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MEDIC-Multitask learning dataset for disaster classification

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ABSTRACT
Urban centres in sub-Saharan Africa are increasingly affected by disasters as well as smaller, everyday hazards. Decision-makers in the region require better information about urban disaster impacts to plan how best to use their resources to reduce risks to the people most affected. This paper reviews the different kinds of publicly available data on human and economic losses from large and small disasters as well as on health impacts of everyday hazards to assess the quality and breadth of information available for urban areas. The findings reveal emergent information about disaster losses in urban areas generated by the DesInventar methodology, but the quantity of data and the coverage of disaster events is not enough to make robust conclusions for a particular city. Data about losses to health from everyday hazards are provided by demographic and health surveys, but their sample sizes are too small to provide accurate or detailed data on individual urban centres or on 'slums'/ informal settlements. The findings highlight the need for more robust data collection that would assist national and local decision-makers to make more informed and location specific choices about disaster risk management. Systematic collection and cataloguing is needed to make information robust enough for planning and policymaking – and to have relevant information for each ward and district within urban areas, including informal settlements.

I. INTRODUCTION

Sub-Saharan Africa (SSA) is one of the world's least urbanised, yet most rapidly urbanising regions [25]. In the context of widespread poverty, climate change, and limited capacity to plan and manage rapid urban growth, towns and cities across SSA are becoming increasingly impacted by a wide range of hazards, encompassing everyday hazards (such as infectious and parasitic diseases, and road traffic injuries) and small disasters (such as localised landslides and floods) and large dis- asters (such as tropical storms, earthquakes, and floods) [1]. Those living in informal settlements lacking basic infrastructure and servicesare often disproportionately affected by such impacts. Moreover, while most attention has traditionally been paid to large disasters, available evidence suggests that the cumulative impacts of everyday hazards and small disasters may be considerably greater [19].

This means that (a) integrated approaches to risk reduction, involving urban planning and environmental management, public health, disaster management, and climate change adaptation, are required if towns and cities in SSA are to be made more resilient; and (b) better, more detailed data for urban areas are required if planners and decision-makers in SSA are to effectively plan for and respond to these disasters [1]. To support these objectives, we argue for a broader conceptualisation of risk that encompasses not just the potential impacts of large-scale events, but also those of smaller-scale events that often account for a larger share of overall losses in terms of health and income, particularly at the household scale ([1,5,19,26,28]. At present, only losses from larger events are recorded by the major disaster databases, but they do not consider the relative im- portance of smaller events (such as localised flooding, endemic diseases linked to poor quality food, water, hygiene, or lack of health facilities, accidents and fires), which are excluded. Accounting for the impacts of smaller events perhaps make the strongest argument for linking disaster risk management with development, especially in areas where the un- derlying social characteristics and living conditions of people, in terms of their capacity to cope with, resist and recover from the impacts of dis- asters, make them more susceptible to harm [4].

This paper examines the availability of data on losses from disasters (small and large) and endemic health hazards in urban areas in SSA and what this data tells us about who is most affected, and why. It reviews the concept of disaster losses, and examines how they are used by the major databases. It also examines the extent to which the major disaster

Table 1
Natural disasters and extent of damage and loss in SSA 2010–2015, EM-DAT data.a

Region	Country	Occurrence	Death	Affected	Injured	Homeless	Total affected
West	Liberia	2	4500	25,714	0	0	25,714
East	Somalia	12	20,211	7649,380	0	20,200	7669,580
West	Sierra Leone	6	4184	35,422	5	2257	37,684
West	Guinea	7	2455	84,476	6	4000	88,482
West	Nigeria	17	4073	8739,594	1229	500	8741,323
West	Burkina F	6	877	7000,705	13	21,000	7021,718
Central	Cameroun	10	1307	327,436	95	34,980	362,511
Central	Chad	10	928	2383,360	0	0	2383,360
Central	Congo DR	18	1569	134,917	1057	12,490	148,464
East	Uganda	14	709	1008,838	1255	3368	1013,461
West	Ghana	12	529	178,917	262	0	179,179
East	Madagascar	13	551	2981,349	1328	225,551	3208,228
Central	Congo	8	324	14,496	89	7500	22,085
West	Niger	18	599	4125,396	5009	34,790	4165,195
East	Kenya	19	593	10,361,686	3479	5000	10,370,165
Central	Angola	10	233	2036,359	31	79,570	2947,997
East	Malawi	13	294	2817,461	651	350	2818,462
West	Togo	4	89	111,954	0	0	111,954
South	Namibia	6	133	956,150	518	0	956,668
East	Mozambique	18	363	1153,217	3737	0	1156,954
South	Zimbabwe	13	213	3883,536	3	475	3884,014
West	Cote D’Ivoire	5	80	6425	0	0	6425
East	Burundi	9	139	3275	232	14,000	17,507
East	Tanzania	9	137	1109,000	312	6776	1116,088
South	South Africa	9	135	347,011	540	3500	351,051
East	Ethiopia	10	145	5979,334	0	0	5979,334
East	Mauritius	1	11	0	82	0	82
South	Swaziland	1	11	400	0	0	400
West	Mali	9	93	4194,612	0	0	4194,612
West	Benin	9	82	775,098	1000	152,759	928,857
East	Rwanda	5	42	18,173	43	5920	24,136
South	Lesotho	4	26	730,515	0	2600	733,115
South	Botswana	2	12	4210	0	0	4210
West	Senegal	8	29	1817,582	163	0	1817,745
Central	CAR	9	20	48,225	121	3870	52,216
West	Gambia	5	11	470,261	0	0	470,261
West	Guinea Bissau	1	2	56,792	0	0	56,792
West	Mauritania	4	8	1550,975	0	2305	1553,280
South	Zambia	6	11	4528	0	20,150	24,678
East	Comoros	3	4	84,498	150	0	84,684
Central	Gabon	5	1	81,926	0	0	81,926
West	Cape Verde	1	0	2500	0	0	2500
East	Djibouti	1	0	200,258	0	0	200,258

