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Settling with and within an Open Canopy Forest: a Landscape Urbanism Proposition for the Semi-arid Savannah of the Lower Zambezi River Basin around Tete (Mozambique)

- Bruno de Meulder, Kelly Shannon, Wim Wambecq

Tete is located in the interior of Mozambique and is embedded in a majestic semi-arid savannah landscape with scrublands and thin, open canopy forests that constitute two ecotones (Figure 1). The miombo woodlands (dominated by the *Brachystegia* and *Julbernardia genii* tree species) occupy areas of higher precipitation and altitude while mopane woodlands (with *Colophospermum* mopane trees) are found in lower elevations (Sedano, Silva et al, 2016). Monumental baobab trees (*embondeiro*, *Adansonia digitata*) regularly dot the territory as vegetal markers - usually not more than 20 meters high, but with trunks up to 10 meters in diameter. They can live for 2,000 years and store up to 120,000 litres of water in their massive trunks; they are places where the spirits of ancestors (*mhondoros*) are called and therefore considered sacred (Figure 2). During the country's war-torn past, they became known as places of sanctuary, offering protection to those fleeing persecution and violence (Isaacman and Morton, 2012). Settlements blanket the semi-arid acacia scrubland leaving almost no place untouched, while at the same time there is the deceitful impression of a pristine landscape. This is largely due to a way of living with and within the landscape. Landscape transformation results from incremental appropriation rather than from intentional intervention. The low density (28 inhabitants/km²) is remarkable in relation to its sheer omnipresent occupation of the landscape. In hindsight, this is logical considering the thin distribution of resources. Livelihoods simply require large surfaces (Figure 3).

Foundational Logics

Tete is as a commercial transit town along the Zambezi River, serving both small to medium-scale inland water transport and through the main landbound trade routes towards the *Monomotapa* in the interior (Newitt, 1995). In Tete, the bridges over the Zambezi are the last crossings for hundreds of kilometres upstream. The bridges are relatively recent, the first dating from the end of the Portuguese colonial regime (1972) that was unsuccessfully legitimised by large-scale development projects. A substantial part of Tete's modernist patrimony dates from the feverish era of artificially induced development. The second, Kassuende Bridge, was completed in 2014,



Figure 1

in the wake of the large-scale coal mining operations that fuelled renewed expectations of development.

The Zambezi has been a symbol of development potential since the times of exploration and colonialism. Ever since then, development has been inherently conceived as a mode induced by exogenous forces, whether colonial or international. In reality, the Zambezi barely affects the semi-arid region it traverses, leaving it relatively unaffected by modernisation. Despite its role in the independence war, *'Tete remained (...) a kind of periphery within the periphery. After independence in 1975, (...) the province continued to reside on the edges of postcolonial modernity'* (Kirshner and Power, 2015). Independence quickly turned into civil war, ending only in 1992 with a peace agreement between Frelimo (*Frente de Libertação de Moçambique*) and Renamo (*Resistência Nacional Moçambicana*). Peace was followed by sweeping economic restructuring, which was soon dominated by international agencies (Jenkins, 2003) and a strong market orientation. The African socialist policies of the seventies indeed quickly lost precedence.

From 2004 onwards, large-scale coal mines, run by international corporations, such as Vale and ICVL, reached operational status (Figure 4). The new industry catalysed infrastructural development (the Kassuende Bridge, asphalted roads, railway lines) mainly to export coal, and induced a massive labour influx and regional growth. At the same time, the infrastructure opened up the region and the pseudo pristine region suddenly found itself at a crucial turning point. The increased and ill-considered exploitation of natural resources distorts the environment. Forests are not merely used to collect wood for fuel and charcoal production, but explicitly cleared at an industrial scale for export (and hardly replanted). Water quality is substantially reduced. Waste disposal is absent while, at the same time, urbanisation is exponentially increasing. Subsistence agriculture and indigenous settlement in the region are threatened



Figure 2



Figure 3



Figure 4

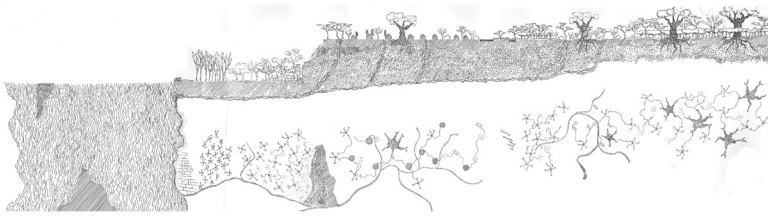


Figure 5



Figure 6

Traditionally, settlements loosely aggregate extended family compounds and are embedded within the thin open canopy forest. Recent investments in housing enclaves, asphalted roads and superimposed street grids create a strong contrast, as if endogenous and exogenous development inherently results in oppositional forms (Figure 5). Large engineered interventions such as the late colonial Cahora Bassa Dam (1974) radically transformed the landscape and significantly altered the Zambezi's flow regime. The river basin lost its rhythm of the usual rainy season flooding which brought nutrients and sediments and now experiences longer dry seasons and extended droughts. It simultaneously suffers from periods of intensive flooding related to tropical cyclones. To add insult to injury, from time to time and without notice, the dam discharges large water volumes. Unsurprisingly, this has all severely affected local livelihoods of farmers and fishermen (Isaacman and Morton, 2012). The Cahora Bassa, a '*colonial security project disguised as development*' (Isaacman and Morton, 2012) is one of the ecologically most devastating dams in Africa. It displaced 30,000 rural inhabitants from their homelands into strategic hamlets (*aldeamentos*) during its construction and the region's rural population has not profited from it. Production is simply exported to South Africa. Since then and until today - as with speculative mining operations, for example - modernisation projects are identified with large-scale displacement, depressing resettlements, livelihood devastation and environmental destruction. Nonetheless, the Zambezi compulsively dominates all 'imagineering' of future development (Figure 6).

