Risk Profile – Mozambique 2015 Floods Reanalysis

1. **The January-February 2015 Mozambique floods, were the worst to affect the country since 2000 and produced large impacts for the inhabitants living along rivers in Mozambique with an estimated $87 million calculated from the analysis.**
2. **Analysis of population in 2000 and 2015 living within the 2015 flood affected zones showed an increase by a higher rate compared to the overall Mozambique population (70% vs. 55%), indicating somewhat increased risk of future loss in these areas, with around 12% of the country's present population living within 1-km from the 2015 flooded areas.**
3. **A countrywide Mozambique exposure model has been developed allowing for reuse for future risk studies for residential and non-residential sectors.**

Why are we looking at Mozambique

- Mozambique ranks third among African countries most exposed to meteorological hazards incl. cyclones, droughts, floods, and related epidemics. The country's 2,700 km coastline along the Mozambique Canal is in one of the most prolific tropical cyclone basins, producing about 10% of the world's cyclones every year. In addition, Mozambique is located downstream of 9 international river basins, that flood frequently and demand effective coordination with the upstream countries.
- The country has had very few national-level risk studies done, with largely differing estimates of built capital available via existing natural hazards scenarios and PDNAs.
- Building typologies and the cost of construction differ greatly across the country meaning that relative vulnerability changes significantly and needs to be explored.

Why is this useful to the TTL?

Mozambique has one of the highest cyclone and flooding hazard levels in Africa. Flooding like the one experienced during January-February 2015 is a recurrent event likely to occur again. By reanalysing the impacts and the extent, better preparation for future events can be made and knowledge crucial for a wider national-level risk assessment exercise can be gained.

Why are we doing the disaster scenario?

The "Disaster Scenarios" Mozambique flood model can be applied to a probabilistic or deterministic modelling effort in the future. The building of this model allows for future events to be quickly analysed and losses to be determined more easily in the residential and non-residential sector. By reviewing the loss differences today vs. at the time of the event, a full suite of scientific studies, knowledge and expertise has been used, which benefits the production of exposure, hazard and vulnerability models for floods anywhere around the world.

Background and historic losses

The 2015 Mozambique floods were a significant event causing over 200 deaths, and around 157,000 displaced.

Disaster Type	Flood		**Deaths**	215
Magnitude and Location	MWI/MOZ		**Homeless**	157000 displaced
Date	26/01/2015		**Houses existing at time**	6,110,007
Country Population at Time	27,660,000		**People in dam./destr. houses**	90,069
Capital Stock at Time (Res.) - $USDmn	9,750		**Houses destroyed**	12,612
Capital Stock at Time (Non-Res.) - $USDmn	12,083		**Houses damaged**	7,284

It also caused around $56 million in residential asset losses.

How did we remodel the scenario?

Initially, basin fill models were undertaken for one river reach, however, it was seen that much more was flooded when looking at the extents from satellite imagery in late January. Thus, the satellite imagery was used directly within the analysis and simple inundation was used to analyse the losses.

