Landscape as Agency: Co-Designing New School Typologies with Children in Rural Sudan

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1. Abstract:

Environmental and social injustices severely impact children's learning spaces in marginalized communities in Sudan. Children in those schools confront hazardous environmental conditions and systemic corruption. Their schools are disregarded by the government, lack basic amenities, and are impossible to navigate, turning them into ghost schools. Children of ghost schools are part of communities with potential, willpower, and resilience. However, these communities' desperation for self-sufficiency hinders them from thriving. This research project focuses on participatory design concerning children's schools, particularly in remote farmer's communities along the Nile River in Sudan, and investigates one primary question:

How can interdisciplinary architecture change the way we think about designing children's learning environments in marginalized communities?

I use design methodologies and interdisciplinary architecture typologies. I also planned workshops to develop means to sustain schools as environmental, and social infrastructures. Participatory design tools have helped me re-think the role of these schools. The Abu-Halima school provided significant input to develop this research. The major contribution of this research project is establishing innovative adaptive systems that can grow in complexity, such as food production, and climate and flood mitigation.

Keywords: ghost schools, marginalized communities, participatory design, co-designing with children, typologies, self-sufficiency.

2. Introduction:

The educational system in Sudan has gone through phases of transformation throughout the years. For centuries, children gathered around the sheikh (Teacher) in the "Khalwa", a day school for young children in villages where they learn how to read and write and solve simple mathematics problems. They also attend the Khalwa to memorize the Quran and learn about the Islamic teachings and values. "The term "Khalwa" signifies withdrawal, seclusion and meditation" (McHugh 1994, 85). The Sudanese have used this term to describe the spatial characteristics of a place for retreat and collective knowledge -- usually a hollowed-out baobab tree or a simple enclosure. This Khalwa learning tradition has generated a model for learning spaces in the Sudanese villages, where their expansion forms a network of learning nodes across the different regions. These nodes and concentrations of Khalwas were considered centers of knowledge. Quickly, the Khalwas became "landscapes" for children to observe, learn, engage, and play; breaking the tribal barriers, and opening the door for a global, inclusive learning environment.

You can think of the Khalwas as settlements with sacred spatial patterns. Many of the Khalwas have been established along the White Nile River; the most prominent were concentrated in what is now known as the flood plain where the Abu Halima farmer community site exists. The Khalwa settlements were designed to be accessible from the major roads, and with access to natural resources, such as the Nile, ground water, and grassland. Architecturally, the Khalwas have always kept a simple vernacular layout; the circle, where the children sit next to each other on handmade palm-straw rugs, and often near jute and straw partitions that provide shading from the intensity of the sun, especially in the summer season.

So much for the discussion of the structure of schools in Sudan. It was into this system that the British came when they colonized Sudan in 1899. Contrary to common belief in the West at the time, the changes imposed by the British were not uniformly beneficial.

"Ghost schools" are children's schools (ages 6-14) in remote marginalized communities that operate on low or no budget. They are generally funded by donors such as community members, teachers, principals, and local non-profits in most cases. These schools are shockingly overpopulated, and impossible to navigate due to their absence in city maps and search engines. The ghost schools are plagued with deteriorating infrastructure and environmental hazardous conditions, which result in the collapse of classrooms during torrential rains and flash floods, and the tragic death of school children every year as a result. Abu Halima, a ghost school, is a four hundred student primary school located in Abu Halima, a tight-knit farmer community, 15 mi (25 km) north of Khartoum, where the White Nile and The Blue Nile merge. It is one of fifteen villages clustered around the Blue Nile's banks. These farmer communities have situated themselves in the most fertile segments of the state of Khartoum (which encompasses the city of Khartoum). Resources such as land, water, and skilled farmers, have made this community of farmers a great potential site for this research project.