In summary, until today, the promise of development, at least from the viewpoint of most of its region's inhabitants, remains a *fata morgana*. Development objectives and achievements are mainly defined by international agencies, such as the extractive industry and its external, international operators, with the support of the State and do not trickle down to the local population. It is easy to understand that the disruption of landscape structures, destruction of livelihoods and displacement of populations has devastating effects.

Contested Territories

Population growth increases pressure on scarce resources in the already stressed open canopy forests of Tete province which, in turn, fuels urban migration. In this sense, Tete exemplifies the current situation in Southern Africa. Its post-colonial heritage includes widespread economic instability, heightened struggles over resources and a tense political context. The majestic, thin and open canopy forest at first sight radiates peace and quiet. In reality, it is full of life and marked by the dramatic shocks undergone by the society it hosts: colonialism, liberation war and the late colonial interventions, including the Cahora Bassa Dam with its massive dislocation, post-1975 socialist land policies and rural villagisation (1977-83) and protracted and low intensity civil war (1977-92) (Figure 7). Most recently, the region has suffered from the consequences of the commitment to privatise State assets — the

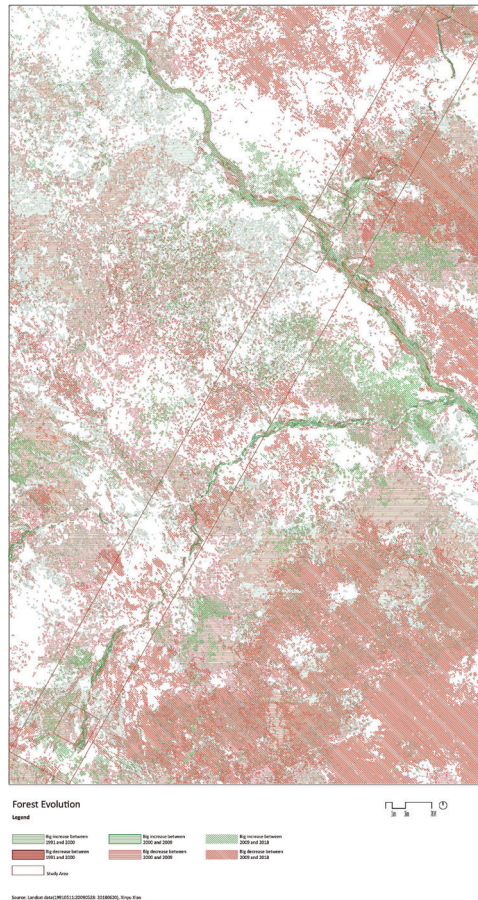


Figure 7

neoliberal expropriation sold as integration into the global market. Tete province counts more land given in concession for mining than not. In the Tete itself, indigenous traditions of living with the land have been juxtaposed with urban legacies of Portuguese colonisation which, in turn, are overrun by contemporary mining staff enclaves that appear as a hybrid of camps and bungalow parks. In the slipstream, spontaneous urbanisation runs rampant. There is no balance between the local tradition of compound building amidst trees and contemporary aspirations of modern bungalows in concrete. Oscillating between communal and socialist land nationalisation on the one hand, and expropriation and privatisation on the other hand, land tenure and its physical articulation has a major impact on urbanisation and

