

Climate Research for Development (CR4D) End of Grant Workshop

21-23 June 2021 | Nairobi, Kenya



Strengthening climate adaptation within low-income informal urban settlements

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Climate change impacts in coastal informal settlements



- More intense precipitation
- Sea-level rise
- Higher wind speeds - windstorms

Climate change impacts in coastal informal settlements



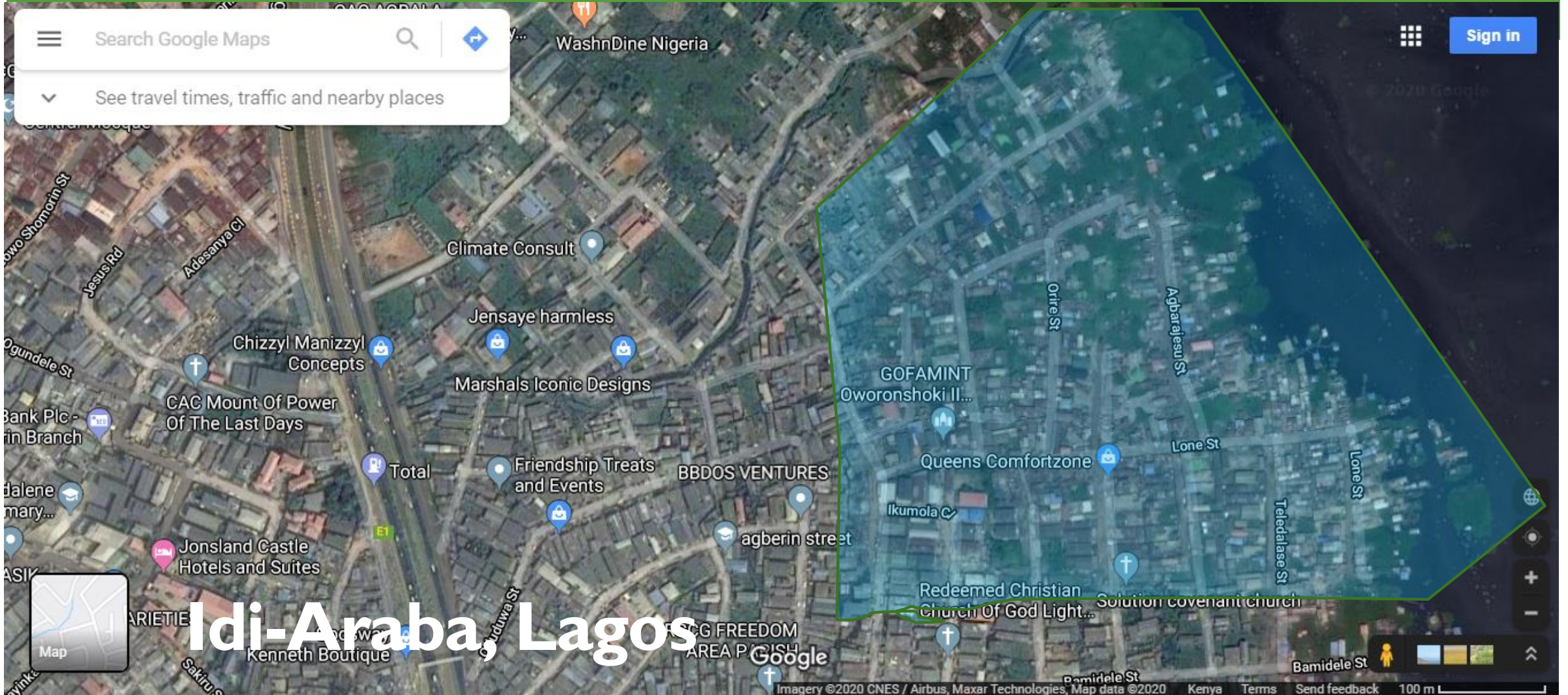
▪ Higher (and increasing) average temperatures

- Rise in mortality and illness from heat stress.
- Extended range and activity of some disease vectors.

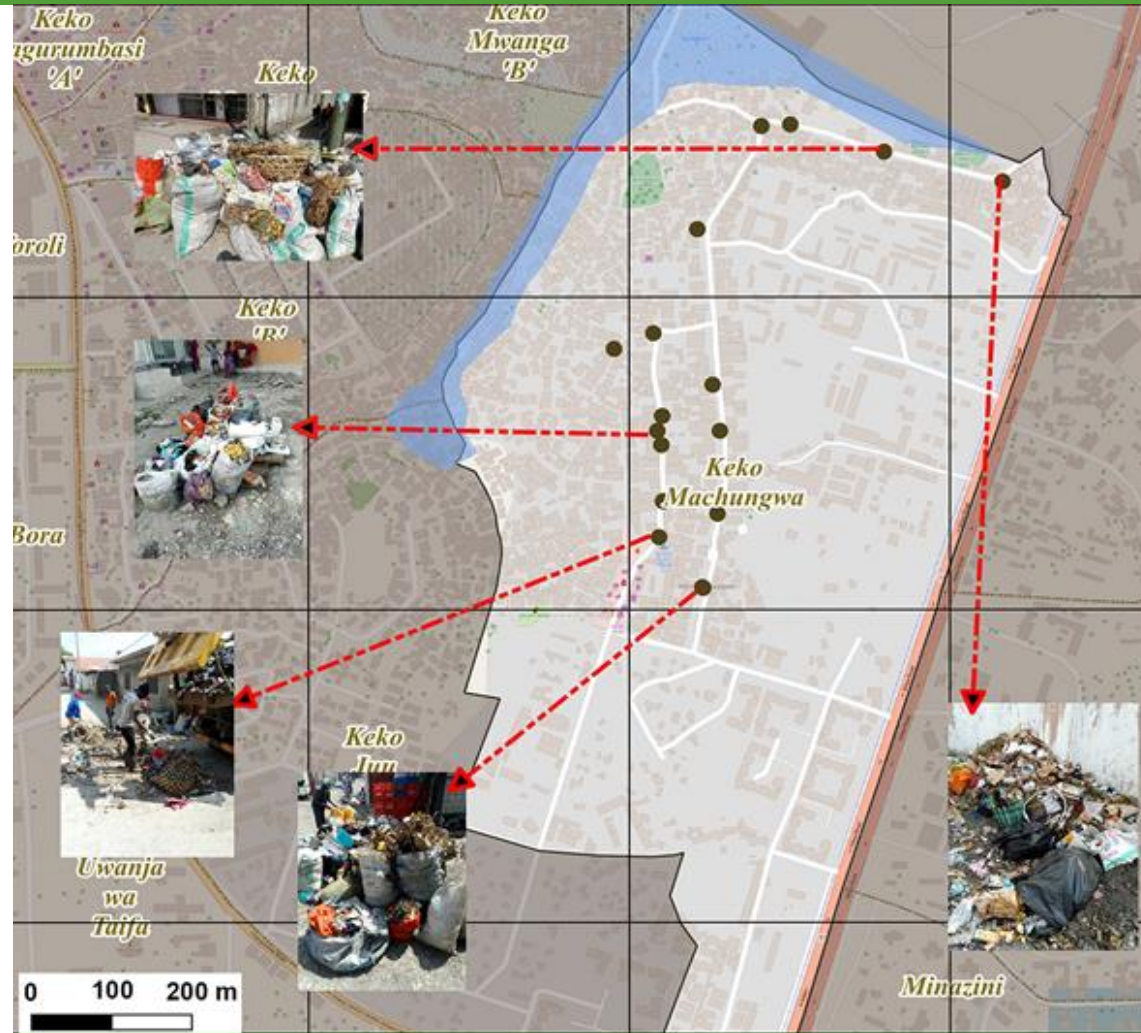
Objectives

- Map risks across spectrum of impacts (flooding, windstorm, heat stress)
- Identify and assess local-level adaptation practices in the built environment within coastal settlements.
- Through co-production, enhance/catalyse/upscale good practices

STUDY AREA(S)



Keko Mchungwa, Dar es Salaam



RESEARCH APPROACH



Transdisciplinarity; Co-production of Knowledge

Generate *usable knowledge* (not merely *new knowledge*) for the intertwined complex challenges related to global climate change and sustainable development (Clark et al., 2016).

