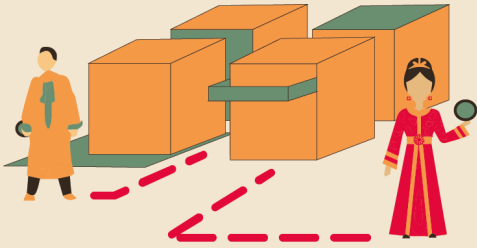
Linked to: O.5/O.2

B.2 - Clean & Moroccan

Urban, landscape and architectural design refer to local spheres in a modern way. High maintenance is avoided.

In architectural design, the façades, mainly the plints, are clean and neat, to lower maintenence cost. However, they allow individuality.

The urban and landscape design must exhibit the beauty of local nature. On top of this, using native species will lower green maintenance.

Creating vital soil for instance means heavy pruning and leaving the green waste. For this, the landscape is allowed to look less neat, to contribute most to the ecocity.

Linked to: B.1/ D.6/C.4/C.6/C.7/C.9/R.5

Supportive Lifestyles pathway

Al Omrane pathway

DISTRICT SCALE PATTERNS
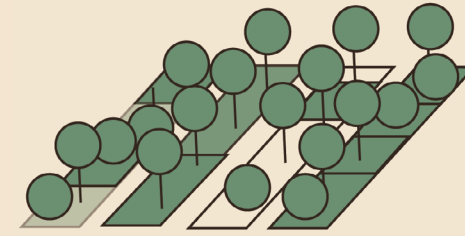
On agricultural land, perennials are mixed with annual crops.

By transforming barren land into argroforestry sites, the landscape can be improved.

Mixing perennials with annuals protects against soil erosion, conserves water and nutrients, stores more carbon below ground, and builds better pest tolerance [1].

By combining (woody) perennials with commercially important and high yielding annual crops, the improvement contributes to climate change adaptation and mitigation, promotes biodiversity and ecosystem functions while enhancing the local food security and economy [2].

Linked to: O.1/O.2/D.4/0.5/D.5/R.3

1. Zhang, Y., Li, Y., Jiang, L., Tian, C., Li, J., & Xiao, Z. (2011). Potential of perennial crop on environmental sustainability of agriculture. *Procedia Environmental Sciences*, 10, 1141-1147.
2. Batello, C., Wade, L., Cox, S., Pogna, N., Bozzini, A., & Choptiany, J. (2014). Perennial crops for food security. In *FAO Expert Workshop on Perennial Crops for Food Security Rome (Italy)* 28-30 Aug 2013.

Circularity & Ecology pathway

D.2 - Stop Depletion

Stop depletion of the acquifer by lowering the water intake from the acquifer on agricultural land.

Due to climate change, the rainfall is getting more unpredictive which results in failed harvests [1]. This leads to rising water demands, mainly on agricultural land [2].

Together with policies, as explained in chapter 3.4 of the Urban Arid Green report, water must infiltrate better. Restoring the soil quality is the first step to restore nature as it will replenish reservers, which benefits agricultural land. On the land, water must be used efficient. Among others, by selecting the right species for the specific landscape.

Reusing filtered wastewater contributes to stopping depletion.
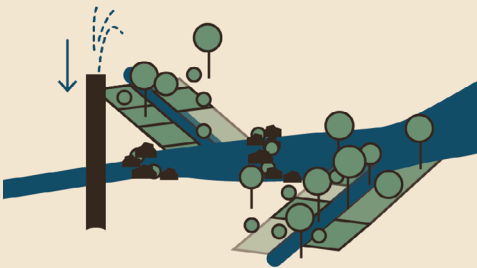
Linked to: D.3/D.2/R.1/R.2/M.3/M.4/M.1

1. Kangalawe, R. Y., & Lyimo, J. G. (2013). *Climate change, adaptive strategies and rural livelihoods in semiarid* Tanzania.
2. Ennabih, A. (2020). *Running out of water.* **https://mipa.institute/8137**

D.3 - Safe Reuse

Water reuse is safe, following possible restrictions as for instance covered irrigation only.

Reusing wastewater is a key to circular use of natural resources, especially in arid regions where water is scarce. Therefore, reuse of water must be stimulated.

There are different methods of wastewater treatment, as explained in chapter 8.6 'Sanitation System' of the Urban Arid Green report.

Some methods allow wastewater reuse without restrictions, which can be the case with treatment via wastewater treatment plants [1].

Decentralised options such as the Ray Hay system, the prototype that treats wastewater through a green facade/ balcony gardens, allows water reuse for covered irrigation [2].

When using different measures of water treatment, everyone should be aware of the consequences. Sickness by mis-use must be avoided.
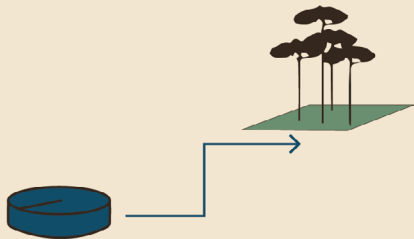
Linked to: D.3/D.2/R.1/R.2/R.3/M.3/M.4/M.1

1. Eawag - Swiss Federal Institute of Aquatic Science and Technology - Eawag. (n.d-b). *Systems.* Retrieved 2 November 2022, from **https://www.eawag.ch/en/research/humanwelfare/wastewater/decentralised-resource-recovery-from-wastewater/systems**
2. Riechelman, C. (2019). *Ray Hay decentralized sewage water treatment and reuse systems.* Campus El ouna, Water Engineering Department, TU Berlin.