East	Seychelles	2	0	7435	0	0	7435

a This table shows which SSA countries from the EM-DAT data available, suffered the biggest disaster losses over the 5 year period. From the authors' analysis, countries have been ranked by fatality rate (number of deaths divided by the frequency of disaster events).

databases capture the effects of hazard events of different sizes, and presents an overview of the data sources from the health sector that could shed light on everyday risks, in particular those related to health. The paper concludes by examining the key limitations of the databases and data sources reviewed, and by identifying potential areas of in- terests for urban researchers.

II. DISASTER LOSS DATABASES

The occurrence of disaster events have been increasingly documented and accounted for in international disaster databases. The United Nations Development Program's Global Risk Information Platform (GRIP) website has a comprehensive list of disaster databases classified as global, regional or national, and this indicates that there are four global disaster databases, EM-DAT, Global Disaster Identifier Number (GLIDE), University of Richmond Disaster Database Project and NatCatService. Additionally, the Dartmouth Flood Observatory has an archive of over close to 4000 large flood events and can be searched by country, and the DesInventar data- base is a collection of national databases, which currently includes 89 countries and is growing in scope.

EM-DAT and DesInventar are central to the analysis in this paper; they are two of the most popular international databases and are widely cited in policy documents and research analyses [10]. Both EM-DAT and De- sInventar attempt to aggregate and classify data to support analysis of both the types and effects of the disasters recorded. They work based on a common standardized classification and definition of types of perils and hazards [12], including sub-national data on 15 countries in SSA (Co- moros, Djibouti, Ethiopia, Kenya, Madagascar, Mali, Mozambique, Mor- occo, Mauritius, Niger, Togo, Tunisia, Senegal, Sierra Leone, Seychelles and Uganda) and partial data on Tanzania (Zanzibar).

The databases have different thresholds about what they consider to be a disaster event. In EM-DAT, for a disaster event to be recorded it must fulfil one of the following criteria: have 10 or more people deaths, 100 or more people affected/injured/homeless, or declaration by thecountry of a state of emergency and/or an appeal for international as- sistance. Whereas the definition for DesInventar database is 1 or more human losses or $1 or more in economic losses. DesInventar uses na- tional and local newspapers, police and public health reports as sources of information and will include a disaster event if there is any kind of human or economic loss. EM-DAT is compiled from various sources including UN, governmental and non-governmental agencies, insurance companies, research institutes and press agencies has a wide range of other sources. Thus, these two databases can portray quite different pictures of disaster losses in a country.

The DesInventar methodology gives a stronger indication of the spectrum of the type of disaster events and considerable analysis has been undertaken to understand the differences between losses from large (in- tensive) disaster events and smaller scale (extensive) events [26–28] and is more conducive to understanding the breadth of everyday losses, small disasters and large disasters in urban areas of SSA. DesInventar defines extensive risk as "the risk layer of high-frequency, low-severity losses [that] manifests as large numbers of recurrent, small-scale, low severity disasters which are mainly associated with flash floods, landslides, urban flooding, storms, fires and other localised events" ([28]:90). The analysis of the available data showed that, since 1990, a majority of the loss and damages have been associated with extensive disasters and accounted for most of the disaster morbidity and displacement, which were a particular challenge for areas already vulnerable because of poor infrastructure and under-development ([28]:96). And where other socio-economic factors and access to resources, such as the reduced levels of education, instability of household income and reserves and the lack of social networks and external support during disaster events, affect the capacity of residents to cope and recover from disaster events [13].

III. NATIONAL LEVEL DISASTER LOSSES IN SSA

EM-DAT and DesInventar show that disasters in SSA are dominated by weather-related hazards such as floods, cyclones and storms, and drought. The major databases also show that in addition to the dominance of cli- matic-related hazards, the disaster profile of SSA highlights the occurrence of disease epidemics, fires, and accidents and earthquakes.

Based on an analysis of EM-DAT data over 80 million people in SSA were affected by large-scale natural disasters, resulting in 45,733 deaths between 2010 and 2015 (Table 1). Considering that there were only 354 disaster events recorded in all the SSA countries during the 5-year period, the fatality rate is relatively high at about 129 deaths per disaster incident. This was found to be significantly higher than natural disaster death rates in South East Asia and Latin America, within the same period.

The disaster losses in the major databases, focus on loss of life, in- jury and displacement. Detailed information on economic (or mone- tised) losses are poorly documented in the EM-DAT database. Non- economic losses are poorly documented as well. For example, the ca- tegories for

'death' and 'injury' do not include morbidity as a secondary effect, even though disasters often create the conditions for disease transmission and the spread of epidemics [11]. The data further suggest that the number of people injured may be under-reported considering the total number of people affected by event. The financial losses were only computed for flood events, despite the relative importance of other types of disasters from country to country.