CO-PRODUCTION ACTIVITIES

- **Transect Walks**
- **Workshops**
- **Community Engagement - Town Hall Meeting**
- **Policy Panel Discussion**
- **Training/Piloting Vertical Growing Systems**

Summary of Co-production Activities

Activities	Date	Location
Site Analysis	Tuesday 3 rd December 2019	Igbokoda, Ondo State
Town Hall meeting	Sunday 23 rd February 2020	Idi-Araba, Lagos
Transect Walks	Several in 2019 and 2020	Idi-Araba, Lagos
Transect Walk	October 2019, March 2020	Keko Mchungwa, Dar es Salaam
VGS Piloting/Training	Saturday 26 th September 2020	Idi-Araba community, Lagos
Policy Dialogue	15 th September 2020	Virtual (Zoom)
Stakeholders Forum	4 December 2020 (Lagos) 7 December 2020 (Akure) 17 December 2020 (Dar es Salaam)	
Workshops	12 th December 2020	Lagos

COMMUNITY ENGAGEMENT - TOWN HALL MEETING



Workshop involving field visits with Policy-makers



STAKEHOLDER ENGAGEMENTS



MAIN DATA COLLECTION METHODS

- **Ethnographic tools**
 - Semi-structured Interviews with residents**
 - Non-participant observations**
 - Documentaries**
- **Survey (questionnaires)**
- **Modelling through GIS**
- **Data logging for micro-climate information**



KEY FINDINGS/OUTCOMES

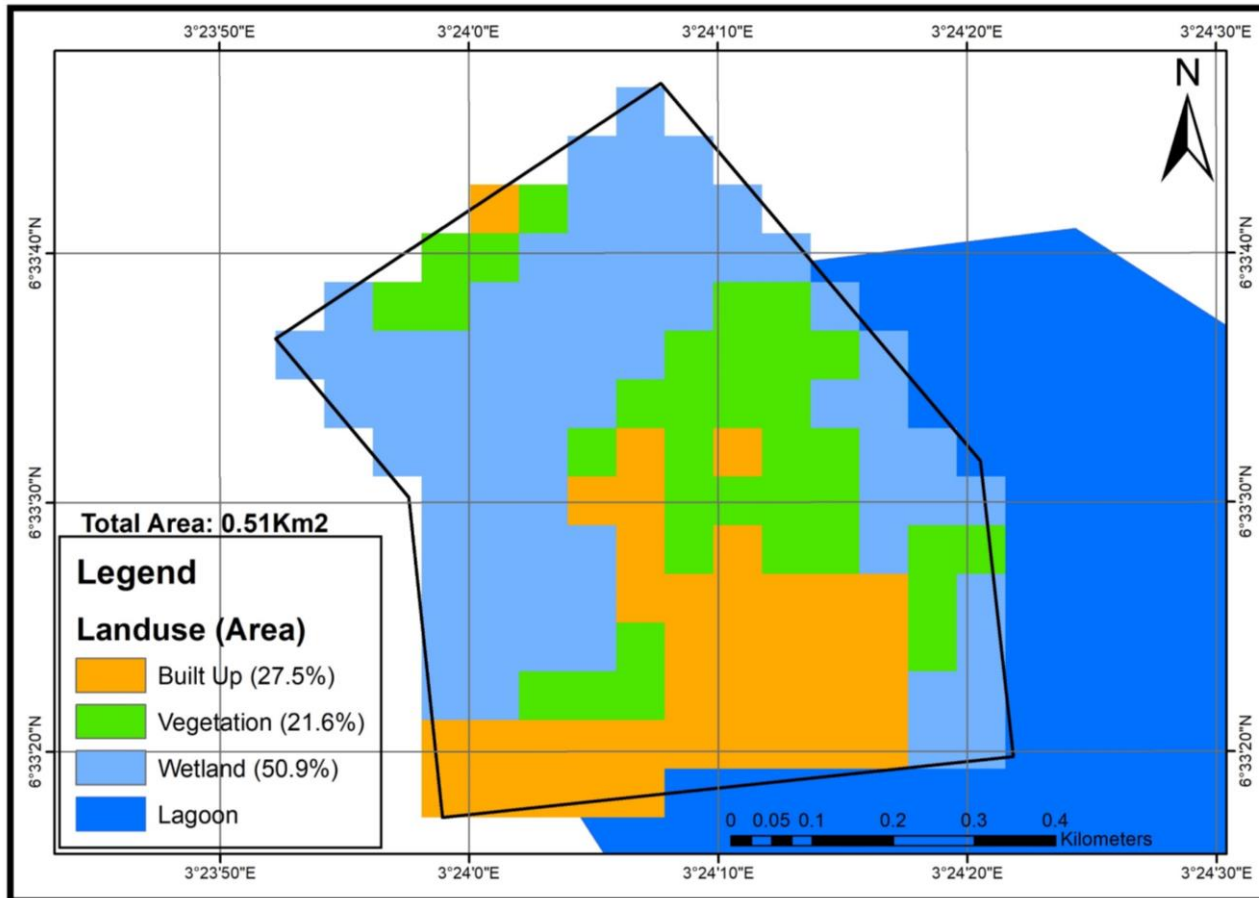
RESIDENTS' PERCEPTION ON CLIMATE CHANGE

- Agreement that **rainfall** is increasing
 - *The 3 - 4 year flooding cycle in Idi-Araba*
- **SLR**: No agreement that sea level is rising
- Agreement that **temperature** is increasing,
 - Also attributed to heat island from physical development
- **Windstorm**: No agreement on significant increase

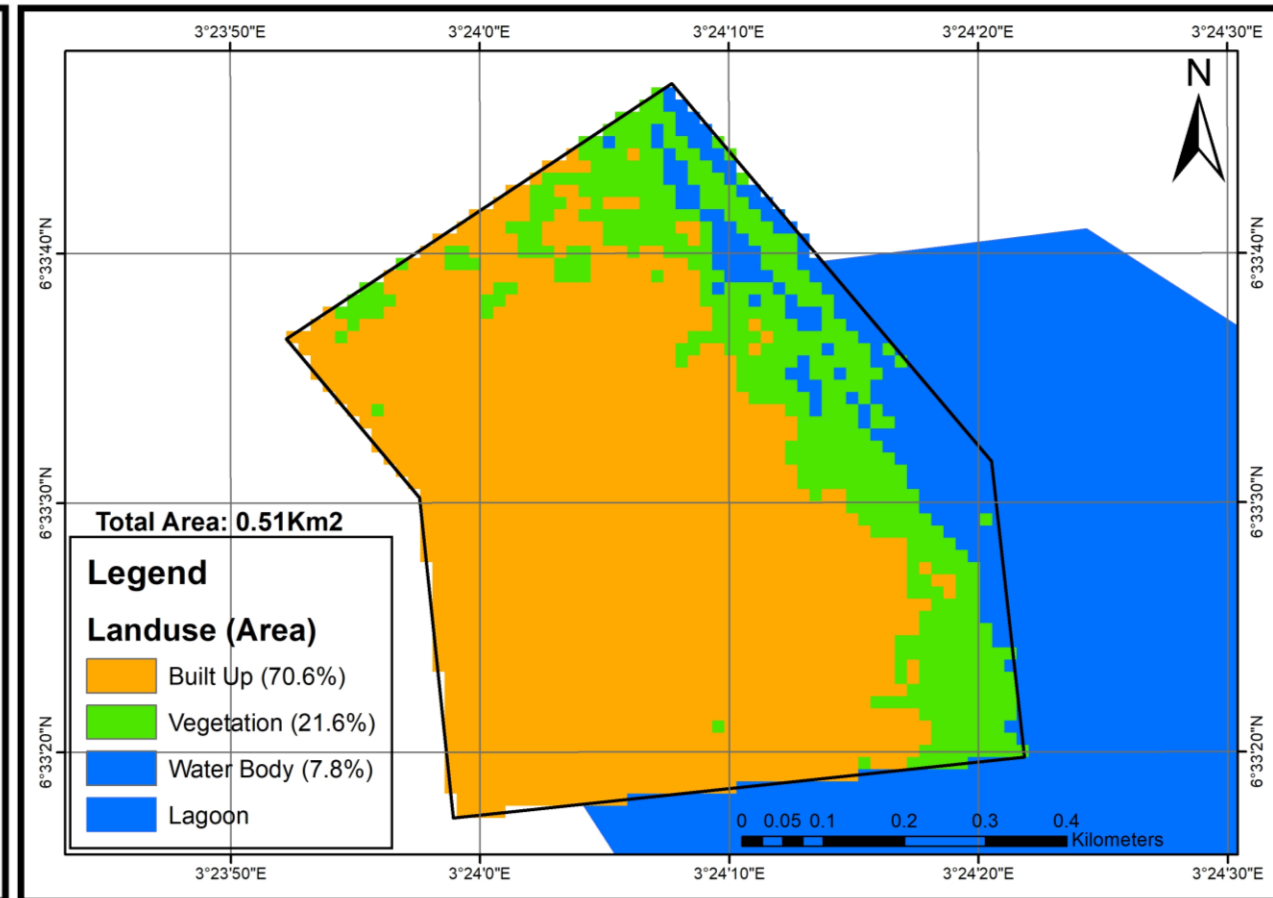
CLIMATE-RELATED IMPACTS

- **Lives** : Heat-related and water-borne sicknesses
- **Livelihoods**: Business disruption; [Re]construction as business
- **Natural Ecosystems**
 - Aquatic life (more fishes in rising sea)
 - Environment for disease vectors
 - Increasingly saline
- **Built Environment**
 - Damage to buildings, available infrastructure