Circularity & Ecology pathway

Circularity & Ecology pathway

47

D.4 - Controlled Grazing

Livestock/wildlife is not repeatedly grazing of vegetation at such a pace that the vegetation does not have the time to regrow.

Livestock must be controlled in order to let vegetation regrow, as explained by Roeland Lelieveld, in chapter 4.2.1. of the Urban Arid Green report.

The land to regrow vegetation must be protected from livestock for at least the first 5 years. After 5 years, livestock cannot gnaw at the crack of the trees. However, without a fence, the vegetation between the trees would be grazed within a day.

Fencing livestock is another option, however, then the system dependents on someone else's business operation.

In any case, the farmers must be considered in the vision. It is better to fit them into the plan beforehand.

The barrier surrounding livestock can be fences, however it can also be very thorny native bushes or reusing organic matter to keep the livestock out.
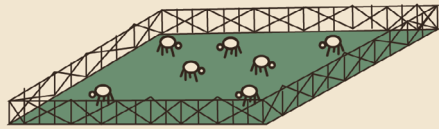
Linked to: R.1/O.4/D.1/C.8/C.3

D.5 - Low-Profile

Businesses are functioning via a low-profile business operation. Over-modern methods, equipment and technology is omitted.

More attention is given to the social, environmental and market consequences of the agricultural and landscape systems.

Locals can easily participate in low-profile business operations. They are more familiar with these methods and the operations remain more traditional.

It provides jobs and income for more people than over-modern methods, equipment and technology. This benefits the local economy.

Linked to: O.4/D.1/D.4/D.2/R.2/R.3/C.2/R.4

Circularity & Ecology pathway

Supportive Lifestyles pathway

Buildings interact without seeking symmetry. There is a diversity in architecture while unity remains.

The design of the form and architecture of buildings takes into account the context of the building. By this, the buildings interact with each other in appearance. Preferably buildings do not seek symmetry, however there is urban continuity.

Throughout the city, there is diversity in architecture. This allows residents to appropriate their neighborhood.

Linked to: B.2/B.1/C.2/C.4

CITY SCALE PATTERNS

Al Omrane pathway
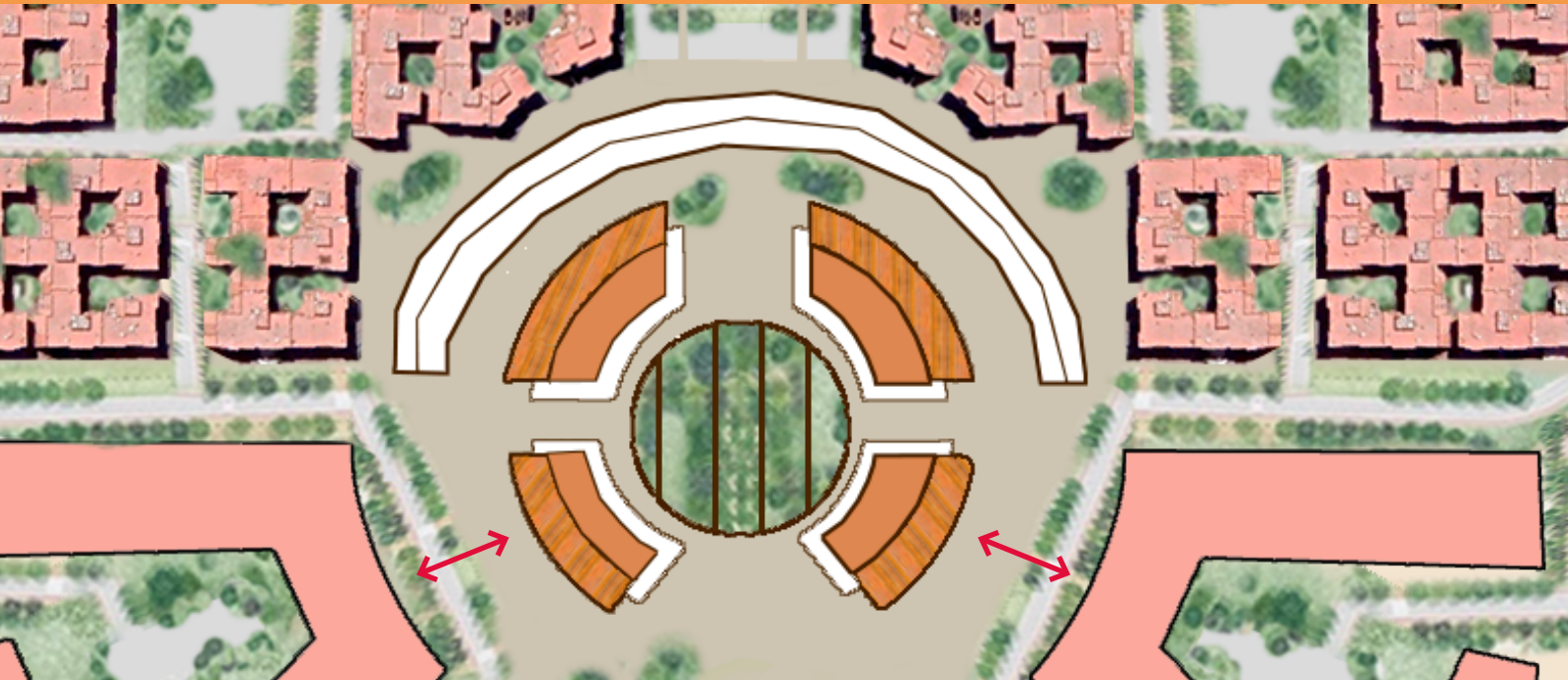
C.1 - Lifecycle Durability

Linked to: D.6/R.5/C.2/C.3/C.4

The urban form of the city allows inhabitants to grow through different stages of life.

