Annex 2

GAR

Global Assessment Report on Disaster Risk Reduction

2015

LOSS DATA AND EXTENSIVE RISK ANALYSIS

UNISDR
The United Nations Office for Disaster Risk Reduction

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Introduction

All four editions of the Global Assessment Report GAR have featured information and data to give a good picture of the impact of disasters, and especially of those losses whose reduction is the target of the Hyogo Framework for Action 2005-2015.

Loss data started to be collected systematically long time ago in several fronts. The private insurance sector had used traditionally this data as integral part of their business, and has long standing records of insured losses which are actively used in the process of assigning price to insurance products.

In the decade of the 90's two non-commercial initiatives started collecting disaster loss and damage data, both of them in the academic sector, one collecting data at global level (CRED's EMDAT database) and another collecting sub-nationally disaggregated data in several countries in Latin America, using a common format and methodology, the DesInventar initiative.

Both initiatives have contributed in great manner to the understanding of risks and disasters, each with its own specific characteristics and coverage. The EMDAT database has collected data with country *'resolution'* (each record in the database refers to the impact of a disaster in one country), whereas the National Disaster Loss Database initiatives collect data with higher *'resolution'* (each record of the national database represents the impact of a disaster in one municipality).

It is fair to say that both initiatives have been very successful: EMDAT has grown to contain more than 20,000 records about disasters with global coverage, and has become with no doubt the obligated reference for all those who research or practice in the area of disaster management and risk reduction. It is one of the data sources more widely cited and quoted and has been the basis of many studies and reports, including the GAR's.

Since the decade of the 90's an increasing number of countries around the world are adopting the simple and well-defined methodology and open source software of DesInventar to report, analyse and display disaster occurrence and losses at the local level through a standard definition of hazards, impacts and other indicators. Because the loss data is captured at the level of local administrative units, this makes it possible to record losses associated with huge numbers of small extensive disasters that are not economically assessed nor internationally reported and thus do not appear in other disaster databases.

In a pattern that resembles the growth of computer processing power, the number of countries systematically collecting disaster loss data has roughly doubled every two years since these efforts began in Latin America in the 1990s.

Only looking at the DesInventar initiative, from 6 countries that started the development of national databases about 20 years ago, there are more than 65 disaster loss datasets based on DesInventar format, covering 82 countries and 3 states or provinces at the moment of writing this Annex. In addition to these homogeneous datasets, several other countries now collect disaster loss data in different formats and with varying degrees of detail and public availability, some of the most notorious being the United States database (SHELDUS), and Australian, Spanish and Canadian databases, all publicly available, and as a recent study [REF JRC 2] revealed also a number of countries in Europe are also engaged in efforts to collect disaster loss data.

This following sections of this Annex will attempt, on one hand, to give a historical perspective of achievements and challenges associated to the major loss data collection initiatives, to highlight some of the results obtained, and to provide a comparison between the consolidated DesInventar datasets and its counterparts on EMDAT.

The exercise seems appropriate for the end of the cycle of the HFA, in a moment where everything indicates that the new Post-2015 Framework for action to be discussed and approved in Sendai, Japan, will propose to countries the continuation or development of these national loss data collection initiatives as key elements in the understanding of risks faced by countries.

Disaster loss databases and in general systematic loss accounting will allow countries to more accurately measure their progress towards the main objective of the HFA, the Post-2015 Framework and in general of Disaster Risk Reduction (DRR): the substantial reduction in losses in human lives, the economy and the environment.

About loss and damage databases

Damage and loss databases contain, for each disaster occurred, a set of indicators, such as mortality or number of houses or hectares of crops lost, describing the effects of disasters upon human life, economy and environment [Ref. Handbook].

The Hyogo Framework of Action states that compilation of disaster risk and impact information for all scales of disasters is essential to inform sustainable development and Disaster Risk Reduction. The ultimate outcome of HFA and one of the main goals of DRR in general, at the end of the day, is to reduce losses caused by disasters – human and otherwise.

International loss data sources, and in particular EMDAT, have proven to be extremely useful for practitioners and those doing research at global or regional level as the data is relatively homogeneous. International data is a must reference when validating national data, and as useful starting point when a new national dataset is being developed.

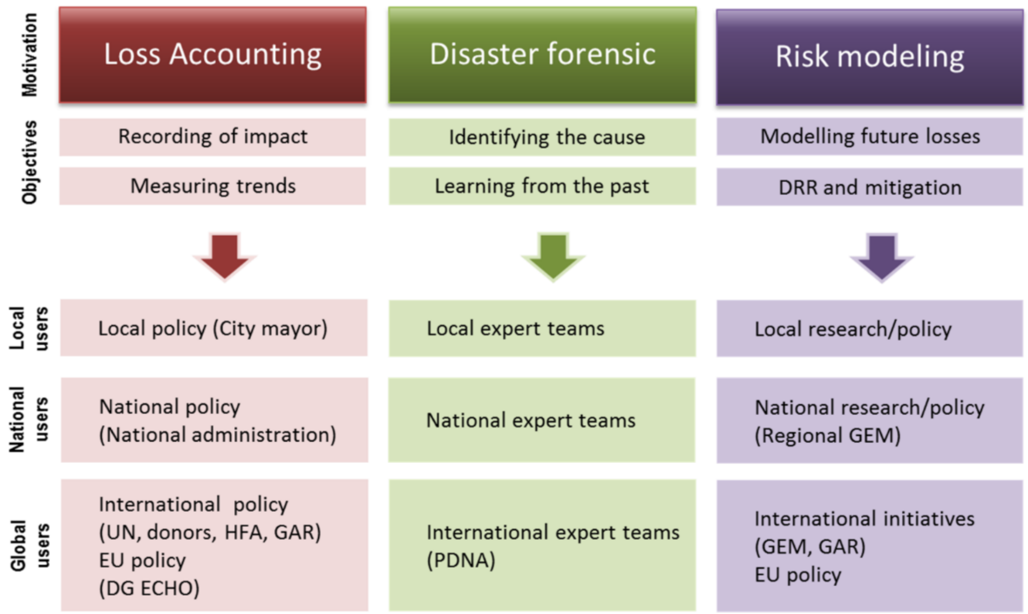
National damage and loss data information can inform decision makers about hazard and risk patterns and feed into risk assessments, and may also serve as an indicator mechanism to monitor the dynamic nature of risk, helping identifying emerging trends and measuring the effectiveness of DRR interventions.

The development of national disaster loss databases represents a low-cost and low-technology, but very high impact strategy to systematically account for disaster losses and therefore to have an evidence base to support decision making. As such, this is the crucial first step to generate the information necessary for risk estimation and to inform public investment planning (Figure 1).

The European Community Joint Research Center has identified in a recent study [REF EU RECOMMENDATION] at least three application areas for disaster loss and damage data:

- **disaster loss accounting** – the primary motivation for recording disaster loss with the aim to document the trends and aggregate statistics informing local, national and international disaster risk reduction programmes;
- **disaster forensics** – which identifies the causes of the disaster through measuring relative contribution of exposure, vulnerability, coping capacity, mitigation and response to the disaster, with the aim to improve disaster management from lessons learnt; and
- **risk modelling** – which aims to improve risk assessment and forecast methods, for which loss data are needed for calibrating and validating model results in particular to infer vulnerabilities.

Figure 1: Applications and usage of disaster loss data



Source: EU Recommendation on Disaster Loss Data

As it will be shown later all disaster loss databases are imperfect as a reflection of the circumstances under which data is collected, the motivation to collect it, the human resources that are devoted to reporting and collecting the data and many other factors.

National Databases: challenges, achievements and future

Since its inception in Latin America in the 90's, initiatives of collecting disaster loss and damage data have faced many challenges. The initial actors in this initiatives were non-for-profit organizations that attempted the construction and later the continuous maintenance with very scarce resources and with very little support from countries.

As the quality, applicability and dissemination of the collected data improved, so the interest from governments and international organizations increased. Several governments such as Panama and Guatemala started officially adopting the databases and soon intergovernmental cooperation organisms such as CEPREDENAC started coordinating activities among the member countries. Financial support started to be steadier with growing interests from donors, especially from the UK, where DFID funded activities during several years in Latin America.

The United Nations Development Program soon took interest and started 'exporting' the initiative and disseminating it in Asia. Pilot projects in several countries showed the advantages of the approach taken by the UN, where institutionalization was a priority. The Tsunami disaster in 2004 triggered enormous interest in the topics of Disaster Management and Risk Reduction and a second wave of countries started its work.

During the last decade both UNISDR and UNDP have heavily invested in developing these data collection exercises, usually accompanied by large capacity building exercises. The benefits of this engagement are easy to identify and the growth in the number of countries collecting data demonstrates that governments need to know more about how and how much are they being affected by disasters.

However, these experiences have highlighted the need for sustained engagement at country level in order to institutionalize maintenance and use of the data. More importantly, experience suggests that support for these systems is best provided within the context of a larger overall programme of disaster risk management with an adequate capacity development. The benefit of this approach is that the capacities acquired lead to data improvements, and, at the same time, the data also become an increasingly effective resource for disaster reduction.

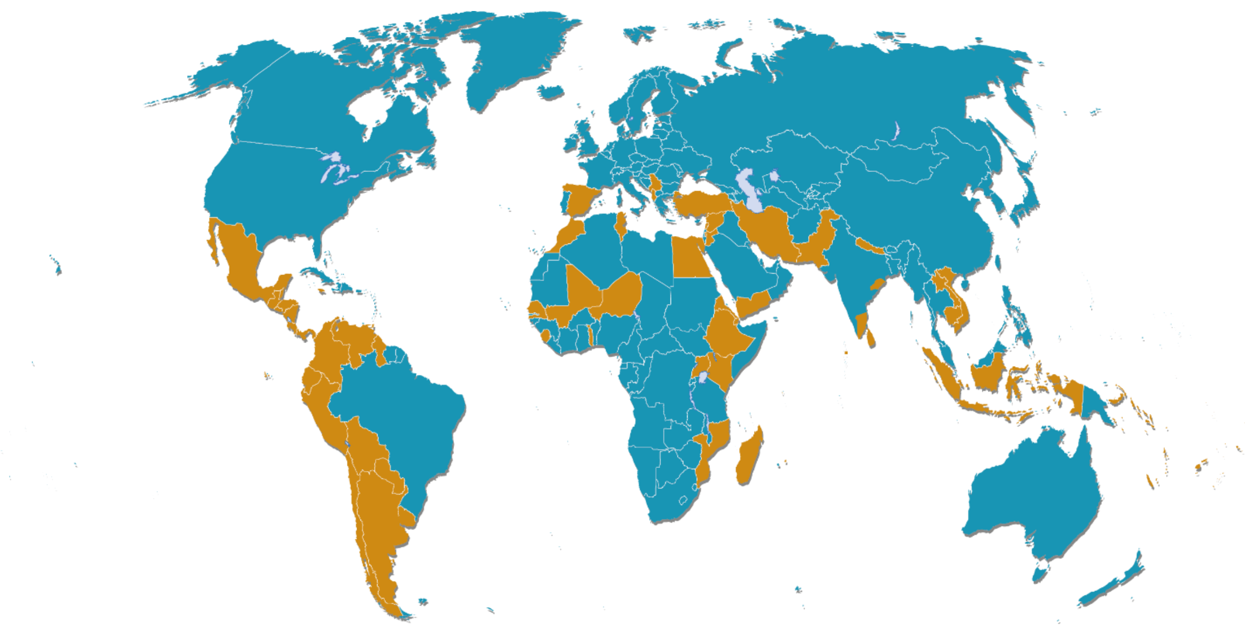
Seeing at the composition of the institutions that have undertaken a sustained effort building national disaster loss databases it can be seen that a first group (in size and success) is composed by a number of national agencies, usually in charge of disaster and emergency management. For example, in Indonesia the BNBP (Badan Nasional Penanggulangan Bencana, National Disaster Management Agency) has proven to be extremely successful not only setting up and keeping up to date the national database, but also in federalizing its use and creating province level databases that are regularly consolidated in the national one. It has also been very successful in integrating the data and reusing the open source software on other applications, such as a system to follow up poverty eradication programs. Other successful examples are Ecuador, Panama, Tunisia, Yemen, Sri Lanka, Syria (until the war, at least), Jordan, Spain and many others.

A second important group is headed by inter-governmental organizations. Such is the case of the Secretariat of the Pacific SPC, which has establish the PDalo (Pacific Damage and Loss information system), with a coverage of 22 countries (island states in the Pacific), or the Indian Ocean Commision (IOC) through which disaster loss databases have been built for the 5 members of the commission (Mauritius, Madagascar, Seychelles, Comoros and Zanzibar).

Many regional and country level databases are currently implemented with international support including by UNDP, UNISDR, and World Bank among others. Supporting the institutionalization of systems to track disaster losses and damage over time at country level has been a major area of work for the UN system over the past decade.

To date the UN system, mostly UNISDR and UNDP, has supported the development of more than 50 databases countries on all continents (see Figure 2). UNDP and UNISDR support has ranged from limited, one-off contributions to comprehensive, long-term support in establishing, institutionalizing and maintaining the database.

Figure 2: Coverage of UN supported national disaster loss databases as of January 2015



Source: UNISDR

Other important implementers of disaster loss databases are Non-Governmental, non-for-profit Organizations and academic institutions. Good examples of these have been NSET (Nepal Society for Earthquake Technology) which has maintained the national dataset for over a decade, and most importantly CorpoOSSO in Colombia, where the inception of the initiative took place and which has invested twenty years of efforts in maintaining the database in Colombia and coordinating funding and updates in 16 countries in Latin America with national governments, other NGO's, and academic institutions such as FLACSO (Latin American Faculty of Social Sciences), Universidad Católica de Chile and UNAM of Mexico.

Box 1: Understanding loss and risk from the bottom-up: national loss accounting

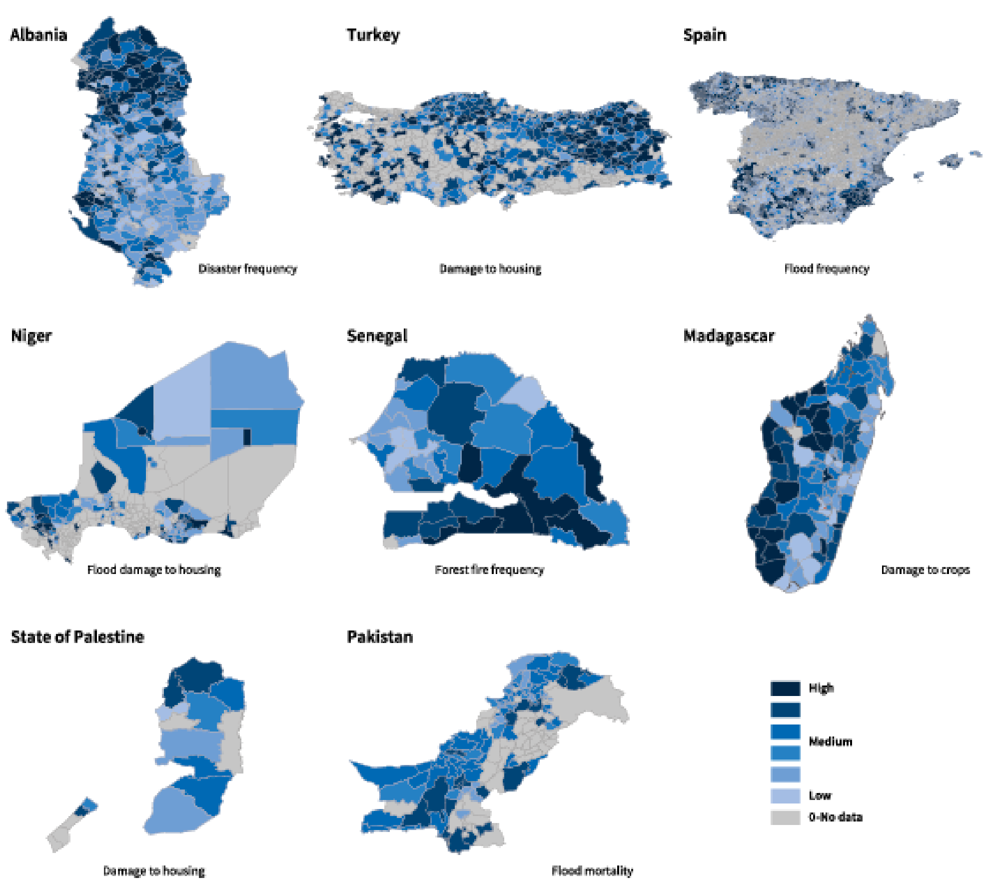
To uncover extensive risks, an increasing number of countries around the world are adopting a simple and well-defined methodology to report, analyse and display disaster occurrence and losses at the local level through a standard definition of hazards, impacts and other indicators. Because the loss data is captured at the level of local administrative units, this makes it possible to record losses associated with huge numbers of small extensive disasters that are not internationally reported and thus do not appear in other disaster databases.

In a pattern that resembles the growth of computer processing power, the number of countries systematically collecting disaster loss data has roughly doubled every two years since these efforts began in Latin America in the 1990s.

GAR15 features data collected using the same methodology and parameters in 82 countries and 3 states (Tamil Nadu and Odisha in India, and Zanzibar in Tanzania).

Countries that have published data sets in the last two years, including: Comoros, Madagascar, Mauritius and Seychelles in the Indian Ocean; Morocco and Tunisia in North Africa; Niger, Senegal, Sierra Leone and Togo in West Africa; Barbados, Grenada, Saint Lucia, Saint Kitts and Nevis, Saint Vincent, and Trinidad and Tobago in the Caribbean; Cambodia, Pakistan and the State of Palestine in Asia; and Albania, Serbia, Spain and Turkey in Europe (see below).

Increase in number of national loss databases featured in Global Assessment Reports



Analysis of data from National Disaster Loss databases

The following pages present the most relevant facts found when analysing the consolidated GAR 2015 dataset. As said above this consolidated database contains data produced nationally from 82 countries and 3 States and provinces which as listed in Table 1, with aggregated main loss indicators.