The data available on DesInventar, for the same period provides a more detailed account of loss by itemizing the number of 'houses de- stroyed' and 'houses damaged', and the number of deaths, injuries and missing persons by disaster event. There is currently very limited in-formation on the monetized losses from the disaster incidents, however unlike EM-DAT data that had financial losses computed for only floods, there was some detail on the financial losses from droughts, coastal erosion and fires, within the limited data available (Table 2).

Table 2 Summary of Natural disasters and extent of damage and loss in select SSA countries 2010–2015 (DesInventar)

Country	Event	Events counted	Deaths	Injured	Houses destroyed/ damaged
Kenya(2010–13)	Drought	317	0	0	0
	Epidemic	8	8	0	0
	EXtremeRains	40	0	0	0
	FlashFlood	3	0	0	75
	Flood	341	478	28	13274
	Landslide	14	37	7	96
	Mudslide	3	4	0	0
	Storm	1	5	0	0
	Thunderstorm	18	25	14	2
	Windstorm	7	0	0	16
Niger(2010–14)	Drought	97	0	0	0
	Epidemic	77	1288	0	0
	Fire	66	26	0	217
	Flood	567	730	174	65501
	ForestFire	110	0	0	0
	Other	276	4957	4	0
	Rains	1	0	0	0
Mali(2010–12)	Drought		245	0	0
	Flood		222	131	9892
	ForestFire		23	0	0
	Thunderstorm		1	1	0
Senegal(2010−14)	Accident	376	728	2082	4
	Mudslide (DégradationDes Terres)	4	0	0	0
	Building Collapse	104	74	338	203
	Epidemic	7	3	0	0
	CoastalErosion (ErosionCôtière)	2	0	2	40
	Bushfires	715	0	0	0
	Lightning	53	68	52	7

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	Fires	205	77	55	864
	BirdInvestation (Infestation Aviaire)	1	0	0	0
	Flood	93	54	15	12531
	Shipwreck (Naufrage)	22	174	68	0
	Drowning	360	603	54	0
	Rainstorm(Pauses Pluviométriques)	13	0	0	0
	Drought	1	0	0	0
	EXtreme Temperature	2	13	0	0
Uganda(2010−14)	Accident	14	45	98	0
	AnimalAttack	19	1	16	0
	Cyclone	1	0	0	75
	Drought	189	12	0	0
	Epidemic	30	259	0	0
	Fire	79	19	30	518
	FlashFlood	1	0	9	20
	Flood	532	69	5	5595
	Frost	1	0	0	10
	Hailstorm	348	13	50	1786
	Landslide	159	1461	22	1663
	Lightning	31	57	214	0
	Mudslide	22	19	0	298
	Other	1	0	0	0
	Rains	8	0	0	12
	Rainstorm	40	8	0	512
	Storm	89	0	72	871
	Thunderstorm	3	0	0	0
	Windstorm	8	0	0	66

IV. DATA ON DISASTER LOSSES IN URBAN AREAS OF SSA

The 2015 UNISDR Global Assessment Report [28] analysed sub- regional data across the 89 national datasets in DesInventar, including the 15 SSA countries.1 For most of these countries, it is possible to infer that some of this analysis is of "urban data" because the events occurred in a sub-region that is almost entirely urbanised, which we can tell based on the cross referencing of the population densities of the sub-region to the known cities or urban centres from another data source

Table 2 (continued)

Country	Event	Events counted	Deaths	Injured	Houses destroyed / damaged
Ethiopia(2010 – 12)	Building Slide	1	0	0	0
	Drought	1285	0	0	0
	Fire	159	0	0	0
	Flood	316	25	0	331
	Hailstorm	2	0	0	0
	Landslide	7	49	0	0
	Plague	899	0	0	0
	Rain	2	0	0	0

aThe zero (0) entries from the DesInventar data represent fields with both a zero count and those that had no data reported.

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(www.citypopulation.de), and on the assumption that the sub-region was a homogenous urban space. Thus we present below an analysis from a selection of large cities, Nairobi (Kenya), Niamey (Niger), Dakar (Senegal), plus Kampala (Uganda) and Freetown (Sierra Leone). It would be possible to extend this analysis to other major cities for the countries included in DesInventar, as there is data available to be analysed, although it requires cross-referencing with the urban popu- lation data, with Google maps and with local knowledge. This could yield some interesting results.

However, a note needs to be made about the quality of the "urban" datasets available in DesInventar. Overall the data for most of the urban areas is not of sufficient quality to reliably make conclusions about the totality of disaster losses in a particular urban area, but it does give an overview about the city and the kinds disasters that are prevalent. Often data is entered for one year and not others. The entries cover certain kinds of events (i.e. fires or traffic accidents or floods) but not for others. This depends on where the data comes from and who is re- sponsible for upkeep of the dataset. One gets the impression that events are still vastly underreported, so the actual extent of losses is much greater than what is presented here. Nonetheless the analysis presents a range of the kinds of disaster events that we would expect to see inurban areas.

4.1. Kampala

In the District of Kampala, Uganda, the types of disasters between 1995 and 2013 were reported to be accidents, fire, flood and disease epidemics, lightning, rains, structural collapse and storm (Table 3). Out of the total number of deaths reported, 97% were caused by accidents.2 Fire caused 63% of the housing damage/destroyed and flooding caused 36%. Flooding accounted for 95% of the people affected by disasters. However, the database as a whole accounts for only 67,529 (4.5% of the population of approXimately 1.5 million) as affected by flooding overthe period, which seems low considering that flooding is common is Kampala during the rainy seasons. There is no data on the economics losses from these events. The dominance of accidents is apparent here because there is a lack of data on other hazards.