The population tree of the new town is shown in chapter 3.1 of the Urban Arid Green report, 'The People of Tamansourt'. The tree shows a low percentage of elderly. However, when the city and its inhabitants age, residents might have different demands and needs. For instance, they might need to move into a different housing typology or might need different amenities.
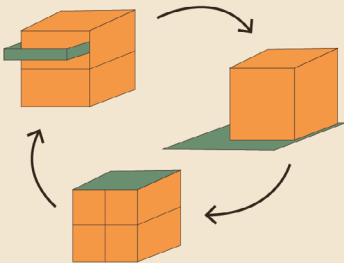
By this, the city allows lifecycle durability and a constant harmonious mix amongst residents.

C.2 - Common Interests

Linked to: O.3/D.1/M.1/B.1/D.5/R.3

Spaces for common interest around the city are available to everyone.

Within the city, common daily activities, such as doing groceries should be mixed with more occasional activities, like sports/arts/health, or collecting green. By this, a common use and interaction between different groups is stimulated.

Places for common interest are needed to activate the green framework of the ecocity further. By positioning these in strategic locations, recognition points and entities can be created.

Facilitating Fabric pathway

LEGEND *

Public facilities

▮	University campus
▮	Extension campus
▮	Parks
▭	Cemetery
▮	Old urban settlements
○	Centres
▭	Industrial zone and economic activities
▮	Education I public health I culture and sports centers
▮	INT1: Artisanal activity zone & business centers
▮	INT2: Artisanal activity zone & business centers

Residential categories

▮	B: Flats, appartment buildings
▮	C1: Flats, appartment buildings
▮	C2: Mostly Villas
▮	D1: Villas
▮	D2: Villas
▮	E1: Economic habitat (with commercial), 72m²
▮	E2: Economic habitat, 70-100m², with commercial 100-150 m²
▮	E3: Economic habitat, 72m² or 70-100m², with commercial 72m² or 100-150 m²
▮	Extension

Figure: Al Omrane Marrakech. (2008). *Tamansourt.* p-181, 183.
Legend: Code (B,C,D,E,INT) based on *(Al Omrane Marrakech, 2008. p-181, 183)*, legend corresponds to visionary model at Al Omrane office Tamansourt, shown on page 70 of the Urban Arid Green report.

Facilitating Fabric pathway

One additional image used to create this impression. Rammed-earth restaurant by Myrthe den Heeten, 2022.

C.3 - Gathering Spaces

Safe & comfortable spaces allow people to come together in public space.

By creating safe and comfortable places to come together in public space, the public space can be activated.

Vegetation can create more comfortable atmospheres, as explained in chapter 3.6 of the Urban Arid Green report 'Vegetation in Tamansourt'. Including vegetation in the design of public spaces is therefore very important.

Linked to: O.1/O.2/O.4/C.8/D.5/C.9/B.2

C.4 - Easy to Explore

The urban form is super clear. It is easy and safe to explore areas one does not necessarily has to go to.

By creating a very clear urban form, residents and visitors can easily explore the city.

When agro- and eco tourism is stimulated in the ecocity, visitors will come to the city for these specific aspects. However, they might spend more time in the city when some interesting features draw their attention. To do this, the urban form must be super clear.

This can be done by specific sightlines or making use of the elevation differences.
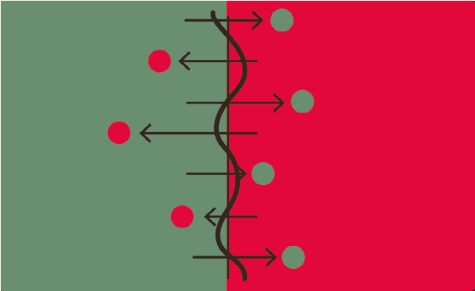
Linked to: C.9/C.2

Facilitating Fabric pathway

C.5 - Break the Barrier

Linked to:C.4/D.1/R.1/D.2/R.4

Within the city, there are no barriers in form of obstacles. The human settlement is not defined by a clear border.

The urban area is seen as a continuous landscape, an integral system.

Subsystems, such as infrastructure, are part of this landscape. These are no additional elements that disrupt the city.
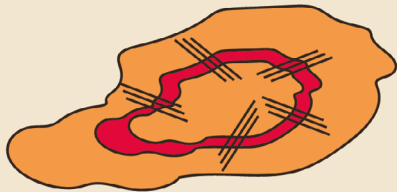
C.6 - Allow Individuality

Linked to: B.2/D.6

Identity must be created. Although a city must look as one whole, the city allows individuality.

The design for a city cannot be a copy-paste one, as every landscape and each context is unique.