As shown in Table 1, the consolidated dataset is composed of 349,325 records. Is important to note that these are a subset of the original records contained in the country produced databases, which accounted for almost half a million records.. The following are the criteria used to filter national databases:

- Only those records related to a specific subset of natural hazards are considered (Figure 3). This subset is composed by weather related (Hydro-meteorological) and geological events. Because of these filters hazards like Epidemic or Animal Attack are not considered, as well as all sort of accidents (traffic, industrial or otherwise) as well as social unrest related events (confict, panic, etc.)
- Only records with any type of impact recorded are considered.
- Only those records with minimal metadata (i.e. source information) are considered
- Records with impact figures considered as spurious are discarded. Most of these are records where instead of a physical affectation unit number (for example number of schools affected) were replaced by the economic value of those units, or even a few records with typing errors.

Figure 3: Composition by hazard of GAR 2015 consolidated dataset

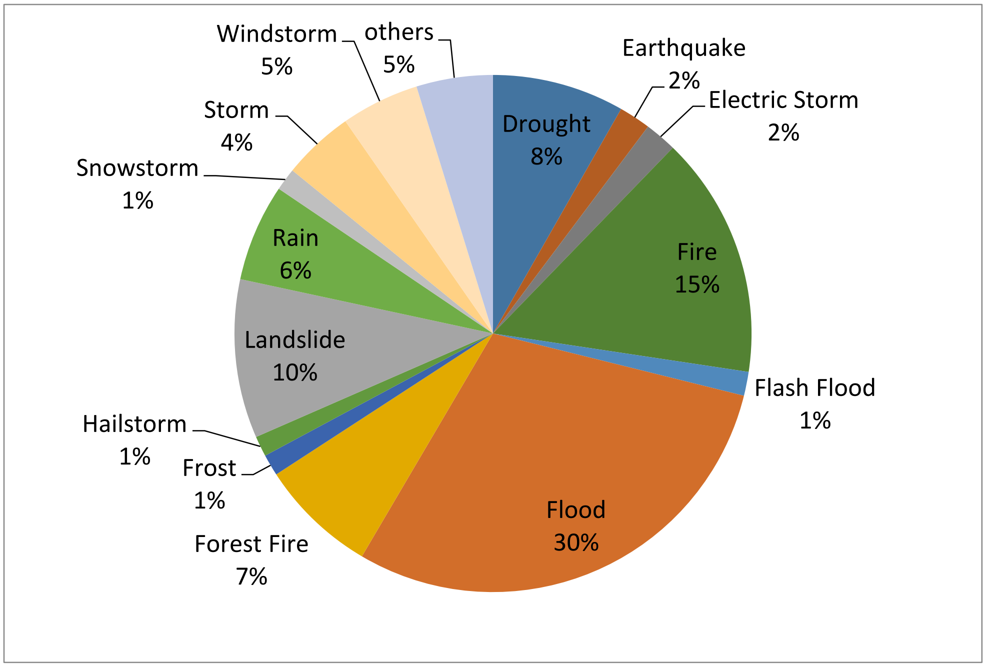


Table 1: National databases and selected loss indicators

Country / State	Records	Deaths	Injured	Missing	Houses Destroyed	Houses Damaged	Affected	Education centers	Health centers	Damages in crops Ha.	Livestock Lost	Damages in roads Mts
Tamil Nadu	14,624	6,925	5,256	3,125	293,424	1,008,780	5,803,245	37	7	2,243,012	7,327	14,344,061
Albania	3,889	432	2,053	21	20,146	67,426	612,696	1,026	52	442,024	39,011	97,182
American Samoa	3	186	-	-	-	-	145	-	-	-	-	-
Antigua & Barbuda	464	19	616	1	1,481	12,905	2,017,800	91	13	1,176	-	64,354
Argentina	16,192	2,827	12,209	759	27,993	106,353	23,168,305	3,681	152	90,014,132	6,937,173	12,093,165
Belize	110	16	5	3	244	15,448	21,390	80	20	1,848,849	1,950	75
Bhutan	250	32	80	-	1,083	17,125	328	291	61	-	365	-
Bolivia	4,585	1,389	1,282	263	8,782	18,336	1,068,344	148	11	4,881,204	856,548	362,577
Cambodia	4,868	1,855	1,414	2	21,161	42,385	5,469	694	62	4,501,374	23,292	3,535,915
Chile	10,929	3,931	7,267	977	624,184	1,628,854	13,177,209	296	105	2,732,079	3,024,817	3,882,669
Colombia	36,766	37,582	26,133	3,124	195,945	1,577,122	27,338,038	3,760	475	3,824,456	2,580,714	4,906,744
Comoros	90	99	149	62	463	1,724	83,794	-	-	1,200	-	-
Cook Islands	25	33	134	-	808	786	19,969	-	-	-	-	-
Costa Rica	14,687	590	97	67	9,628	68,874	163,078	529	69	213,084	6,363	562,127
Djibouti	369	952	365	42	-	-	5,234	-	-	258	15,655	-
Dominica	400	73	3,009	-	2,172	9,108	2,232,766	6	6	10,539	722	29,960
Ecuador	14,258	3,517	3,596	1,246	14,371	89,885	3,082,627	2,651	23	3,114,378	340,694	4,385,790
El Salvador	5,155	4,375	10,983	643	174,816	225,278	1,134,831	187	30	102,572	5,153	54,494
España	11,515	537	334	-	-	68,299	-	-	-	409,804	4,350	-
Ethiopia	8,560	7,980	961	-	29,993	377	119,698,312	8	1	1,335,032	2,923,914	-
F. S. of Micronesia	18	123	252	-	1,197	11,702	56,100	-	-	-	-	-
Fiji	103	595	227	10	14,331	38,260	2,923,438	227	9	8,560	-	-
French Polynesia	11	56	-	-	-	-	11,161	-	-	-	-	-
Grenada	71	36	693	-	415	33,719	265,208	69	5	741	14,394	449,159
Guam	9	15	-	-	-	5,000	28,179	-	-	-	-	-
Guatemala	5,912	2,459	3,547	1,184	40,674	198,706	8,302,081	1,377	77	600,057	975	1,164,324
Guyana	815	99	1,544	3	808	113,201	539,818	31	4	113,068	320,111	733
Honduras	7,354	13,315	260,326	12,830	52,310	138,322	2,962,675	426	65	2,217,762	31,906	1,285,451
I.R. Iran	6,104	127,171	72,158	3,437	139,681	517,574	2,684,169	105	2	11,857,854	1,144,601	5,372,048
Indonesia	15,558	193,590	331,088	17,461	1,074,973	1,106,057	21,915,862	29,879	3,523	3,503,504	-	108,544
Jamaica	891	675	475	51	10,474	170,187	4,061,639	1,168	223	67,418	672,069	716

Jordan	600	152	2,266	68	91	596	332,148	2	-	840	23	90,001
Kenya	1,225	452	245	10	22,138	7,554	7,621,223	-	-	63,797	49,462	20,000
Kiribati	5	4	-	-	-	-	84,785	-	-	-	-	-
Laos	3,703	235	46,952	38	26,522	108,888	4,600,035	459	51	1,784,123	25,356	39,774
Lebanon	2,527	156	723	39	181	1,366	561,870	11	3	17,700	5,547	2,001
Madagascar	1,378	1,399	2,898	832	399,191	110,615	1,916,653	746	122	2,667,350	22,662	143
Maldives	1,921	80	820	27	1,719	9,640	187,330	30	17	-	-	70,252
Mali	1,354	229	357	5	32,644	3,908	10,630,141	72	-	18,393	8,875	-
Marshall Islands	13	1	1	-	100	24	27,900	-	-	-	-	-
Mauritius	1,110	138	621	15	1,850	13,204	63,357	-	-	95	344	-
Mexico	34,086	33,176	4,347,549	9,760	476,223	3,619,433	127,665,357	30,633	701	52,503,593	9,789,872	37,827,699
Morocco	713	2,165	3,149	266	5,109	21,915	22,391	628	23	281,807	1	1,115,529
Mozambique	3,370	103,630	1,445	651	586,312	180,959	29,901,393	23	8	638,249	79,407	1,280,961
Nauru	1	-	-	-	-	-	-	-	-	-	-	-
Nepal	18,295	13,913	15,428	1,512	235,580	211,099	6,365,035	3,645	37	986,240	688,787	701,048
New Caledonia	12	12	100	-	-	-	3,628	-	-	-	-	-
Nicaragua	1,157	2,750	1,126	1,150	18,052	38,563	1,368,679	34	14	785,240	333	3,180,247
Niger	1,317	804	192	-	71,009	1,624	950,138	16	1	689,097	875,987	-
Niue	6	1	-	-	13	-	2,900	-	-	-	-	-
Orissa	10,517	36,332	13,472	364	1,941,951	3,985,523	128,042,508	10,043	378	23,642,119	3,992,748	73,258
Pakistan	3,719	68,333	301,237	3,394,648	2,284,353	1,082,682	29,723,615	10,514	4,153	25,056,079	299,283	1,674,120
Palau	5	-	-	-	112	270	28,000	2	-	-	-	-
Palestine	405	63	138	2	67	798	12,235	-	-	-	-	-
Panama	3,978	463	1,825	40	15,509	93,068	459,092	62	18	2,661,608	5,768	6,084
Papua New Guinea	158	6,325	2,047	565	15,121	19,413	5,761,210	6	3	-	200	-
Paraguay	367	98	35	-	2,581	22,727	249,691	12	1	745,904	32	200
Peru	17,059	40,703	126,656	6,904	231,433	388,036	3,043,732	3,477	305	2,259,009	756,416	3,927,308
Saint Kitts and Nevis	487	24	7	-	304	1,638	1,303,873	116	20	983	104	150
Saint Lucia	149	40	118	11	730	1,803	483,233	84	18	4,130	-	-
Saint Vincent & the Grenadines	227	27	69	3	935	6,056	260,515	38	8	6,334	5,233	31,067
Samoa	20	399	660	18	920	4,827	386,167	7	2	100	-	-
Senegal	327	513	169	6	136	62,878	379,194	11	3	3,745	142	-
Serbia	1,414	198	1,025	2	4,497	52,793	491,877	68	13	950,928	50,162	558,506
Seychelles	636	7	88	-	28	2,854	6,793	12	4	6	-	176
Sierra Leone	289	121	297	-	2,247	943	14,739	-	-	-	-	-

Solomon Islands	68	611	116	12	10,077	11,425	583,598	10	13	-	-	-
Sri Lanka	22,486	34,008	22,323	2,043	149,277	422,876	31,911,105	6	1	117,585	-	-
Syria	7,326	679	1,312	-	468	1,311	809,681	67	11	634,469	25,676	-
Timor Leste	825	185	26	-	1,697	16,441	207,105	2	-	269	-	-
Tokelau	4	-	-	-	-	-	3,358	-	-	-	-	-
Tonga	33	33	15	-	1,217	1,030	372,893	2	3	-	-	-
Trinidad and Tobago	2,378	62	168	-	80	334	48,500	14	-	14,936	31,100	-
Tunisia	1,926	350	450	131	17,821	24,728	91,206	89	5	837,288	369,467	17,022
Turkey	4,469	30,364	66,314	-	18,641	826,468	16,146,981	-	-	-	279	3
Tuvalu	12	24	1	-	30	-	22,652	-	-	-	-	-
Uganda	2,253	2,660	1,520	625	28,848	5,852	9,244,793	492	7	56,834	111	336,397
Uruguay	1,382	256	275	4	2,554	36,029	91,851	13	1	30,595	22,309	13,940
Vanuatu	77	335	218	-	29,529	10,079	693,759	3	1	-	-	-
Venezuela	5,765	3,072	569	793	50,988	158,200	2,930,058	179	123	1,512,069	693,710	569,076
Vietnam	1,469	9,941	101,650	3,146	680,784	647,859	8,243,226	-	-	-	-	-
Wallis and Futuna	5	6	-	-	-	-	10,520	-	-	-	-	-
Yemen	1,702	4,172	1,099,142	369	23,327	37,626	28,862	-	10	20,234	1,881	9,752
Zanzibar	10	1	2	-	58	43	1	-	-	-	-	-
TOTAL	**349,325**	**811,186**	**6,912,069**	**3,469,370**	**10,154,611**	**19,547,791**	**677,775,496**	**108,395**	**11,073**	**253,035,883**	**36,753,381**	**104,244,800**

Estimation of economic losses in National Disaster Databases

Why estimate losses?

The development of national disaster loss databases is the crucial first step to generate the information necessary for risk estimation and to inform public investment planning. As a second step, the physical losses recorded in the databases can be translated into monetary/economic losses enabling an initial evidence-based estimate of recurrent losses.

Until countries are aware of how much they are losing and how much they may lose in the future they are unlikely to decide to invest in risk reduction- a simple cost-benefit analysis question, where benefits are avoided or reduced losses in the long term and costs are the investments needed to implement the risk reduction measures.

The question of how much are countries losing can be answered only by systematically collecting in well-structured databases all disaster losses, whereas the question of how much they may lose in the future has to be addressed using techniques such as the probabilistic risk assessment that is featured in GAR 2013 and GAR 2015.

However, economic data **reported and collected** in disaster loss databases is very scarce and inconsistent. This common pitfall occurs in most databases **including both national and international** databases. EMDAT, for example, has only 27% of its records with an economic loss value, which are usually estimated by different institutions following a number of economic assessment methodologies and criteria, including inclusion criteria of direct, indirect, macroeconomic and ripple effects values. National disaster databases have even less coverage (less than 20%) given many of disasters reported are small scale disasters for which no expert economic assessment is ever conducted.

Exceptions to this rule are insurance databases, which due to its own nature collect business related data on insured losses and estimate total losses based on market penetration indexes and other expert criteria. It's important to note that figures in developing and poor countries are much less reliable that the estimations made in countries where market coverage is very high – typically developed or medium-high income countries. An unfortunate fact given most of the urgent work on disaster risk reduction has to be done precisely in those countries.

Taking advantage of the fact that, on the contrary, national datasets contain much better data on physical impact, UNISDR and its scientific partners developed a methodology to assign a conservative value of **direct losses** to a very large number of records in these databases [REF GAR 13, CIMNE Paper].

This annex presents a short summary of the innovative methodology developed for GAR 2013 to assess the economic impact of disasters at all scales taking advantage of a common and *homogeneous set of quantitative physical damage indicators collected in the 82 countries of the GAR Consolidated Dataset presented in the first section of this Annex. It also presents a new, more refined and hopefully accurate methodology to assign economic value to agricultural losses expressed in national databases as number of hectares of crops damaged or destroyed.*

All national consolidated datasets contain the following physical impact indicators:

- **Human losses** and affectation (fatalities, injured, missing, evacuated, relocated, affected, among others). These indicators were not used in the economic valuation, despite suggestions of several methodologies for including some value of losses (i.e. indirect losses due to deceased, cost of medical attention and relief, etc.)

- **Houses Destroyed**: The number of homes submerged, levelled, buried, collapsed or damaged to the extent that they are no longer habitable.

- **Houses Damaged**: The number of homes with minor damage, not structural or architectural, which may continue being lived in, although they may require some repair or cleaning.

- **Crops** and woods damaged: The number of hectares of cultivated or pastoral land or woods destroyed or affected.

- **Livestock lost**: The number of animals lost (bovine, porcine, ovine).

- **Educational facilities damaged**: The number of nurseries, kindergartens, schools, colleges, universities, training centres, etc., destroyed or damaged.

- **Health facilities damaged**: The number of health centres, clinics, local and regional hospitals destroyed or affected by the disaster.

- **Roads affected**: The length of transport networks destroyed and/or rendered unusable, in metres.

Some of the advantages and limitations of disaster loss data physical damage indicators are:

- Indicators are number of units affected or destroyed and thus are data easy to collect as there are no requirements to apply any arbitrary calculation, such as the case of the economic loss assessment. It’s a simple exercise of counting.
- These indicators are collected in many cases accurately and with high priority as the base for planning an effective response. For example, data on housing is used for temporary shelter provision, agriculture data is used to look into potential food security issues, education and health facilities are immediately surveyed as critical shelter and functional elements during response, etc.

- However, some indicators may not be collected when the disaster does not necessarily trigger an emergency response, or depending on the type and focus of the agency and personnel conducting the data collection. Therefore, these physical indicators are to be taken as the *lower bound* of the damage, which in general is higher.
- Information collected in national disaster databases should not be considered as the full set of all disasters happened in the countries. Experience indicates that many events are not registered for a variety of reasons. Also, not all reports of disasters contain quantitative information on all of the damage indicators and in many cases only a qualitative note is left. Therefore the impact registered in these databases has to be considered as a ***conservative minimum impact measure***.
- As with any data source collaboratively collected, there may be, of course, mistakes, typos and inaccuracies, despite the best efforts of those in charge of building these datasets.

Valuation of built infrastructure damage

Given the value of houses have a high variability within a country, and from country to country, the approach taken was the same approach as used in the evaluation of housing losses in several Risk Assessment Models (CIMNE, 2013): the replacement value of a house was assessed as the cost of the smallest 'social interest housing solution'. The concept of what this solution may be varies and as expected it is much more valuable in high-income countries.

In order to have a comparable measure, and a methodology that could be systematically applied in any country, the value of a house was calculated as the value of a 45 square meter house – i.e. a very small housing solution.

For the costing of these 45 meters of construction a research was conducted using many sources and variables, including salary levels, construction costs , census data on housing, economic indicators, etc.

This cost for square meter of construction is calculated in the methodology based on data from different sources and a statistical analysis that correlated very well the costs in countries where data is available and GDP Per Capita.

The statistical regression produced a formula n used to assess the value of a square meter of construction in the countries of the sample (1SqMt=304 + 0.0118*GDPpc).

Loosely following a suggestion from the ECLAC methodology (UNECLAC, 2003) the value of a damaged house is evaluated as 25% the replacement value of a (social interest) housing solution. In order to assess the value of the urban infrastructure associated to loss of houses an additional 40% over this value was added which should account to water, sewage, roads, green areas, electrical and communications infrastructure that usually results damaged in disasters (CIMNE, 2012).

The consolidated 'DesInventar' disaster loss datasets also contain the number of health facilities and schools damaged by disasters. Schools range from small rural schools to large Universities and similar variances exist in health facilities. Thus, these facilities have a much higher variance than houses in size and therefore in economic value.

A similar research and statistical processing allowed the design of a simplified and conservative valuation method for these facilities, which was estimated, very conservatively, as a minimal unit:

- **Education Facilities**: Construction area for small schools was estimated as a facility of two classrooms of 6x5 meters (60 sqM2) plus a common area of 15 sqM2, for a total of 75 sqM2.