DECIMATION OF NATURAL ECOSYSTEM

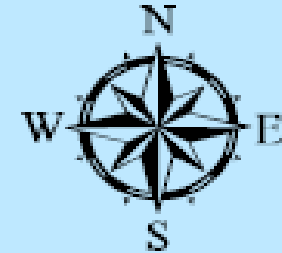


1990



2020

LAND AREA LIKELY TO BE IMPACTED AT 1 METER SEA LEVEL RISE



Third Mainland Courts

University Preparatory Secondary School

Climate Consult

RCCG Freedom Area Parish

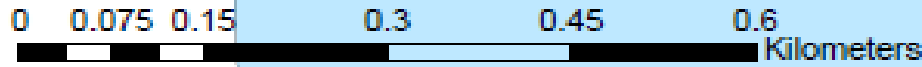
St Danie's Hospital
Otunba Bakare Avenue

Oke-Eri Street

Lagos Lagoon

Legend

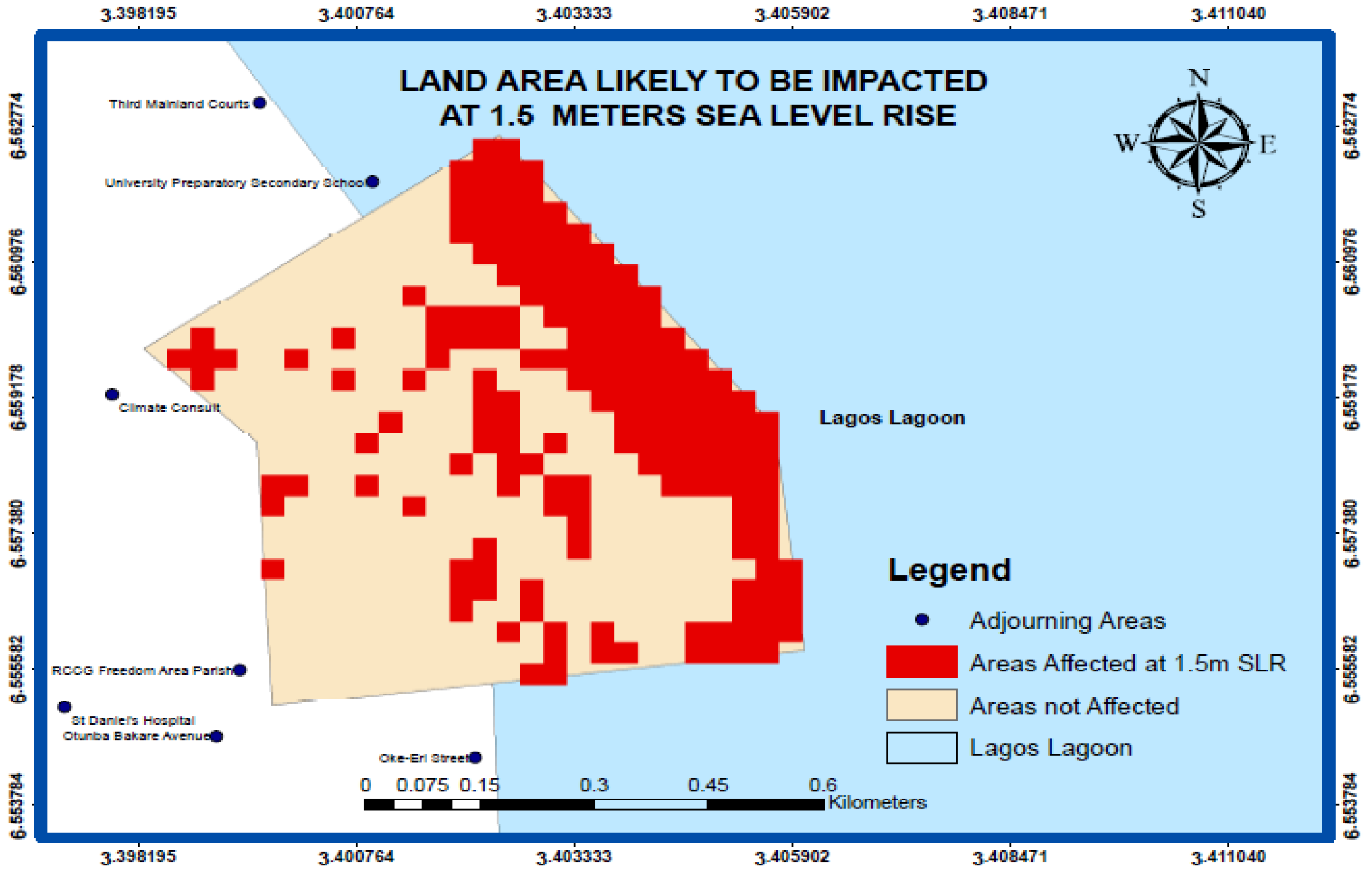
- Adjourning Areas
- Areas Affected at 1m SLR
- Areas not Affected
- Lagos Lagoon



6.562774
6.560976
6.559178
6.557380
6.555582
6.553784

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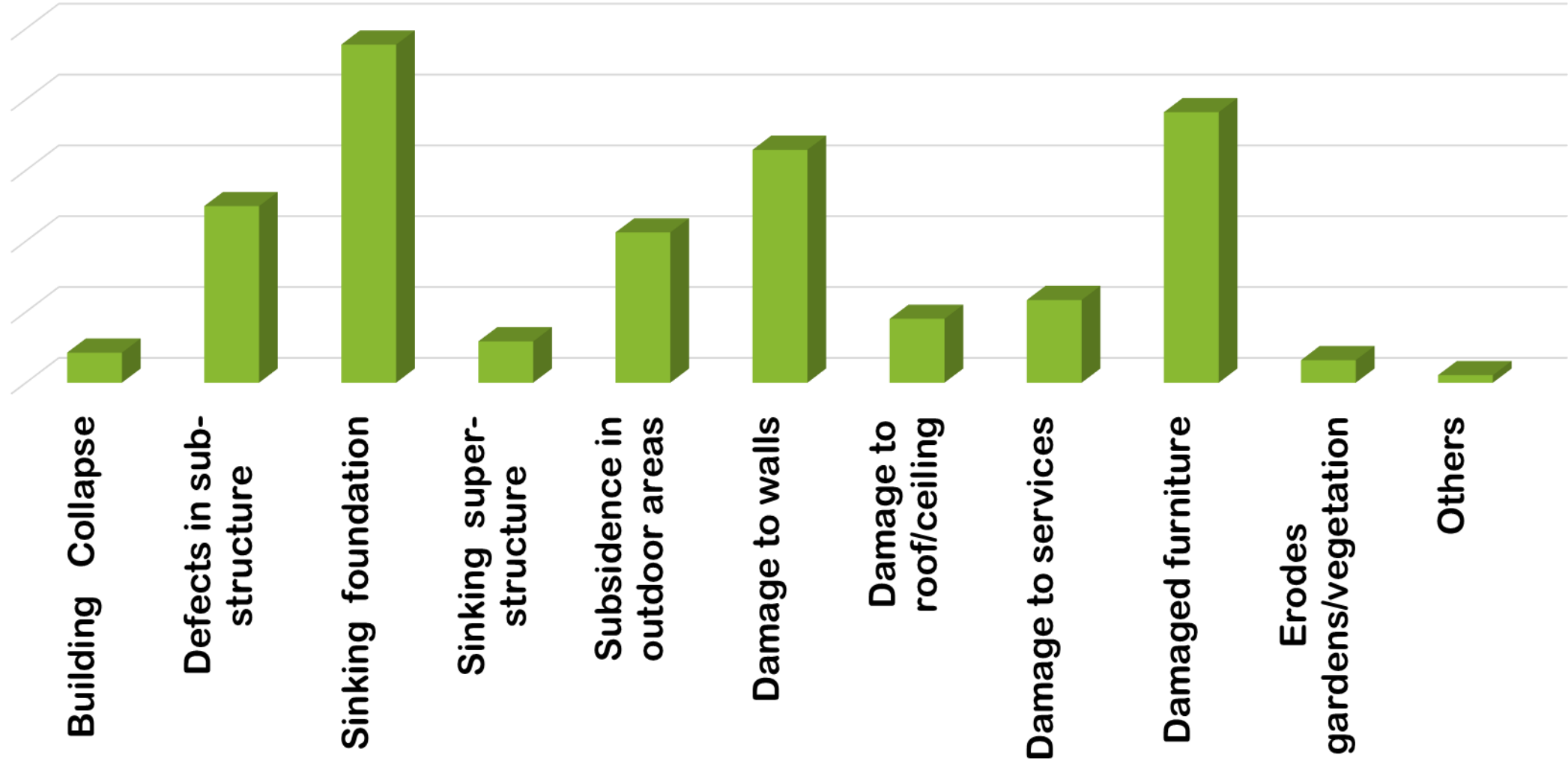
3.398195 3.400764 3.403333 3.405902 3.408471 3.411040