The city aims for a harmonious mix amongst its residents. For this, the design of the city must acknowledge the differences between people. Every person is unique in demands and needs. The city must facilitate this, a human dimension is required.

Facilitating Fabric pathway

RESIDENTIAL

RESIDENTIAL

RESIDENTIAL

RESIDENTIAL / COMMERCIAL

Ceratonia siliqua, native tree
15 - 25 m
10 - 17 m

Arbutus unedo, native smaller tree
3-5 m

STOP

STOP

PUBLIC PARK / FORESTRY

5 m pedestrian

3 m two way cycling, skating, running

3,5 m one way traffic

STOP AGROFORESTRY

3,5 m one way traffic

5 m two way cycling, skating, running

7 m pedestrian

lamppost every 20 m   lamppost every 50 m

lamppost every 20 m

lamppost every 50 m

lamppost every 20 m

crossing

Facilitating Fabric pathway

C.7 - Create Entities

Linked to: B.2/D.6/C.2

For people to appropriate their space, entities are created throughout the city.

The ecocity as a whole is a physical entity, as it is a built-up area midsts of a natural landscape. Elements of the entity can be the specific coloured façades, or seasonal parks enclosing the city. However, the city can also embody multiple different entities.

By creating and allowing these entities within the city, the population is given the opportunity to appropriate the space. This is essential to built the social layer, espacially in new towns.

C.8 - Improve Quality of Space
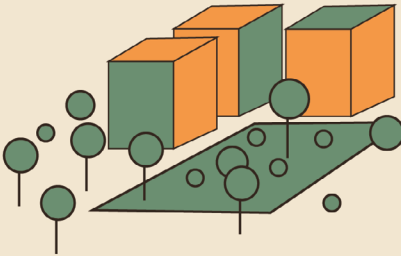
Linked to: B.2/D.6

Development must ensure an improvement of the quality of space.

Cities transforming into ecocities will experience sustainable urban development. During the process, it must be ensured that the quality of space will improve. By this, the ecocity becomes a more desirable place to be.

For instance, high dams can be build to create water safety. However, by aiming for a nature-based solution, as presented in the Urban Arid Green report, the quality of space can be improved as well. A solution must simultanuously aim for a spatial benefit.

Facilitating Fabric pathway

C.9 - Clear Structure

The hierarchy in routes is clear and expandable. Different functions in different districts. Non-residential buildings are more expressive.

The entrance routes are based on flows and sightlines, easily guiding people through the city. Cities include centers and those are easy to find due to the clear structure of the city and hierarchy in infrastructure.

Different districts house different functions, and this is strengthened by the urban layout.

Non-residential buildings are more expressive in architecture and location This makes the urban layout easy to read. Entrances stand out in architecture and expression for the same purpose.

Linked to: B.1/B.2/D.3/D.6/C.2/C.3/C.4/C.5 /C.7

REGIONAL SCALE PATTERNS
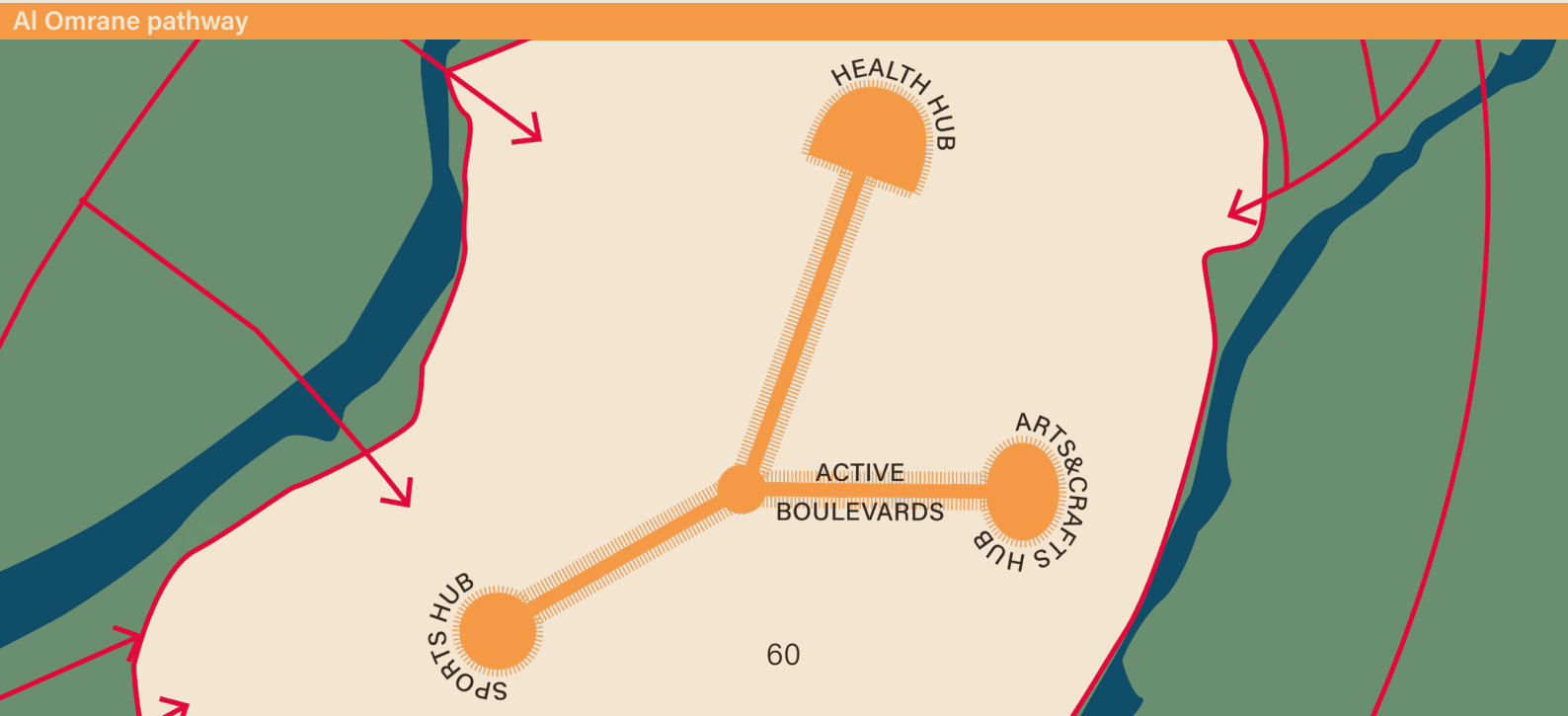
Al Omrane pathway

