

DEEPENING SHALLOW FORM: RENEGOTIATING LANDSCAPE AND INFRASTRUCTURE IN THE SAHEL

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INTRODUCTION

This design led investigation attempted to answer the question of how landscape architects might work to address the increasingly urgent challenges of climate change in the Sahel region of Sub-Saharan Africa, an area experiencing some of the most drastic urban growth anywhere on the planet. Situated around the discourse of landscape based approaches to urbanism, it has sought to challenge the narrative of the insensitive foreign expert implementing expensive and inappropriate solutions, and argues for the potential of working with infrastructural intervention as a means to induce systemic change through strategic projects. More specifically, the central questions presented here ask how landscape architects can work to apply their professional skills towards addressing the impacts of climate change being felt with disproportionate strength across the Global South. Using the hydro-agricultural infrastructure of Mali as an example, this discussion identifies one way in which landscape based methods can be used to expand the capacity monofunctional, rigid, and fracture-critical infrastructure systems with relatively modest intervention. It does not ask *why* landscape architects should interject with their expertise into the South, but *how* one might do so in order to address, avert, or mitigate the significant risks that arise out of inaction.

FRAMING THE INVESTIGATION

The research for this project began by identifying the Sahel as a region for further study due the intensity of the environmental and demographic challenges which arise there. Fittingly derived from the arabic word for “shore”, the Sahel refers to the semi-arid zone of transition between the Sahara Desert to the North, and the Savannah plains to the south. Receiving ~200-600mm of precipitation yearly during a very short wet season, the Sahel is an expanse of territory defined by climate rather than lines of political jurisdiction. As such, this region has had stable yet fluid borders due to the large swings in precipitation over long time periods, and within the annual cycle of wet and dry seasons. While understanding and working with political jurisdiction is critical to actually delivering designs into built form, it is the patterns of seasonal rains and river flow determined by basic physical and chemical processes which drive the rhythm of life in human settlements and their larger ecological surrounds in the Sahel. These are reflected not only in the adaptation of organisms, but in the evolution of ethnic groups distinguished by relationships with specific elements of this dynamic region, from sedentary farmers growing dryland crops or cultivating rice (*Bambara* and *Rimaibe*), nomadic herders moving with seasonal rains (*Fulani*), and communities with livelihoods based on fishing (*Bozo* and *Bamboro*). While historically distinct,

these various communities have relied upon close interaction and trade to form a cultural complex capable of reacting and adjusting to extreme shifts in climate, where the ebb and flow in the prominence of various kingdoms and trading empires have occurred in tandem with periods of abundance in rainfall or drought.¹ With agricultural modernization and redistribution of power to distant urban regions, the habitual practices of these different groups have begun to drastically change, seeing people transition from specific areas of expertise into a mix of general practices including aspects of fishing, farming, and crop growing in order to meet their needs.

These abiotic, biotic, and cultural processes work at the regional level to organize investigation and research by allowing for the identification of critical patterns which can be more difficult to discern from the scale of the site. In this case, the large scale framing of long term and inter-annual levels of precipitation that define the Sahel are understood best in the context of the equatorial low pressure system of the Intertropical Convergence Zone (ITCZ) that is responsible for the wet seasons. Working within a large-scale framework acts to challenge the bias that can arise from strictly local observations. For example, recent research links the severe drought experienced across the of the late 1970's and early 1980's with the subtle changes in global sea surface temperatures, rather than over-grazing and intensification in land use which were long assumed to be the primary factors.² Further research also indicates a new state of more erratic precipitation patterns, correlated to ocean warming pushing the ITCZ southwards, which are of critical importance in crafting projects which anticipate and properly address the effects of climate change into the future.³ Revealing the relationship between these processes to physical form provides a means for unifying work across scales of time and place, in this case using hydrological structures to move from these strategic issues that occur across the four major watersheds of the Sahel inwards through individual river sheds and into localized catchment areas that can engage with the details of context specific to a specific place. As part the larger dialogue on landscape urbanism vis-a-vis infrastructural systems, Pierre Belanger has argued for this approach of 'sliding across scales' to engage fully between the territory and the site.⁴ This research worked to use this methodology specifically to identify points of tension between underlying operational logics of physics, ecology and related cultural traditions, with the super-imposed order of modern infrastructure systems extended across territorial scales which explicitly service urban regions.