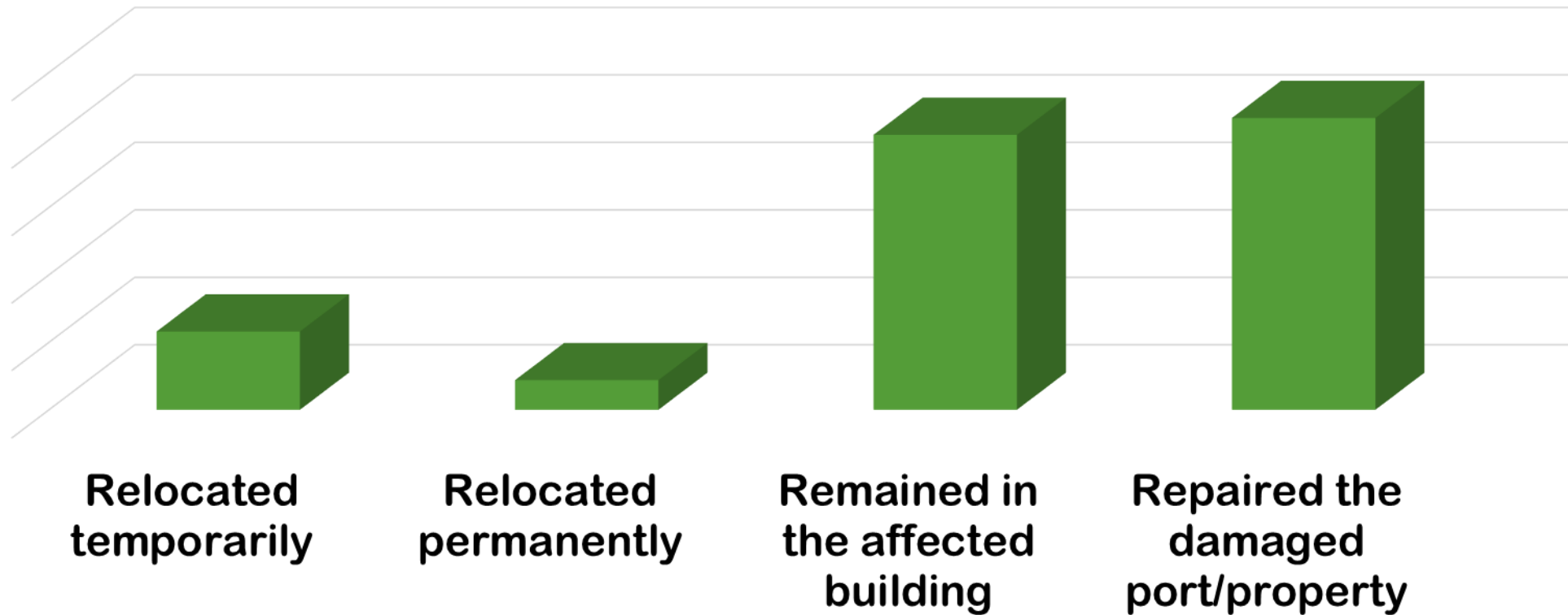
Sea level rise impacts on Buildings/Roads in Idi-araba

Projected SLR	No of Buildings to be affected	No of Roads/Streets to be affected
0.5m	8	
1m	33	2
1.5m	326	23
2m	903	32

SLR/flooding affected houses? 43.6% - YES
56.4% - NO



Action when SLR/flooding affected building



Structural measures against SLR/Flooding	Percentage	
Place valuable goods/furniture on a higher level	17.9	
Raise ground floor level of the building	8.9	
Raise the height of the house's platform	5.3	
Erect a barrier/embankment	3.4	
Construct drainage (culvert/gutter)	7.4	
Clear/de-silt drainage	4.9	
Drain stagnant water	8.7	
Create a pathway for water around the house	11.2	
Sand-fill surrounding of the house	11.3	
Construct wooden bridge	3.7	
Add another floor to the building	3.0	
Use weather-resistant materials on building before the rainy season	5.1	
Create outlet for easy outflow of water	6.8	
Plant trees/grasses/shrubs	0.3	
Cut down vegetation	1.9	
Other measures,	0.2	

(RE)SHAPING THE BUILDINGS



(RE)SHAPING THE BUILDINGS





Sustainably living on water - Some design Ideas



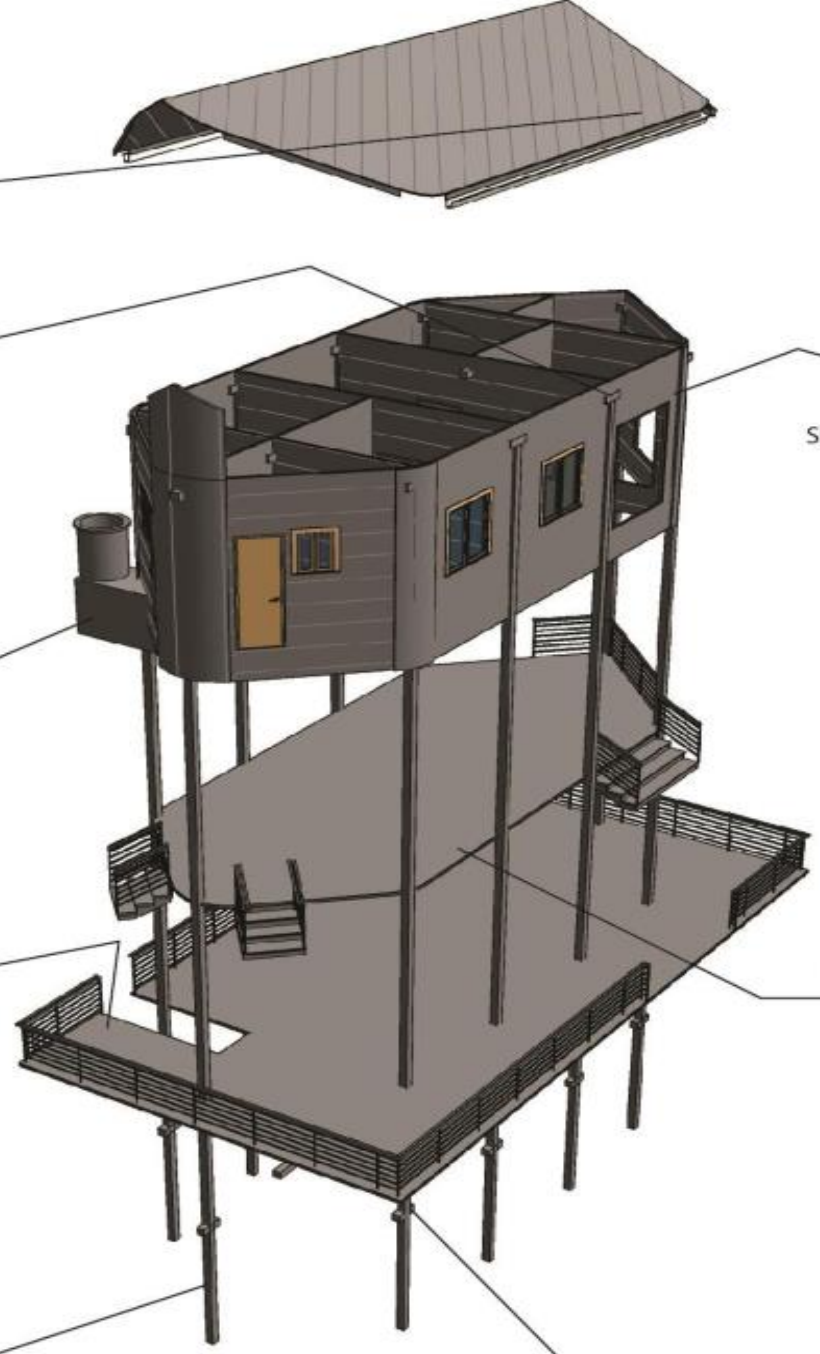
SPLIT BAMBOO ROOF COVERING PROPERLY CHanneled TO STORE RAINWATER FOR CONSUMPTION

IRON WOOD WEDGE TO HOLD THE BUILDING IN PLACE IN CASES OF EXTREME RISE IN SEA LEVELS

HUMAN WASTE COLLECTION SYSTEM TO PROMOTE HEALTHY SANITATION IN THE COMMUNITY

SUSPENDED BAMBOO FLOOR MEMBERS TO HOLD THE DWELLING AFLOAT IN EXTREME RISE IN SEA LEVEL CASES. IT IS SUSPENDED ON THE IRON WOOD WEDGE BELOW

IRON WOOD STANCHION MEMBER

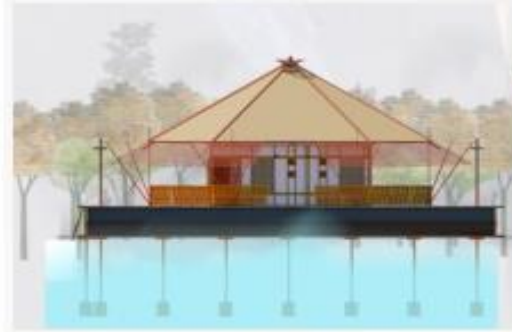


SPLIT BAMBOO MEMBERS AS WALLING MATERIAL

SUSPENDED BAMBOO PLATFORM TO SERVE AS FLOOR FOR THE HOUSE HOLD DWELLINGS

IRON WOOD WEDGE TO SUSPEND THE DWELLING ABOVE FLOOR LEVELS

AMPHIBIOUS HOUSING CONSTRUCTED USING LOCALLY SOURCED BUILDING MATERIALS



Window: Lexan Polycarbonate (Acrylic)

Local Pile: foundation Iron wood

Floor Bamboo Paquette

Roof: Cross Laminated Timber

Wall: Cross Laminated Timber

Wind turbine for energy generation

Mosquito Net

Roof designed to collect water for use in building interior spaces.