HEALTH HUB

ARTS&CRAFTS HUB

ACTIVE BOULEVARDS

SPORTS HUB

R.1 - Reduce Flash floods

Flash floods must be reduced by infiltrating water as soon as possible. Downstream, room for the river is made to lower peaks in discharge.

Many cities are linked to waterbodies. To create a safe urban area, the waterbody cannot flood. Flash floods must be reduced. For this, the entire system of the waterbody must be considered, as mentioned in chapter 4.2.2 of the Urban Arid Green report.

Downstream, space must be created for the water. This can be done in various ways, for instance by making extra channels, removing obstacles, deepening or widening the waterbody, or creating pits so rainfall won't reach the waterbody.

Upstream, water must be collected and retained. There are many options to do this, for instance via vegetation, meandering, terraces, (covered) reservoirs and/or (organic) dams.

By this, the water can infiltrate and the waterbody won't flood, creating safe spaces. The space becomes more attractive to recreate.

Linked to: O.4/D.2/D.4/C.8/O.5/M.1

R.2 - Intake & Return

Water is not only taken from the natural system. Clean water is also returned to nature, replenishing the aquifer.

Aiming to enhance the natural system, the city and its activities cannot only take from the system.

Water is taken from the aquifer for decades. The human activities should not only stop/lower this activity, the aquifer should also be replenished.
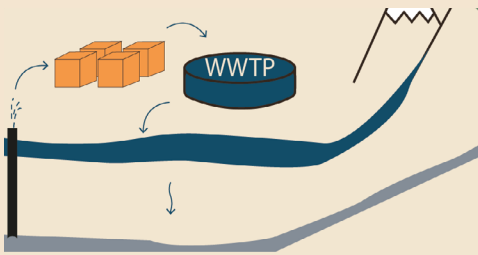
Linked to: D.2/D.3/R.1/M.1/M.4

Circularity & Ecology pathway

trees as city walls

no grazing

pv and safety

one-meter-high dams every 500 m

social safety

lamppost every 20 m

3 m depth

62

Circularity & Ecology pathway

clean drinking water

water for nurseries and first phase only + fertilizer

rainfall and snowmelt

wadi

infiltration

sewage system

WWTP

63
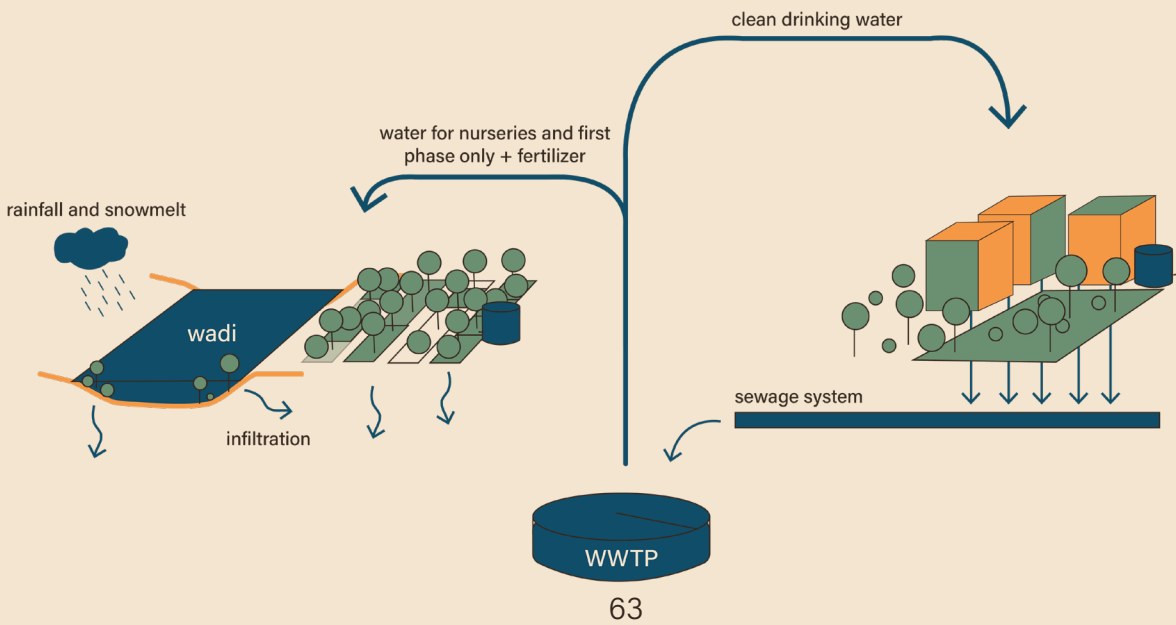
R.3 - Fair Financial System

The financial system is fair.