- **Health facilities** were characterized as a waiting room of 3x4 Mts. (12 sqM2), a consulting room of 3x4 M an operating/first aid section of 5x4 Mts. (20 sqM2), with a medicine depot and maintenance area of 4 sqM2, for a total of 48 sqM2.

The idea behind this model of facilities is that in the developing world health and education facilities are much more inexpensive and scattered over the territory than in the developed world (GAR 2013).

In order to assess the value of damages to roads the study took as a base the average costs of rehabilitation of roads from a comprehensive study conducted by the World Bank, the ROad Costs Knowledge System (ROCKS) developed by the Transport Unit – TUDTR of the Bank. This study arose from the need of public works agencies, contractors, consultants and financial institutions of having road costs information, which in general is locally available, but many times this information is scattered, and collected in unsystematic and unstructured ways.

ROCKS produced estimates for preservation work (renovation, rehabilitation and improvement) and for development work (construction of new roads). It also summarized the results by World Bank regions. Roads in turn were categorized as paved and unpaved. For the effects of GAR 2013 and 2015 valuation exercise the **cost of road rehabilitation** was taken as a proxy to measure the value of the impact of disasters, as most of the work on roads after disasters must be considered as rehabilitation, despite in some cases a full reconstruction of the roads have to be undertaken and also because rehabilitation cost figures are much more conservative than development work.

The methodology also took into account the difference in cost between paved and unpaved roads by distributing road damage on paved and unpaved roads according to data published by World Bank on the percentage of the road network of the country that are paved.

The costs obtained using World Bank's data are thus expressed in Average rehabilitation works costs per Km for paved (214,000 $/km 31,000 $/km) and unpaved roads.

For a complete description of the methodology please refer to GAR 2013 Annex II and its bibliography.

Agricultural Damage (refined methodology for 2015 exercise)

Compared to damage to housing, agricultural losses may be somewhat more difficult to report, giving an incomplete picture of the real extent of the damage. In reality, damages to agriculture are considerably higher than what countries have recorded.

From 347,000 records in the national databases, 26% (91,686) register quantitative (presented as number of hectares of crops lost) or qualitative (yes/no indicator) about the existence of damages to the agricultural sector.

Most of the agricultural damage (98.5%) is associated to weather-related hazards. Three disaster types, namely flood, drought and forest fire, represent 82 % of the damages with a total of more than 209 million of hectares affected. (see table at the end of the document).

The importance of agricultural damage due to disasters is undeniable, especially when looking at extensive risks, as explained in GAR13 annex 2 (LINKS), ECLAC assessments show that agricultural damage accounts for 80% of total damage to the productive sector in weather related hazards, against only 20% in the industrial and commercial subsectors.

The objective of including a valuation of this damage is to include at least a proxy of what the minimal damage to agriculture may be based on what databases have recorded. However, there are many challenges: disaster loss databases don't record, with a few exceptions, the type of crops damaged nor the level of affectation, which in general is suggested to be total destruction.

The valuation of agricultural damage is focused on determining crop direct costs, using FAO indicators and mainly to producer price per ton in US$. "Annual Producer Prices or prices received by farmers for primary crops, live animals and livestock primary products as collected at the farm-gate or at the first point of sale." (FAO).

Other direct and indirect loss, such as loss of revenue from the lost crop, other crops that the farmer won't be able to plant, damage to productive soil, damages to irrigation infrastructure, machinery and equipment, storage infrastructure, fencing, and damages to stored fertilizers, seed, produce etc. are not taken in account on this methodology.

Determining crop direct cost

To calculate an estimative price per hectare damaged for GAR15, the methodology assigns a price per country using the FAO datasets (http://faostat.fao.org/).

3 indicators have been used:

- Producer price per ton (USD), 2011
- Yield (hectograms / hectare (hg/ha))
- Area Harvested

As mentioned earlier, with few exceptions, the type of crop damaged is not recorded. The price "producer price per ton" is not equivalent for all crops in a country. For example, In El Salvador, the price to producer (ton) is 30 times higher for green coffee than oranges (4,160 US$ per ton of green coffee – 132 US$ per ton of oranges).

For the 3 indicators, all types of crops were merged per country, to obtain for each type of crop their producer price / Yield / Area harvested. If one of these 3 indicators was missing for a type of crop, the crop in question has been removed from our methodology.

Albania	Producer Price (USD/tonne)	Wheat	USD	406.6	Yield	Wheat	Hg/Ha	42300.52	Area harvested	Wheat	Ha	69219
Albania	Producer Price (USD/tonne)	Barley	USD	339.2	Yield	Barley	Hg/Ha	30633.8	Area harvested	Barley	Ha	2840
Albania	Producer Price (USD/tonne)	Maize	USD	386.8	Yield	Maize	Hg/Ha	59869.28	Area harvested	Maize	Ha	61200
Albania	Producer Price (USD/tonne)	Rye	USD	339.2	Yield	Rye	Hg/Ha	24285.71	Area harvested	Rye	Ha	1400
Albania	Producer Price (USD/tonne)	Oats	USD	367.9	Yield	Oats	Hg/Ha	23106.65	Area harvested	Oats	Ha	12940
Albania	Producer Price (USD/tonne)	Potatoes	USD	277.7	Yield	Potatoes	Hg/Ha	242210.5	Area harvested	Potatoes	Ha	9500
					Yield	Sugar beet	Hg/Ha	200000	Area harvested	Sugar beet	Ha	2000
Albania	Producer Price (USD/tonne)	Beans, dry	USD	1329	Yield	Beans, dry	Hg/Ha	17569.44	Area harvested	Beans, dry	Ha	14400
					Yield	Broad bean	Hg/Ha	11530.05	Area harvested	Broad beans,	Ha	183

In green, the data kept for the analysis, in red, the data not kept as Producer Price data is missing.

The indicator Yield (hg/ha) has been converted to ton per hectare, in order to calculate a price of all yield of one crop; the price of the crop was multiplied per its yield in ton and per its area harvested.

Price for all yield = (Price X Yield (T/ha) X Area Harvested (ha))

In order to obtain one unique value per country, the sum of all crops prices for all yield has been divided by the total of the area harvested. The average price for crops/ha in 2011 US$ is obtained for 100 countries, from 237 US$/ha for Niger to 22,838 US$/ha for Japan.

Using a similar approach used in GAR 2013 to extrapolate a good proxy socioeconomic indicator for the cost of crops for countries for which no information is available, a set of regressions against GDP per capita were conducted trying to find a measure for crop costs for countries without FAO indicators.

The average price for crops for missing FAO data, using calibration via GDP per capita, presents some limitations. The price obtained by the regression was around 2,265 US$/ha. But this average price cannot be applied for developing countries and developed countries.

For this study, we have grouped countries by income groups from the World Bank income group classification:

- High Income (OECD)
- High income (non OECD)
- Upper middle Income
- Lower middle Income
- Low income

The calculation for missing FAO data using calibration via GDP per capita plus income groups leads to results that go from 3,051 US$/ha ($y = 0.0344x + 3051.3$) for high income (OECD) countries to 565.8 US$/ha for low income countries ($y = 0.6891x + 565.8$).

The regression using the equations per incomes calibrated with GDP gave an artificial price for all countries with missing FAO data. (see table at the end of the document).

In addition to crop losses, national disaster loss databases also contain information on livestock lost.

Determining livestock direct cost

As per the definition of livestock in the DesInventar data collection methodology it is only taken into account 4-legged animals such as goats, sheep, cows, buffalos, horses, etc.

The value of these animals has high variance in terms of the price per kilo and the number of kilos per animal, which in general determines its value, although dairy producing livestock could be valued in an entirely differently manner being the source of livelihood of many communities.To calculate a "price" per cattle lost, the methodology assigns a price per country using also the FAO dataset, Producer Price (USD/ton) for Meat live weight.

In order to obtain one unique value per country, the average of average of producer price per ton has been calculated.

For Bulgaria, the average price for meat live per ton is 2,215.35 US$ with a maximum of 3,464,7 US$/ton for sheep to 1,572.3 US$/ton for Buffalo (FAO, 2011).

An average price for meat live per ton in 2011 US$ is obtained for 82 countries, from 746 US$/ton for Slovak Republic to 8,735.85 US$/ton for Japan.

With the same methodology applied for crops, a set of regressions against GDP per capita, were conducted to find a price for cattle for countries without FAO indicators. A new indicator price per cattle lost (100kg instead of ton) has be assigned. (see table at the end of the document).

Estimates of crop and livestock direct cost

The main goal of the study is to avoid the over-estimation of direct losses. Therefore, the calculation of losses is made in a very conservative way.

From the 2 values obtained above, price of crops per hectare and per country, and, price of cattle per 100kg per country, the methodology provided the most conservative pricing taking in consideration that:

"At various stages of growth, the estimated reduction in harvest per hectare of a specific crop caused by, say, floods can be varied. For instance, a flood that will submerge newly planted taro for 2 to 3 days may cause a 100% reduction in harvest while the same flood may cause only a 50% reduction in harvest of taro at maturing stage."

Source : http://www.fao.org/docrep/015/an544e/an544e00.pdf#page=41

"The resulting estimates indicate that the total impact of the tsunami on the agricultural sector of Thailand amount to 376.4 million Baht, or its equivalent of US$ 9.65 million. Of said amount, 279 million Baht (76% of the total) represent damage to assets, and the remaining 94.7 million Baht (24%) are production losses. "

Source:
http://www.adpc.net/maininforesource/dms/thailand_assessmentreport.pdf#page=8

Thirdly, ECLAC assessments were also taken into account.

Based on these considerations, this study proposes that:

For damages to crop – 25 % is lost; for cattle lost – the weight assigned per livestock lost is 75kg.

Extensive and Intensive Risk Analysis for GAR 2015 consolidated dataset

The basics of Extensive Risk

Previous editions of the GAR defined 'extensive risk' the set of very frequent disasters associated to relatively low intensity hazards[1]. In layman terms, extensive risk is associated with the idea of widely spread "small and medium scale" disasters.

Extensive risk 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 localized events. In addition, damage from electrical storms and lightning are increasingly contributing to loss from extensive risk due to wildfires.

At the time when the HFA was adopted, the mortality, physical damage and economic loss from extensive risk had not been accounted for in national or international reports, except in a number of Latin American countries. As a result, this risk layer remained largely invisible. However, since 2007, a sustained effort to assist countries in systematically recording local disaster losses (UNISDR, 2009a, 2011a, 2013a) has generated systematic and comparable evidence regarding the scale of extensive risk from over 80 countries (Box 4.2). Given that 95 per cent of these databases have been built using a comparable approach and methodology, it is possible to analyse these local records at a global level of observation.

Unlike intensive risk, extensive risk is less closely associated with earthquake fault lines and cyclone tracks than with inequality and poverty. In many cases, the hazard, exposure and vulnerability are simultaneously constructed by the underlying risk drivers.

Extensive disaster risk is magnified by drivers such as badly planned and managed urban development, environmental degradation, poverty and inequality, vulnerable rural livelihoods and weak governance. Extensive risk refers to the risk layer of high-frequency, low-severity losses. In general, this layer is not captured by global risk modelling, nor are the losses reported internationally. One key feature of the GAR (UNISDR, 2009a, 2011a, 2013a) has been to highlight the contingent liabilities associated with this risk layer, which tend to be absorbed by low-income households and communities, small businesses, and local and national governments, and which are a critical factor in poverty (UNISDR, 2009a).

In cities, for example, poverty forces low-income households to occupy areas of low land value that may be exposed to floods, landslides and other hazards (Wamsler, 2014). Informal settlements are usually characterized by highly vulnerable housing and a deficit of risk-

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[1] UNISDR Terminology 2009: "*The widespread risk associated with the exposure of dispersed populations to repeated or persistent hazard conditions of low or moderate intensity, often of a highly localized nature, which can lead to debilitating cumulative disaster impacts*". See GAR 2009, GAR 20011, GAR 2013.

reducing infrastructure such as drainage (Mitlin and Satterthwaite, 2013). At the same time, speculative urban development, which can lead to the paving of green areas in rapidly expanding cities and subsidence due to the over-extraction of groundwater, may also increase the frequency and severity of urban flooding (UNISDR, 2013a).

In the past few years four exercises were conducted using in national disaster loss databases in order to define the threshold that would divide disasters in "extensive" and "intensive"; these exercised aimed at obtaining a set of limits within which a *minimum* number of disasters would accumulate the *maximum* possible mortality and economic damage (GAR 2011, Annex II). All of these exercises converged in similar thresholds that separated the samples available in two mutually exclusive sets. As no consistent economic valuation of damages was available in those datasets, mortality and destruction of houses were used to define the thresholds, which were set at 30 people killed and 600 houses destroyed.

Summary of main patterns found in the dataset

As per design, these thresholds accumulate in a very small number of disasters (0.86%) approximately 87% of total mortality and 84% of all houses destroyed are the consequence of intensive risk disasters. However, other impacts such as damages to houses, agricultural assets and public services, and in general the economic damage is distributed very differently.

Table 2 shows a summary of extensive and intensive damage figures for the sample.

Risk type Hazard Records % Deaths % Houses % Houses % Economic loss %

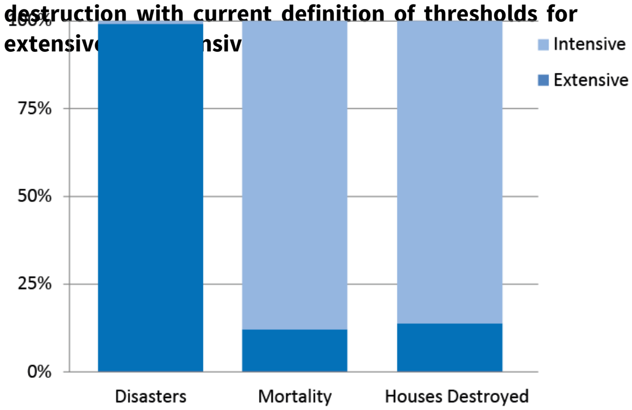
Risk type	Hazard Type	Records	%	Deaths	%	Houses Destroyed	%	Houses Damaged	%	Economic loss	%
Extensive	Hidro-met	335,795	96.13	107,114	13.2	1,476,291	14.6	10,213,834	52.3	187,817,423,368	43.9
	Geological	10,515	3.01	4,739	0.6	139,236	1.4 %	618,262	3.3	10,298,045,561	2.4
Intensive	Hidro-met	2,449	0.70	265,771	32.8	6,395,253	62.9	5,301,601	27.1	160,923,250,472	37.6
	Geological	566	0.16	433,562	53.4	2,143,831	21.1	3,414,094	17.5	69,210,850,972	16.1
TOTAL		349,325	100.0	811,186	100.	10,154,611	100.0	19,547,791	100.	428,249,570,375	100.

Table 2: Extensive/Intensive summary of main impacts

As it can be seen the two columns of the right tell a very different story: almost half (47.3%) of the economic losses are rather caused by extensive disasters, and more than half (55.6%) of damages to housing are also

One of the most interesting facts of these thresholds is that all *extensive/intensive pattern discovered based on them have remained invariant as more and more data and countries have been added to the analysed sample*. The first sample consisted on 11 countries (GAR 2009), the second had 22 (GAR 2011) the third analysed 56 countries (GAR 2013) and for this edition of the GAR data from 80 countries is still presenting the same trends and patterns, both for the entire sample as for the new countries.

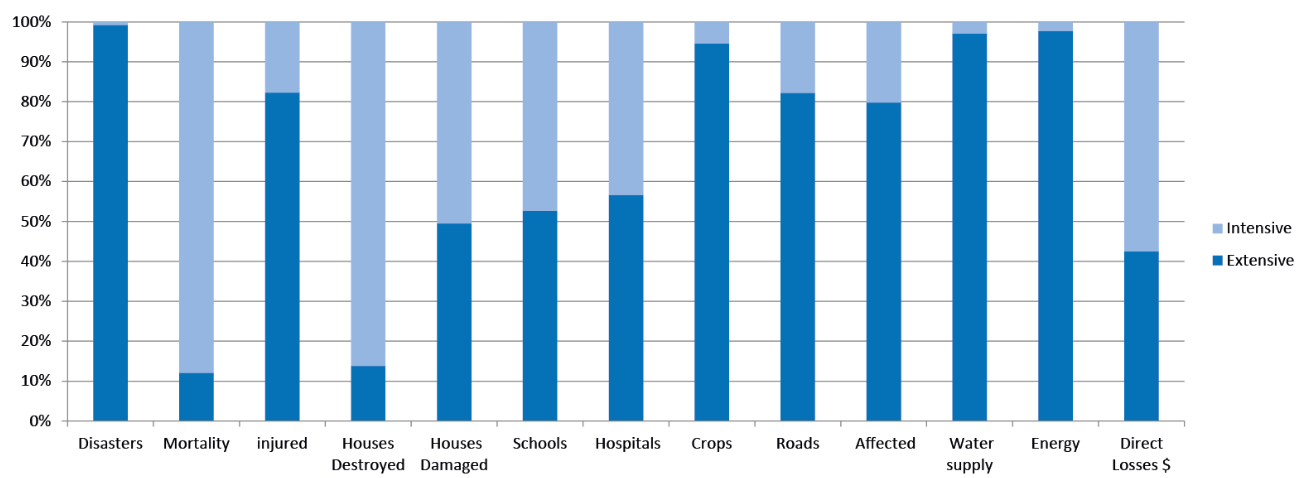
Figure 4: Number of disasters, Mortality and house destruction with current definition of thresholds for extensive[illegible]nsiv[illegible]



National databases have nevertheless many other indicators of damage. When taking into account the whole picture of different types of damages things start to look different, and the true impact of extensive risk is revealed.

It was already noted that damages to agriculture, roads and most public utilities, as well as affectation to population is to be associated in a higher degree to extensive risk. Among other similar measures, 82% of injured, 80% of all affected people, 81% of damage to roads and 93% of damages to agricultural crops are caused by extensive risk disasters. The real picture could look like in Figure 5.