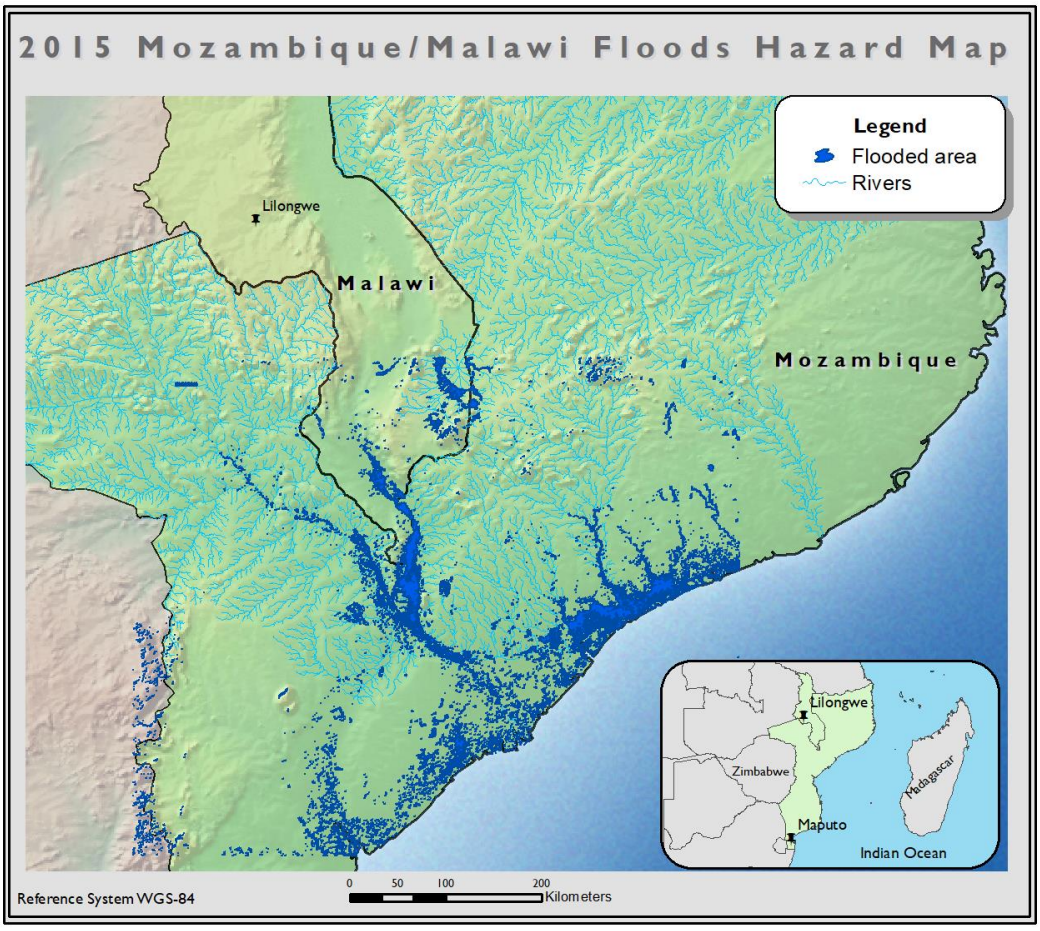

Figure 1: Flood extents for the Mozambique 2015 event.

The assessment of the Mozambique residential and non-residential buildings exposure at the time of the 2015 floods was done at the district resolution (the highest resolution available for the 2007 Mozambique Population and Housing Census). There are 148 districts in Mozambique. The 2007 census data are available on-line in PDF reports for 144 of the 148 districts (for the 4 missing districts (Gilé, Mabote, Muembe and Rapale-Nampula) analysis was done on the basis of the data of the surrounding districts). January 2015 district-level population was estimated by projection from 2007 making reference to 2012 LandScan population layer and to official Mozambique 2014 projected population. The exposure is household- based and it was assumed that one household corresponds

to one dwelling unit (as housing data by population or by dwelling units were not available). Households are distributed by outer wall type as per the 2007 census. For the unit costs of construction (UCC in USD per square meter) three homogeneous inventory regions were considered: a) Maputo City & Maputo Province (incl. cidade de Matola); b) Remaining 11 cities (cidades); c) Rest of Mozambique (122 mostly rural districts). The UCCs are based on 2012 information with quite low UCC values for the vernacular houses. For the size of the dwellings, data on number of rooms were captured in the 2007 census but could not be accessed on-line. We used our Africa cities exposure development work to propose Mozambique dwelling sizes for different outer wall typologies. Non-residential exposure was developed using appropriate non-residential to residential built floor area ratios for each of the three homogeneous inventory regions (reference was made to building footprint data in Nairobi and Dar es Salaam for the estimation of non-residential floor areas in the urban districts). The non-residential built floor area is distributed to Commercial, Public and Industrial occupancy. The exposure is adjusted to the Gross Capital Stock of Mozambique allowing for devaluation of older buildings. The exposure sums to 9750 million USD for residential buildings (Fig. 2) and 10261 million USD for non- residential buildings. In Fig. 3 the district-level per capita residential exposure is shown. It ranges between 73 and 2377 USD as it is influenced by the house typologies, dwelling sizes, unit cost of construction and the mean size of the households in each district.