Forming Community Based Organisations could enhace a fair financial system. This organisational method is used in Africa Wood Grow as well, as explained by Roeland Lelieveld in chapter 4.2.1 of the Urban Arid Green report.

An important aspect to a fair financial system is that profit is made by all actors involved, not just for one investor. This gives purpose to the community.

Linked to: D.1/M.1/D.5/C.2

R.4 - Lifting the Ecocity

The idea of the Ecocity is lifted to the regional scale.

An ecocity is not limited to the non-physical city borders.

Certain systems, such as the water, electricity, food or waste system, exceed over city-level. When advancing on the transformative framework of an ecocity, these systems will be rethought.

On top of this, the natural system rewilds over city borders.

The idea of the ecocity can thus be lifted to a territorial level, as the transformation process will influence different regional-scale systems.

Linked to: R.5/O.5/D.5/R.3/D.1/O.4/D.2/R.1R.2

Supportive Lifestyles pathway

Facilitating Fabric pathway

NEW RESIDENTIAL DISTRICT

The new towns are linked to other cities. They adapt to the relief and are integrated to the geographical and historical site. Their territory allows further development.

The new town is embedded in the already existing urban landscape. It considers the processes that went on before the founding of the city.

As the new towns are meant to resolve urban congestion, the city is in close connection to nearby cities. However, the city must be a self-sustaining city that does not rely on the urban amenities of others.

Linked to: R.4/R.3/C.4/C.5/C.7/C.9/D.6/B.2

MULTI-SCALAR PATTERNS

Al Omrane pathway
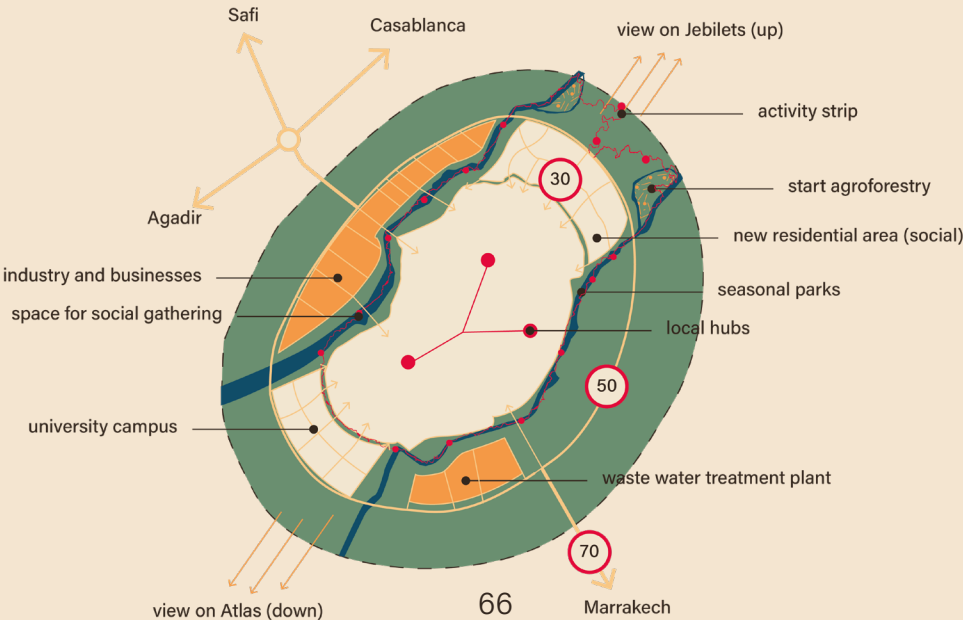
Safi

Casablanca

view on Jebilets (up)

activity strip

30

start agroforestry

Agadir

new residential area (social)

industry and businesses

seasonal parks

space for social gathering

local hubs

50

university campus

waste water treatment plant

70

view on Atlas (down)

Marrakech

66

67

M.1 - Reduce, Reuse, Produce

Aim for closed cycles on every level, that have as little negative impact on the environment as possible.

The usage of resources and the amount of waste must be reduced. This can be done by closing loops. On top of this, renewable resources must be used for production, to stop depletion of resources.

The aim for circularity must be carried out on various scales. From the individual that is part of the ecocity, to the region the ecocity is part of.
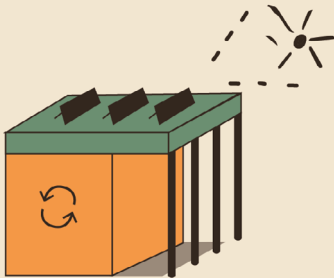
Linked to: D.2/D.3/R.2/M.2/M.3/M.4/O.5

M.2 - Nutrient Recovery

Nutrients are recovered from wastewater. This can be done via centralised and decentralised methods, on different scales.