Figure 5: Distribution (%) of different types of losses between Extensive and Intensive



Box 2: Intensive vs extensive risk: two different footprints

The variables used to define the threshold between intensive and extensive disaster losses are mortality and housing destruction. Statistically, the threshold is fixed at:

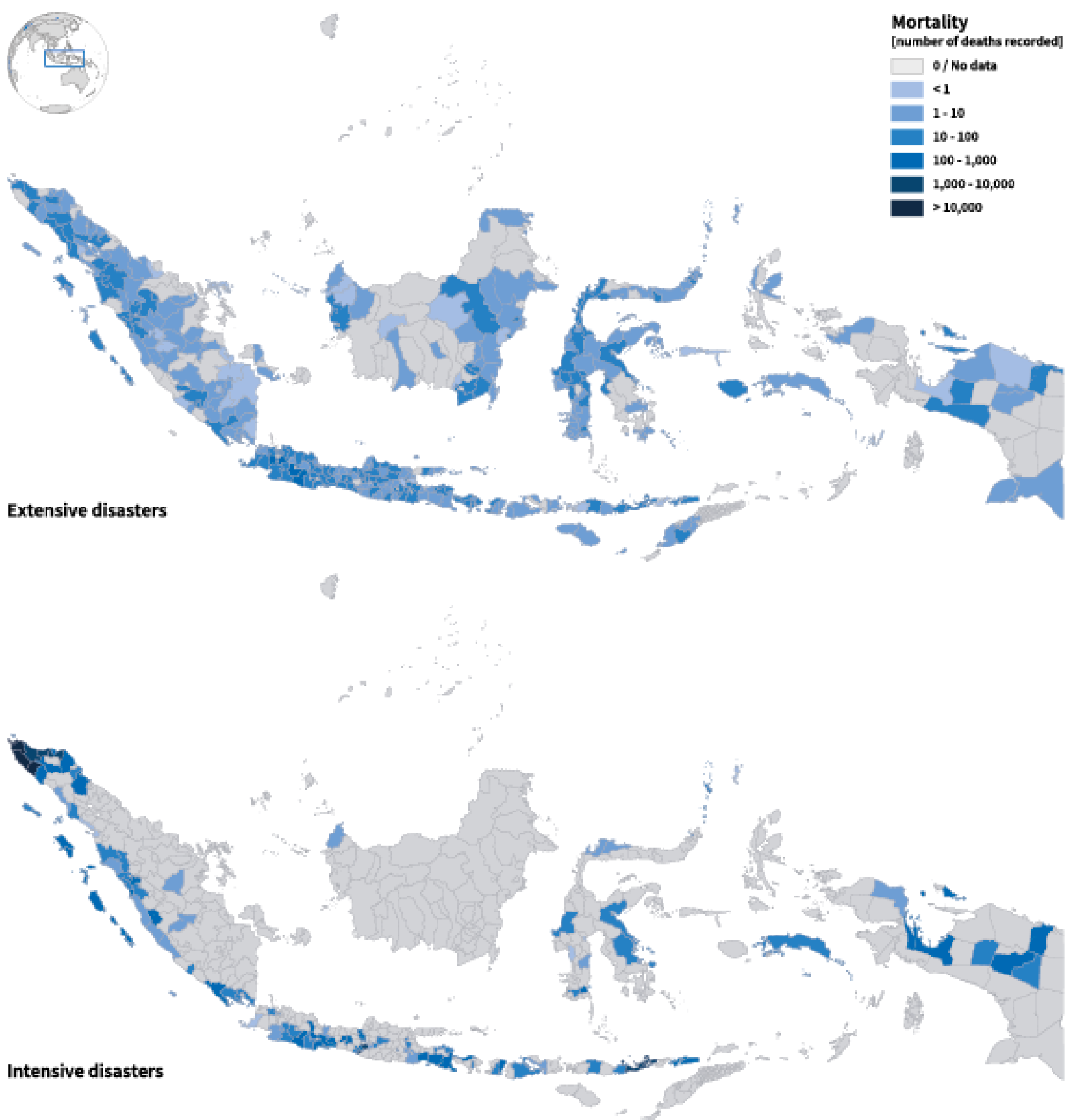
Mortality: less than 30 people killed (extensive); 30 or more killed (intensive); or

Housing destruction: less than 600 houses destroyed (extensive); 600 or more houses destroyed (intensive).

This threshold has proved robust even as the universe of national disaster databases continues to grow.

As the case of Indonesia shows, extensive and intensive disasters have very different footprints (see below).

The different footprints of extensive vs intensive disaster loss in Indonesia, 1990-2013



(Source: UNISDR with data from Indonesian national loss database.)

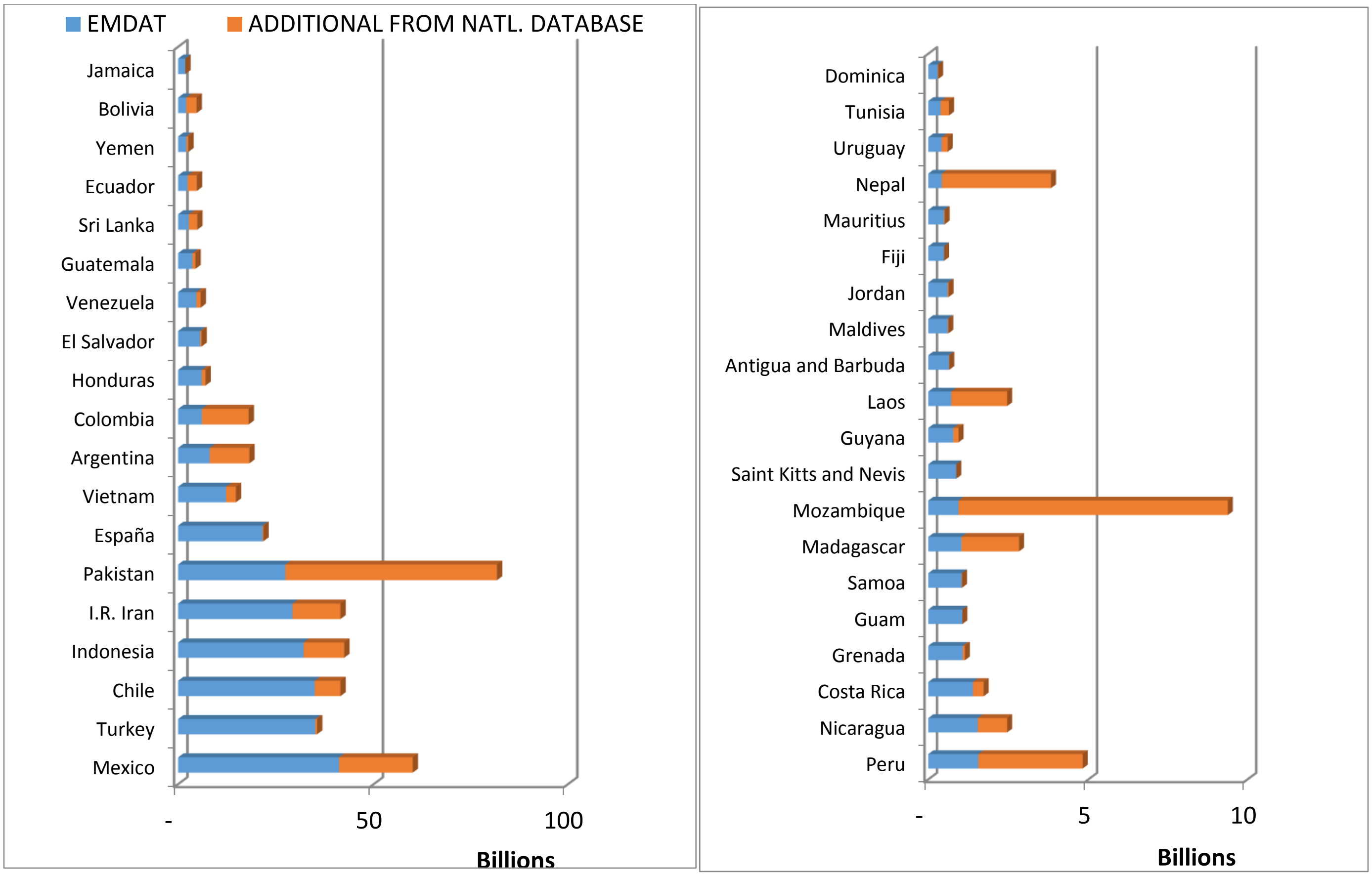
Economic loss value of extensive and intensive risk disasters

The last bar of Figure 5, **direct economic losses**, tells a great deal of the weight of extensive risk in the overall landscape of disasters. The results of this estimation, calculated with a consistent and conservative methodology initially developed to be used in risk assessments (ERN 2011) and later modified to estimate damages recorded in disaster databases, revealed that direct economic losses due to extensive risk could be around 45% of the total losses, with the remaining 55% due to intensive risk.

The total economic damage so calculated is perhaps short for both intensive and extensive risk as it **does not take into account**, for example, high value assets such as bridges or major infrastructure usually affected in intensive disasters, and neither does evaluate specific damages to several sectors of the economy, including industrial and commercial sectors and well as real costs of damage to public utilities which are reported to be affected in the large majority of cases by extensive risk disasters.

Comparing these values against available economic assessments from international sources, mainly EMDAT global database, it was found that the GAR direct loss valuation methodology is very conservative, assigning a value that is on average 42% of the value of losses of the same events in EMDAT (Figure 6). This is explained by the missing elements explained above and the fact that indirect losses are still to be accounted.

Figure 6: Economic losses reported in EMDAT and additional losses found in national databases, 1991-2013. Top 40 countries of GAR 2015 consolidated disaster database.



Nevertheless, his economic estimation methodology permits assigning a consistent and homogeneously calculated economic value to losses of literally hundreds of thousands of small and medium disasters for which otherwise no information would be available, and that fall out of the radar of international attention. With the 56 countries sample of GAR 2013 it was calculated that total losses are likely to be at least 50 percent higher that reported in international global sources. With the current sample of 80 countries this claim remains valid, with total losses **59% higher** than reported.

Fragile Small Islands States

One of the first striking facts of this economic valuation is that the top 14 Historical Annual Average Loss per capita (HAAL/pc) countries in the sample are island states (in the Pacific, the Caribbean and the Indian Ocean), highlighting the fragility of these states when facing disasters. This same situation is seen **both** for total losses and extensive risk losses. HAAL/pc is calculated based on accumulated losses, number of years of data collected and population in 2012 (Table 3).

Table 3: Economic evaluation

Country	Extensive Risk Economic loss	Years in database	Population 2012	HAAL	HAAL/pc
Tuvalu	190,256,450	38	9,847	5,006,749	508.45
Marshall Islands	449,840,527	28	54,816	16,065,733	293.08
Cook Islands	129,286,574	23	19,569	5,621,155	287.25
Federated States of Micronesia	240,780,779	21	111,542	11,465,751	102.79
Jamaica	9,468,685,438	38	2,709,300	249,175,933	91.97
Samoa	466,758,628	29	183,874	16,095,125	87.53
Tonga	315,413,265	40	104,509	7,885,332	75.45
Guam	343,348,647	27	182,111	12,716,617	69.83
Mauritius	3,497,118,920	40	1,286,051	87,427,973	67.98
Grenada	275,276,980	41	104,890	6,714,073	64.01
Antigua and Barbuda	140,652,661	25	89,612	5,626,106	62.78
Palau	22,550,467	32	20,609	704,702	34.19
Fiji	846,780,918	39	868,406	21,712,331	25.00
Vanuatu	216,238,963	40	245,619	5,405,974	22.01
Guyana	624,023,915	39	756,040	16,000,613	21.16
Argentina	30,915,023,376	38	40,764,561	813,553,247	19.96
Saint Vincent & the Grenadines	84,043,133	41	109,365	2,049,833	18.74
Solomon Islands	362,251,020	41	552,267	8,835,391	16.00
Chile	10,802,573,925	40	17,269,525	270,064,348	15.64
Panama	1,970,713,632	42	3,571,185	46,921,753	13.14
Saint Kitts and Nevis	12,855,007	22	53,051	584,319	11.01
Laos	1,415,438,310	21	6,288,037	67,401,824	10.72
Maldives	104,580,713	37	320,081	2,826,506	8.83
Mexico	39,702,684,760	40	114,793,341	992,567,119	8.65

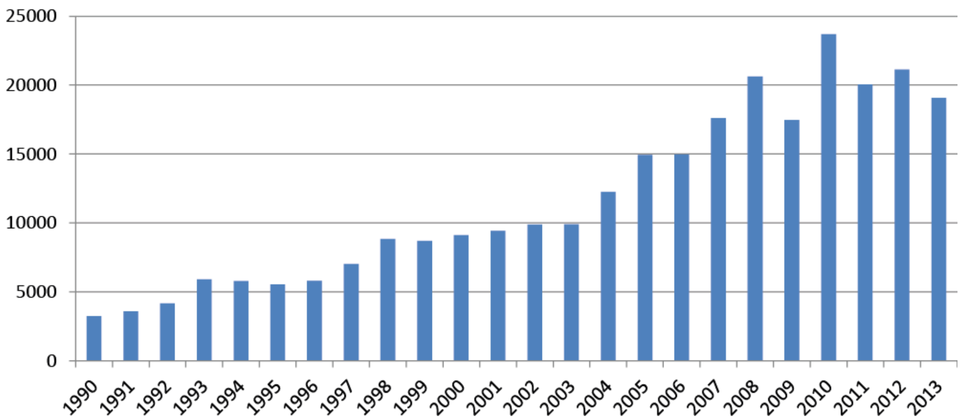
Trends: mortality, economic loss. Absolute and per-capita

Consistently with previous analysis most extensive risk impacts have an increasing trend, with a decrease in the last 3 years. The following charts show trends for the set of countries that have collected data for the period 1991 – 2013, 67 out of the 80 countries of the sample.

An interesting fact, still to be reviewed at the light of more up to date data is that years 2012 and 2013 were much lower in disaster losses than the previous years.

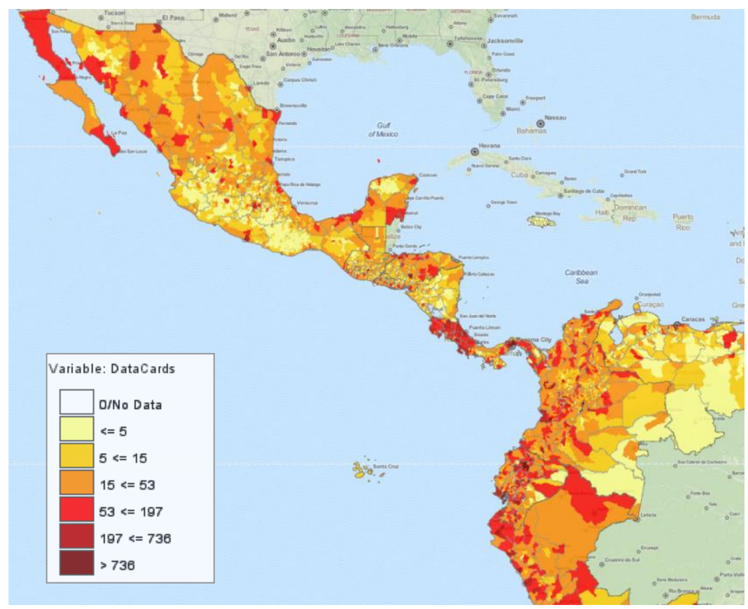
Frequency: taking number of records as proxy for frequency, given most extensive risk disasters are very localized, generating only one record per disaster, it can be seen a clear trend to increase, with the caveat of the last two years.

Figure 7: Number of extensive disaster records per year in countries with data 1990-2013



The wide distribution of extensive disasters can be illustrated in the Figure 8 where it can be seen that the majority of municipalities of the sample (in this case in Latin America) are affected by some manifestation of extensive risk.

Figure 8: Number of extensive disasters in municipalities in several Latin American countries.



The sample analyzed covers 1368 provinces or equivalent administrative divisions (in India, where states as as big as most countries, districts were taken), and 23135 municipalities. Out of these only 19 first level units (1.4%) are free of disasters, and about 63% of all municipalities have been affected by disasters (noting than half of those non-affected are in Spain, which has an extremely detailed network of 8088 municipalities).

Mortality: Both global and national datasets provide very similar numbers on fatalities, given it is probably the most reliable indicator of disaster impact (Figure 9 and Figure 10).

Figure 9: Mortality charts from all disasters EMDAT

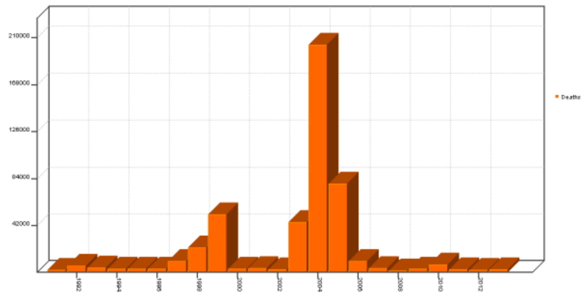
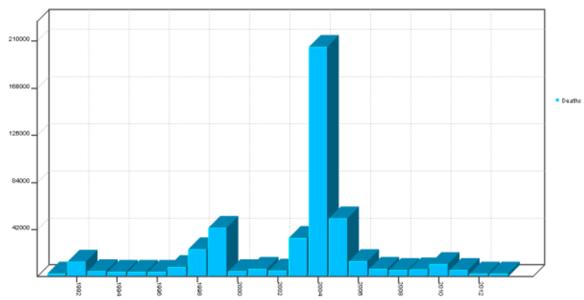
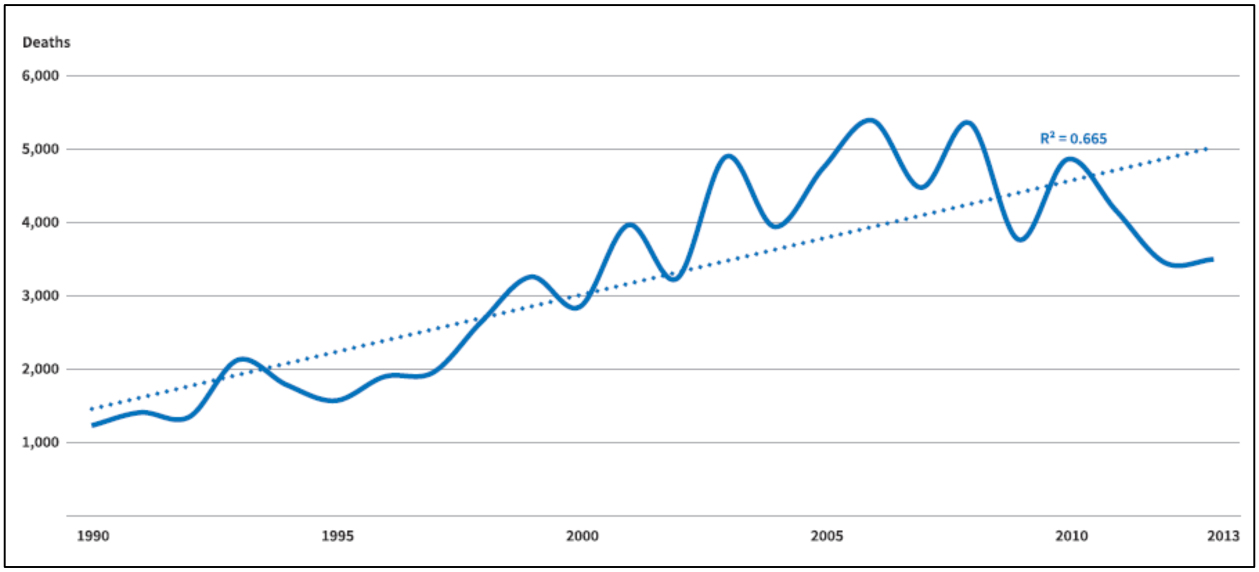


Figure 10: Mortality from National Databases.   Note similarity



In contrast to what risk assessments say about **catastrophic (intensive)** risk today being lower than 20 years ago, extensive mortality has continuously increased in the sample – same pattern as with previous smaller datasets. The number of fatalities per year has roughly more than triplicated in the past 25 years. Across the countries of the sample, extensive disasters are responsible for only 14 per cent of total disaster mortality. However, since 1990 extensive mortality has increased almost four-fold in those countries that have consistent data spanning that period (Figure 11), and the trend is statistically significant.