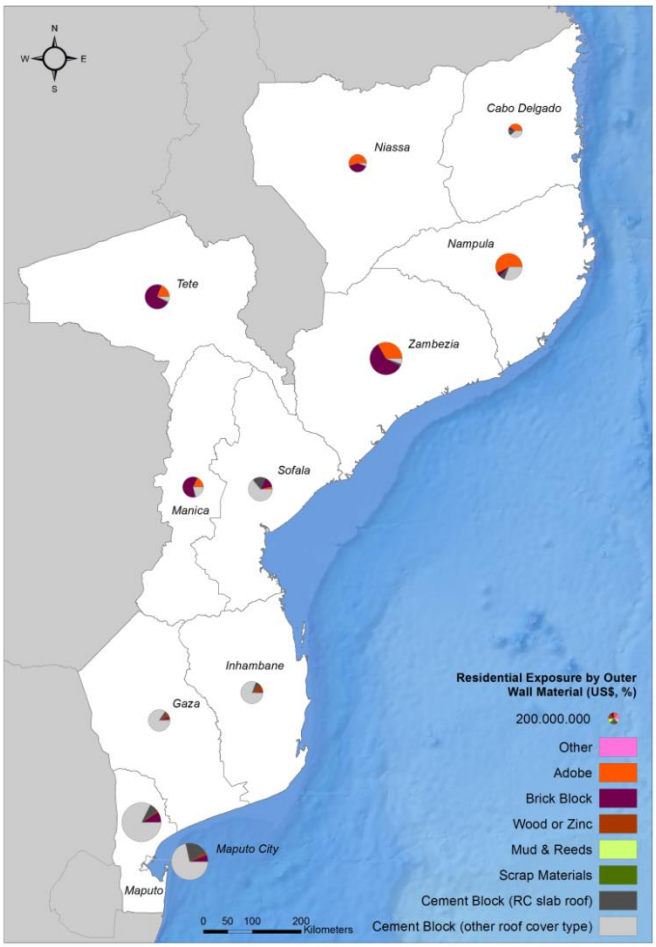

Figure 2: Residential exposure in Mozambique. The map shows the size of the exposure in USD (scaled pie charts) and its breakdown into outer wall typologies for each of the 11 provinces. Cement block is predominant in the South, brick block in the centre and adobe in the north of Mozambique.

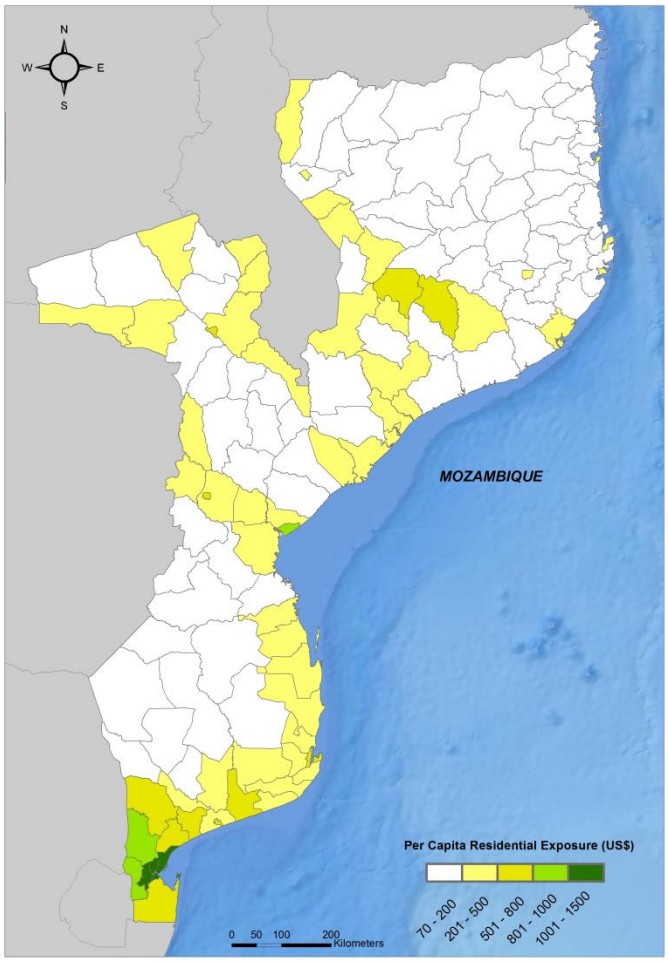

Figure 3: Per capita residential exposure in Mozambique (in USD) at district level.

Buildings' **vulnerability** was characterised via historic floods in other locations around the world, although one set of functions from Mozambique was sourced from the World Bank post-2000, as part of the global study of Huizinga et al. (2017). Given the lack of water height data for this event and uncertainties in the digital elevation model, an integrated curve approach was made from 0-3m on the basis of the basin approach for 1 reach being used as the approximate

What are the potential losses due to the reanalysis?