3. Background and Literature Review

Environmental Concerns Greenway and School Resiliency

Climate change's effects on communities such as Abu Halima, located in the most vulnerable segment of the Nile, the flood basin, can be detrimental. "The Nile basin is also characterized by poverty, environmental degradation, and frequent natural disasters" (Melesse, Abtew, and Setegn 2014). The landscape and settlements' dynamics are drastically influenced and controlled by the Nile's water level in Abu Halima. This community has had successive years of drought due to climate change, and flooding has resulted in hundreds of schools like Abu Halima, being damaged or destroyed. Abu Halima is in rough shape. The arid grounds, the absence of green space, shade and drinking water have all created harsh conditions for the children. These environmental conditions including pervasive flooding that the children must face, impact their mental health and daily performance drastically; they also threaten their existence and well-being. Figure 3.

Figure 3. Abu Halima School

 "Children's education is now at risk of interruption due to floods" ("SUDAN Floods_Sector Situation Report_14 September 2020_v2.Pdf," n.d., 5). Figure 2.[1] "Young children are thought to be particularly sensitive to heat waves" (Xu et al. 2014, 239). "Outdoor play poses significant health risks during heatwaves due to the direct effects such as heat stress, dehydration and decreased ability to concentrate" (McNicol 2019, 1). Not to mention that the absence of greenway in Abu Halima has greatly contributed to the children's struggle. Fink argues that "Greenways historically have been highly valued for their benefit to human health and wellness as linear recreational corridors" (Fink 2016). He also argues that "Greenways are an excellent land use product of resilient communities" (Fink 2016).

Rural communities are threatened and significantly impacted by the constant change in green infrastructure" (Tóth 2016). It is important for designers to acknowledge that "Green infrastructure systems improve the ecological resilience and sustainability of rural landscapes and help mitigating the effects of changing climate" (Benedict, McMahon, 2006). In terms of landscape planning, it is necessary to consider greenways being integrated linear components of a holistic network represented by the rural green infrastructure (Tóth, 2015). Fabos and Ryan argue that the benefits from greenway design are significant. They play an important role in preserving the ecosystems along rivers, and maintain biodiversity and provide countless recreational opportunities (Fábos 2004). Abu Halima rural community is in desperate need for a green system that absorbs the floodwaters and generate shade and edible landscapes for resilient community and high functioning children. According to Fink, "Greenways as green infrastructure provide the basis for large scale, interconnected landscape systems, that when strategically planned for coastal and shoreline communities can serve to absorb floodwaters, lessen the impact associated with stormwater damage, and keep residents out of hazardous landscapes" (Fink 2016).

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[1] *"Heat waves—sporadic periods of elevated temperatures outside the normal range of climate variability for a specific region—occur throughout the world and are projected to become more frequent and intense in the future". (Meehl and Tebaldi 2004, 12).*
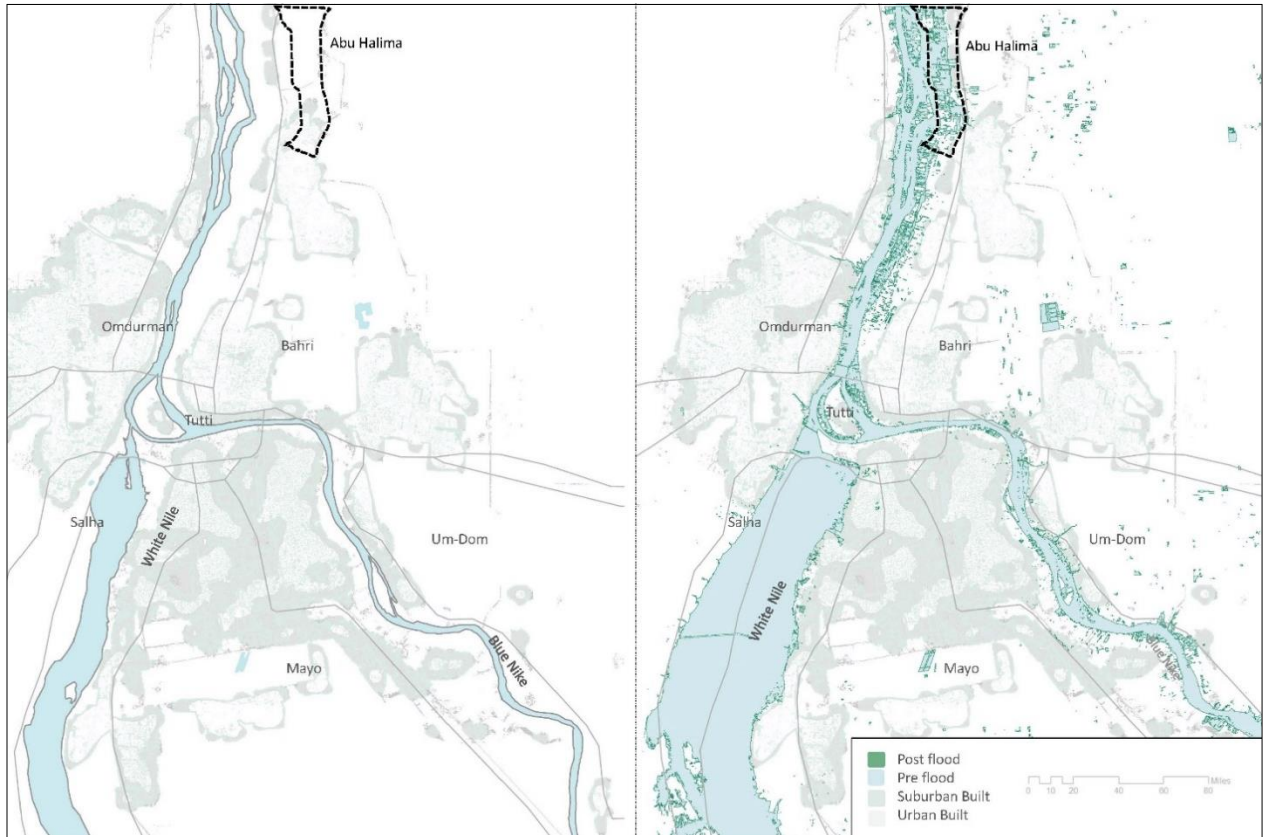
Figure 2. Khartoum Pre-Post Flood Map from 2018 Data