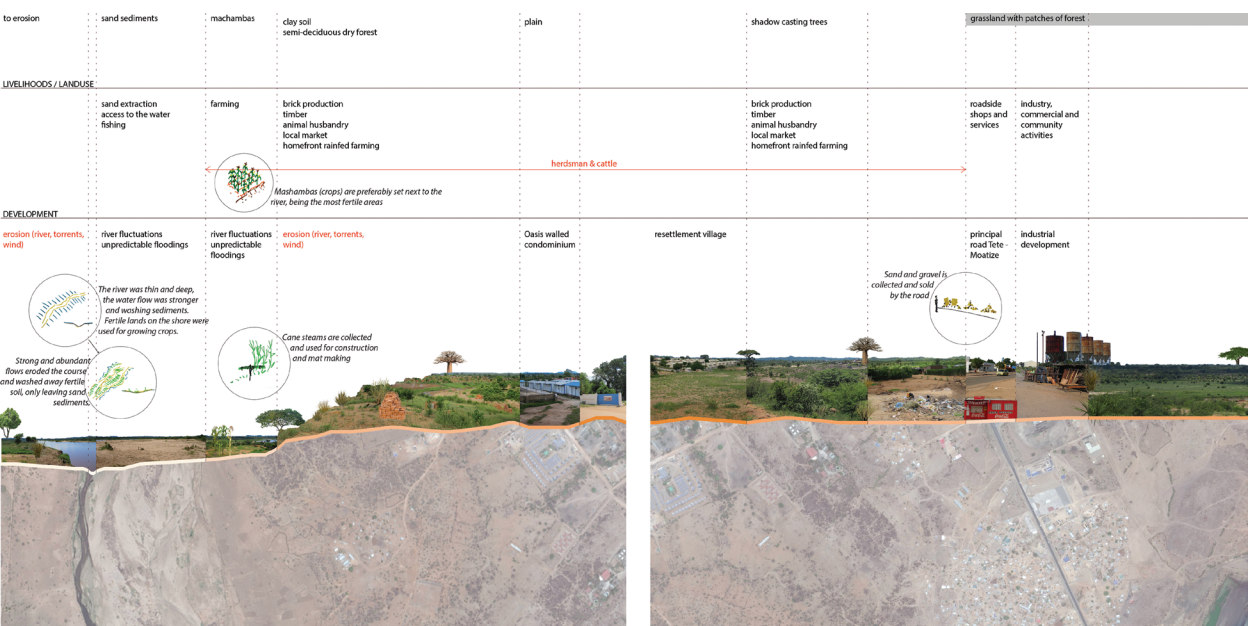


Figure 8

its forms. Contemporary plots are more often than not fenced and walled. Traditional homesteads settle in the open canopy forest landscape. The city becomes an idiosyncratic assemblage that mixes both systems in the maelstrom of construction that overwhelms the territory.

Almost without exception, exogenous investments in enclaves colonise the plateaus between the Zambezi's tributaries. New developments usually organise grids (but seldom pave the roads), erect fences and walls, connect (sometimes partially) to hard-engineered but often intermittent water supply and electricity grids and install air conditioning that may function only sporadically. In many regards, they are zero degree reproductions of the colonial European city, the *cidade de cimento* (without the asphalted roads). Local development cannot afford the regulated city-in-the-making on the plateaus and consequently overwhelms the slopes between plateaus and riverbeds, absorbing original settlements along river embankments, disrupting thin forests and opening new routes to ever increasing erosion. Erosion carves smooth passages to the riverbeds that remain the daily water resource for settlements on the slopes. Boundaries in the rural settlements are mostly dynamic, blurred and defined by trees and other vegetation rather than by built elements, although watering places for cattle are significant markers; fences are an exception in the landscape. The urban settlements on the slopes are commonly labelled as *bairros* (informal city) (Diamantini, Geneletti et al., 2011). Density on the plateaus is low and development relatively slow (remaining 'emergent' urbanity for a very long time) while on the slopes it is

higher and rapidly increasing (Figure 8). Most households attracted to Tete, with the expectation of development, can indeed not afford the formal plateau grids. Services on the slope are only a very vague expectation for the faraway future. In this way, colonial disparities are reproduced.

Throughout the region, there is a growing disparity of living conditions between the city and the countryside, as well as within the city between the *cidade de cimento* and the *bairros*, and in the countryside itself, between the plateau enclaves and the settlements on the slopes. In general, poverty reigns. Most of Mozambique's smallholder farmers rely heavily on rain fed agriculture and have limited use of irrigation, chemical fertilisers and pesticides. They tend to produce enough food to feed their families for less than eight months a year; they are 'deficit producers,' selling quantities after harvest and buying food when prices are higher (Cunguara and Hanlon, 2012). Upland hill farmers grow sorghum and maize in the rainy season and many raise cattle and goats. Those near the Zambezi can harvest maize and vegetables as well in the dry season if the unannounced flash floods from the dam do not intervene.

Framing the Territory by a Transect

From February-June 2018, 15 international post-graduate students and Mozambican graduate students¹ tackled the vast array of contemporary challenges in the Tete region. The landscape urbanism investigations were co-conducted by Universidade Zambeze (Mozambique) and OSA-KU Leuven (Belgium). Design research was carried out on a representative transect (a 10 km x 125 km strip) of the territory, stretching from Luenha (on the Revuboe River), passing through Tete (on the Zambezi River) and reaching Moatize (on the Revuboe and Moatize Rivers and site of the Vale mining concession) (Figure 9). There was a nuanced reading of the landscape followed by projections of possible future occupation (Figure 10). The transect crosses the semi-arid savannah landscape and exemplifies natural and cultural landscape dynamics: persistent drought, massive erosion and recurrent flooding events that all are predicted to increase under the influence of climate change. The emerging, but already omnipresent and highly disruptive coal mining industry, new hydroelectric dams and other development projects place the ecology of the Zambezi Basin at further risk of compromise (Kirshner and Power, 2015).

