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Indicators for Disaster Risk and Risk Management

Program for Latin-America and The Caribbean

Jamaica

IDB

Environment, Rural Development and Disaster Risk Management Division

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ACRONYMS

AHP	Analytic Hierarchy Process
CARICOM	Caribbean Community (Disaster Risk Management)
CBD	Convention on Biological Diversity
CCA	Caribbean Conservation Association
CCRIF	Caribbean Catastrophe Risk Insurance Fund
CDEMA	Caribbean Disaster Emergency Management Agency
DDI	Disaster Deficit Index
Desinventar	Disaster Inventory System
DM	Disaster Management
DRM	Disaster Risk Management
DRR	*Disaster Risk Reduction*
ER	Economic Resilience
ES	Exposure and Susceptibility
ESEB	Low-income Socio-economic Strata (ESEB, estratos socio-economicos de bajos ingresos, in Spanish).
FP	Governance and Financial Protection
GDP	Gross Domestic Product
IDB	Inter-American Development Bank
IDEA	Institute of Environmental Studies of the National University of Colombia (IDEA in Spanish)
LDI	Local Disaster Index
LR	Lack of Resilience
MCE	Maximum Considered Event
NGO	Non Governmental Organizations
NEPA	National Environment & Planning Agency
NWA	National Works Agency
ODPEM	Office of Disaster Preparedness and Emergency Management

PATH	The Programme of Advancement through Health and Education
PIOJ	Planning Institute of Jamaica
PVI	Prevalent Vulnerability Index
RI	Risk identification
RMI	Risk Management Index
RR	Risk Reduction
SF	Socio-economic Fragility
UDC	Urban Development Corporation
ECLAC	Economic Commission for Latin America and the Caribbean
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNISDR	United Nations International Strategy for Disaster Reduction

Abstract

The Inter-American Development Bank developed a System of Indicators of Disaster Risk and Risk Management (hereafter the Indicators) during 2003-2005 in collaboration with the Institute of Environmental Studies (IDEA for its Spanish acronym). The general aim of the Indicators is to improve the understanding of disaster risk and risk management performance of the borrowing member countries. The Indicators consist of four different components that represent vulnerability, risk and risk management performance of a country: the Disaster Deficit Index (DDI), the Local Disaster Index (LDI), the Prevalent Vulnerability Index (PVI) and the Risk Management Index (RMI).

This Technical Note presents a summary of the Indicators results for Jamaica. Overall, there has been some important progress on disaster risk management (DRM) in Jamaica especially seen in the DDI and PVI. On the other hand, the country faces some challenges for further disaster risk reduction. The challenges include a high concentration of small-scale disasters in only a few areas of the country (according to the result of LDI) and the need to improve risk reduction activities for reducing the risk (according to the result of RMI), among others.

1. INTRODUCTION

The Inter-American Development Bank developed a System of Indicators of Disaster Risk and Risk Management (hereafter the Indicators) during 2003-2005 in collaboration with the Institute of Environmental Studies (IDEA for its Spanish acronym)[1]. The general aim of the Indicators is to improve the level of understanding of disaster risk and risk management performance of the borrowing member countries. The target users of the Indicators include both public and private sectors, especially for those who oversee planning and implementation for sustainable development of the countries.

Effective Disaster Risk Management (DRM) in general requires a multidimensional (cross-sectorial) approach that includes technical/science, engineering, socioeconomic development, and financial perspectives or approaches. In order to understand the level of disaster risk and risk management performance in a holistic manner, the Indicators consist of four different sub-indicators: the Disaster Deficit Index (DDI), the Local Disaster Index (LDI), the Prevalent Vulnerability Index (PVI) and the Risk Management Index (RMI). The DDI measures, from a macro-economic perspective, the country's financial capacity to attend for rehabilitation and reconstruction process when a disaster hits a country. The LDI identifies the extent of spreading damages resulting from small-scale (or frequent) disasters in a country. The PVI measures the vulnerability condition of a country. The RMI measures performance, or institutional capacity for managing the disaster risk at the national level.

Using the standard methodology of the Indicators[2], this Technical Note presents a summary of Jamaica's results for the period of 1995 - 2012[3]. This Technical Note first reviews the characteristics of natural hazards in Jamaica, then reviews the methodology and results of each sub-Indicators: DDI (Section 3), LDI (Section 4), PVI (Section 5) and RMI (Section 6). The final section concludes and summarizes all results of the Indicators.

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[1] This System of Indicators was designed between 2003 and 2005 with the support of the Operation ATN/JF-7906/07-RG "Information and Indicators Program for Disaster Risk Management", financed from the Government of Japan.