	Historic	Modelled
Residential Damage (mn USD)	56	61
Residential Stock (mn USD)	9750	9750
Res Stock exposed to floods (mn USD)		154
Residential Loss Ratio	0.57%	0.63%
Non-Residential Damage (mn USD)	9	29
Non-Residential Stock (mn USD)	12083	12083
Non-Res Stock exposed to floods (mn USD)		245
Non-Residential Loss Ratio	0.07%	0.24%

The losses are modelled to be around 61 million USD for residential stock and 29 million USD for non-residential stock. The Mozambique floods primarily affected the Zambezia and Sofala provinces with very few losses in other locations.

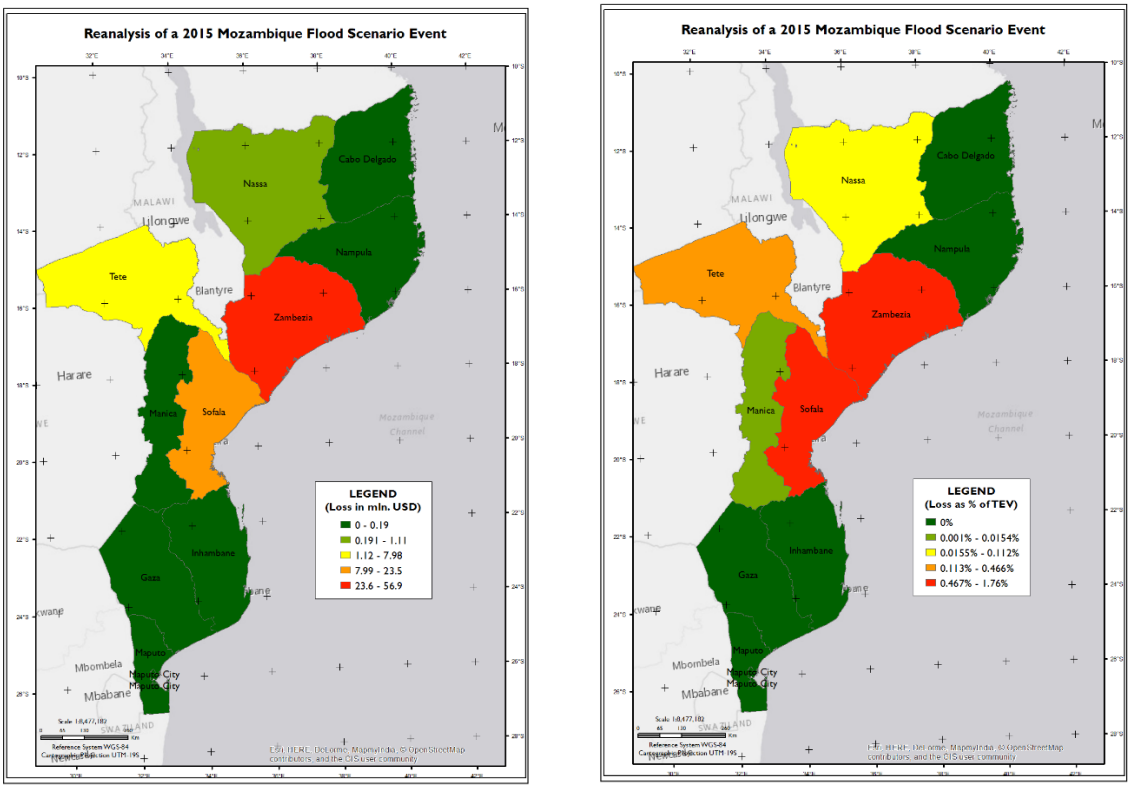

Figure 4: Left: Loss per administrative level 1 unit in million USD; Right: Losses as a percentage of the total exposed value in each administrative division.

Province	Residential Loss (USDm)	Residential Exposure (USDm)	Res. Loss Ratio	Non-Res Loss (USDm)	Non-Res Exposure (USDm)	Non-Res. Loss Ratio
Zambezia	38	1328	2.86%	18.89	1902	0.99%
Sofala	16.73	723	2.31%	6.75	826	0.82%
Tete	5.52	756	0.73%	2.46	955	0.26%
Niassa	0.75	355	0.21%	0.36	632	0.06%
Manica	0.12	541	0.02%	0.07	694	0.01%

What is the return period of such an event?

This event was much smaller than the 2000 Mozambique flood when around 250,000 people lost their homes and 2 million were affected, as opposed to 326,000 in 2015. It is in the order of a 5 year event according to the GAR2015 PML curve for flood.

Why was it important to collate the data?

Flood events occur on a regular basis in Mozambique and it is important to know the exposure for the next event as well as to understand the uncertainties in flood assessment in Africa.