The biggest city of Tanzania, Dar es Salaam, faces increasing flood risk, causing frequent sickness, loss of life, and widespread damage to property. Dar es Salaam is one of the fastest growing cities in the world. More than 70% of the residents live in informal settlements. Many of them are located in flood prone areas like river valleys and floodplains, which flood annually. Because of their limited coping capacity, residents are not able to recover from the impacts of this flooding. Due to the change of precipitation patterns, the flood risk is likely to increase in the future, putting even more people and assets at risk during more frequent and intense floods. This graduation project seeks to answer the main research question: How can urban form and landscape help to mitigate the effects of floods on citizens in Dar es Salaam, Tanzania?

For areas with a high density of buildings, multifunctional courtyards are proposed. The existing building structure is strategically densified, and filled with new buildings to shape courtyards. Inside, a variety of interventions reduce the water run-off into the river valley, treat waste water and generate income via urban agriculture and aquaponic systems. For the river valley the construction of “chinampas” is being proposed, which creates a high retention capacity for storm water while enabling agricultural activities and connectivity across the river valley throughout the wet and dry seasons. At the edges of the valley, different interventions are located in order to reduce and clean run-off water before entering the valley. The combination of spatial interventions to reduce the flood risk with urban agriculture reduces the impacts and increases the ability of residents to deal with future hazards.

The design proposals are supported by a implementation strategy and complementing policies which reduce pollution, steer future urban development and introduce new renting models to host a higher diversity of lifestyles with different economic abilities.
DAR

courtyards and chinampas for urban water management in Dar es Salaam

Impacts:
- improved soil conditions
- increased biodiversity
- natural water purification
- more river space
- reduced run-off
- reduced pollution by waste
- reduced blocking by waste

Interventions:
- keep infiltration capacity
- increase food production (courtyard system, chinampa system)
- relocation in 500m zone

Problems addressed:
- rural green industry
- urban industry

Impacts:
- industrial water purification
- more river space
- reduced run-off
- reduced pollution by waste
- reduced blocking by waste

Interventions:
- relocation in 500m zone
- waste water treatment plant for industry
- riverine buffer zone
- maintain main infrastructure
- waste network

Problems addressed:
- pollution of soil/water
- destruction of ecosystems
- in flood risk areas on occupied = cheap

no institutional capacity  no money  settling in informal settlements  no formal economy/jobs

rapid urban growth  destruction of ecosystems  pollution of soil/water  no infrastructure/services

no coping capacity  damage of houses  loss of income  informal economy (at home)

main problems

Beke-Marleen Hörmann - Mona zum Felde
Mentor: Frank van der Hoeven - Frits van Loon
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Beke-Marleen Hörmann
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- why courtyard?
  - arabic/muslim courtyard culture
  - small scale intervention
  - good climate - shade/green space
  - implementation by units
  - don't have to move
  - community based units

- courtyard concept
  - rainwater collection
  - aquaponic system
  - natural system
  - composting chickens
  - sanitation biogas system
  - fish pond
  - infiltration
  - evaporation
  - input
  - output

- courtyard agriculture cycle
  - rainwater
  - evaporation
  - water tank
  - pump
  - fish pond
  - infiltration
  - composting
  - chickens
  - biogas
  - biogas cooking
  - sanitation biogas system

- cross section west- and east side 1:250

- cross section west- and east side 1:250
DAR

Courtyards and chinampas for urban water management in Dar es Salaam

Courtyard plan 1:200
DAR courtyards and chinampas for urban water management in Dar es Salaam

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riverine buffer zone

chimampas

constructed wetlands

retention areas

connections - neighbourhood

connections - river valley

urban forestry

intervention schemes

south-north section 1:1000/1:200
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water level August
water level December
water level April

25m²*0.5m = 12.5m³
25m²*0.125m = 3.125m³
maximum capacity per 100m² chinampa:
12.5m³+3.125m³ = 15.625m³

spatial requirements for 1 person/year

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<th>Crop</th>
<th>Area (m²)</th>
<th>Contribution (%)</th>
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<td>Wheat</td>
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<tr>
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<tr>
<td>2 Chickens</td>
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food demand covered by production on chinampas

contribution to food demand of neighbourhood

0.5m = 12.5m³
0.125m = 3.125m³

maximum capacity per 100m² chinampa:
12.5m³+3.125m³ = 15.625m³

chinampa water capacity

chinampa food capacity

• chinampa water flow

• chinampa section

• chinampa plant scheme 1:200