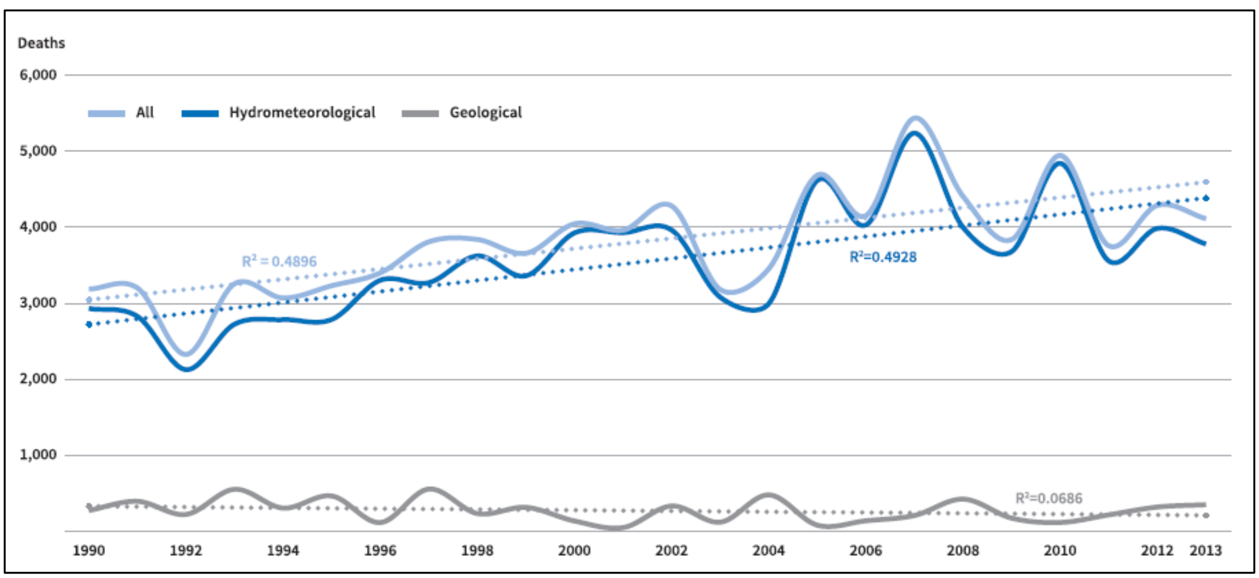
Figure 11: Mortality data from Extensive disasters (National Databases)



Source: National Disaster loss databases, consolidated dataset.

A similar trend can be observed among smaller-scale disasters in global loss data sets (Figure 12). There is a statistically significant trend towards increasing mortality in events with fewer than 100 deaths.

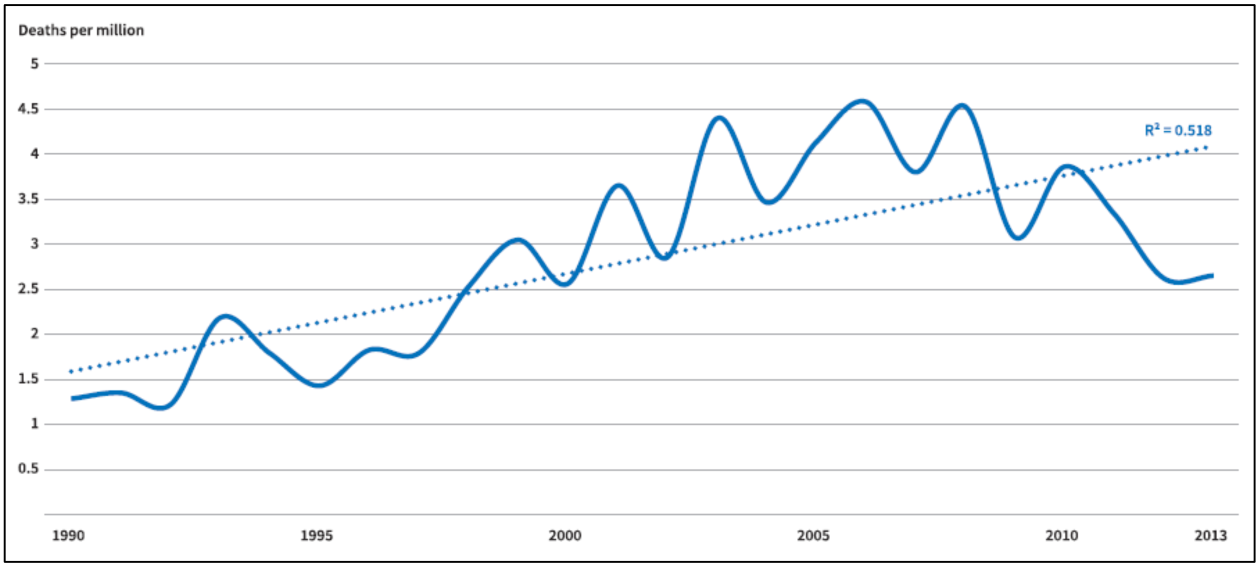
Figure 12: Mortality in events with fewer than 100 deaths (global data sets)



Source: UNISDR with data from EM-DAT.

Extensive disaster mortality is also increasing relative to population size (Figure 13).

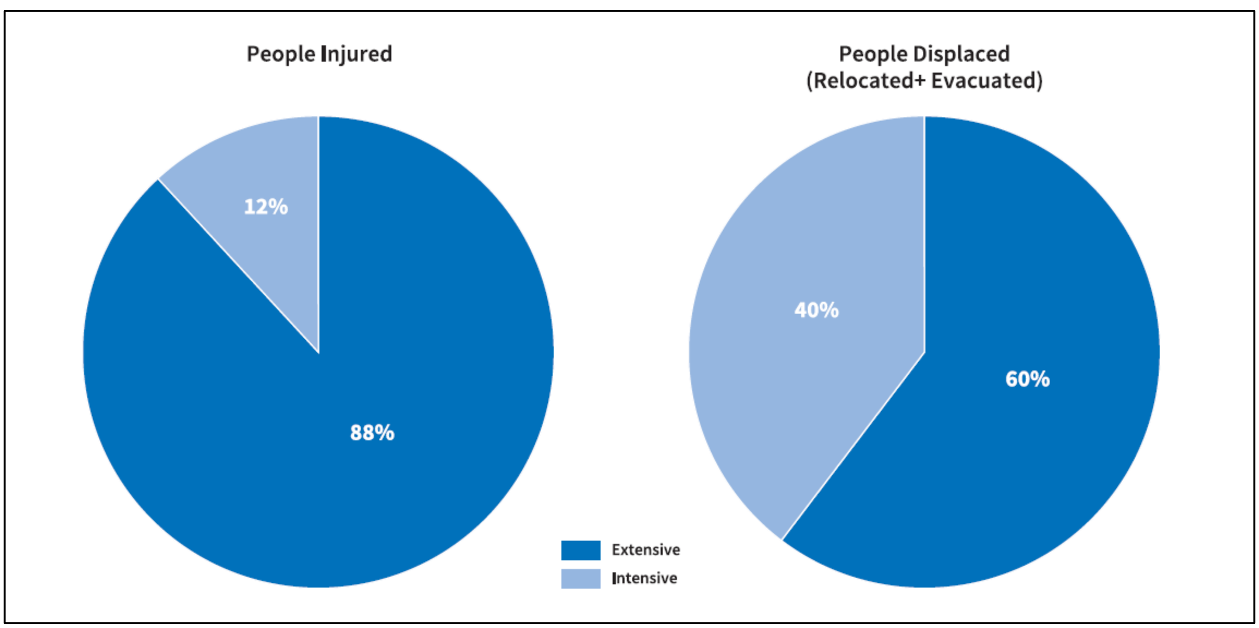
Figure 13: Extensive disaster mortality as a proportion of population (65 countries, 2 states)



Source: UNISDR with data from national disaster loss databases.

While extensive risk is responsible for only a small percentage of mortality, it is associated with a far more significant proportion of morbidity and displacement (Figure 14), both of which feed directly back into poverty.

Figure 14: Proportion of injured and displaced persons reported in extensive disasters (65 countries, 2 states)



Source: UNISDR with data from national loss databases.

This makes extensive risk a central concern for the low-income households and small businesses that depend on public infrastructure and for the local governments that provide it. These reported losses all show statistically significant upward trends from 1990 onward. In part, these trends reflect improved reporting in some countries. However, upon closer analysis, this bias has only a low to moderate influence on the overall trends.[2]

Economic losses due to extensive risk are (as overall losses) increasing dramatically. This increase is not the only relevant aspect of extensive losses. In Chapter 1 of GAR 2015 it is shown how these economic losses are constantly eroding economic growth and development of countries, taking back a substantial share of public and private investment.

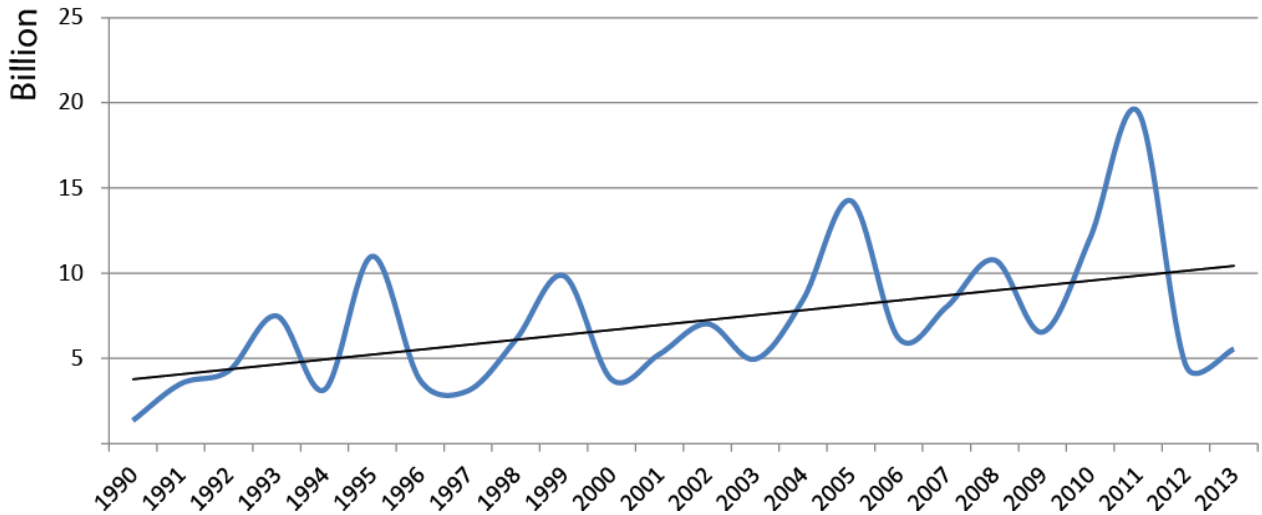
Extensive risk particularly challenges the achievement of sustainable development goals in areas and regions already characterized by social inequality and exclusion. The deficit of infrastructure in these areas is already an underlying driver of vulnerability and disaster risk and weakens resilience. The loss of this infrastructure in disasters further aggravates the situation, generating a vicious cycle. For example, a deficit of primary health facilities increases the vulnerability of low-income households that suffer flooding. Households with poor health are likely to be less resilient to disaster loss, and the damage or destruction of those facilities in disasters further compounds the situation.

The economic value of these social assets is significant. While the economic losses from intensive disasters are usually evaluated by governments or international organizations and insured losses are assessed by the insurance industry, the economic cost of extensive risk is largely unaccounted for and ultimately reabsorbed into poverty. Estimates of the cost of those unreported disasters highlight a growing and largely unknown economic loss since 1990 (Figure 15) as well as an overlooked poverty factor.

Economic losses due to extensive risk in the 80 countries sample has, at least, triplicated in average since 1990, **in constant value dollars.**

[2] Only a very small group of countries show an increasing trend that can be associated with improved reporting, but the population of those countries (and the impact reported) is low in comparison to the majority of countries with loss databases. The group with low reporting bias accounts for more than 95 per cent of the population represented (1.6 billion) and 74 per cent of all reports in the sample. Reports of mortality impacts show similarly stable patterns, and reports on other types of impacts show slightly higher trends which suggest that better reporting should be taken as one of the causes of the increase, but with a moderate to low influence. See Annex 2 for more details.

Figure 15: Economic loss from Extensive disasters. Figures in USD 2012



In Figure 16 and Figure 17, note the similarities on years with large scale disasters (1999, 2004, 2010, 2011) and higher losses in general for all years in national databases.

Figure 16: Economic loss charts from all disasters EMDAT

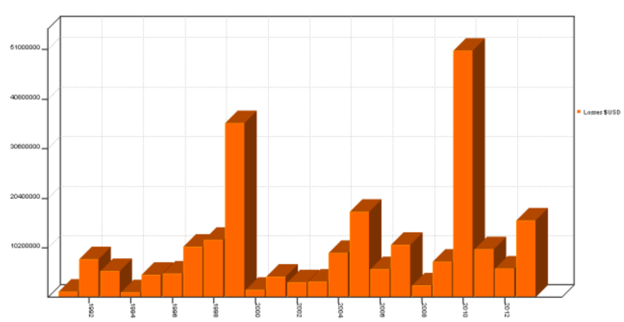
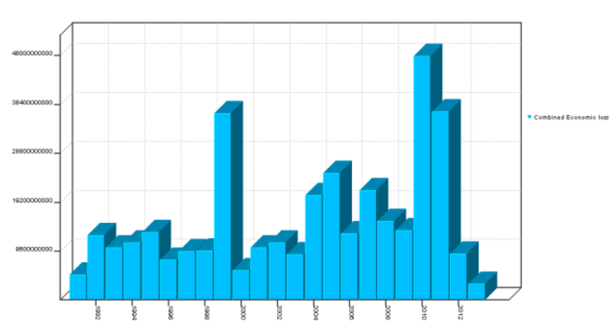
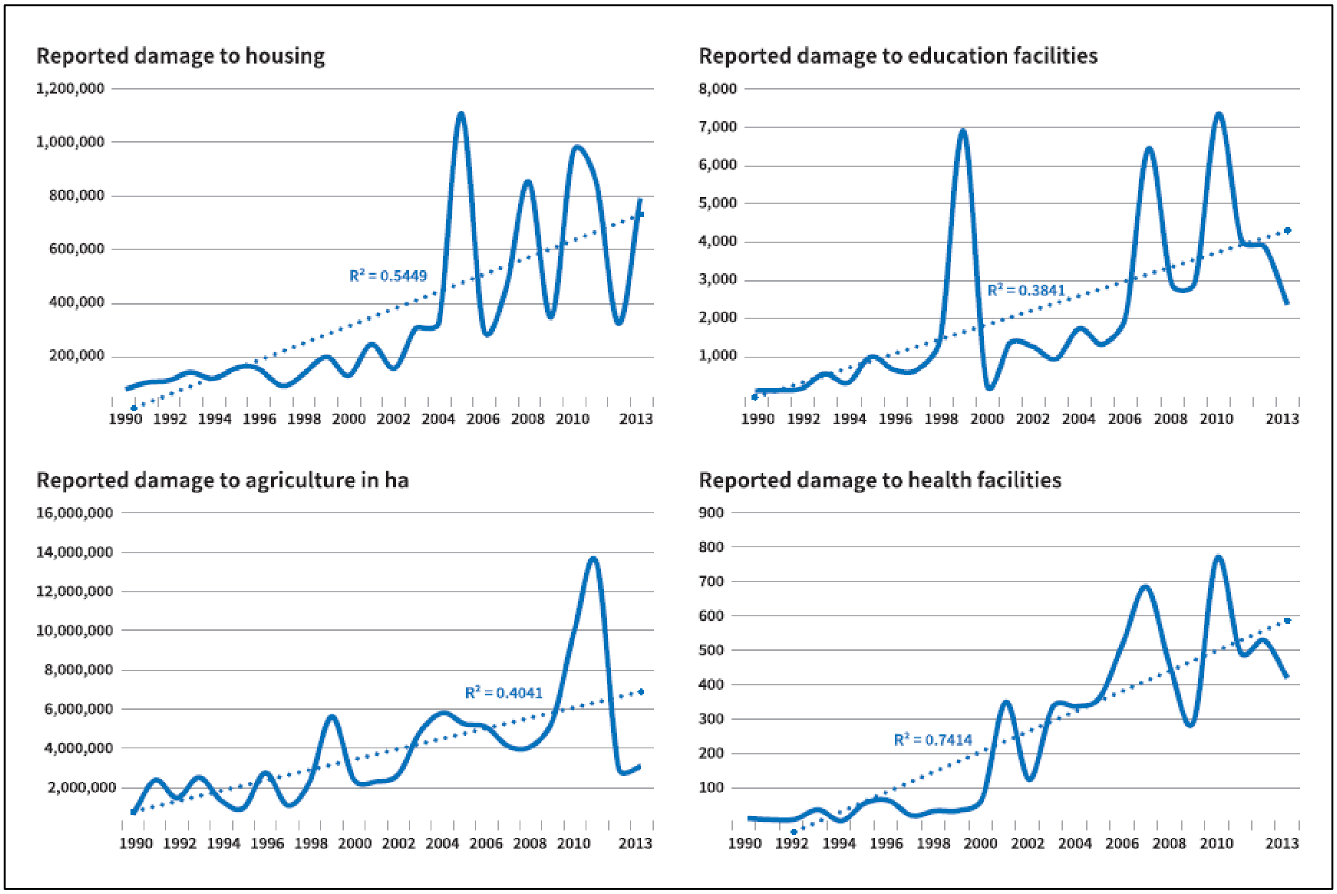