The agricultural complex of the *Office du Niger* (ON) located just upstream of the Inner Niger Delta in Mali represents such a point of tension, as it diverts a steady flow of water from the Niger River which amounts to less than 10% of the yearly flow, but from 60-80% of the river's water during the dry season. Established under French colonial administration prior to 1950, the ON is the articulation of urban influence extended into the periphery, where large swathes of land were to be brought into production explicitly for the purpose of serving an export based economy within Mali to supply French textile and manufacturing industries. Cotton, rubber, sugarcane, and rice crops were the primary targets for this new area of production, with forced labour and re-settlement of people from across the region as the initial means of building the system of agricultural production at lowest cost to the administration. Through his surveys during 1919-21, French engineer Émile Belimé identified fossilized branches of the Niger River leading into derelict alluvial floodplains rich in fertile sediment. His plan called for these areas to be brought back to life with a barrage that would create a reservoir along the river, raising water levels enough to restore flow and irrigate up to 1 million hectares. The artificial regulation of water flow of the Niger River which began in 1946 with the completion of the Markala Barrage, and the top down form of administrating agricultural lands, has continued following the independence of Mali in 1961. Development of the area has been slow, and by the turn of the century some 100,000Ha were under irrigation, yet numerous large-scale expansions are currently underway that will see cultivated lands triple to over 300,000Ha by 2040. Since independence, cotton and rubber have been abandoned in favour of Asian rice varieties and sugarcane as the primary planting strategy, both of which are highly susceptible to drought and require great amounts of water to thrive.

THE FORM OF INFRASTRUCTURE

The performance of this infrastructure is at odds with the prevailing logics of the Inner Niger Delta, a crucial wetland habitat the size of Belgium which is flooded by the Niger River swollen from seasonal rains in its Southern headwaters. This incredibly rich and diverse ecosystem provides critical overwintering habitat for millions of European birds and waterfowl, and acts as a bulwark against the encroaching sands of the Sahara directly adjacent to its North. It is a critical resource for its 1.5 million human inhabitants, and in supplying the rest of land-locked Mali with 50-100,000t of fish annually and over 50% of its domestic rice supply. The fluctuation of river flow responsible for the inundation of the Delta varies significantly, flooding anywhere from 8000km² as seen during the drought of 1984, to well over 36,000km² in 1957. As the wettest of the past 45 years, 2016 has seen 25,000km² flooded, yet this would be considered only an average year in the 50+ years of records prior to 1968. The floodwaters rise as much as 6m, sustaining rich biological activity well into the dry season, and function as an engine of socio-economic development for the region. Fishing, river trading, movement of livestock, crop varieties and growing techniques endemic to this area are all tailored to this annual ebb and flow to form a highly managed ecosystem. The traditions of architectural form in the settlements occupying the highgrounds of this area, along with the patterns of agricultural activity shaping the land present examples of what John T. Lyle calls “Deep Form”, where the physical shapes and structures are reflective of underlying ecological process.⁵ Building on this notion, Kongjian-Yu argues that traditional farming tactics in particular, developed through trial and error over long periods of time, ‘illuminate the underlying basis for deep forms as expressions of compromise between nature and human desires, balancing natural processes and cultural intervention’.⁶

In contrast, the modus operandi of the current food production system has little to no active relationship with the basic operational logic of the area and its dynamic hydrological rhythms. It is a zone for agriculture only, excluding animal herders accustomed over millennia to moving their herds through the land, and in separation from the “nature” enclosed within nearby forest reserves. The amount of water delivered to the ON upstream of the Delta remains consistent from year to year, regardless of the huge variation in precipitation, and in accordance to the flow rates delimited by the geometry of the gravity fed canal system. It represents *shallow form* par excellence, a type of intervention built around machine dimension and universalized standards ‘which hovers on the surface of the land without connecting to nature’s ongoing processes’.⁷ American architect Thomas Fisher expands on this critique, describing such approaches to infrastructure as being “fracture-critical”, in that they require physical, political, and economic stability to a degree which leaves them prone to catastrophic failure when conditions change.⁸ Support for his argument of this fragility is proven quite dramatically within the ON, as two major irrigation expansions have fallen apart in the past decade alone. The first being the Malibya project funded by the former regime of Moamar Qaddafi, which built a 40km long, 120m wide canal to irrigate 100,000Ha of land to supply Libyan markets only to have it sit idle as the political turmoil in Libya deprived the project of funding and leadership. The second being the 90,000Ha American funded Alatona expansion, where funding and work was halted due to the coup over the elected leader of Mali. Smaller but more numerous fractures have appeared over time through poor maintenance, water-taxation system leading to illegal diversions, and numerous small scale conflicts between herders and local pastoralists without deep roots in the area who attempt to exclude animal passage over their lands.