Figure 1. Arial View of Abu Halima School

4. Methods, Data

My methodology is focused on child engagement. I have used qualitative and quantitative data, ranging from surveys, interviews, and children's drawings. In addition, I used design methodologies such as site analysis, and landscape architecture typologies (flood mitigation, erosion control, and thermal comfort, to regenerate the soil, flora, and fauna), co-designing with children, and mapping. I have also designed a series of children and community workshops to develop means to sustain schools as environmental and social infrastructures. Engagement and participatory design tools have helped me, and the Abu Halima community, re-think the role of these schools in their immediate and larger context.

4.1 Site Analysis

I started with the site analysis process to define the problem, surveying the school's grounds, amenities, and types of activities available for students, taking photographs of the classrooms, the arid grounds conditions, and defining the capacity. This step was crucial for investigating the current conditions, and opportunities. It has helped me understand the dynamics of this one school and the children's needs. Also, the site analysis has significantly influenced the design and decision-making processes. It was clear to me that the site has hazardous infrastructure conditions, including ceiling leaks, and the lack of ceiling and wall insulation. The absence of natural light and ventilation makes these classes uninhabitable all year round, especially in the rainy season. Similar to the classrooms, the school grounds do not facilitate learning experiences for the children of Abu-Halima. Despite the extensive outdoor areas, it is hard for the students to utilize the grounds as learning spaces or play spaces because of their aridity, and the lack of shaded areas and trees. With no access to trees and greenways, it is impossible for the children to play outside for a significant time without suffering heat exhaustion.

4.2 Interviews

The methodology used in this research includes interviews with community members, including farmers, principals, and teachers. As the lead architect and curator of this research project, I worked towards establishing connections between the children, the community, and the environment in which they live.[2]

Abu Halima's current principal Muntasir Ahmad, and former principal Amani Saied (who is currently the principal of "Al-Sorojab" primary school, also a ghost school located in Al-Sorojab community, within two miles distance from Abu Halima), both raised concerns over the issue of school meals affordability. I also learned from the interviews that children must function without food in a seven-hour school day. "Some children come to my office and ask me for food, and I pay for their lunches, but many don't feel comfortable to ask. It is heartbreaking" (Muntasir Ahmad Interview). Through these interviews and follow-up meetings with the two principals, I brainstormed some ideas and solutions such as planting fruit trees. The idea was welcomed by Mr. Muntasir. He said growing fruit trees and vegetables such as potatoes, zucchinis, and eggplants will be a good source of nutrients for the children.