Figure 17: Losses recorded n National Databases



All indicators related to economic damage due to extensive risk continue to show an increasing trend. Among them the number of houses damaged, the number of schools and health facilities damaged, the number of hectares of crops damaged or lost, etc. The following charts show graphically this common pattern:

Figure 18: Reported damage from extensive disasters to housing, education and health facilities and agricultural production (65 countries, 2 states)



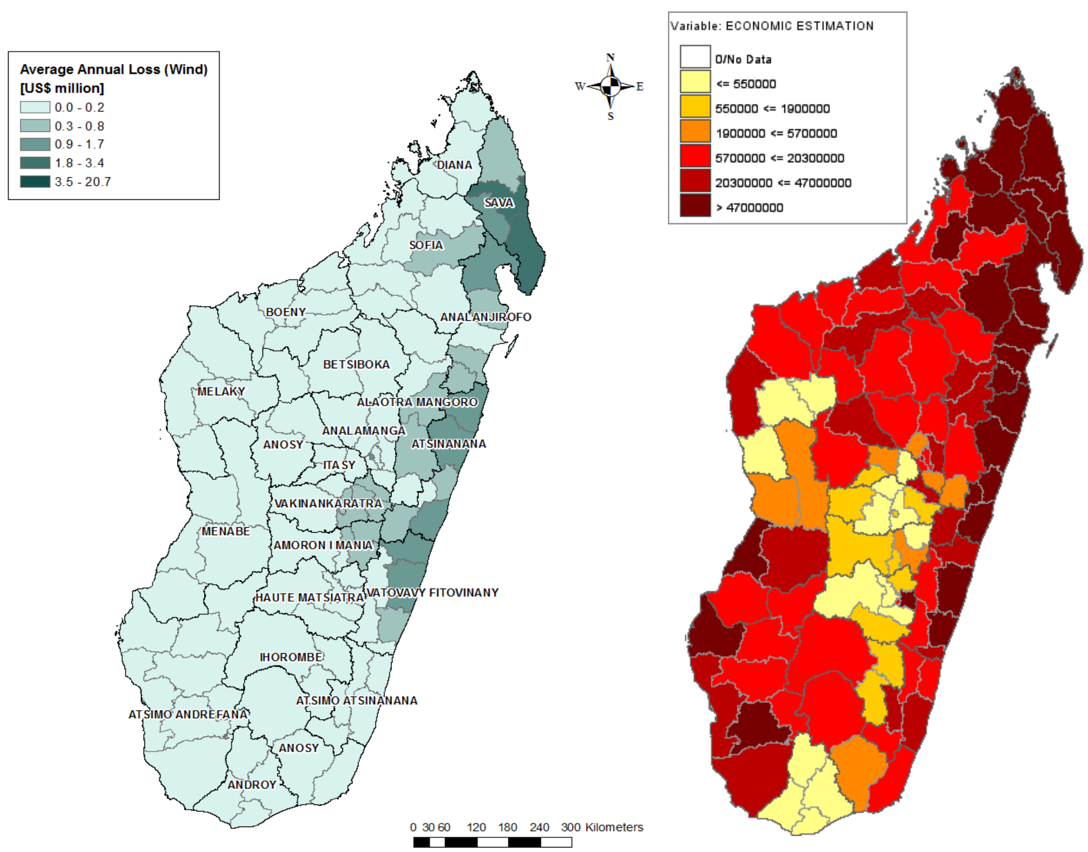
Disaster loss accounting and Risk Assessments.

One of the hypothesis that have been around for a long time is that realized risk (or the actual impact of disasters over a relevant period of time) should converge to the actual level of risk as the observation window grows up to allow capturing events of longer return periods. This should be particularly true in the case of relatively frequent (low return period), recurrent events such as floods or other weather related events.

The new GAR 2015 Global Risk Assessment and corresponding drill-down exercises have started to show how loss data can provide accurate proxy indicators of risk, and furthermore loss data can complement and provide additional highlights on aspects of risk such as higher than normal vulnerable areas.

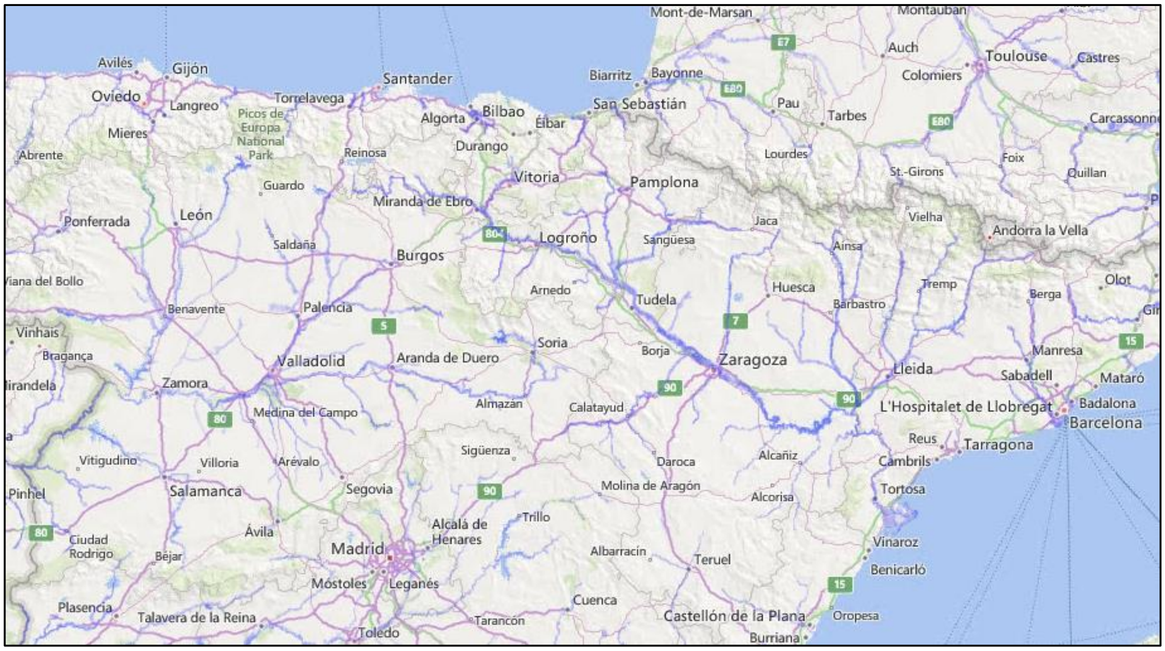
Figure 19 shows how the patterns of Expected Annual Average Loss (EAAL) closely match the patterns shown by recurrent losses due to cyclones in Madagascar, a country regularly battered by cyclones. It can also be seen that a few of the poorest districts in Madagascar, in the south east coast are historically more affected than what the risk assessment predicts. In this case the loss database presents evidence that those districts may present higher vulnerability than the currently assigned in the model.

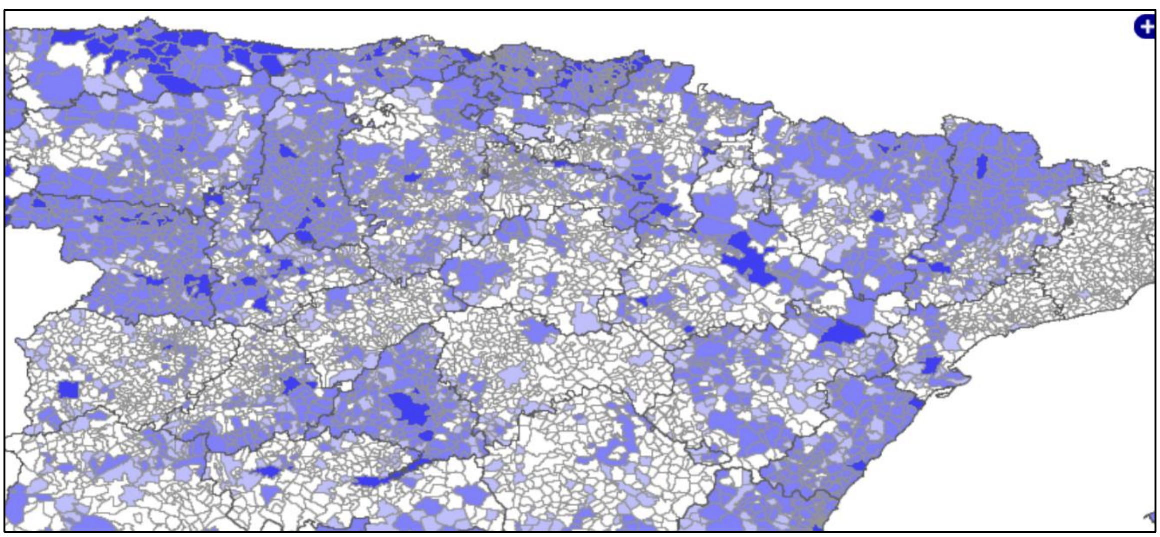
Figure 19: Madagascar - Cyclone probabilistic risk profile and Accumulated Cyclone losses



Note the overlapping patterns of riverine modelled floods and number of reports on each municipality in northern Spain in Figure 20.

Figure 20: Flood Hazard Map (500 yrs RP) and Historical Flood frequency in northern Spain





Analysis of data from Global Data Sources (EMDAT)

Global data from EMDAT has been thoroughly analysed by many authors, including CRED itself, with its newsletters and annual statistical reviews. In this short section of the annex there is an attempt to show a new perspective at looking at this important global data.

EMDAT trends are extremely useful as the level of reporting has been apparently uniform during the last two or three decades at least, since the inception of the database. It has to be noted that some of the charts that will be shown here have appeared in CRED's own publication.

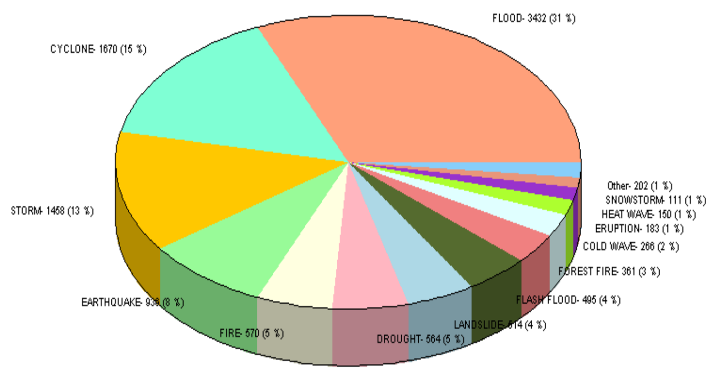
In order to have a comparable approach this annex analysis take into account the same set of hazards taken into account in the GAR Consolidated dataset, that is the set of disasters associated with hydro-meteorological and geological phenomena, including fires associated to drought and other weather conditions. This criteria excludes, for example, epidemics and industrial accidents, among others.

The composition, in terms of frequency, of disasters of this set, between 1970 and 2013 is shown in Table 4 and Figure 21.

Table 4: Frequency of disasters

Event	Records	Deaths	Affected
FLOOD	3,432	220,781	3,300,598,998
CYCLONE	1,670	771,561	679,187,732
STORM	1,458	32,661	252,148,001
EARTHQUAKE	936	1,055,888	172,627,260
FIRE	570	16,160	1,024,757
DROUGHT	564	680,621	2,030,063,658
LANDSLIDE	516	32,077	9,641,640
FLASHFLOOD	495	55,816	164,035,170
FORESTFIRE	361	2,096	5,934,301
COLDWAVE	266	15,710	12,381,234
ERUPTION	183	26,065	4,845,243
HEATWAVE	150	149,270	4,724,926
SNOWSTORM	111	3,709	81,226,703
AVALANCHE	91	4,178	73,615
COASTALFLOOD	77	3,258	20,823,059
TSUNAMI	30	251,216	2,905,635
SUBSIDENCE	2	321	3,138
TOTAL	**10912**	**3321388**	**6742245070**

Figure 21: Composition of disaster impacts by hazard in EMDAT



A most interesting fact is that earthquake disaster is number 4 in frequency, recorded with a higher recurrence than landslides, winter storms or droughts. The high participation in the landscape of disasters contrasts with the picture provided by national databases where geological phenomena disasters have less than 2% of the overall frequency.

This can be explained by the minimal threshold imposed to the records, and probably to reporting biases, as earthquakes are usually very well documented (and sensed) by a wide geological observation network.

In the same line of logic, there are less Storm disasters (local convective storms, extra-tropical cyclones, tropical depressions, etc.) than Cyclones, a fact that seems completely counter-intuitive, but may be explained by the fact that EMDAT only captures events of a certain magnitude, and the fact that along earthquakes, cyclones are very well documented, when they do landfall are very damaging, and also very well exposed in media sources.

As shown in the next sections, national disaster loss databases present a very different picture, taking into account the number of countries sampled (data collected only considers 82 countries) it is easy to see that the most frequent disasters are floods, landslides, droughts, etc. Earquake only appears in position 10 and cyclone on position 17, in a probably better correlation of disasters with frequency (return period).

Comparison and consolidation of national and global data sources with GAR 2015 dataset

Annex II of the 2013 Edition of presented a systematic comparison between EMDAT and the consolidated GAR dataset for that edition, containing data for 54 countries and 2 Indian states. In order to follow up and continue confirming or to dismiss the conclusions of that study, the same comparison has been made using GAR 2015 82 countries and 3 states data.

Figure 22 and Figure 23 make a same set of countries comparison by frequency of hazards, showing again a pattern in which geological disasters are much more prominent in EMDAT that localized disasters such as landslides or flash flood. Again, the number of earthquake disasters in EMDAT for the 82 countries sample is third in frequency, above all other weather related disasters, and the number of cyclones surpasses greatly the number of local storms (which include winter storm events).

Figure 22: EMDAT composition by hazard (80 countries of GAR sample)

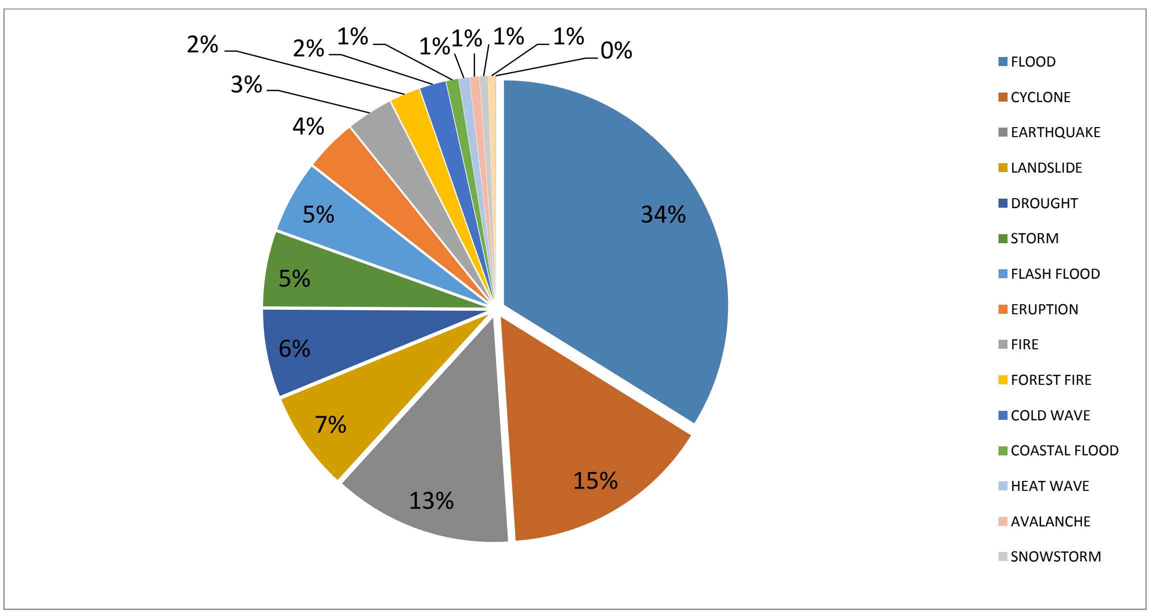
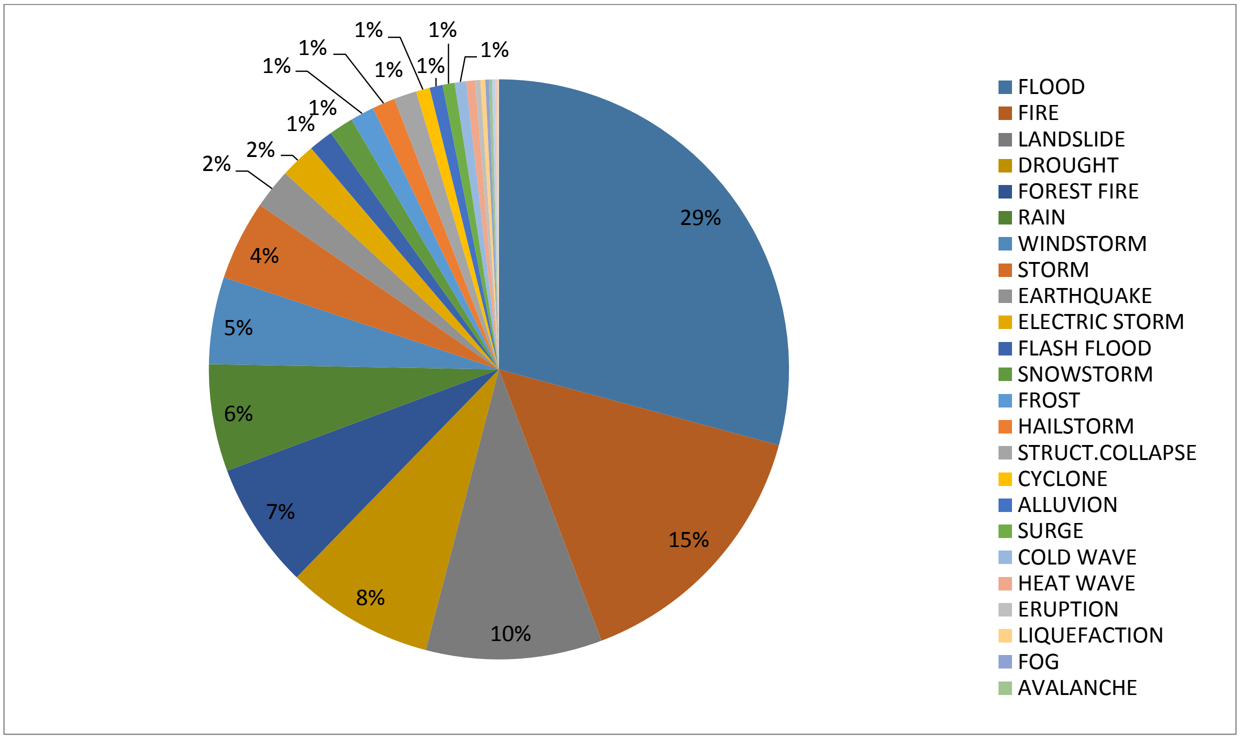


Figure 23: Frequency by hazard, National databases



National databases show a somewhat different perspective, once smaller events are included: Earthquake records represent only 2% of all records, while localized hazards such as landslides, local storms, forest fires and windstorms are of higher frequency. The overall ratio or climate and weather related hazards is much higher than in EMDAT.