¹ The project discussed in this paper has been elaborated as part of the South Initiative initiated by OSA-KU Leuven in cooperation with Universidade Zambeze (Mozambique). Major input was generated by the landscape urbanism studio co-organised by the Master of Human Settlements and the Master of Urbanism and Strategic Planning on Tete (Spring semester 2017-2018) directed by K. Shannon and studio instructors E. Barbosa, B. De Meulder and W. Wambecq. The studio participants were Maher Nimer Moh'd Al Abed, Marlies Aerts, Rayan Al Ghareeb, Alfredo Manhota Antonio, Xavier Ordoñez Carpio, Nathan De Feyter, Clara Medina Garcia, Elis Locia Matchowani Mavis, David Djenga Muiruri, Nadia Nusrat, Julia de Souza Campos Paiva, Thuy Nguyen Thi, Valentina Tridello, Xinyu Xiao, Huazhou Ye and Vincent Van Praet who developed a separate track as an undergraduate thesis.



Figure 9

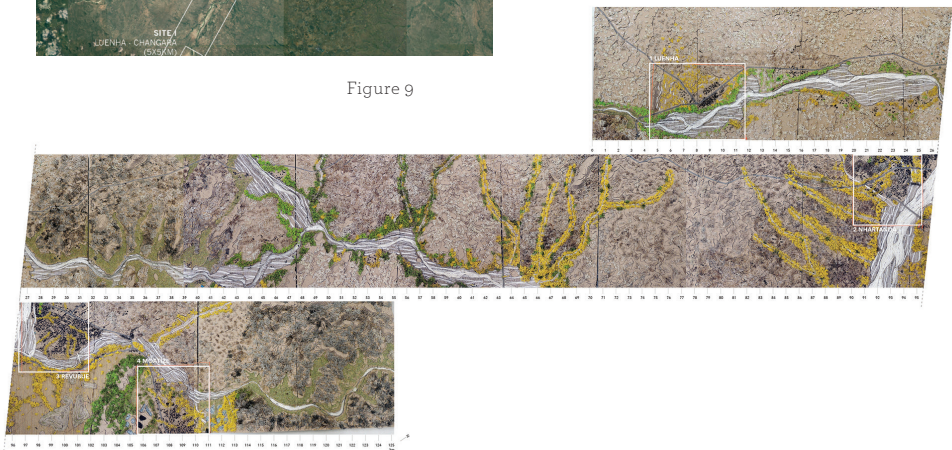


Figure 10

The design research investigated the modes of occupation in the dynamic landscape that oscillate between condominiums for mining technicians and nearly complete immersion of village life within the natural environment for the mass of the population. Traditional settlements are inscribed within the dynamics of self-renewing ecologies that the savannah forests of the region offer. The largest part of the population is highly dependent on the resourcefulness of the landscape (self-reproducing, but nowadays very stressed). The aforementioned dynamics imply that living conditions will become significantly harsher in the future. Livelihoods are fundamentally disrupted by factors such as climate change, overgrazing and other effects of intensified use, massive deforestation and invasive mining industries, including the dramatic erosion that is generated through these processes, beginning with major impacts on water security.