4.2. Nairobi

See in a city of over 3 million people [8].3 46% of deaths were caused by flooding and 53% by epidemics, predominantly cholera outbreaks and swine flu. Flooding caused all of the reported housing damage/destruction. From the data, both flooding and disease epidemics are a problem in Nairobi. However, the database is very much lacking in detail and therefore does not provide an accurate picture of the risks in Nairobi; given its current level of detail, the database would not be useful for supporting policy-making.

4.3. Niamey

The database for Nairobi, Kenya, documents sporadic incidents of flooding, drought and disease epidemics (see Table 4) with only 52 entries across four years (2002, 2009, 2010 and 2012). It does not seem to record any entries for fires or accidents, which we would expect to

Niamey, Niger, has a population of 978,029, according to the census in 2012. The Niamey region, which is what is reported on in DesInventar, has a population 1026,848, thus 95% of the regional po- pulation lives within the city boundaries, making it perhaps useful to analyse as an urban area. Data entries for every year between 2000 and 2013 show that epidemics and floods are the prevailing disasters (Table 5). Epidemics caused 99% of the 968 reported deaths. There is quite detailed reporting of epidemics, with 96 entries indicated and mostly measles and some meningitis outbreaks. For example, 5469 cases of measles, resulting in 161 deaths was reported on 21 April 2004. This is the kind of information and level of detail that can assist with policy-making and planning. Fifty- one floods were reported across years of 2000, 2006, 2010, 2013, including 34 incidents of flooding in 2013 ranging is size from 0 to 932 houses destroyed. There are no other types of events reported and likely this is a big gap in the data.

4.4 Dakar

The synthesized data on Dakar region includes 4281 data entries from four urban districts, including Dakar, Guédiawaye, Pikine, and Rufisque (Table 6). While there are a few entries that go as far back as 1989, the database becomes more populated as of 2002. Road accidents are overwhelmingly the largest number of entries, totalling 82% of all events. Fires, drowning, structural collapse, industrial disasters and flooding are also prevalent. Drowning caused 441 deaths, road acci- dents caused 257 deaths and industrial disasters caused 147 deaths (in two incidents). Drowning is a major cause of death due to ferry acci- dents. Over 390,000 people (12% of population) were recorded as being aff ected by flooding and it accounted for 99% of all housing damages and destruction. This looks like quite a well-developed data- base compared to the others, in that it covers a lot of different kinds of events; this is more the kind of profile we would expect to see in a city. However, it is likely the numbers of events are still hugely under-re-ported.

4.5 Freetown

The Western Area of Sierra Leone includes the capital, Freetown as well as the Western Rural Area. The database has entries from 2006, and then 2009–2014 (Table 7). Deaths are attributed to all of kinds of events, although maritime accidents (235 deaths), road accidents (174 deaths) and epidemics (215 deaths) are the most prevalent, accounting for 79% of all deaths recorded in the database. Fire accounts for 83% of all the houses destroyed/damaged and flooding for 7%. The amount of losses from maritime accidents and fires is notable in this database. Again, like the Dakar database, there is a wide range of events, however the losses are likely under-reported.

Table 3
Losses by disaster type in Kampala District, 1995–2010 (DesInventar).

Event	Data cardsa	Deaths	Injured	Missing	Houses destroyed	Houses damaged	Affected
Accident	14	4452	17013	0	0	0	0
Epidemic	7	36	0	0	0	0	787
Fire	15	7	27	0	212	0	2040
Flood	10	37	0	2	122	0	67529
Lightning	1	1	0	0	0	0	0
Rains	1	0	0	0	1	0	0
Storm	2	0	0	0	0	0	184
Structural Collapse	1	12	183	0	0	0	0

a Data cards refers to number of reports in the database.

Table 4
Losses by disaster type in Nairobi District, 2002–2013 (DesInventar).

Event	Data cards	Deaths	Injured	Missing	Houses destroyed	Houses damaged	Affected
Drought	9	0	0	0	0	0	0
Epidemic	21	22	0	0	0	0	120
Flood	21	30	5	1	60	333	100
Forest Fire	1	0	0	0	0	0	0

Table 5
Losses by disaster type in Niamey, 2000–2013 (DesInventar).

Event	Data cards	Deaths	Injured	Missing	Houses destroyed	Houses damaged	Affected
Epidemic	96	968	0	0	0	0	26302
Flood	51	4	6	0	13039	473	13810

Table 6
Losses by disaster type in Dakar, 1989–2015 (DesInventar).

Event	Data cards	Deaths	Injured	Missing	Houses destroyed	Houses damaged	Affected
Coastal Erosion	1	0	2	0	0	0	0
Drowning	249	441	56	14	0	0	0
Epidemic	8	0	0	0	0	0	599
Fire	404	33	40	0	21	169	1800
Flood	47	19	7	0	3	63862	390239
Industrial Disaster	2	147	0	0	0	0	0
Locust	2	0	0	0	0	0	915

Road Accident	3890	257	5619	0	0	2	0
Sinking	4	10	4	0	0	0	0
Storm	2	0	0	1	0	0	0
Strong Wind	7	2	0	9	0	0	0
Structural Collapse	92	36	301	0	9	49	0
Swell	1	0	0	3	0	0	0
Wild Fire	5	0	0	0	0	0	0

Table 7
Losses by disaster type in Western Area, Sierra Leone, 2006, 2009–2014 (DesInventar).