Economic loss compared by hazard is also very different if looked from the international perspective than from the national perspective.

Figure 24 shows that 34% of all losses in the 82 countries sample are due to Earthquakes, the highest source of economic losses, close to the combined losses of the second and third causes (cyclones and floods - 41%).

This 34% of earthquake losses drops to 15% in national databases, which show (see Figure 25) that floods are the highest source of losses (also 34%) and show that losses in weather related events follow a pattern that is linked to the frequency of many small and medium events: local storms and extreme rain precipitation events accumulate more losses than cyclones, despite these are very destructive, but the accumulated impact of very high frequency events associated to extensive risk surpasses the relatively infrequent cyclones.

It is interesting to note that both data sources coincide in the measurement of losses associated to drought events, 8% of total losses.

Figure 24: Loss by hazard in EMDAT

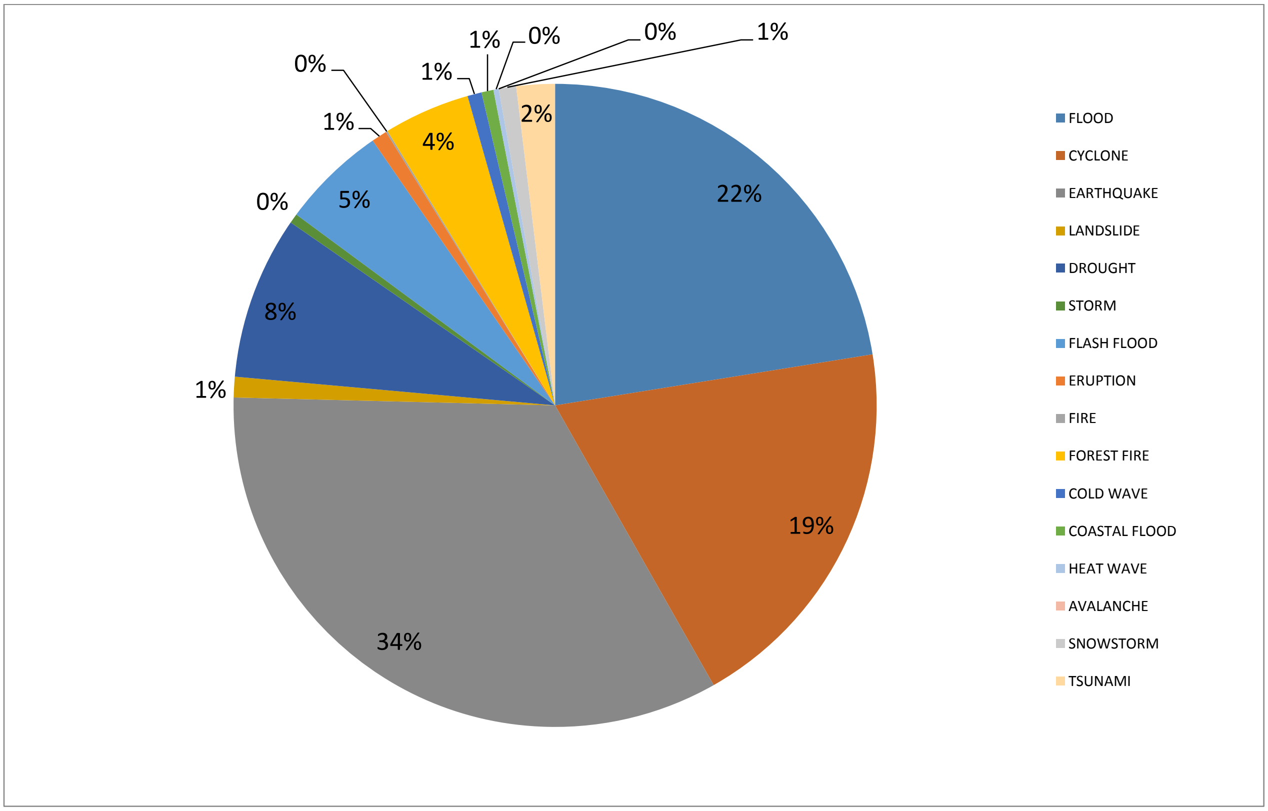
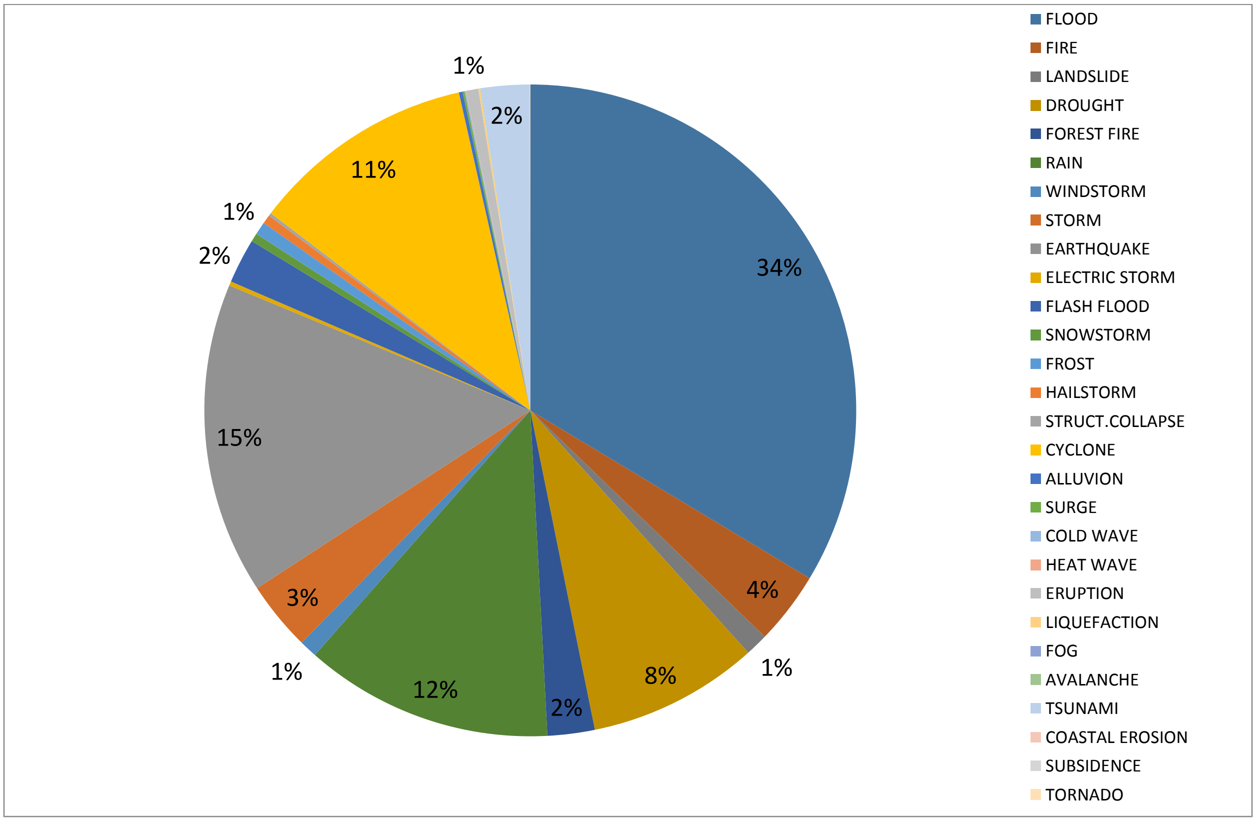


Figure 25: Loss by hazard, National databases



The objective of the comparison is to establish what could be the real level of economic losses due to natural hazard disasters, given there is a minimal threshold to report in EMDAT (i.e. it doesn't purposely register small and medium disasters) , and given that in that dataset there are only 30% of records with an economic valuation.

The comparison uses two methods: bulk comparison (total figures of losses are compared between the two databases) and a dataset consolidation method.

The bulk comparison method compares totals by year (on years on or after 1991, when all countries of the sample started reporting losses), against the conservative **direct losses,** and based on the statistics of all available DALA's and ECLAC assessments adding a 50% of direct losses as (also conservative) estimate to obtain total losses.

Results are shown in Table 5, but give a first indication that losses should be at least 50-60% unregistered in EMDAT.

Table 5: comparison of EMDAT and nationally reported losses

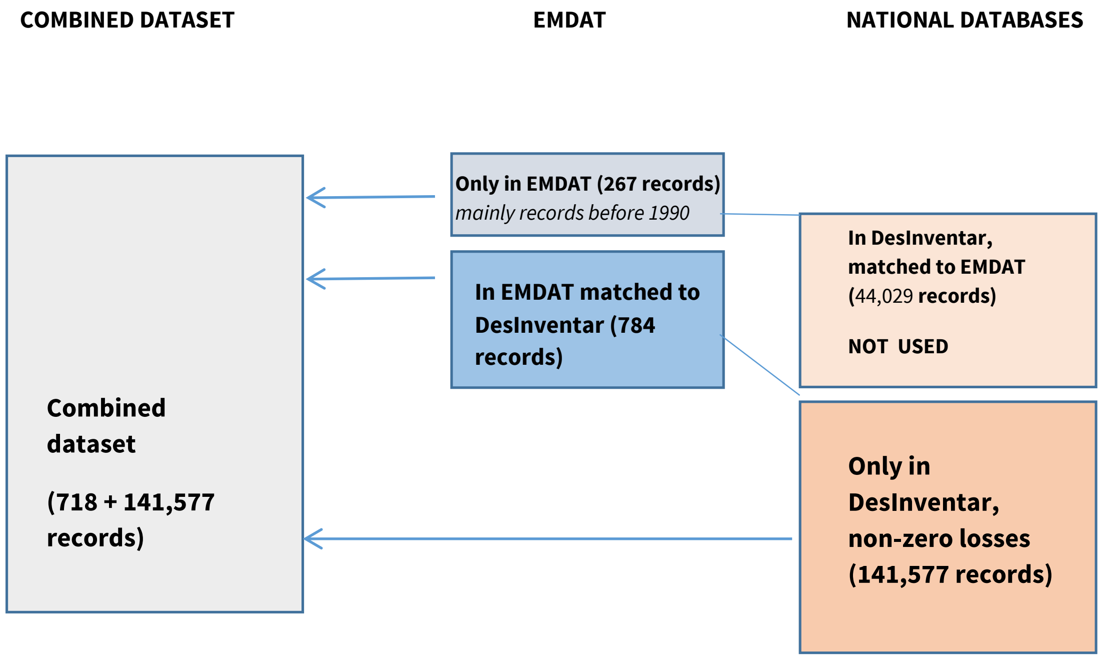
Year	LossesEMDAT	DirectLossesNatl.	Direct+Indirect	
1991	2,612,255,787	3,053,780,345	4,580,670,517	175%
1992	12,290,006,368	3,605,346,736	5,408,020,104	44%
1993	8,320,925,734	8,372,795,801	12,559,193,701	151%
1994	1,745,882,657	5,652,146,097	8,478,219,145	486%
1995	6,664,427,611	2,622,451,311	3,933,676,967	59%
1996	6,924,652,844	4,969,661,381	7,454,492,072	108%
1997	14,619,135,655	6,169,042,207	9,253,563,310	63%
1998	16,036,559,894	7,491,707,817	11,237,561,726	70%
1999	47,881,825,079	11,763,132,729	17,644,699,094	37%
2000	2,085,774,806	6,055,594,345	9,083,391,517	435%
2001	5,477,293,660	22,995,011,192	34,492,516,787	630%
2002	4,095,101,681	23,810,239,570	35,715,359,355	872%
2003	4,092,969,863	9,226,955,028	13,840,432,541	338%
2004	11,152,405,723	21,854,202,507	32,781,303,760	294%
2005	20,417,276,810	18,371,384,109	27,557,076,164	135%
2006	6,535,561,273	13,490,374,111	20,235,561,167	310%
2007	11,933,641,803	18,645,852,197	27,968,778,295	234%
2008	2,636,498,928	15,821,632,258	23,732,448,388	900%
2009	8,144,117,132	15,810,339,678	23,715,509,517	291%
2010	53,551,264,003	37,858,054,260	56,787,081,390	106%
2011	10,230,865,015	24,577,335,465	36,866,003,198	360%
2012	6,346,327,552	10,798,365,335	16,197,548,002	255%
2013	15,880,554,000	5,365,844,524	8,048,766,786	51%
TOTAL	**279,675,323,879**	**298,381,249,002**	**447,571,873,503**	**160%**

The second method aims at consolidating both datasets by taking EMDAT as a baseline, and, as per the question that sparked the exercise add:

- All records below the EMDAT threshold (not registered purposely in EMDAT)
- Records corresponding to those in EMDAT without a loss estimation (about 70% or records in EMDAT don't have an economic loss figure)

It is worth noting again that some countries do not have records, of have only few ones prior to 1991, reason of a number of records in EMDAT not having a equivalent on national databases. The consolidation, however takes the full 43 years of data given there are quite a few very strong and well established national dataset with that time coverage.

The following diagram depicts how the consolidation is designed:



Differences found between the internationally reported losses and those obtained by valuation of physical impact recorded in national datasets can be explained in a number of ways.

On one hand losses in national datasets do not include damage to high value infrastructure assets (bridges, utility networks, large buildings, damns, monuments, etc.) and does not include damage to the Industrial and Commercial subsectors. This explains why some countries which have suffered large scale disasters, especially of geological nature, have much higher losses in EMDAT. A good example is Iran.

On the other hand it is well known that national datasets contain much more information about small and medium disasters, which are not captured in EMDAT. This explains differences in countries where extensive risk accounts for the majority of the losses, like in Mali, Vietnam or Colombia.

These facts inspired the second method aiming to obtain a more realistic picture of what real losses are.

The principles behind this method are simple:

- When economic loss was found to be reported internationally, it was used. This ensures on one hand that high cost infrastructure asset losses, industrial and commercial as well as indirect losses are considered. This is based on the assumption that reported losses have been taken and validated from authorized sources, which should account for all these losses.

- All other losses are then taken from the national loss datasets. This ensures that small and medium disasters (those below the threshold and those which wer not 'catched' by EMDAT) as well as those for which no economic valuation is available internationally are taken into account. EMDAT has 3568 entries for the set of 82 countries considered, in the period 1970-2013.

Therefore the combined dataset was assembled in the following way:

- All records from EMDAT *with economic loss reported* for the 82 countries of the sample were taken as a primary base, a total of 1051 records of disasters: 300 more than the 718 records considered in GAR 2013. This difference comes from the inclusion of **25** disaster prone countries, including countries like Pakistan, Turkey, Spain, Albania, and Serbia.
- Using a two pass approach, the set of matching records was identified in the national datasets.
- The first pass was completely automated and matched events based on several criteria, including date (a range of dates around the EMDAT dates was used), a similar family of hazard (i.e. floods, flash floods, heavy rains, and similar were grouped and matched to flood events when they were within the range of dates and geographically near (same country, same provinces) .
- Once this automated procedure was carried out a thorough and comprehensive manual revision of each of the 1051 disasters was conducted. This manual revision matched records such as droughts and other long onset disasters, and tried to find manually matches for all EMDAT records without one after the first pass. The level of matching was only 75% due to several factors, among them:
  - Several of the new countries do not have data for all of the 43 years considered since 1970.
  - Spain produces a database concentrated in Floods and Storms – thus missing all other hazards.

- This two pass process matched national dataset equivalents for 784 of the 1051 target disasters, involving **44,029** records in the national datasets. These 44,029 records were assigned a "DISNO", or EMDAT Disaster Number. The resulting data can be queried in www.desinventar.net, in the GAR 2015 Consolidated database. The DISNO was stored in the GLIDEnumber field of the disaster table. The number of records in national datasets is much higher due to several factors, being the most important the disaggregation of the data (a disaster that affects multiple municipalities is reported one record per municipality, and that a large scale disaster may be perceived as multiple smaller disasters of different types (i.e. flood, flash flood heavy rain, landslides.)

- Once the 44,029 common records were identified, the remaining records containing a non-zero direct economic loss were 'added' to the original sample of 1051 EMDAT records, a total of 155,476 non-zero records (out of 305,254 total records).

The combined record set assembled in this way has the following characteristics:

- It contains the total losses reported internationally and registered in EMDAT. This accounts to **295 billion** USD spread over the 43 year of the comparison.
- It contains all possible records associated to extensive risk that are not captured by EMDAT. **Direct** loss associated to these records amounts to **178 billion USD**.
- Given the nature of the economic valuation (only direct losses) and the statistic from DaLA's that indirect damage is approximately 50% of direct damage, both direct and indirect losses can be added, depending on how conservative the new set valuation is wanted.