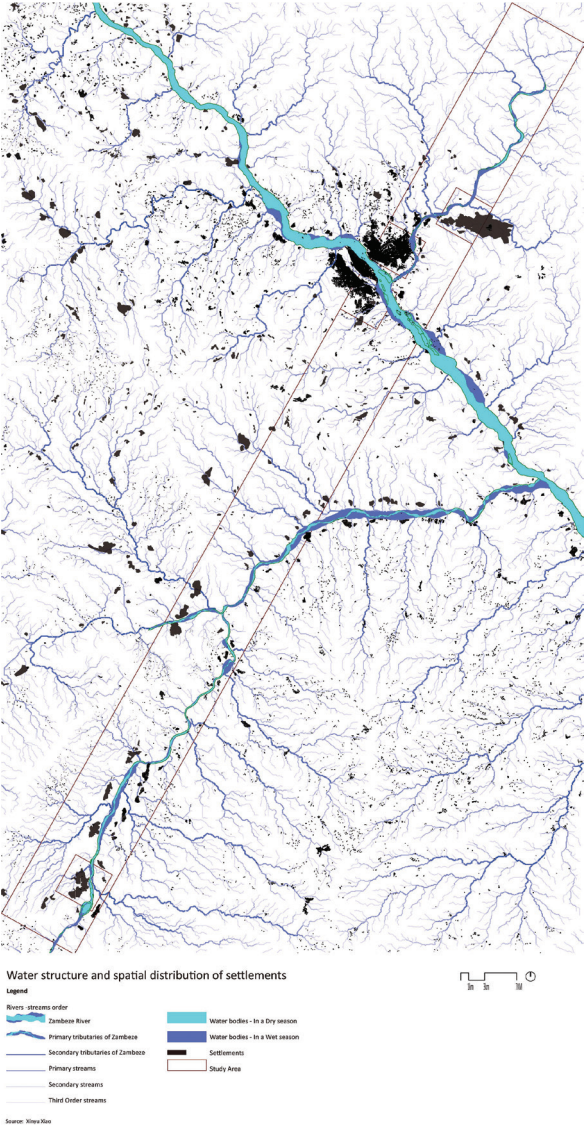


Figure 11

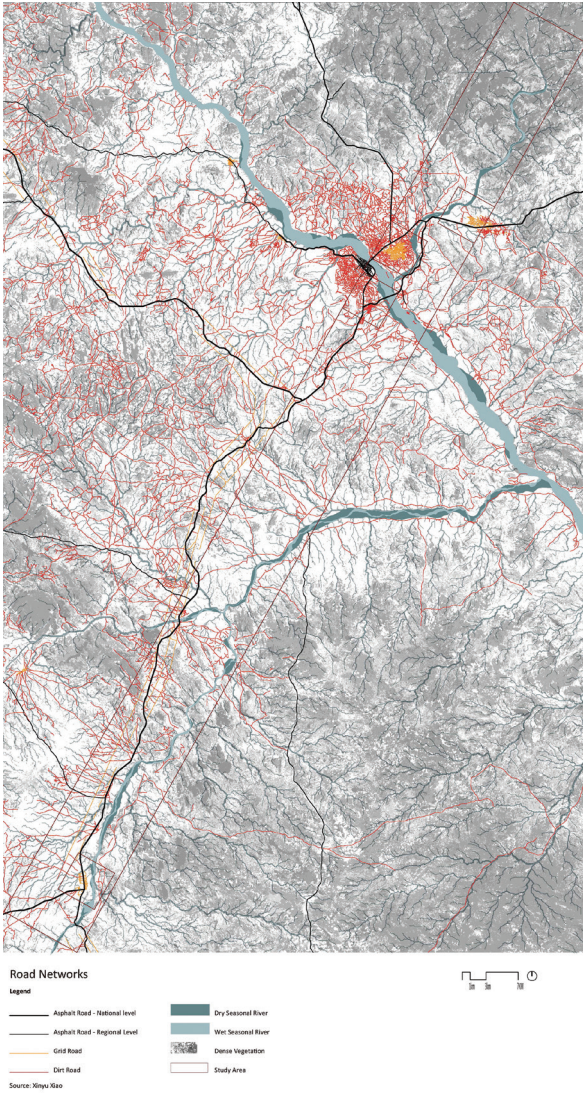


Figure 12



Figure 13

The design investigation aimed at generating landscape urbanism strategies that critically reinterpret and reinvigorate local settlement practices, through clever and respectful use of resources along with adapting to the challenges and expectations of contemporary life with new techniques and innovative alternatives to the status quo. Resisting the flattening and destructive forces of globalisation in such vital backrooms of the modern economy, could imply inverting development from the consumption to the production and reproduction of the landscape.

The transect includes the complex system of tributaries of the Zambezi, which not only evacuate runoff from Tete province but also have a structural role in local livelihoods and lifestyles. The Luenha and Revuboe rivers are arguably two main lifelines of the province. They flow throughout the entire year with seasonal fluctuations and are, more than the Zambezi River itself, accessible for all kinds of water-related activities. The settlement pattern showcases a tremendous consistency in its spatial occupation: settlements follow the lifelines, the generally seasonal riverscapes (Figure 11). Access to water is a precondition for occupying the territory. The modern, mostly orthogonal grids, from colonial origins or postcolonial neoliberalism, occupy the higher, safe plateaus - those eternally in-the-making *cidade de cimento*. The slopes in between house the *bairros* (Figure 12). The Mozambican part of the East African region is also known for its *inselbergs*, or rocky promontories (Jenkins, 2003). These volcanic outbursts are spread throughout the region

in isolated or group configurations. All urban concentrations in the transect are related to these isolated mountains that exacerbate the water runoff and consequent erosion.

The transect covers a range of scales of settlements that hook onto the different water lifelines, both rivers of continuous flow, as well as dry rivers (digging for water, pumping water, etc.) of all sorts (small scale paths to large, wide flash-flood riverbeds) (Figure 13). The framing of the transect affords working with different topographic conditions (soft and hard slopes, height differences), soils (hard rock soil, sand, clay, etc.) and settlements in order to re-establish a self-sustaining landscape. The territorial vision sought to counterbalance large-scale development interventions that, while bringing volatile development, ultimately prove disruptive and unsustainable. The alternative is a systemic design approach towards these environmental resources and their dependant local economies to ensure a sustainable, self-renewing landscape.

Leapfrogging Development: Iterating Between Site and Technique

The strategy of revisioning the territory was, on the one hand, to iterate between the systemic use of local practices, inherent relation of landscape (resources) and settlement (needs) and, on the other hand, to leapfrog the modernisation wave in order to build a collective system that spatially determines the region. The whirlwind rush of so-called development can be tempered by an understanding of and capitalising on the region's assets. As the world finally wakes up to the devastating effects of modernism, the Tete region can literally leapfrog over the pitfalls of development and adapt settlement and occupation of the land to the qualities of the landscape while simultaneously making use of advanced technologies and techniques. Systematically shifting and exchanging hard-engineered, centralised and hierarchical paradigms for decentralised, heterarchical systems opens up interesting perspectives. Solar and wind energy do not necessarily require vast interconnected grids — which are often difficult to complete in this context. Instead, new technologies could allow the region to skip the phase of centralised infrastructures and the systematic gridding of the territory and move directly to punctual infrastructures that embed themselves in the landscape based on the location of assets (sun exposure, wind, soil, orientation, etc.). As such, they would extend the resourcefulness of the landscape rather than superimpose conventional large-scale infrastructure on it.