Event	Data cards	Deaths	Injured	Missing	Houses destroyed	Houses damaged	Affected
Accident	9	9	4	0	0	0	0
Accident (Maritime)	119	235	52	0	0	0	3962
Accident (Road)	46	174	200	0	4	3	5
Conflict	10	1	47	0	10	4	1000
Drought	2	0	0	0	0	0	500
Drowning	2	7	0	0	0	0	0
Epidemic	46	215	39	0	0	0	1117
Fire	241	30	233	0	1338	457	10546
Flood	50	27	29	0	310	0	2308
Landslide	16	57	50	0	20	0	99
Lightning/ Electrical Storm	2	5	0	0	0	0	0
Storm/ Gale	40	14	69	0	944	654	5999
Structural collapse	5	4	10	0	0	1	0

4.6 Findings

This analysis of DesInventar for urban areas on SSA brings up some findings about the utility of this database for understanding disaster losses in urban areas:

- DesInventar data provides a general idea of the subnational dis- tribution of disasters, but there is a lack of consistent data in the database, which makes accurate conclusions about any of the cities problematic. For an individual city, some kinds of events are re- ported in detail, whereas other kinds of events are not reported atall. The cities analysed all show quite diff erent events and levels of losses. Some of this variability comes from the diff erences across the cities, for example, maritime accidents are a major loss of life in Freetown and measles is prevalent in Niamey (and likely to be a problem in other cities but not recorded). However, we assume that much of the variation in results across the cities is due to a lack of comprehensive data in the database.
- The methodology of DesInventar could be very useful for under- standing a range of diff erent kinds of disaster events that are typical in urban areas if the database was accurately populated. DesInventar picks up very small-scale events (for example a house fire or an accident). If a good level of data was reported in the da- tabase, it would provide a very telling picture about the extent of losses to a range of types of events within diff erent areas of the city and could be a very useful tool for policy-making. Most of this data does actually exist in cities, held by police, hospitals, Red Cross and other organisations, but it is not being systematically reported in this database, and more eff ort to made to combine or cross reference data held at these local sources.
- DesInventar does not usually report on “everyday” human losses related to endemic conditions caused by environmental factors, such
- as deaths from diarrhoeal disease (unless it is classified as an epi- demic, eg. cholera), malaria or deaths resulting from a lack of medical attention and morbidity. It is this everyday risks and health perspective that is needed to extend the range of analysis about human losses to include those related everyday

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hazards which would lead to a more comprehensive accounting of extensive risklosses.

Thus, what is needed is more comprehensive information collected at the city-level about the causes of pre-mature deaths and other losses. DesInventar is potentially a powerful for tool for analysing risks in an urban area, but the databases for SSA cities would need to be properly populated, using locally available data. Currently data is not being analysed and collated in this way in most urban jurisdictions in SSA. Secondly, DesInventar could be even more comprehensive if it included health records from local hospitals that could account for the endemic health conditions caused by environmental factors.

The next section of this paper turns to look at what kinds of in- formation are available from the health sector that could shed more light on human losses in urban areas of SSA, particularly regarding everyday hazards. As mentioned earlier, it is the accumulation of these extensive every day human losses that accumulate and lead to bigger losses as compared to large disasters. Also, if premature death from diseases were included as everyday disasters it would change com- pletely the picture of risk and vulnerability.

V. DATA ON HEALTH IMPACTS IN URBAN SSA

Health conditions and diseases (endemic and epidemic) in SSA have been documented by the World Health Organisation (WHO) through its Global Burden of Disease Project and by USAID through its Demographic and Health Survey (DHS) programme. The DHS pro- gramme provides data for urban and rural areas across most African countries. Data from the DHS permits analysis of indicators on health and its determinants at country level.4 The WHO regional office for Africa also publishes the African Health Observatory, which provides comprehensive statistics on disease prevalence and burden across the region. The information is reported at country level, and some data are separated into rural and urban, but it is not possible to derive details of particular urban areas.5 From the perspective of those who need to understand the most important risks facing their city, the lack of urban details is a major shortfall.

Available data compiled by the WHO shows that 43% of deaths in 2004 were caused by infectious and parasitic diseases (such as diar-rhoea, respiratory diseases, malaria, etc.), many of which have large environmental contributions (Fig. 1). This figure rises to 57% when respiratory infections are considered.

There was similar distribution in individual SSA countries. For in- stance, the mortality distribution for Kenya (also in 2004) reported an average of 52% mortality from infectious and parasitic diseases. Looking into the prevalence of disease epidemics, the global distribu- tion of recent cholera cases reported between 2010 and 2013, revealed that a majority come from SSA. A more detailed look at siX countries (Kenya, Malawi, Niger, Nigeria, Senegal and Uganda) showed a total of 3278 reported cases. The data on the reported number of deaths in these countries within the 3-year period was incomplete, although a comparison between the data that was available in both categories showed an average loss of 28 deaths per documented outbreak of cholera [30]. But while much attention has been paid to disease epi-demics, which have in some cases resulted in enough impacts to be classified as 'disasters', infectious and parasitic diseases (e.g. diarrhea and malaria) tend to have larger cumulative health impacts over time.