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[2] *Copies of the actual survey questions are available on request*

4.3 Surveys:

As part of my community engagement work, I crafted a survey for the teachers and staff and a second survey for the children. The surveys included three sets of questions; the first set were about the school environment, the second about the meals, and the third were to address the children's needs and dreams.[3] The surveys were successfully completed by the children, grades 5-8, girls and boys. They provided significant input to develop this research and have all revealed troubling facts. For instance, 80% of the children who attend Abu Halima do not eat the one meal the school cafeteria sells. 90% of the children dream of eating fruits and vegetables for school meals. My survey also showed that 100% of the children suffer from dehydration daily and dream of having access to cool drinking water. 85% want air cooler units in their classrooms. Also, many older children ages 13-16 mentioned that they are often heat exhausted because of the high temperature in the classrooms and would love to have a space to nap and rest during the breaks. 100% dream of planting fruit trees that provide shade, and 63% want to plant flowers. And 76% are fearful of floods and classroom collapse.
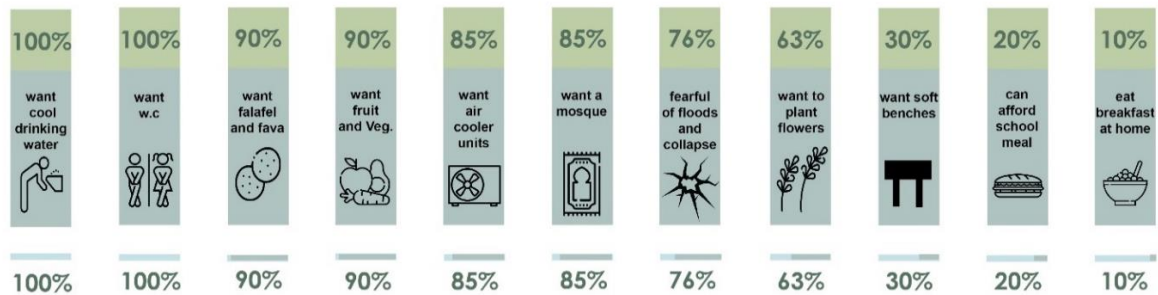

Figure 4. Abu Halima Children's Surveys Chart

5. Results

Co-Designing Greenway and Landscape Typologies with Children

Hill argues that Methods that are child-centered and conducted in groups have often been found to be valuable (Hill 2006). My main goal was to actively engage the children in the entire process and give them a sense of agency and ownership of their school. Therefore, I decided to establish a couple of jumpstart participatory activities for the children and community members. The children's activities specifically were designed to be conducted in pairs or groups. They had the chance to talk to each other, brainstorm ideas, and provide individual outcomes as part of the process. I provided colored pencils and white papers and asked children grades 1-8 to draw their dream school. The children of this school were informed by the principal and teachers about the activities, filled the surveys, and generated some impressive and powerful pencil colors' drawings.

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[3] *I employed a research assistant to administer the surveys to the children. Hill argues that children are highly sensitive to their micro environment which research takes place (Hill 2006, 82). In general, children in Hill's study preferred school as a setting for surveys, but most stressed that questionnaires should be administered by outsiders, as I did, not teachers, to avoid influence and censorship.*

I received 39 drawings from the children ranging from individual drawings to full site plan drawings for a school campus with a great emphasis on shade and fruit trees, and green playgrounds and benches.
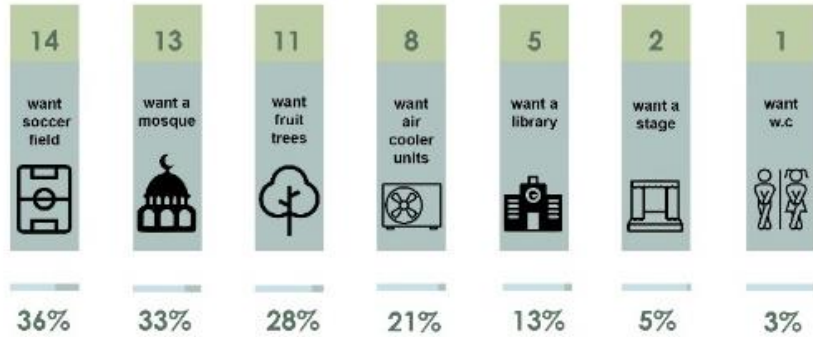