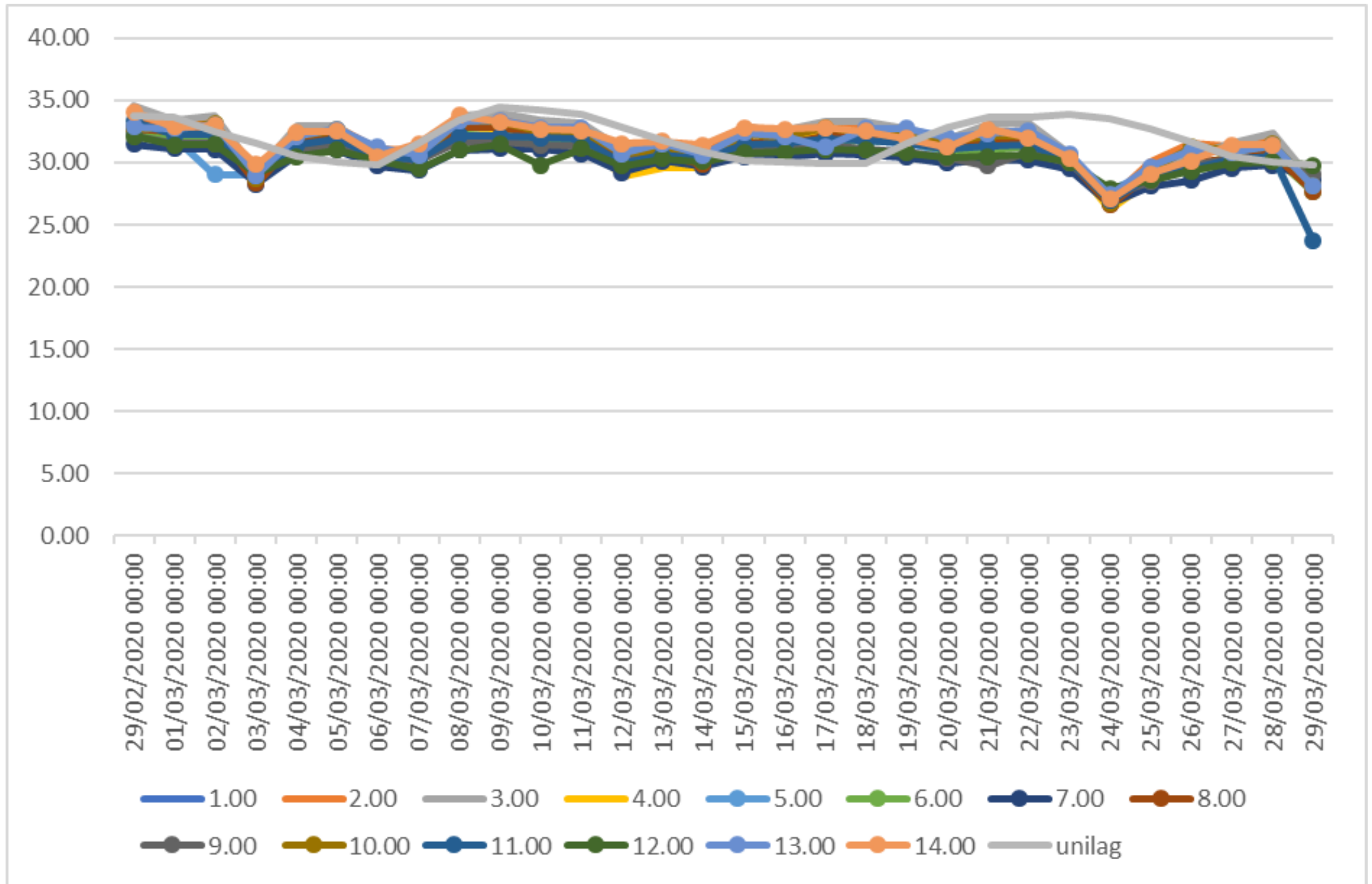
COPING STRATEGIES: NON-STRUCTURAL

- Self-help, and Family Support
- Social network - churches, other community groups
- Awareness
- External Support – NGOs, charity organizations

More generalist, not themed at climate adaptation

MICRO-CLIMATE MONITORING

- Rainy Season: 28 February to 30 March 2020
- Dry Season: 30 November to 30 December 2020
- Minimum/ Maximum Indoor Air Temperature: **24.1⁰C/39.1⁰C**
- Minimum/Maximum Outdoor Air Temperature: **24.1⁰C/40.1⁰C**
- Average Outdoor Temp largely same with formal parts of Lagos.
- Average Indoor Temp not within Thermal comfort Index



... SPATIAL GROWTH IN KEKO MACHUNGWA...



K. Machungwa 2005



K. Machungwa 2011



K. Machungwa 2019

House types: form and building materials

	House Type	Existence (%)
1	Swahili & modified Swahili	72
2	Rooms in a row	20
3	Bungalows	4
4	Semi-detached	3
5	Others: hostels, single flats, etc	1

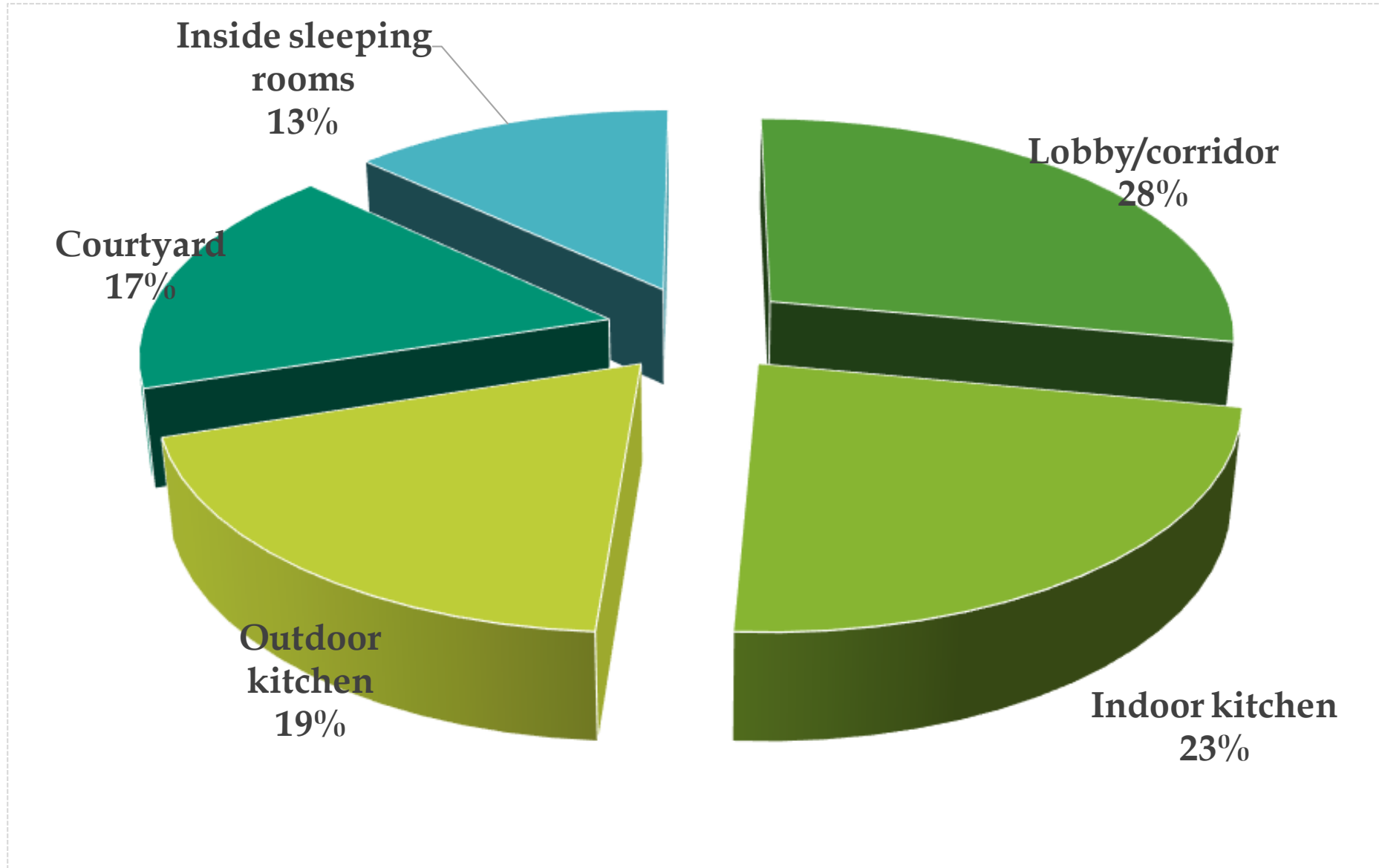
Building structures in informal settlements have high flexibility in terms of space layout and functional accommodation within, particularly HBEs

	House Type	Presence (%)
1.	Iron sheets	2
2.	Mud and pole	1
3.	Cement: sand block walls	97

The predominant house type by building materials is cement-sand block wall structures

Cooking locations

...impact on increasing heat stress...affected by house type & space



Water availability

...behaviour towards green structures, self use for cooling...