DEEPENING SHALLOW FORM

Utilizing the existing canal networks as the part of the architecture for intervention, this project attempts to *deepen* shallow form through additions to the functional program which develop the range of ecological activity and economic potential supported by the infrastructure system itself. The basic premise of the techniques and technologies employed within the ON leave a wide opening for improvements which do not necessarily require dismantling and rebuilding of the current infrastructure, yet are capable of making them responsive to downstream needs and more

resilient to external shocks. The highly regulated site of the Macina-Ke district which has been the focus here forms a sort of anthropogenic watershed employing a strategy of mono-cultural rice production. It functions on the gravity driven premise of water supply from high points in raised supply canals along the perimeter delivered inwards to the fields through secondary and tertiary canals before flowing into the inverse network of drainage trenches. To address the weaknesses outlined, the interventions employ soft strategies of crop diversification, agro-forestry and ecological intensification through the network of supply canals, drainage canals, and low points within the area which remain too wet for agricultural activity for most of the year.

Changing the range of crops grown to include dryland staples of millet and sorghum, along with more drought tolerant but lower yielding African rice strains, allow the possibility for responding to changing levels of water flow in the river and local precipitation that are monitored through an existing system along the entire Niger River. Planting tree species valued for their economic potential, for example, is a simple yet effective solution along the supply canals which can utilize water normally lost through seepage. This works to supply locals with building materials, firewood, and a range of other products associated with selected tree species like the *Baobab* and *Doum palm* which have commercial potential which benefits primarily local actors. The drainage system can be used as a network for animal herds to travel through the area, planted with a selection of groundcover, woody shrubs, and tree species which are geared towards producing fodder and fruits while functioning simultaneously as a series of shelterbelts and erosion control measures. Grazing along these specified corridors works to address conflict between herders and farmers, reducing the negative impact on soil quality and crop production caused by trampling herds while promoting use of excess water found in drainage canals. The basic comforts provided by shade of the trees is also a simple yet powerful result of design thinking which can be maintained year round by staggering of nitrogen-fixing white acacias, which keep their foliage in dry season, and fruit producing jujube trees which shade during wet season. Lastly, focusing on the currently un-used pockets of low areas submerged in drainage waters through the year can provide opportunity for establishing nesting habitat. Research has shown that irrigated rice paddies are already used as feeding grounds by nearby wetland bird species, and contrary to the belief of many do not actually impact crops, instead feeding on the insects and pests which farmers struggle to control. By planting appropriate tree and wetland plant species, this relationship can be established into a positive feedback cycle where birds can actually live and feed in within the agricultural area. In this way, the agricultural infrastructure is transformed from being biologically barren into a reliable ecological reserve rich in diversity, improved in its overall performance for all measures (biodiversity, crop yields, etc.) and with greater cultural sensibility to the location in which it is situated.

FROM HUMAN TO HUMANE ECOLOGIES

This project has specifically targeted infrastructure as a strategic forum of intervention because it offers broad potential for inducing systemic transformation of urban regions rather than symptomatic responses to specific issues after the fact. The approach taken works directly to address impacts extended from urban centres of the built environment into the broader territory, and the array of challenges provided by climate change in issues like food security and water scarcity. Rather than being reactive, the idea of deepening shallow form in the *Office du Niger* suggests how even simple planting strategies can work to significantly alter and expand the functional program while simultaneously advancing economic and ecological agendas. By no means do these particular interventions discussed represent the best means of working towards better solutions for rapidly growing urban regions of the Sahel. The obvious weakness here is a strategy which has not, for reasons of practical difficulty, engaged or consulted in person with the actual stakeholders of this area. However, the evidence suggests that these actions would benefit those living and working in the area, those in the cities relying upon it for their food supply, and those who are investors/land owners. It is quite clear that the current approach is already outdated, inefficient, prone to conflict and anything but resilient in the long run.

Landscape based forms of urbanism engender a diversity of approaches that can still maintain the coherence required to effectively address complex challenges, allowing those with relevant knowledge and skills to work beyond their “home-range”. While there are many institutional, financial, political and geographical obstacles to working in areas like Inner Niger Delta, it should be clear that practice focused almost exclusively on the post-industrial cities of the North is not enough. A sober assessment of the consequences of inaction on climate change using the most generous of scenarios in predictive models, should instil a true sense of urgency given the impact of comparatively minor disruptions currently being experienced in countries like Syria. Moving beyond ism requires that landscape architects and urbanists act to project a need for their expertise, and divert some part of their attention to the areas in which they are currently absent and most useful. As such, the main thrust of this research has not been to merely affirm the presence of this infrastructure as part of a human ecosystem, but to suggest how one could work to make it a more humane ecosystem.

ENDNOTES

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