The design investigation explores the hypothesis that some modern technologies can naturally align with strategies that are based on clever and sustainable use of self-renewing local resources. Local practices embody



Figure 14



Figure 15

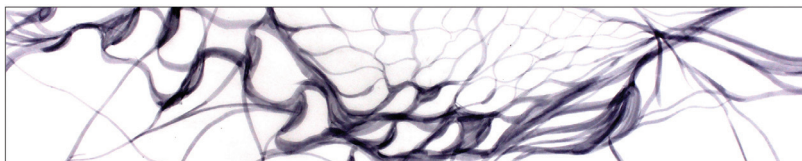


Figure 16

local experience and knowledge of the territory's resources. This underpins the paradoxical position of the design research: combining cutting-edge technology such as wind and solar power, with (often considered) archaic approaches.



Figure 17

Intensifying the Open Canopy Forest

The design research sought to anchor local development on the landscape (understood as a container of renewable resources). The resourcefulness is premised on the soil(s) and the water that gives life to the environment of thin, open canopy forest. Nothing is abundant in the semi-arid savannah; everything appears vulnerable, which explains the dispersion of activities and people in the landscape — always oscillating between the riverbeds below and the plateaus above. Regardless, all is always in an open forest; it is the main characteristic and quality of the environment. As in all forests, it is an entity within itself and, at the same time, contains a multitude of interdependent elements. The territory's loose, dispersed settlements are inscribed within the open forest. Settlement and forest are intimately intertwined. The one does not dominate the other or vice versa.

Therefore, a premise of the design proposal was to not construct a settlement in isolation or to concentrate on settlement; on the contrary, it was to (re)construct the open canopy forest as a polyvalent host environment — as a fundamental landscape structure in which settlement could be embedded. The forest is then designed as a multitude of elements, a polytechnic whole, as Lewis Mumford would argue (not just conventional, mono-functional infrastructures like roads and pipes), capable of hosting a multitude of activities and providing a multitude of performances, i.e. delivering products of all kinds and generating various microclimates, environments and atmospheres.



Figure 18

Most importantly, the design proposal's reconstruction of the open canopy forest intensifies, densifies and diversifies the quality of the territory in relation to the local soil and water conditions and safeguards the openness of the forest, not only in the sense of ecological capacity, but also open to practices and uses of various kinds, centuries old and brand new.

There is an inherent ambiguity – a looseness in the design strategies – which teeters between unity and variety, monotony and specificity. Reforestation (intensifying the forest) on the countryside's vast plateaus is approached quite differently from the planting schemes in various urbanised areas of Moatize, Tete and Changara/Luenha. Planting on slopes where spontaneous urbanisation occurs requires different strategies from increasing canopy coverage on gridded plateaus, where planting schemes can also contribute to wastewater treatment and recycling (Figure 14).

Afforestation strategies on sites that are vulnerable to soil erosion will differ from those that stabilise and cover erosion gullies into sun-protected, cool passages between plateaus and riverbeds (Figure 15). Creating a natural canopy for the market in a dry riverbed (Figure 16) is not the same as productive tree planting aimed at mitigating the impact of climate change on declining moisture levels in the soil.

Squaring Water Cycles

The open canopy forest strategy aims to recuperate and intensify a self-renewing landscape. An essential condition for the strategy is water. However the shortage of water for domestic, livestock, agricultural and industrial use is generally recognised as the region's primary development obstacle. The Zambezi River is difficult to access and too monumental in scale to allow simple, affordable and intensive use of it. Hence, the Zambezi River itself



Figure 19

only plays a peripheral role in the Tete region. Traditional settlements are not accidentally concentrated on tributaries. During the rainy season, massive quantities of water come as quickly as they disappear. Waiting for sufficient water supply from public agencies is like waiting for Godot. At the other end of the spectrum is soil erosion. Changing water tables, overgrazing and drying out of soils together with more intense rainfall patterns all contribute to the endemic erosion in the region that gains dramatic levels in places like Luenha in Changara. Consequently, the reconceptualisation of water management as an integral component of the complex water cycle is the second base line of the design strategy. Climate change is shortening the rainy season and increasing rain intensity. There is an urgent need to harvest water everywhere, particularly in dispersed locations.

Therefore, design strategies concentrate on water harvesting and the prolongation (in time and space) of (rain) water trajectories. The design proposal deploys water spreading systems from the foothills onwards in the form of stone contour bunds or so called 'contour ridges' (Ietc, 1998). Applied as a device, they generate a bund constellation in the landscape that partially diverts water, partially absorbs it and partially stimulates water infiltration and groundwater recharge. It allows the intensification of tree coverage (that combats the drying out of soils) and other vegetation (Figure 17). Over time, the strategy to slow, store and infiltrate water would operate as if it was one large-scale drip irrigation system that extensively covers the plateaus, between hills and riverbeds. The interventions are low tech and adapt to the local conditions of the site. They would spur incremental gains in soil fertility, retain humidity and regenerate the environment. The strategy relies not so

much on interventions, but rather on the insertion of an element that then catalyses a chain of natural processes to recreate the environment. It is a strategy that directs natural development, rather than the artificial creation of an environment.