Another example of major health losses in SSA is from the pre- valence of malaria. Evidence suggests that those living in informal settlements face a heightened risk [7]6 and that there is a positive correlation between malaria prevalence and environmental conditions related to improper waste and sewerage channels at the household scale [17]. In Dar es Salaam, de Castro et al. [6] found that a large number of breeding sites for the anopheles mosquito were concentrated in lower elevation parts of the city or near drains that require cleaning or re- habilitation, and that entomologic inoculation rates (i.e. the number of infective bites per person per year) were likely to be significantly higher in informal settlements and marginal localities near the periphery. From WHO records (2004), there were an estimated 627,000 malaria deaths worldwide in 2012 (uncertainty interval, 473 000–789 000), and out of this estimate, most occurred in sub-Saharan Africa (90%).

These losses from infectious and parasitic diseases may not be ca-tegorised as "events" in disaster databases because they occur regularly and are generally too small to meet the criteria to be recorded, nor do we have information about events in specific urban centres.

WHO introduces an interesting dimension of losses, which provides more depth into the conceptualisation of losses from disease pre-valence. The measure is termed as the Disability-adjusted life years (DALYs), which is a summary of the disease-burden on a population accounting for the years of life lost as a result of premature

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death, disability or the years lost due to ill health (WHO, 2012). It gives a more detailed appreciation into how diseases that may not result in death have significant impact on the livelihoods and productivity of its suf-ferers.

The DALYs measure has recently been adapted and used to the impact of disasters and it promises to provide a view into a dimensionof losses that is not accounted for by the focus on mortality, morbidity

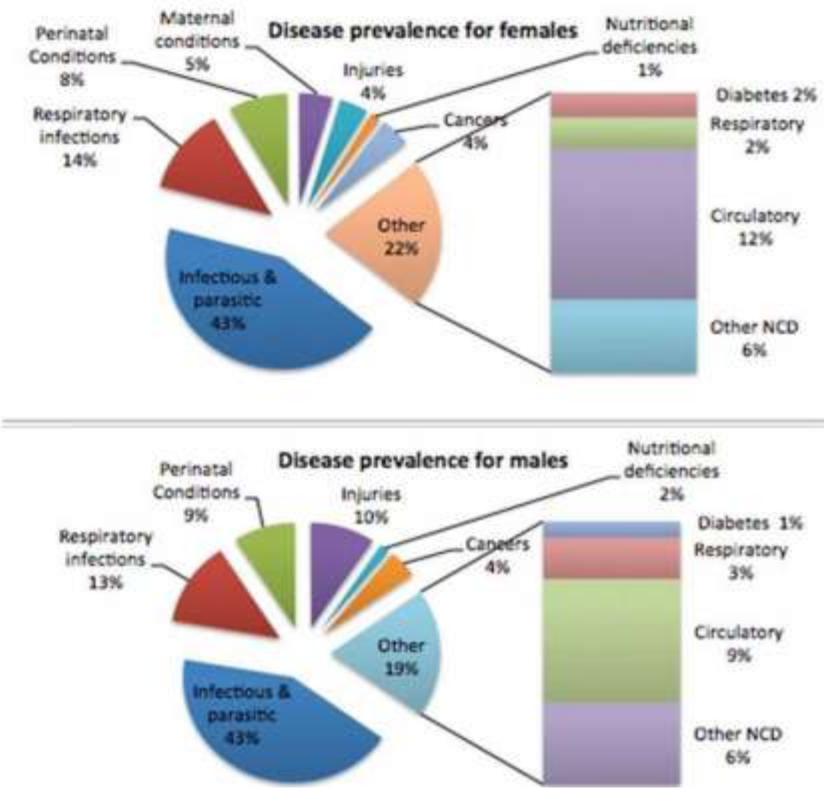

Fig. 1. Disease prevalence and percentage of mor- tality for females and males in Africa (redrawn from [30]).

or damage to houses and infrastructure [18]. The application of this novel DALYs to better understand the eff ects of extensive risk in SSA could be explored further.

5.1 Studies focusing on urban areas

One of the few detailed urban studies on health and population dynamics conducted in Nairobi, Kenya, by the Africa Population Health Research Centre (APHRC) showed that in 2012 residents sampled from a cross-section of slums, were generally disadvantaged compared to the rest of Nairobi and Kenya [2]. For instance, the lack of good drinking water and poor drainage were cited as the major needs for the slum residents, as access to good water was a problem for one-in-five slum residents in Nairobi [2]. The health risks and subsequent losses in these urban slums were on occasion even higher than those of rural Kenya.For instance child mortality and under-5 mortality rates in the urban slums were higher than the rates in rural Kenya, and Kenya as a whole [2].7

The usefulness of the above study is that they included a re-
presentative sample of informal settlement dwellers (which the DHS do not) and the disaggregated nature of the data shows other interesting demographics of the sampled populations (such as the subdivisions ofthe urban area, age, ethnic group, etc) that helps to understand the depth of urban health risk and disease burden. Again the methodology employed allows for an appreciation of other significant background information (on households and the population) that underlies these risks.

The lesson and challenge for disaster researchers working on SSA, from this example of the APHRC study would be to produce compre-hensive data to cover the broad range of risks (including the health) and other extensive everyday risks that urban populations in the study sites face, with sufficient background data that enables for a broader knowledge of the risks and where possible the underlying factors that account for them.