To grow vegetation, fertilizers are needed. Fertilizers are made out of NPK's (nitrogen, phosphorus and potassium). These nutrients can be recovered from wastewater [1].

By recovering nutrients from the city's wastewater and using this to fertilise the soil, the greening process benefits from the city. This way, the urban area and natural system complete each other.

This process touches upon various scales, partly depending on the method used to recover nutrients.

The recovery starts with the individuals that produce the nutrients. When using a centralised method, their share, together with that of their fellow residents, is transported to the treatment facility via shared infrastructure troughout the city. The nutrients leave the facility as fertiliser, and are used by farmers to fertilise the soil.
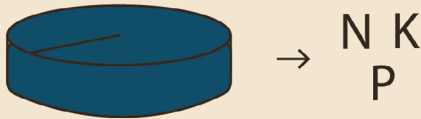
Linked to: O.3/O.4/D.4/M.4/O.5

1. Etter, B., & Udert, K. (2016). *VUNA Handbook on Urine Treatment*. Eawag. Retrieved January 1, 2023, from **https://www.eawag.ch/fileadmin/Domain1/Abteilungen/eng/projekte/vuna/doc/VUNA_Handbook_Urine_Treatment.pdf**

Circularity & Ecology pathway

Circularity & Ecology pathway

One additional image used to create this impression: Blue Diversion Autarky toilet by Eawag / EOOS.

M.3 - Store & Save

Excess water is captured and stored for later purposes.

The urban area can function as a natural sponge. By including vegetation and restoring the soil's quality, water can infiltrate in the soil.

Rainwater that falls on sealed surfaces can be captured in tanks for later purposes.

By this, the rainfall and water is used optimally.

Linked to: D.1/D.2/R.2/M.1/O.5/C.8

M.4 - Wastewater Treatment

Wastewater is treated. This can be done via centralised and decentralised methods, on different scales.

The wastewater treatment must be an integral plan troughtout different scales and scopes in the city.

The urban, landscape and architectural design must complete each other on this aspect.

The urban plan must foresee the right (sewage) infrastructure and space for the treatment process. The architectural design must nicely fit the reuse into people's homes. The landscape design must take into account the method of reuse.

The treatment of water will affect people's habits. For instance the resident's by assuring they won't flush certain chemicals down the drain or farmers by assuring they follow the water reuse restrictions.
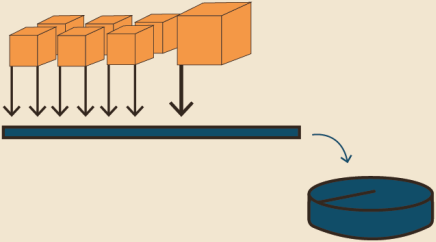
Linked to: O.3/O.4/D.2/D.3/R.1/R.2/M.1/ M.2/M.3/O.5

Circularity & Ecology pathway

Circularity & Ecology pathway

One additional image used to create this impression: Ray Hali

THE URBAN ARID GREEN LANGUAGE

Below, the Urban Arid Green Language is displayed as a possible sequences of patterns, showing the biosphere as the foundation of the ecocity.

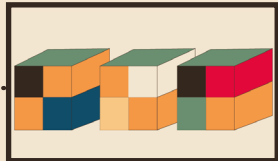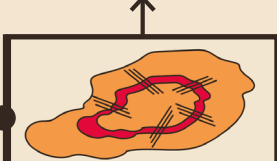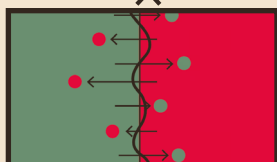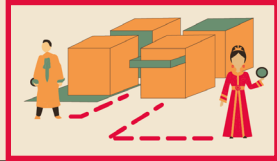LEGEND

— Results in

···· Go hand in hand

→ Sparking

—•— Prerequisite

FAIR
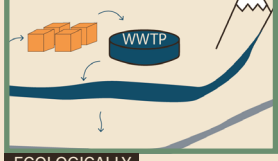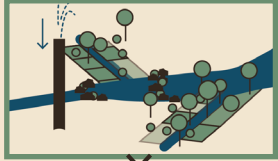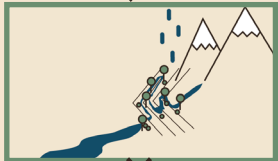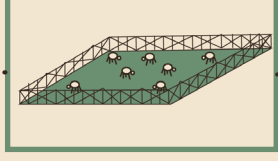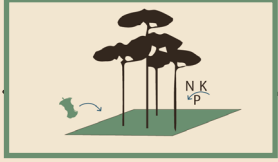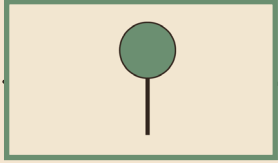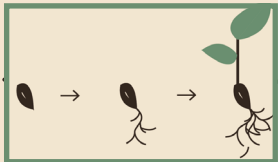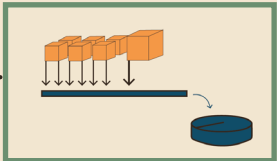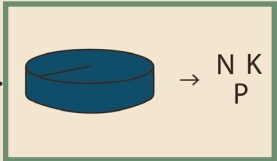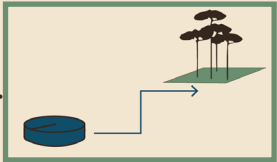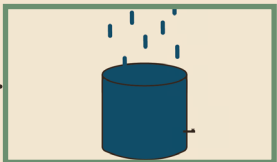
ECOLOGICALLY HEALTHY
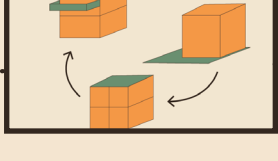
PLEASANT