Consequently, new habitats, lifestyles and economies can emerge, all embedded in a richness and diversity of vegetation, indigenous to the savannah and based on the multiple resources the open forest environment produces. Where water passes, infiltrates, accumulates or is directly harvested, there would be different intensifications of the forest. Grassland vegetation would be vastly recovered regionally, strengthening the traditional livestock economy of goat farming. Forests would be regrown to fix soils, grow fruits and for charcoal production. The reintroduction and valorisation of the *baobab* would reveal the long term objective, namely that the wettest zones, close to the systems that guide the water, become community *machambas* (from Swahili and meaning family agriculture units) (Figure 18). In other words, the project is focused on the region's diverse forest environment to provide for the over 75% of the rural and urban population that depends on it for essential resources (Salmão and Matose, 2007).

Luenha is developed as a showcase for this strategy. Luenha in Changara suffers grave consequences from drought. Its location on the plateau approximately forty meters above the Luenha River, a tributary of the Zambezi, means that water accessibility is an ever-increasing problem. Erosion gullies are literally eating their way into the formally occupied plateau. The rainfall on the higher elevation mountain belt and deforestation results in powerful seasonal torrents that aggravate the situation. The relocation of families close to the unstable steep edge was planned by the municipality on the opposite side of the main road, but quickly became subject to land speculation. Many plots have been bought by migrating Zimbabweans. The design intervention is located uphill from the village and small, linear cut and fill operations (contour bunds) create a system of long infiltration dams. The system is devised not to stop and hold the water, but instead to spread water over the barren, deforested land. Downhill, erosion is countered by a mixture of hard and soft engineering strategies to allow the threatened landscape to become productive. Embedded in the strategy is safe access from the plateau towards the riverscape. The forest is stretched from the river to the mountains and takes in the village. Reintroduction of water and forest in the village creates a shift towards a new rural-urban interface, no longer based on eternally unfinished grids but on natural water structures, agricultural production and walking paths that seamlessly lend themselves to a productive, self-renewing landscape. Centuries-old water storage systems are rethought, wherein design strategies make creative use of the new urban materials that recent urbanisation generates (such as walls demarcating plots in urban environments). New, domain defining walls in urban settlements are upscaled to optimise water harvesting (Figure 19).



Figure 20

Repurposing Erosion

Closer to rivers and whenever urbanisation is encroaching slopes near riverbeds, erosion gullies are stabilised with planting, while simultaneously manipulated to catch and channel rainwater and develop smooth passages between water and land, river and plateau. These wide, planted passages covered with canopies simultaneously host new patches of agricultural land which are closer to the water table and protected from the harsh sun, with their soils gaining fertility through the sediments brought by the water flows that are gently slowed down.

As such, soil is the third central point of attention in the strategy to rebuild landscape vitality. There are two points of entry: firstly, strategies to mitigate erosion and secondly, design intervention for existing areas of erosion. Local rural practices are proposed to be upscaled and optimised to accommodate ongoing urbanisation, such as the *machambas* that recycle previous brickmaking sites. The existing shallow pits are generally more humid (since they retain water) and cooler and are consequently repurposed as kitchen gardens. They are an open invitation to anticipate intensified production and plan their reproduction (Figure 20). On a much larger scale, but in the same line of thought, the design research proposes a similar anticipation and transitional logic of land with regards to mining operations. Vast plantation schemes preceding mining operations can protect the surrounding environment from inevitable air pollution (extreme dust), incrementally enrich soils and build a more resilient, intense and productive landscape. The intelligent disposal of sterile mining material would allow the construction of large-scale water storage facilities that are protected from evaporation and can drastically extend water availability. In other words, mining operations can also be repurposed to complement rainwater harvesting. In fact, such a proposition merely upscales the ancient practice of water storage techniques for semi-arid and arid environments.

All in all, the design research couples the insertion of new technologies like solar and wind energy in the landscape with construction strategies that concentrate on forest, water and soil. The aim is to rehabilitate and establish a base structure for the landscape which can, in turn, sustain human settlement. The strategies are primarily anchored in local practices that build upon their rationality by upscaling and optimisation.

Note: A shorter version of a piece of the text concerning the analysis of the environment (settlement in an open canopy forest) has been published as one of the cases within a study of promiscuous landscape occupations (De Meulder, B., Shannon, K., 'Intensive and Promiscuous Occupation of Landscapes' in *Urban Landscapes in High Density Cities*, B. Rinaldi, P. Yok (eds.), Berlin: Birkhauser (2018, forthcoming) served as a base for this contribution.