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VI. OTHER DATABASES AND DATA SOURCES ON RISKS AND EVERYDAY HEALTH LOSSES

There are many other data sources that could be used to better understand the nature and scale of disaster and health related losses in urban areas in SSA. Table 8 summarises several databases that capture the losses associated with everyday hazards, and small and large dis- asters at diff erent scales.8

6.1 National databases

Vital Registration Systems collect data on births and deaths at country-level; however, few are up-to–date in low- and middle-income countries (UN 2014). Nor are vital registration systems linked to po-pulation registers (which combine different sources of data, including from censuses) and Demographic and Health Surveys, etc.) for countries or urban and rural and areas. Consequently, comprehensive current information on the demographic characteristics and health outcomes for each resident of a given country, town or city, is often unavailable.

Table 8
Major data-bases for everyday hazards and small and large disasters at diff erent scales.

Scale	Everyday hazards	Small disasters	Large disasters
International and regional		WHO Global Burden of Disease indexes, including road traffic accidents by region and country	– EM-DAT
National	The Demographic and Health Survey (DHS); have data for rural and urban areas but not for specific cities let alone informal settlements	DesInventar – African coverage: Comoros, Djibouti, Ethiopia, Kenya, Madagascar, Mali, Mozambique, Morocco, Mauritius, Niger, Togo, Tunisia, Senegal, Sierra Leone, Seychelles, Uganda, and Tanzania (Zanzibar)	National databases (e.g. Australia, Canada, Nepal, Orissa, Philippines, St. Lucia, Sri Lanka, etc.)
Sub-National (urban and rural)		Demographic and Health Surveillance Systems (DHSS)	DesInventar, but urban districts not always differentiated from rural districts
Individual	Hospital episode data (mostly relevant to everyday hazards, but potentially useful for uncovering the health impacts of larger events) Health passports for some countries (e.g. Malawi)		
Event specific	Police records	DesInventar records loss and damage from multiple hazards that can be disaggregated	Earthquakes: The United States Geological Survey (USGS) Technological disasters: Awareness and Preparation for Emergencies on a Local Level (APELL) Floods: Dartmouth Flood Observatory (DFO and United States Weather Service (NWS) Tsunami: National and Geophysical Data Centre (NGDC) Industrial Accidents: Major Accident Reporting System (MARS, Major Hazard Incident Data Service (MHIDAS)

6.2 Sub-national databases

Demographic and disease surveillance systems collect data on dis- ease burdens and their distribution for small geographic units (e.g. neighbourhood, town, city, district, etc.) ([16]: 3). Such systems pro- vide a critical foundation for disease prevention and control, but seldom exist in lower-income countries/towns or cities, and even less in informal settlements, with the notable exception of Nairobi [9].

Urban Health Observatories (UHOs) also monitor heath and its de- terminants at the intra-urban scale by collecting and compiling sec- ondary data from censuses and Demographic and Health Surveys, among other data sources, and by analysing this data using remote sensing and GIS mapping. UHOs aim to provide urban policymakers with detailed data and maps showing the social and spatial distribution of disease burdens as a basis for informing targeted investment in de- prived urban localities. Several pioneering cities, such as Belo Horizonte, Brazil (see [29]), have developed UHOs, but few exist (or have been documented) in SSA.

6.3 Household/individual databases

Hospital episode data provide details of the individual admitted (including age and gender), where they were admitted, and the diag-noses made. However, details about where the individual admitted lives or where their health was aff ected are often unrecorded. This makes it difficult to examine the potential links between social and environ- mental factors and health outcomes.

Hospital admission and mortality counts can be used to show tem- poral trends associated with exposure to diff erent seasonal or climatic conditions in the short- or long-term, which could be of potential use for urban research and policy on climate change adaptation [23]. Hospital data where residential details of patients are recorded, could also becross- referenced with particular disaster events to examine the number

6.4 Event-specific databases

Numerous data sources collect event-specific information on parti- cular disaster hazards (e.g. floods, earthquakes, technological disasters, etc.) and everyday hazards. Data sources on the former are listed in Table 8 and are relatively straightforward. Data sources on the latter include police reports on crime specific events (e.g. homicide, assault) and accident specific events (e.g. road traffic accidents). Data on road traffic accidents at the national level make international comparisons possible, as demonstrated by the WHO global observatory,9 although this data are not at a fine enough scale to permit sub-national analysis. Newspaper records collect varied information on newsworthy events, including crime and violence, road traffic accidents, and dis- asters and their eff ects (e.g. number of people killed or displaced, number of buildings damaged or destroyed, etc.). But newspapers tend to cover events that warrant media attention, thus excluding smaller everyday events (e.g. localised disease burdens). Their archival value as a long-term secondary source may be limited by the priority to provide timely and accurate reporting of events as well [31].

VII. CONCLUSIONS

Several key data limitations can be summarised from the databases and data sources reviewed above.

7.1Lack of collated datasets on disasters that can show extent of losses in urban areas

This analysis has shown that there is some data available about disasters, everyday risks and health-related losses in sub-Saharan Africa, and that some of this data can shed some light on losses in urban areas. But there is still a major lack of collated data that can accurately show losses in urban areas, and even less in informal settlements. In DesInventar, many countries are yet to sign up to report national da- tasets, and the quality of data, in terms of being able to understand the losses in a particular urban area, is still weak. We contend that much of the data does exist (in accident records, police, fire and hospital records and news media and in some locations vital registration systems), but needs to be collated into databases in order to be useful for local ana- lysis, planning and policy-making.