Figure 73: Urban Arid Green Pattern Language

CONCLUSION

4

CONCLUSION

There are limited resources, water, food, and energy, in arid areas. These resources are crucial to combat the challenges that current and future human societies living there are facing. Urban design could play a role in combatting these challenges, by designing to advance on the transformative framework towards an ecocity. This includes designing a circular system, to optimally use these scarce resources, together with a fair social and economic system. Furthermore, the (growing) human population in an ecocity must construct the system, instead of destruct it.

The generic principles of such a framework must be translated into a spatial design. The process of applying these patterns to the Tamansourt Ecocity 2040 project was a process of constantly adjusting, designing and testing. By testing the method, other landscapes can learn from this and use it as a tool to communicate with all different stakeholders involved. The translation of the generic principles must be shared openly to help and inspire similar cases.

A network of ecocities should be formed to take action, and together build towards global sustainability.

An ecocity is not only formed by its focus on circularity and ecology. The most important is to formulate a plan that everyone agrees upon. When developing a phasing, short-term successes and long-term goals must be included. This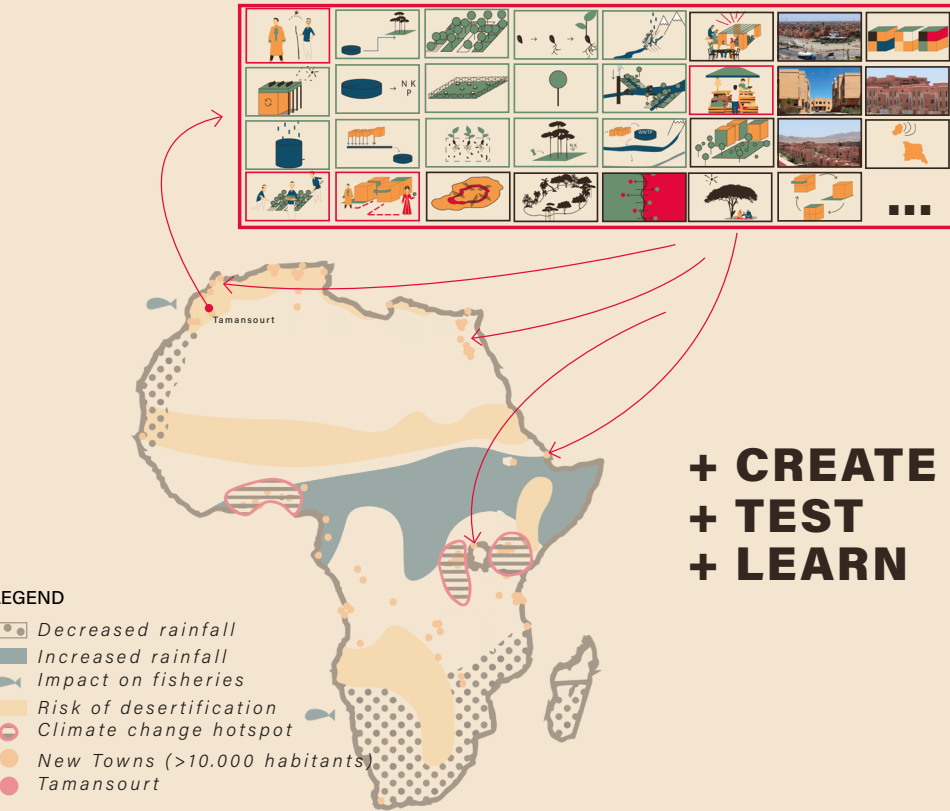 is to be of interest to different stakeholders. The locals should be empowered and engaged in the transition. They'll make or break the sustainable urban development aimed for. They have to co-create the ecocity.

As the Al Omrane pathway is based on the design guidelines for all Moroccan new towns, the Urban Arid Green language can be used in the development of other Moroccan new towns as well. However, the set can also be applied to other urban landscapes, including new towns and already-existing cities. Specifically, ones that are under the pressure of the scarcity of natural resources, population growth, urbanisation and climate change. Though, to some level, all cities are facing this, due to climate change and unequally divided resources and capital.

Every landscape might need to add its site-specific pathway, like the Urban Arid Green project developed the Al Omrane pathway. By this, the Urban Arid Green language allows unique dialects for different landscapes.

Though, time must tell whether or not population growth and urbanisation are sustainably addressed in Tamansourt, as sustainable urban development includes the unforeseen future situation as well.

+ CREATE
+ TEST
+ LEARN

LEGEND

- Decreased rainfall
- Increased rainfall
- Impact on fisheries
- Risk of desertification
- Climate change hotspot
- New Towns (>10.000 habitants)
- Tamansourt

Urban Arid Green langague created and tested via Tamansourt, shared with other cities to formulate different dialects. Background from (Keeton, 2020).