These conclusions, however, must be taken at face value. The sample used is still taken from a relatively small sample - 82 countries, and EMDAT has global coverage. It is very difficult to demonstrate that this pattern would be the same in all countries of the world, especially in developed economies, although a sample of this size, taken from 3 continents **could be considered reliable for developing countries.**

As mentioned also in previous annexes, GAR 2011 featured a comparison of extensive risk behaviour using data culled from SHELDUS and 22 national datasets. Losses reported for the period 1991 to 2008 were very close (441 billion USD in EMDAT and 429 billion in SHELDUS) making internationally reported losses only 3% higher in a bulk comparison. However, SHELDUS losses only consider direct damage (losses to infrastructure and agricultural crops) so the conclusions presented here should stand based on the assumption of an additional 50% on indirect losses.

Table 6: Matched losses

Country (All losses in million USD 2013)	TOTAL NATIONAL RECORDS	TOTAL DIRECT LOSSES	MATCHED NATIONAL RECORDS	MATCHED NATIONAL DIRECT LOSSES	NOT MATCHED RECORDS	NOT MATCHED NATIONAL LOSSES	EMDAT LOSSES	CONSOLIDATED (EMDAT+NOT MATCHED)
Mexico	26,987	44,251	5,742	23,319	21,245	20,932	41,144	62,076
Turkey	3,203	3,737	30	3,258	3,173	479	35,069	35,548
Chile	4,917	29,990	314	23,244	4,603	6,747	34,919	41,665
Indonesia	15,448	30,171	759	19,803	14,689	10,368	32,113	42,480
I.R. Iran	4,824	15,567	819	3,290	4,005	12,277	29,247	41,524
Pakistan	3,716	62,147	384	5,605	3,332	56,542	27,415	83,957
España	7,994	378	1,210	78	6,784	299	21,596	21,896
Vietnam	1,459	14,399	727	11,859	732	2,540	12,254	14,794
Argentina	7,527	11,451	539	1,310	6,988	10,141	8,085	18,226
Colombia	26,876	14,008	988	1,953	25,888	12,055	6,061	18,116
Honduras	5,529	2,396	891	1,199	4,638	1,197	6,039	7,236
El Salvador	4,537	4,316	987	3,995	3,550	321	5,641	5,962
Venezuela	4,090	2,408	262	1,313	3,828	1,095	4,679	5,774
Guatemala	5,592	2,112	819	1,343	4,773	768	3,674	4,442
Sri Lanka	20,969	4,208	1,710	2,041	19,259	2,167	2,726	4,894
Ecuador	13,569	2,502	141	132	13,428	2,370	2,430	4,800
Yemen	1,612	575	53	56	1,559	519	2,115	2,633
Bolivia	3,771	2,775	387	127	3,384	2,647	2,095	4,742
Morocco	713	528	12	71	701	456	2,050	2,506
Jamaica	535	1,155	216	1,148	319	7	1,853	1,861
Cambodia	4,868	2,108	29	7	4,839	2,100	1,766	3,866
Peru	9,227	6,903	558	3,346	8,669	3,557	1,563	5,120
Nicaragua	1,157	1,098	100	178	1,057	921	1,544	2,465
Costa Rica	12,727	676	981	341	11,746	336	1,395	1,730
Grenada	53	214	9	138	44	76	1,076	1,152

Guam	7	19	5	19	2	-	1,067	1,067
Samoa	13	39	7	30	6	10	1,043	1,053
Madagascar	1,340	8,839	237	7,038	1,103	1,801	1,036	2,837
Mozambique	3,255	11,710	322	3,276	2,933	8,435	948	9,382
Saint Kitts and Nevis	406	24	75	19	331	5	876	881
Guyana	750	556	35	392	715	164	781	945
Laos	3,703	1,782	63	32	3,640	1,750	715	2,464
Belize	106	1,766	22	81	84	1,685	713	2,399
Antigua and Barbuda	357	104	87	80	270	24	644	668
Maldives	1,584	101	236	80	1,348	21	606	627
Jordan	511	28	12	-	499	28	606	633
Fiji	68	222	25	220	43	2	491	494
Mauritius	1,010	32	4	12	1,006	20	491	511
Nepal	15,246	4,134	307	404	14,939	3,730	423	4,153
Uruguay	1,378	205	26	15	1,352	189	420	610
Tunisia	1,802	602	43	339	1,759	262	385	647
Dominica	294	23	24	13	270	10	298	308
Kenya	1,225	495	18	1	1,207	494	273	768
Papua New Guinea	122	358	8	8	114	350	257	607
Panama	3,820	2,045	74	131	3,746	1,914	246	2,160
American Samoa	2	-	1	-	1	-	240	240
Lebanon	2,305	34	24	1	2,281	33	234	266
Serbia	1,408	808	1	79	1,407	729	139	868
Uganda	2,249	650	36	273	2,213	377	108	485
Tonga	23	31	6	26	17	5	83	88
Paraguay	367	350	20	44	347	305	74	379
Niger	1,200	1,479	22	21	1,178	1,459	68	1,526
Senegal	319	228	5	0	314	228	61	290
Trinidad and Tobago	2,092	30	11	1	2,081	29	56	85
Ethiopia	8,545	1,005	217	34	8,328	972	49	1,021

New Caledonia	8	-	1	-	7	-	49	49
Niue	5	-	1	-	4	-	48	48
Seychelles	630	16	52	6	578	9	47	56
Saint Lucia	127	31	21	16	106	15	45	60
Albania	3,112	351	37	56	3,075	295	33	327
Saint Vincent & Grenadines	173	46	24	11	149	35	20	55
French Polynesia	8	-		-	8	-	12	12
Vanuatu	53	547	1	12	52	535	9	544
Comoros	85	7		-	85	7	5	12
Bhutan	250	95		-	250	95	5	100
Tokelau	3	-	2	-	1	-	4	4
Djibouti	326	1	1	0	325	1	3	5
Federated States of Micronesia	15	49	4	10	11	38	1	39
East Timor	824	92		-	824	92	-	92
Marshall Islands	9	2		-	9	2	-	2
Mali	1,354	663		-	1,354	663	-	663
Palau	4	4		-	4	4	-	4
Palestine	272	4		-	272	4	-	4
Solomon Islands	42	97		-	42	97	-	97
Sierra Leone	289	47		-	289	47	-	47
Syria	7,138	292		-	7,138	292	-	292
Tuvalu	10	1		-	10	1	-	1

These conclusions, however, must be taken at face value. The sample used is still taken from a relatively small sample - 82 countries, and EMDAT has global coverage. It is very difficult to demonstrate that this pattern would be the same in all countries of the world, especially in developed economies, although a sample of this size, taken from 3 continents **could be considered reliable at least for developing countries.**

GAR 2011 featured a comparison of extensive risk behaviour using data culled from SHELDUS and 22 national datasets. Losses reported for the period 1991 to 2008 were very close (441 billion USD in EMDAT and 429 billion in SHELDUS) making internationally reported losses only 3% higher in a bulk comparison. However, SHELDUS losses only consider direct damage (losses to infrastructure and agricultural crops) so the conclusions presented here should stand based on the assumption of an additional 50% on indirect losses.

Table 7: Agricultural losses calculation

In black: Value calculated with FAO Data

In red: Value extrapolated with WB Data

Country Name	ISO_3_code	Average price for crops / ha (in US$ 2011)	Average price per cattle lost (100kg)(in US$ 2011)
Afghanistan	AFG	988.8930609	206.552244
Albania	ALB	3382.508524	346.7175
Algeria	DZA	3455.266482	273.8995419
American Samoa	ASM	4472.6	242.27
Andorra	AND	4092.2	222.06
Angola	AGO	3597.59397	273.225402
Antigua and Barbuda	ATG	9450.458715	256.5799201
Argentina	ARG	876.9554625	163.465
Armenia	ARM	3775.77199	417.8833333
Aruba	ABW	14718.38933	290.5179127
Australia	AUS	1018.731579	196.265
Austria	AUT	3463.839685	396.25
Azerbaijan	AZE	2285.758076	207.974
Bahamas, The	BHS	13098.80865	280.0839641
Bahrain	BHR	13508.07103	282.7205865
Bangladesh	BGD	936.2326933	247.1628095
Barbados	BRB	10589.645	263.9189871
Belarus	BLR	1680.130123	194.96
Belgium	BEL	6621.161607	299.762
Belize	BLZ	3674.147995	270.5171228
Benin	BEN	2646.29472	251.9251318
Bermuda	BMU	40123.55069	454.1875277
Bhutan	BTN	3246.426897	279.2277711
Bolivia	BOL	1991.957659	270.7993141
Bosnia and Herzegovina	BIH	1579.171494	270.7951872
Botswana	BWA	3167.121602	288.4543773
Brazil	BRA	1766.539373	317.7271735
Brunei Darussalam	BRN	21300.42299	332.9218517
Bulgaria	BGR	1117.882042	221.535
Burkina Faso	BFA	1013.663476	218.9140866
Burundi	BDI	678.1955694	80.31863709
Cabo Verde	CPV	2161.926288	486.095
Cambodia	KHM	1171.093738	297.4807198
Cameroon	CMR	1705.690786	224.7540362

Canada	CAN	991.4688137	180.6866667
Cayman Islands	CYM	4092.2	222.06
Central African Republic	CAF	906.8535619	165.609879
Chad	TCD	684.1319236	341.4781691
Channel Islands	CHI	4092.2	222.06
Chile	CHL	10173.74589	211.7041254
China	CHN	4642.866075	234.1325
Colombia	COL	3933.131642	207.805
Comoros	COM	1166.482969	295.1796847
Congo, Dem. Rep.	COD	822.6745312	123.5997663
Congo, Rep.	COG	2117.492075	316.0004595
Costa Rica	CRI	8528.930448	117.89
Cote d'Ivoire	CIV	1868.311442	226.2780519
Croatia	HRV	1888.354609	275.59
Cuba	CUB	3446.312749	278.577332
Curacao	CUW	4092.2	222.06
Cyprus	CYP	4274.440647	300.9175786
Czech Republic	CZE	1691.755524	212.8666667
Denmark	DNK	1839.802773	198.5666667
Djibouti	DJI	1893.774028	235.4463588
Dominica	DMA	3305.175745	283.5703864
Dominican Republic	DOM	2876.198169	275.0461795
Ecuador	ECU	1911.774269	144.91
Egypt, Arab Rep.	EGY	2066.855329	380.066
El Salvador	SLV	1624.900466	188.1
Equatorial Guinea	GNQ	13291.28693	281.3239817
Eritrea	ERI	868.6886481	146.5634215
Estonia	EST	902.7857665	214.2666667
Ethiopia	ETH	807.6019593	106.5814286
Faeroe Islands	FRO	4092.2	222.06
Fiji	FJI	3739.133334	268.2181132
Finland	FIN	1244.958414	286.9079773
France	FRA	3163.7641	273.4519896
French Polynesia	PYF	4092.2	222.06
Gabon	GAB	2472.746713	313.0195267
Gambia, The	GMB	922.5832009	173.4598614
Georgia	GEO	1504.054532	202.61
Germany	DEU	2628.742173	277.3603069
Ghana	GHA	2058.551818	240.8334724
Greece	GRC	4747.297981	268.86
Greenland	GRL	4092.2	222.06

Grenada	GRD	3215.992862	286.7254412
Guam	GUM	4092.2	222.06
Guatemala	GTM	2097.570717	308.8273809
Guinea	GIN	878.6529695	151.5361833
Guinea-Bissau	GNB	976.3859352	200.3104786
Guyana	GUY	2391.061683	522.5433333
Haiti	HTI	1082.088312	253.0619623
Honduras	HND	1987.113939	269.0552371
Hong Kong SAR, China	HKG	18820.43953	316.9448646
Hungary	HUN	1472.309698	271.7366667
Iceland	ISL	22540.72664	276.6226595
India	IND	1902.492859	238.5857462
Indonesia	IDN	2123.880752	388.4925
Iran, Islamic Rep.	IRN	3284.374398	556.84
Iraq	IRQ	3451.706219	278.3865253
Ireland	IRL	2151.898426	260.81
Isle of Man	IMN	4092.2	222.06
Israel	ISR	15456.86237	483.5525
Italy	ITA	4534.729005	253.94
Jamaica	JAM	15907.11204	274.347316
Japan	JPN	22838.11749	873.585
Jordan	JOR	3316.5717	270.2656612
Kazakhstan	KAZ	452.0161401	244.436
Kenya	KEN	1122.532084	311.015
Kiribati	KIR	1924.968049	246.6783821
Korea, Dem. Rep.	PRK	565.8	
Korea, Rep.	KOR	14215.90806	232.9228245
Kosovo	KSV	2150.525269	327.8947132
Kuwait	KWT	25632.62145	360.8315054
Kyrgyz Republic	KGZ	1667.482772	284.5325
Lao PDR	LAO	1871.076862	373.02
Latvia	LVA	1058.43626	158
Lebanon	LBN	5497.463268	296.055
Lesotho	LSO	1866.475086	225.6168355
Liberia	LBR	825.5413979	125.0304955
Libya	LBY	3508.354086	276.3824734
Liechtenstein	LIE	4092.2	222.06
Lithuania	LTU	1081.81178	194.8566667
Luxembourg	LUX	50995.01559	411.9
Macao SAR, China	MAC	32198.07413	403.1286236
Macedonia, FYR	MKD	3186.610566	258.8166667

Madagascar	MDG	942.5043197	173.02
Malawi	MWI	816.6928843	120.6145851
Malaysia	MYS	2023.563059	381.048
Maldives	MDV	3367.531	281.3644222
Mali	MLI	433.6340867	328.9166667
Malta	MLT	8187.842016	281.4204157
Marshall Islands	MHL	3921.105191	261.7804296
Mauritania	MRT	1854.022923	221.1331884
Mauritius	MUS	4461.533048	473.7533333
Mexico	MEX	1707.697654	167.675
Micronesia, Fed. Sts.	FSM	2070.017211	298.9061973
Moldova	MDA	1253.397146	159.7333333
Monaco	MCO	72416.33752	662.2298194
Mongolia	MNG	1087.452299	141.2866667
Montenegro	MNE	3242.430271	285.7901555
Morocco	MAR	1177.725869	300.7216558
Mozambique	MOZ	917.5603352	170.9531664
Myanmar	MMR	565.8	
Namibia	NAM	3520.308566	275.9595555
Nepal	NPL	799.6094426	234.1199419
Netherlands	NLD	10676.56093	177.3425
New Caledonia	NCL	4092.2	222.06
New Zealand	NZL	5266.739938	191.5333333
Nicaragua	NIC	1918.16678	128.68
Niger	NER	237.4202184	142.7283333
Nigeria	NGA	2014.787076	279.0194966
Northern Mariana Islands	MNP	4092.2	222.06
Norway	NOR	2726.951362	397.7804079
Oman	OMN	6835.300456	284.518935
Pakistan	PAK	1865.028582	225.0959933
Palau	PLW	2683.449735	305.5654103
Panama	PAN	1923.551907	295.6411095
Papua New Guinea	PNG	1928.602275	247.9869567
Paraguay	PRY	1089.494931	332.5270037
Peru	PER	2593.465241	157.92
Philippines	PHL	1252.582264	196.085
Poland	POL	1361.197128	218.488
Portugal	PRT	3359.268791	252.9266667
Puerto Rico	PRI	15319.15254	294.3882555
Qatar	QAT	41333.86012	461.9847968
Romania	ROU	2000.264643	195.0666667

Russian Federation	RUS	838.1992182	207.35
Rwanda	RWA	1648.186083	124.035
Samoa	WSM	2112.534628	314.2154327
San Marino	SMR	4092.2	222.06
Sao Tome and Principe	STP	1881.36981	230.9799753
Saudi Arabia	SAU	14199.28858	287.1736702
Senegal	SEN	325.9496283	95.21142857
Serbia	SRB	1538.105921	243.7166667
Seychelles	SYC	2417.420202	314.9768325
Sierra Leone	SLE	910.294605	167.3271548
Singapore	SGP	18497.84615	331.75
Sint Maarten (Dutch part)	SXM	4092.2	222.06
Slovak Republic	SVK	1541.167411	74.67
Slovenia	SVN	3229.392348	226.615
Solomon Islands	SLB	1911.078456	241.67716
Somalia	SOM	565.8	-4.5952
South Africa	ZAF	2282.752287	254.9366667
South Sudan	SSD	1955.51984	257.6791578
Spain	ESP	2417.309523	86.42
Sri Lanka	LKA	1520.421536	78.4175
St. Kitts and Nevis	KNA	9853.218083	259.1746476
St. Lucia	LCA	3246.584431	285.6431923
St. Martin (French part)	MAF	4092.2	222.06
St. Vincent and the Grenadines	VCT	3422.594226	571.565
Sudan	SDN	629.139854	241.8008369
Suriname	SUR	3075.739985	520.49
Swaziland	SWZ	2118.191833	316.252421
Sweden	SWE	1760.729445	304.5735969
Switzerland	CHE	11631.11539	414.562
Syrian Arab Republic	SYR	1725.9	175
Tajikistan	TJK	1198.7189	211.4966667
Tanzania	TZA	931.2950947	177.8075907
Thailand	THA	2085.636669	179.5066667
Timor-Leste	TLS	1841.409581	216.5915055
Togo	TGO	846.5313045	194.9776764
Tonga	TON	3786.37807	266.5467192
Trinidad and Tobago	TTO	4957.438164	578.665
Tunisia	TUN	584.5215886	289.03
Turkey	TUR	2767.995962	742.63
Turkmenistan	TKM	3501.717747	276.6172495
Turks and Caicos Islands	TCA	4092.2	222.06

Tuvalu	TUV	3795.276648	266.231911
Uganda	UGA	869.5563283	146.9964432
Ukraine	UKR	1075.994597	138.892
United Arab Emirates	ARE	20461.33951	327.5161601
United Kingdom	GBR	2998.605239	212.26
United States	USA	2004.787727	196.55
Uruguay	URY	1403.642274	182.0366667
Uzbekistan	UZB	1903.091746	238.801387
Vanuatu	VUT	2098.659232	309.2193224
Venezuela, RB	VEN	6155.778903	255.1975
Vietnam	VNM	2164.455406	238.727013
Virgin Islands (U.S.)	VIR	4092.2	222.06
West Bank and Gaza	PSE	8215.564155	668.815
Yemen, Rep.	YEM	2349.648705	226.7615298
Zambia	ZMB	1887.442245	233.1664753
Zimbabwe	ZWE	1130.968338	277.4558689