		No of people	%
Source of water	Municipal pipe-borne water	295	73
	Community borehole	103	25
	Hand-dug well	56	13
	Stream	31	8
	Sachet/Bottled Water	8	1
Water satisfaction: quantity	Yes	383	96
	No	22	5
Water satisfaction: availability (frequency of flow)	Yes	368	91
	No	37	9
Water satisfaction: quality (clean, safe)	Yes	370	91
	No	36	9

Presence of green structures around building structures

Presence of grasses and/or shrubs within approximately 5m around the house	No	282	69.46%
	Yes	123	30.3%
Presence of trees immediately around the house	No	226	55.67%
	Yes	180	44.33%

Perception on climate change vs. heat stress

There is increasing heat (higher temperature) in Keko Machungwa over the years	Yes	320	80%
	No	54	13%
	I don't know	30	7%
Caused by climate change?	Yes	207	50.99
	No	121	29.8
	I don't know	68	16.75
Other causes apart from climate change?	<ul style="list-style-type: none"> ✓ Congestion of houses and overpopulation = 88 ✓ Lack of trees/greening = 17 ✓ Poor planning (lacking open space) = 6 ✓ Poor house design and construction = 11 ✓ Activities: cooking, home-based industries = 6 		

INDIVIDUAL COPING MEASURES WITH HEAT STRESS

1. Sleeping on the floor;
2. Sleep on a wet bedsheets;
3. Opening windows;
4. Sit outside for fresh air and wind, which is rare;
5. Body hygiene to allow skin breathing, e.g. avoid oil-based cream
6. Reduce body exercise which produce heat;
7. Never cook indoors;
8. Have an open bucket of water to direct the heat into the water;
9. Cover my head with clothes a vail;
10. Stay indoor half naked;
11. Look for places with tree to rest .

BUILDING-RELATED COPING MEASURES

	Yes (%)	No (%)	N/A (%)
Plant vegetation inside the house	15	81	4
Plant trees around the house & increase shade around homes	25	70	5
Raise headroom of building (add block courses)	15	78	7
Increase window size	18	74	8
Change wire mesh/net for better airflow	34	57	8
Extend roof eaves	11	80	9
Use reflective colours for walls/roofs	17	72	11
Fix a ceiling	15	74	10
Lighter curtain material	34	57	9
Develop pergolas	7	63	30
Install external blinds, shade clothes	13	76	11
Use low heat-emitting bulb and other energy-efficient appliances	29	61	9

VERTICAL GREENING/FARMING: WHY?

- **Land/Space Availability/High Density**
- **Soil problems**
 - *salty soil in coastal areas*
- **Boost Green Space Coverage & Food Production**

THE GREENING HOUSING CHALLENGE

Targeting

POST-COMPETITION

- Implementation
- Presentations/Participation at Event
- Multiplying Knowledge & Skill

GREENING HOUSING INNOVATION CHALLENGE

TASK Design a Vertical Greening System suitable for real-life implementation for a low-income, dense urban environment, for instance, a slum in Lagos or blighted inner-city neighborhood in a medium-sized city like Akure.

HOW TO REGISTER

- Send your name(s), matric no(s), and discipline(s) to ghcinnovation20@gmail.com
- Watch the Youtube Video on VGS webinar on the Official pulcher page (https://bit.ly/VGS2020_webinar)

REGISTRATION ENDS ON 25TH MONDAY, MAY 2020

SUBMITTALS to ghcinnovation20@gmail.com

2D & 3D DRAWINGS — 500 WORD RESEARCH DOCUMENT — BY SUNDAY 31ST MAY 2020

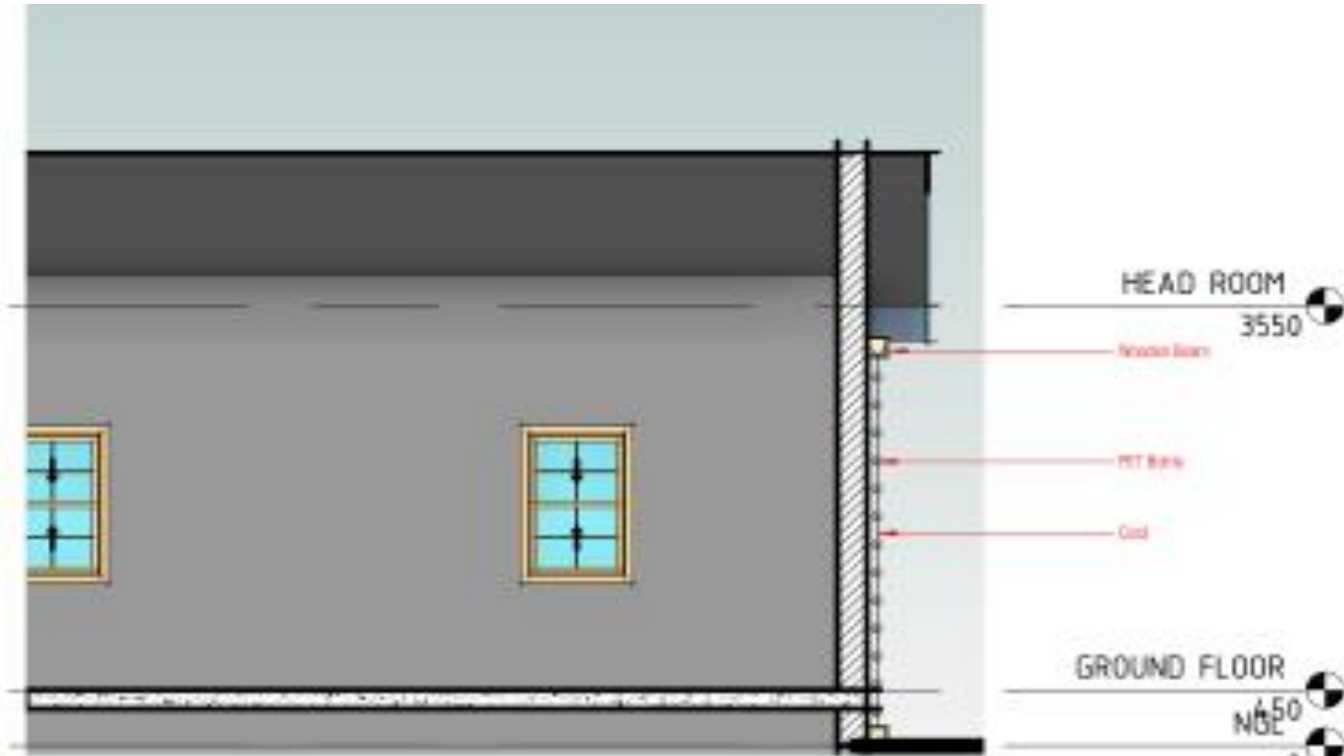
PRIZES
N50,000 to the Top 3 Entries
Worthy Mentions apart from the Top 3
Chance to present your Proposal at the next Pulcher Event