[2] This report does not include detailed methodological descriptions. For more information related to the methodology of the Indicators, see https://publications.iadb.org/handle/11319/5911

[3] The study has been implemented under the Technical Cooperation RG-T2174 (ATN/MD-13414-RG), whose main objective is to update the Indicators in 14 countries (Argentina, Belize, Bolivia, Colombia, Costa Rica, Chile, Ecuador, El Salvador, Guatemala, Jamaica, México, Nicaragua, Peru, Dominican Republic) and to apply them to two countries (Brazil and Venezuela).

2. CONTEXT OF NATURAL HAZARDS

2.1. General Context and National Economy

Jamaica is an island nation of the Greater Antilles, 234 kilometres (145 mi) in length and as much as 80 kilometres (50 mi) in width, with a landmass of 11,100 km^2. It is situated in the Caribbean Sea, about 145 kilometres (90 mi) south of Cuba, and 190 kilometres (120 mi) west of Hispaniola. Jamaica is the third largest island and the fourth largest country in the Caribbean. The island is home to the Blue Mountains inland and surrounded by a narrow coastal plain. Most major towns and cities are located on the coast. Major towns and cities include the capital Kingston, Portmore, Spanish Town, Mandeville, Ocho Ríos, Port Antonio, Negril, and Montego Bay. The Kingston Harbour is one of the largest natural harbours in the world.[4] Figure 1 presents an estimative of population for the different parishes and their variation since 1982.

The country's GDP was approximately US$14.26 billion in 2013; its growth rate has been -0.5% and 0.2% in 2012 and 2013, respectively. During that period, current account and trade balance have been in a deficit near to 11.05% and 10% of GDP, respectively. The total public debt reached 123.6% of GDP, the total debt service as percentage of exports and income has been in the last years close to 38.2%. In 2013, the inflation rate was over 8.3%[5] and the unemployment rate estimated on the order of 15.2%. The gross capital formation as proportion of GDP has grown since 2000 and was closer to 20% in 2012. The exchange rate in 2013 fluctuates around J$99.83 per US dollar. Table 1 presents a summary of macroeconomic variables for the country.

The literacy rate of the population over 15 years old was approximately 87%[6] in 2012. The percentage of population living below national poverty line was approximately 17.6% in 2010 and the number of hospital beds per one thousand inhabitants was 1.7 (2012).

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[4] http://www.ccrif.org/content/membercountry/jamaica.
http://www.imf.org/external/np/seminars/eng/2013/caribbean/pdf/jamaica.pdf.
[5] The World Bank Data. http://data.worldbank.org/indicator/NY.GDP.DEFL.KD.ZG [Last consulted: 30 November 2014]
[6] UNESCO Institute for Statistics.
http://data.uis.unesco.org/Index.aspx?DataSetCode=EDULIT_DS&popupcustomise=true&lang=en [Last consulted: 30 November 2014]

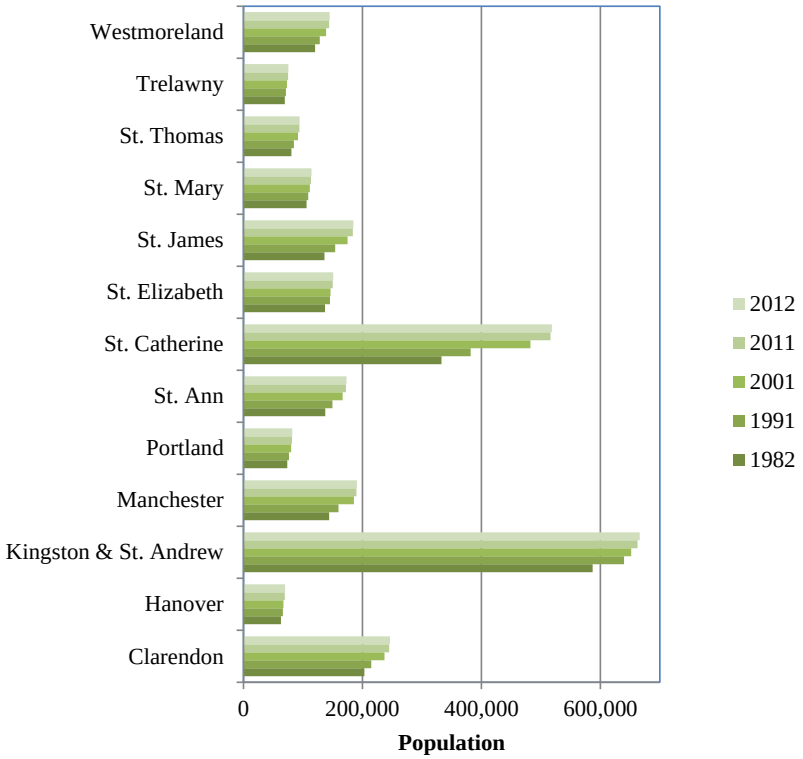

Figure 1. Population by parishes (Source http://www.citypopulation.de/Jamaica.html)