Figure 5. Abu Halima Children's Drawings Chart

What I learned from the surveys, interviews, and the data, has led me to plan and design landscape typologies better to fit Abu Halima's expectations and needs. Still, before that, it was vital for me to develop a timeline for this research that starts with a small farmers community like Abu Halima and extends to identify, map, and support every single ghost school in similar communities along the Nile River in Sudan. Figure 6.
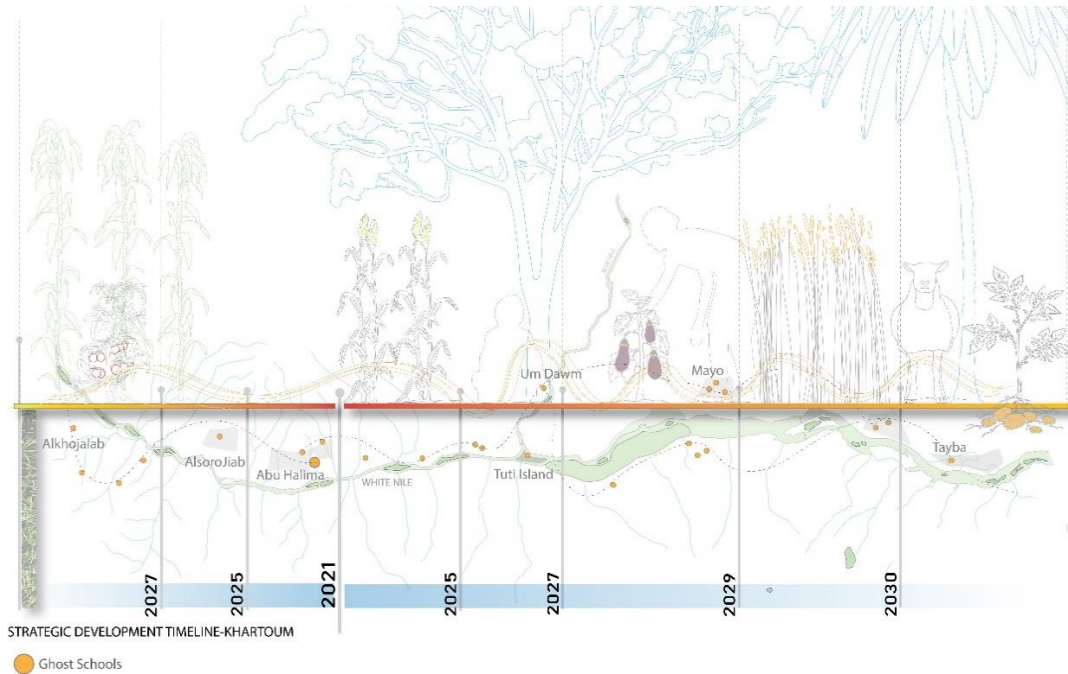

Figure 6. Ghost Schools' Strategic Development Timeline

Landscape and Greenway Typologies

The typologies are focused on site-specific conditions such as landscape practices for flood mitigation, erosion control, and thermal comfort. It also introduces simple activities to regenerate the soil, flora, and fauna; and most importantly, producing food and culinary alternatives. This typology communicates design and environmental knowledge to different age groups through simple black and white illustrations.

Bioswales

I designed a green network system for flood mitigation, erosion control, food production and thermal comfort in Abu Halima. The typologies include a system is constructed of liner bio swales. The swales in Abu Halima will also control and divert the flood, absorb a portion, and distribute the rest water to constructed overflow areas. This typology will reduce the overall runoff volume, and the flow rate will save the school and other community houses and buildings from collapsing during the flood season. The bioswales' linearity makes the system deployable in Abu Halima due to its flat topography. Not to mention that the swales will host quick-growing vegetation that increases stormwater absorption, reduce flood runoff, attract birds and other species, and naturally stabilizes the soil. Figure 7.