VERTICAL GREENING SYSTEM

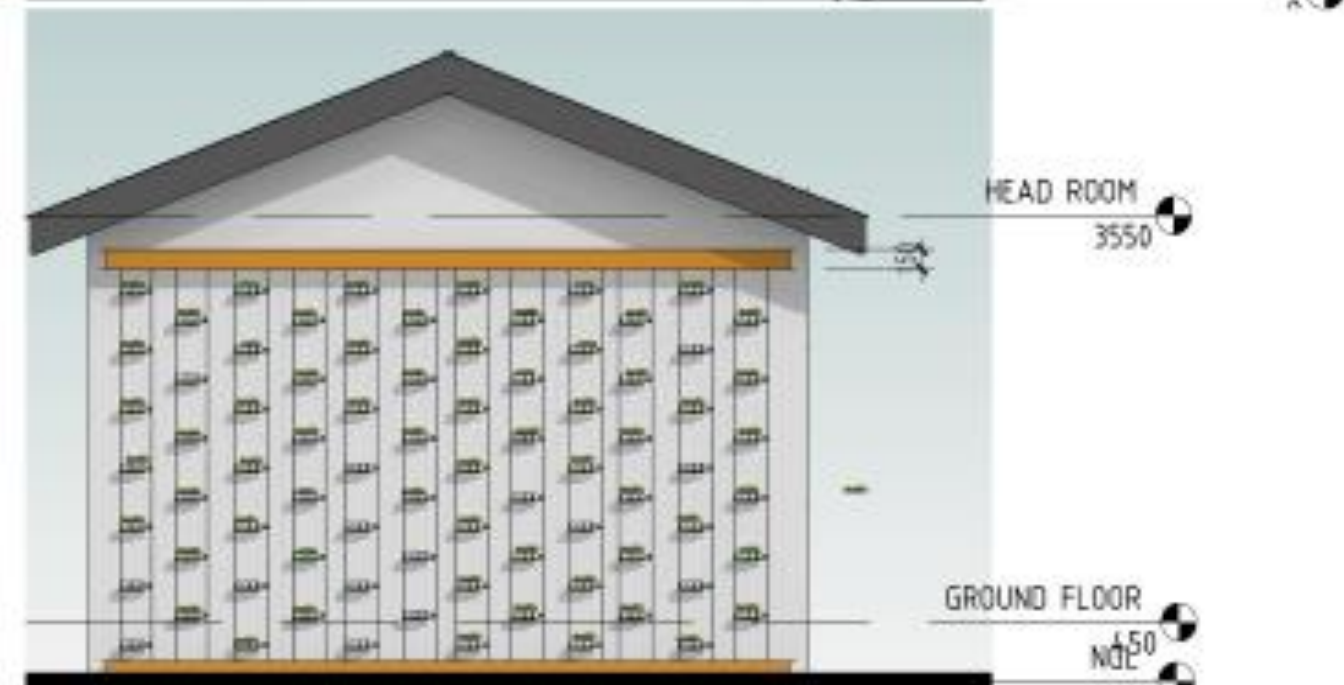
VGS

GREEN HOUSING

PULCHER
UNVEILING THE HIDDEN BEAUTY OF ARCHITECTURE



VGS_ Pet Bottle Prototype
FLOOR PLAN, ELEVATION, AND SECTION







VGS_ HDPE Pipes Prototype

Floor Plan And Elevation.

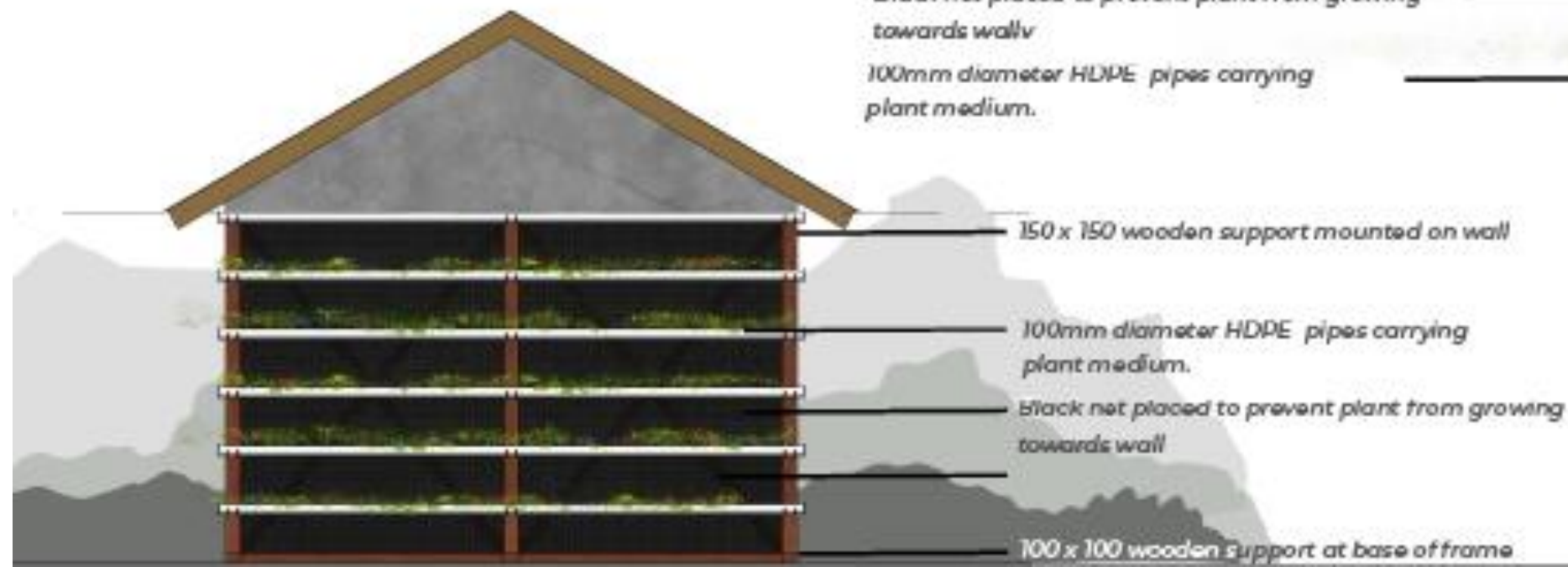
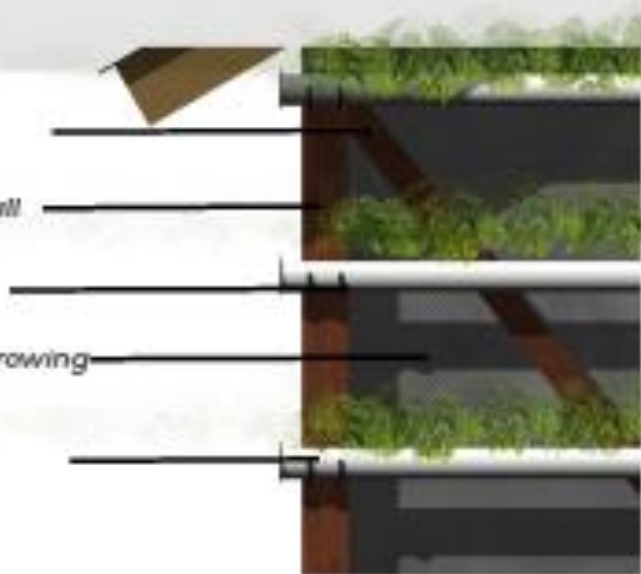
100 x 100 wooden brace for supporting frame

150 x 150 wooden support mounted on wall

Y-16 steel anchor to hold HDPE pipes

Black net placed to prevent plant from growing towards wall

100mm diameter HDPE pipes carrying plant medium.