Table 1. Main macroeconomic and social indicators

Indicator	2000	2005	2010	2012
GDP (US$ billion)[7]	9,065	11,228	13,207	14,196*
Trade balance (% GDP)[8]	-3,955	-9,553	-13,421	-11,051*
Total debt service (% exports and income)[9]	18.6	22.3	27.9	38.2
Unemployment (%)[10]	15.5	11.2	12.4	15.2*
Population living below the poverty line[11]	18.7	14.8	17.6	**
Human Development Index[12]	0.671	0.70	0.712	0.715*

* *2013 Data* ***No data available*

[7] International Monetary Fund Data. http://www.imf.org/externa [Last consulted: 30 November 2014].
[8] Idem.
[9] The World Bank Data. http://data.worldbank.org/indicator/DT.TDS.DECT.EX.ZS [Last consulted: 30 November 2014].
[10] Bases de datos y publicaciones estadísticas. Comisión Económica para América Latina, CEPAL. http://interwp.cepal.org/cepalstat/WEB_cepalstat/Perfil_nacional_economico.asp?Pais=JAM&idioma=e [Last consulted: 30 November 2014].
[11] The World Bank Data. http://data.worldbank.org/indicator/SI.POV.NAHC/countries/JM?page=1&display=default [Last consulted: 30 November 2014].
[12] UNDP – Human Development Reports. http://hdr.undp.org/en/content/human-development-index-hdi-table [Last consulted: 20 November 2014]

2.1. NATURAL HAZARDS

Figure 2 presents the classification by mortality risk for Jamaica. According to this figure, the greatest relative mortality risk (deaths per 1 million people) per year is due to landslides and to "multiple relative mortality" with a medium-high level, followed by cyclones with a medium-low level and earthquakes with a very low level. In relation to absolute mortality, that is, annual average deaths, multiple mortality and landslides have a mid-level, followed by cyclones with a medium-low level and earthquakes with a very low level. Appendix I details the hazardous condition of the country.

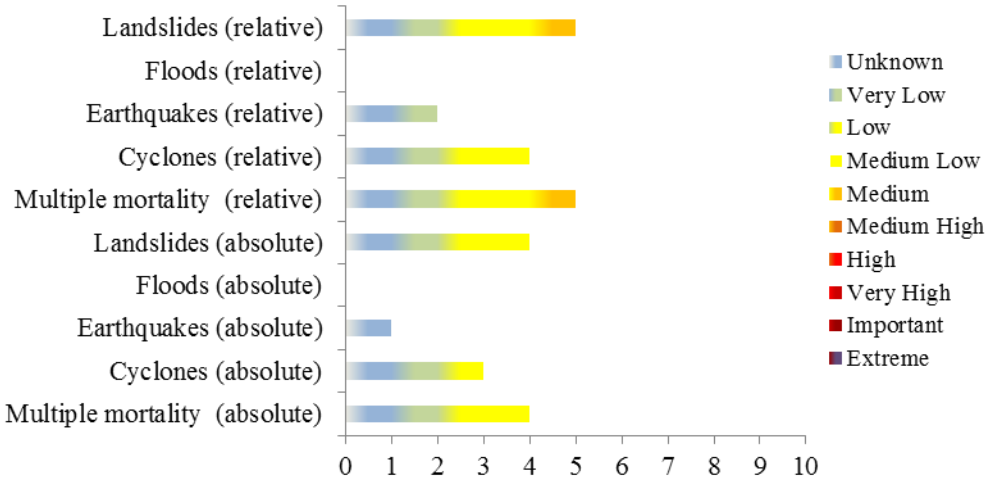

Figure 2. Classification by mortality risk (Source: UNISDR, 2009)

3. The Disaster Deficit Index (DDI)

3.1 Methodology

The DDI measures whether a country has sufficient financial resources or accesses to attend immediately an eventual catastrophic event. This index captures the ratio between the direct probable public infrastructure damages caused by eventual Maximum Considered Event (MCE, or return period of an event once every 50, 100 and 500 years) and the financial capacity to repair and reconstruct immediately once disaster hits (or economic resilience (ER) in this study).