7.2 Assimilating disasters losses and endemic health-related losses

Disasters are usually considered episodic, and thus there is a focus on disaster events as an occurrence of a particular phenomenon or losses over a period of time. As mentioned earlier, diff erent databases assume diff erent loss thresholds for considering an event as a 'disaster'; for example EM-DAT considers 10 or deaths or 100 or more people af- fected/injured/homeless. DesInventar considers much smaller events— 1 or more human loss or $1 or more in economic loss, and therefore is more useful for characterising the overall human and eco- nomic impacts of risks.

However, none of the disasters methodologies go so far as to con- sider endemic kinds of health losses that occur everyday and are therefore not considered to be episodes or events; for example a death related to malaria or maternal health. We contend that, in order to have the full picture of losses for an urban area, we would need to under- stand the full range of disasters as well as everyday health impacts. The availability of this kind of information would be a powerful policy and decision-making tool.

7.3 Lack of disaggregated data for urban areas

The demographic and health surveys uses aggregate data to achieve national representation, and while they do report for urban and rural areas, the data does not allow for an analysis of losses in a particular urban area. Nor does it shed light on health inequalities across high- and low- income areas within an urban population). DesInventar does disaggregate data to potentially permit an analysis of urban areas, but the detail, coverage and consistency of data remains lacking.

As [15] point out, the lack of disaggregated data can be partly overcome by examining census data on vulnerability factors and the determinants of health linked to housing conditions, access to basic services, space per person, cooking fuels used, protection against ex- treme weather, etc. This data can shed light on neighbourhoods or areas where social and vulnerability factors that make them more susceptible to disasters and everyday hazards are high, and where investments to address these underlying factors need to be made. The use of census data has also been promoted to assess vulnerability to climate change at the intra-urban scale [22], but many census authorities do not provide census data in a form that allows for a proper identification of informal urban settlements or the detailed analysis of each urban centre and by small area units within each centre – that would show the scale andnature of intra-urban inequality.

7.4 Limited spatial coverage

While DesInventar has expanded to include 15 countries in SSA, its geographic coverage remains limited in the region. Spatial coverage within SSA countries is also limited by the diff erent ways in which 'urban' and 'rural' settlements are classified.10 In countries where many small urban centres are classified as 'rural' or as 'large villages', the proportion of damage and losses from disasters occurring in smaller urban centres is likely to be under-estimated. This is particularly problematic considering that disaster risk may be increasing fastest in small and medium-sized urban centres since their capacities to plan and manage urban growth are relatively weak [26].

7.5 Tying loss data to the underlying drivers of risk

Acting on loss data also requires making links into the underlying drivers of those losses; for example, collecting data on social factors (e.g. age, gender, income, ability, migrant status, etc.), environmental factors (e.g. access to quality housing, basic services, etc.), and political and institutional factors related to planning and decision-making pro- cesses at multiple levels. EXternal factors linked to climate change must also be better understood in relation to internal factors linked to urban growth and change, and poverty. But information on climate change has its own limitations, and is seldom used directly for urban decision- making, as observed in Accra and Maputo [24].

If sub-national databases become more precise and comprehensive in capturing urban loss and damage from everyday hazards and dis- asters (small and large), it is highly likely that the observed trends would reinforce the view that urban risks are increasing fastest in urban areas, in particular those where local governments are unable to ef- fectively plan and manage urban growth, and unwilling to address the needs of their low-income populations [11,20].

7.6 Areas of interest for research

There are several areas of interest for researchers that are identifi- able from the analysis above. Firstly, we think more needs to be done to bring the health and disasters research (and sectors) together to be able to better address risks. There is the need for further research on losses related to everyday hazards (which would be picked up by health data), and small and large disasters, and more research to assess their relative importance for urban losses. This could lead to the inclusion of health measurements and metrics in disasters databases, which we think should be seriously considered as it would give a much more nuanced picture of the spectrum of losses people are facing. Secondly, and re- lated to the point above, for individual cities, more research needs to be done that combines diff erent data sources (e.g. DesInventar, newspaper archives, hospital data, police reports, Demographic and Health Surveys, etc.) to create a more detailed and comprehensive picture of urban risk. Where detailed demographic and health data is lacking this research could consider using census data to examine underlying social and environmental risk factors within and between urban populations. There are also lessons to be learnt from the experience of African cities that have implemented DesInventar and disease surveillance systems, and identify the data sources and lessons they present for developing innovative research methodologies. Thirdly, there is a potential of using DALYs and other health metrics to uncover the significant repercussions that disease burdens often have for low-income urban populations (see [14]). Fourthly, on the concerns of data quality raised, it will be useful for more disaggregated data collection to uncover the social and spatial distribution of urban risk within and between populations of small and intermediate urban centres and large cities.

7.7 Policy Implications

Our analysis in this paper is useful for policy and decision-makers in SSA cities, particularly planners and those working on disaster risk reduction to acknowledge this critical issue of the lack of reliable dis- aggregated data and the need for innovative approaches to policy for- mulation and implementation in the interim, as datasets are improved. It draws attention to the need for a shift from disaster recovery oriented policies to focus more on mitigation, preparedness and basic services that address everyday risks, alongside the paradigm shift that the cu- mulative losses from smaller everyday risks were higher than large- scale intensive risks.

Also, in the absence of detailed disaggregated data in SSA cities, there is the need for policy makers to adopt more grassroots partici- patory approaches to verify and triangulate information and involve different interest groups in the process of policy formulation and data collection to create more inclusive and socially just outcomes. Georeferenced granular data is important for city planners in producing risk sensitive policy and interventions in sectors that interact with the production of everyday risks such as healthcare provision, transport policy, and provision of water and sanitation infrastructure.

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