PREPARATORY WORKS FOR SOWING

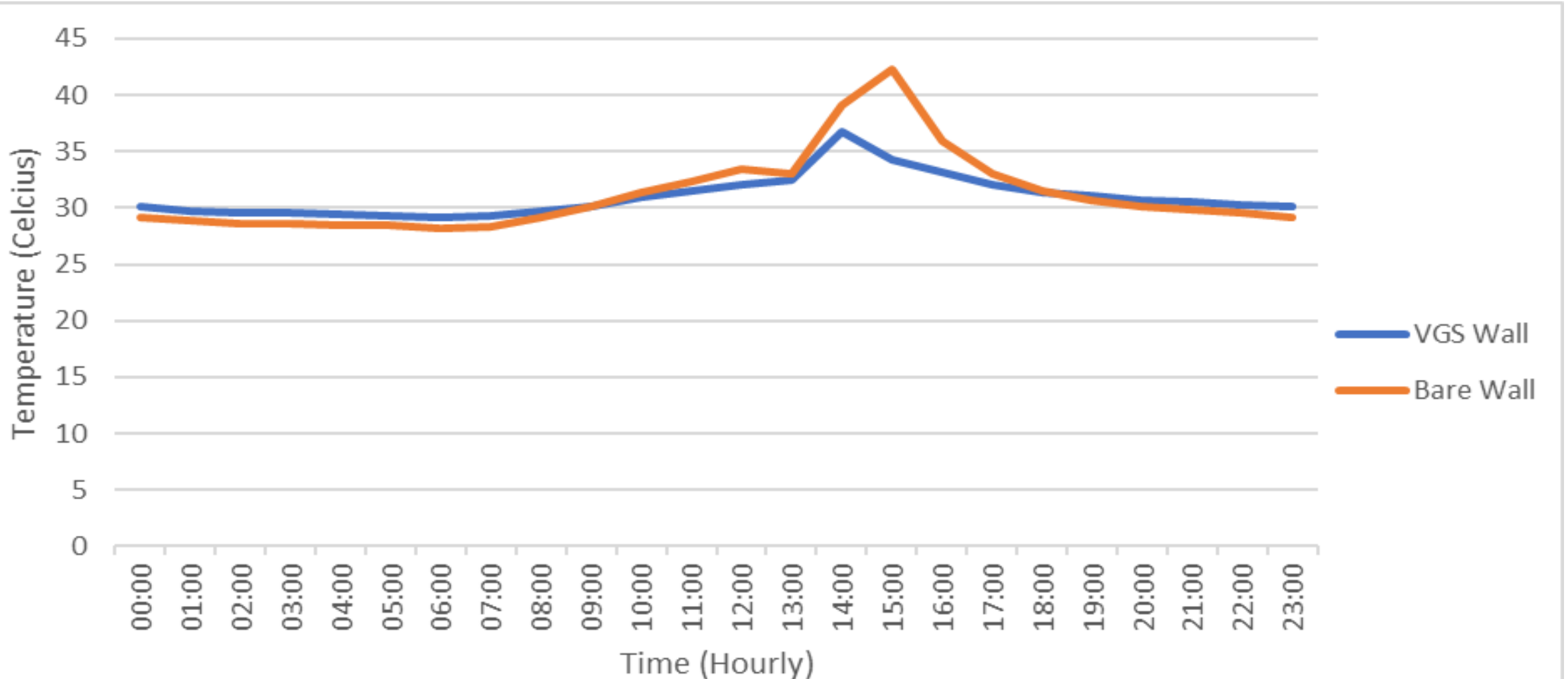


STRUCTURE

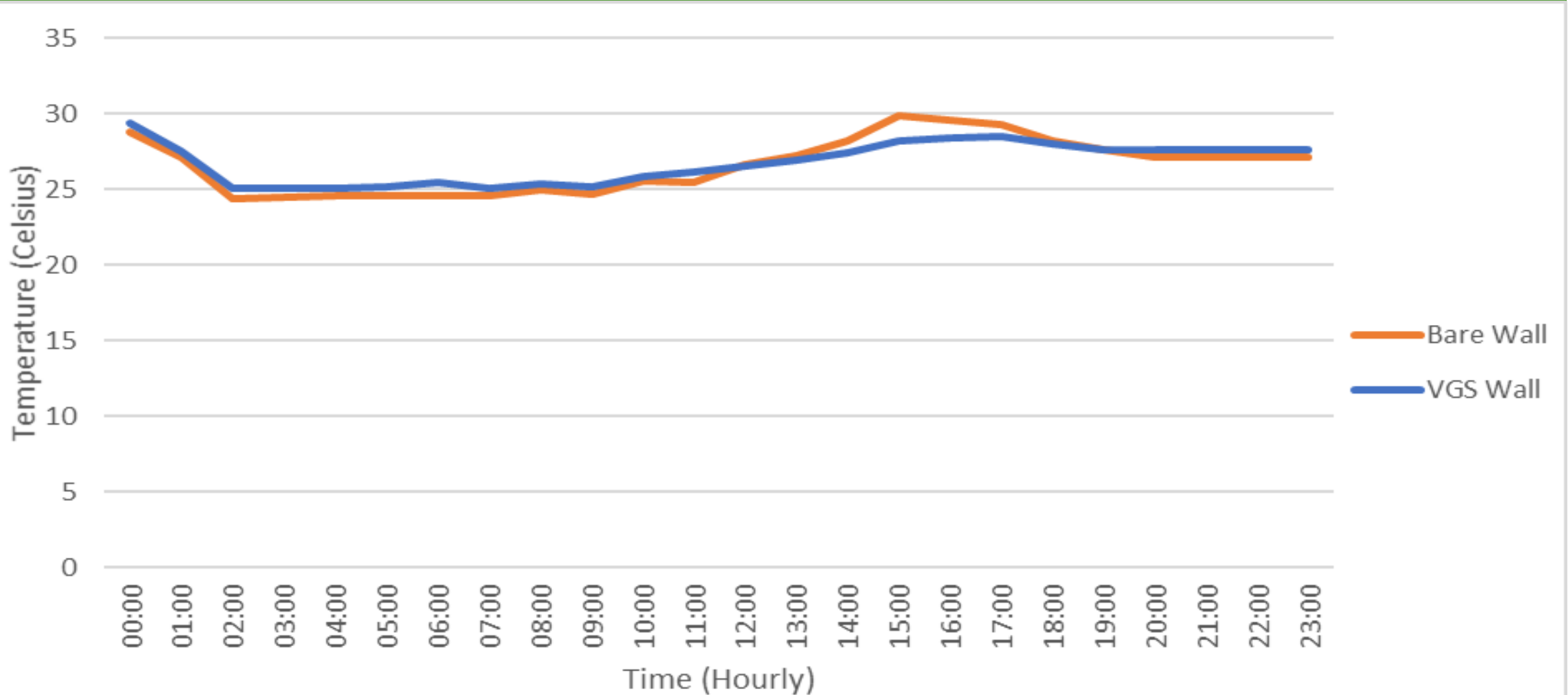
... GROWING GREENS 3 WEEKS AFTER
SOWING ...



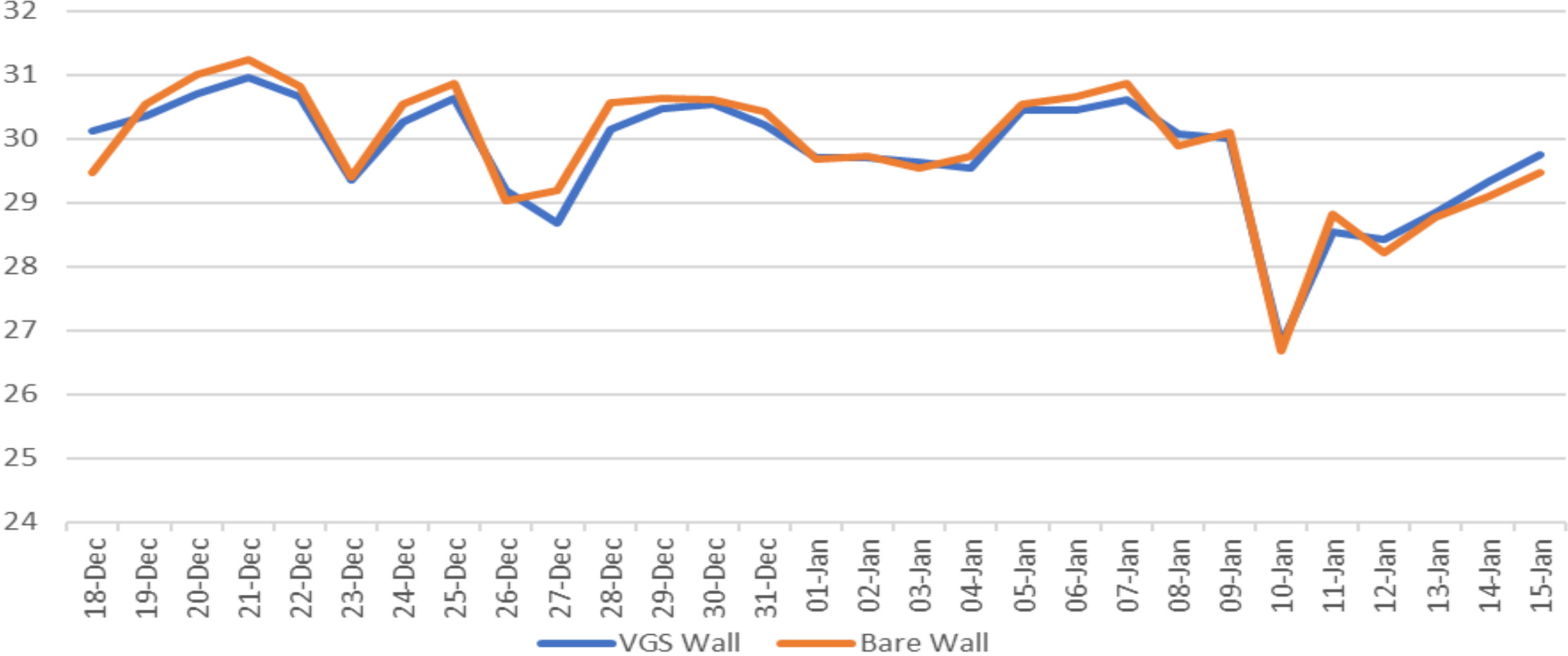
Hourly average between VGS wall and bare wall for hottest day



Hourly average between VGS wall and bare wall for coldest day



Daily average of VGS wall versus bare wall for 30-day period



OPPORTUNITIES & CHALLENGES

- Locally fabricated, Local Materials
- Attracted attention
- Relatively affordable to own: \$89-\$100
- **Socio-cultural Issues - Perceptions, Belief**
- **Question of Aesthetics**
- **Availability of blank walls**
- **Maintenance – watering, picking weeds**

KEY TAKE AWAYS

- Socio-economic aspirations vs adaptation/environmental ideals
- Early warning systems and Awareness (Community-based)
- Improvement in Infrastructure and Services
- Housing Upgrading – Incrementally?
- Ecosystem Restoration (NBS) and Promoting Green Infrastructure
 - *Fine-tuning VGS - Extended micro-climate and other assessments*

ACKNOWLEDGEMENTS



- Dr Nathalie Jean-Baptiste
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- Non-Academic Collaborators/Participants



United Nations
Economic Commission for Africa





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