Figure Captions

Fig. 1: Tete's recent dispersed urbanism envelopes the open canopy forests of the dry, semi-arid savannah up to the nearby rocky promontories. (Huazhou Ye, 2018)

Fig. 2: The majestic *baobab* holds a symbolic and central position in the open canopy forest, including its relation to settlements. (Xavier Ordóñez Carpio, 2018)

Fig. 3: The thinly spread resources of the territory result in nomadic lifestyles. Cattle, for example, are moved through large swathes of territory for grazing and access to water. (Alfredo Antonio Manhota, 2018)

Fig. 4: Vale is currently the largest coal mine operator in the region and its extraction processes are systematically destroying ecologies, radically altering the landscape and disrupting local livelihoods. (Clara Medina Garcia, 2018)

Fig. 5: A section through Luenha, Changara, exemplifies its challenges. Between the rich riverscape, the eroding slope and the scarcely inhabited semi-arid savannah lies the formally occupied urban tissue, in deep crisis due to creeping erosion, water scarcity, forest clearing and consequent soil depletion. (Xavier Ordóñez Carpio, 2018)

Fig. 6: Caricature of the lower Zambezi River Basin in Mozambique, from the Indian Ocean. Four landscapes can be distinguished: the artificial environment of Cahora Bassa Dam and Lake in the mountains, the semi-arid savannah landscape around Tete, the flat flood plains of the Zambezi, and the majestic delta. (Vincent Van Praet, 2018)

Fig. 7: The forest evolution over the last decades reflects different and sequential moments of disturbance and recuperation of the vegetation, following societal changes. (Xinyu Xiao, 2018)

Fig. 8: A section over Moatize-Revuboe illustrates the occupational logics from riverscape, slopes and plateaus. (Nathan De Feyter, Clara Medina Garcia, Nadia Nusrat, Julia de Souza Campos Paiva, 2018)

Fig. 9: Indication of the transect of the design research investigation. The transect deliberately crosses the Zambezi River perpendicu-

larly, focussing on its tributaries, the Luenha and Revubue, as the most important lifelines of the territory.

Fig. 10: A modelled vision of the transect produced at the scale 1/20,000 (625 x 40cm). A nuanced depiction and renewal of the open canopy forest frames future occupation and composition in the regional vision. Pervasive riverscapes bind together settlements on plateaus stretched between water and rocky promontories. (OSA-KUL, 2018)

Fig. 11: Rivers are the lifelines of the region. Settlements mainly follow rivers that flow throughout the year or dry rivers whose beds allow easy access to groundwater. The scale of settlements is proportional to that of the waterways. (Xinyu Xiao, 2018)

Fig. 12: Formal occupation on the plateaus (*cidade de cimento - orange*) follows gridded infrastructure, while the rural, organic settlement patterns on the slopes (*bairros - red*) are anchored to the territory's fine-grain maze of unpaved paths, which are intertwined with the water network. (Xinyu Xiao, 2018)

Fig. 13: The Revuboe River is a water source and hosts numerous daily life practices, including cleaning, praying, playing, etc. Similar to the open canopy forest, the region's waters foster a multitude of uses and meanings. (Wim Wambecq, 2017)

Fig. 14: The 5x5 kilometre model for the Nhartanda project at the scale 1/5,000 (100 x 100cm). The project includes the re-establishment of a water harvesting system and a continuous, yet diversified open forest canopy from plateau, to tributaries, to slopes to the Zambezi. (Xavier Ordóñez Carpio, Elis Locia Matchowani Mavie, Xinyu Xiao, David Djenga Muiruri, 2018)

Fig. 15: Luenha is requalified with diverse planting techniques, from the erosion gullies to new open canopy forests towards the rocky promontories. (David Djenga Muiruri, 2018)

Fig. 16: The existing flood prone market of Nhartanda is reconfigured as an archipelago in the braided dry riverbed. Small vending islands are inserted in the valley forest that provides a shaded canopy. (Valentina Tridelli, 2018)

Fig. 17: Low-tech contour bunds are dispersed over the devastated region to recover vegetation by slightly intensifying surface water presence and groundwater recharge. A wetness gradient would allow for a variety of productive landscapes under the forest canopy, from agricultural fields to grazing grasslands. They would also structure new settlement. (Xinyu Xiao, 2018)

Fig. 18: Overview of the agriculturally productive Nhartanda dry river, a dry branch of the Zambezi that lies between the *cidade de cimento* and the more recently settled *bairros* on the slopes (Huazhou Ye, 2018). The collectively organised agriculture could become systemic places of production, based on low tech landscape interventions.

Fig. 19: The only partially completed orthogonal occupation of the Moatize plateau could be transformed into a water harvesting machine by inserting retaining walls. Small water reservoirs would allow both individual production and collective landscape creation. (Thuy Nguyen Thi, 2018)

Fig. 20: A new vision for Moatize and the Revuboe River activates creeks as productive spaces, based on the characteristics of working with different soils and extraction processes (clay extraction for brick, sand extraction etc.). (Nathan De Feyter, Clara Medina Garcia, Nadia Nusrat, Julia de Souza Campos Paiva, 2018)

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RADICAL² DEVELOPMENT

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FOLIO is produced by the Graduate School of Architecture, University of Johannesburg, located in the southern hemisphere, and The Bernard & Anne Spitzer School of Architecture, New York City, in the northern hemisphere. ¹ *One person's winter is another's summer.*

² radical (*adj.*), relating to or affecting the fundamental nature of something; far-reaching or thorough; advocating or based on thorough or complete political or social change; (*noun*) a group of atoms behaving as a unit in a number of compounds.