Nile

Overflow Areas
Bioswale Network
Abu Halima School

School

Figure 7. Bioswale Network in Abu Halima Community

Abu Halima Reforestation

Another typology I designed was the reforestation of Abu Halima. Abu Halima Community is arid despite its proximity to the Nile. It requires planting trees in the Abu Halima community. Reasons for practicing urban reforestation in Abu Haliman include urban beautification, increasing shade, modifying the urban climate, improving air quality, blocking the "Haboob", and restoration of the trees after a natural disaster, and food production.[4] Fruit and Shade Trees Fruit trees such as Guava, Date Palms, and Citrus are grown successfully in Abu Halima around the Nile River and in Khartoum state. The third typology is distributing Jute patches in the community's public yards. Jute is an ancient resilient plant that is widely produced in Sudan. The patches serve as nitrogen fixers but are also high in nutritional value. Not to mention that the plant is quick-growing and does not require any fertilizer pesticides and is ready to harvest in two to four months. Figure 8.
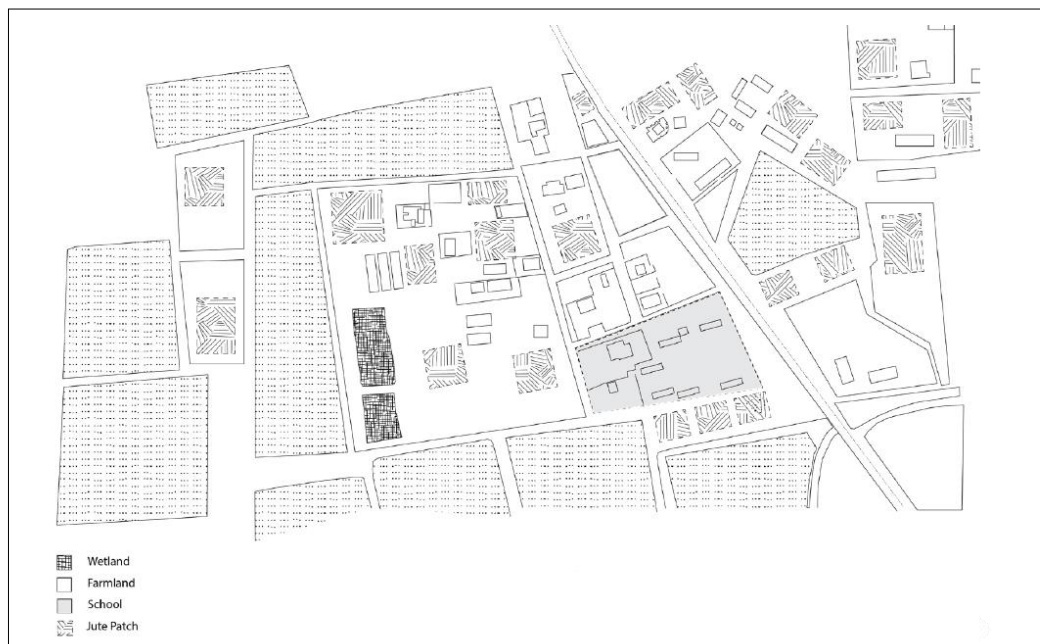

Figure 8. Jute Patches Distribution in Abu Halima Community

6. Conclusion

After one year of working with Abu Halima community, it was impressive to see how the four-hundred children [practiced their agency] through their design thinking process and environmental solutions. Abu Halima children will participate in the implementation of the landscape typologies and record their observations through the seasons. This new greenway rural paradigm can be extended and deployed in Sudan and other sub-Saharan countries that share the Nile and possibly similar communities with comparable topographical and environmental conditions. This research project is the first step toward improving the experience of the children of ghost schools in Sudan.

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[4] *Haboob, is the strong wind that occurs primarily along the southern edges of the Sahara in Sudan and is associated with large sandstorms and dust storms and may be accompanied by thunderstorms*

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