Damages caused by the MCE are estimated with a probabilistic risk assessment (PRA) model, based on the function of (i) intensities and frequency of natural hazards, (ii) the public infrastructure exposed

to natural hazards and (iii) the physical vulnerability of the public infrastructure that exposed to hazard impacts. The ER is obtained from an estimation of the possible internal and external financial resources or accesses that government should necessary to repair and reconstruct public infrastructure immediately after catastrophic event. A DDI greater than 1.0 reflects the country's inability to cope with disasters even having external resources as much as possible. The greater the DDI, the greater the financial gap.

Additionally, an evaluation of a complementary indicator, DDI'_{CE} has been calculated to illustrate the portion of a country's annual Capital Expenditure that corresponds to the expected annual loss or the pure risk premium. That is, what percentage of the annual investment budget would be needed to pay for eventual extreme disasters (IDEA, 2005; Cardona, 2005). The DDI'_{IS}[13] is also estimated with respect to the amount of sustainable resources due to surplus; i.e. the saving which the government can employ to attend the impacts of disasters. The DDI'_{IS} is the percentage of a country's potential savings at present value that corresponds to the pure risk premium.

3.2 Results - Probable losses due to MCE.

The process to estimate probable losses due to MCE is as follows: (i) define the most intensive and frequent hazard of the country (as briefed in the previous section and Appendix I) (ii) estimate the total value of exposed public assets of the country[14], (iii) define vulnerability function depending on the intensity and frequency of MECs[15], and (iv) estimate the probable losses due to MCE. See Country Disaster Risk Profile for Jamaica for detailed probable losses due to earthquake and hurricane[16]. On this theoretical base, the probable losses due to MCE for DDI is calculated in a simple manner using built areas and its exposed value.

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[13] Surplus or savings of the country.

[14] Public infrastructure in this study includes, in addition to public infrastructure, low-income housings. This "low-income housings" is called a low-income socio-economic strata (ESEB, estratos socio-económicos de bajos ingresos, in Spanish). ESEB is necessary to include in this study because in most cases the governments need to assume the responsibility in case of catastrophe for rehabilitation and reconstruction even though these are a part of private assets. See Main Technical Report: https://publications.iadb.org/handle/11319/5911.

[15] In this study MCE refers a maximum hazard event possible in a country once in 50, 100 and 500 years. See Annex A.

[16] https://publications.iadb.org/handle/11319/6382

Figure 3 shows estimations of built areas in different components of the country and its variations in time (from 2000 to 2012). These exposed elements were calculated based on the available information in 2012. Using a standard cost per square meter of sample construction types, construction area, Figure 4 presents the approximated exposed values for the whole country[17].

Table 2 shows the values of the potential losses for the country for the Maximum Considered Event, MCE, with 50, 100 and 500-year return periods. These estimations were made at the whole country level in the period of 2000, 2005, 2010 and 2012. In addition, Table 4 presents the values of pure premium or the required annual amount to cover possible future disasters in each period. The DDI and DDI' for 2000, 2005, 2010 and 2012 of analysis were calculated based on the estimates of the potential maximum losses and expected annual losses respectively (i.e. the numerator of the indicators).

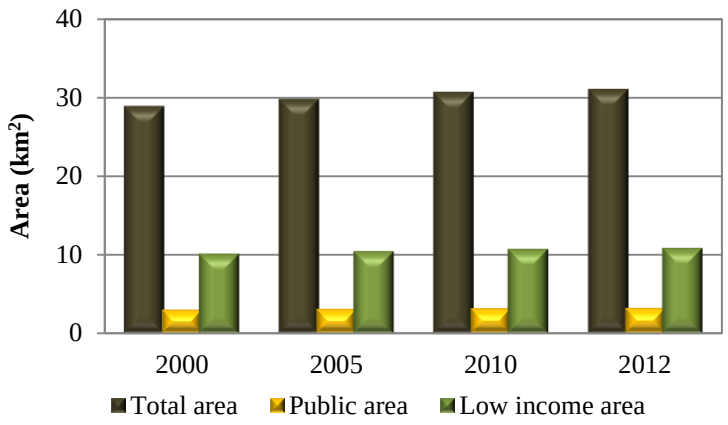


Figure 3. Total built areas, by component, in square km

[17] These technical explanations are available in http://idea.unalmzl.edu.co. See also Ordaz & Yamin (2004) and Velasquez (2009) for detail of this methodology.

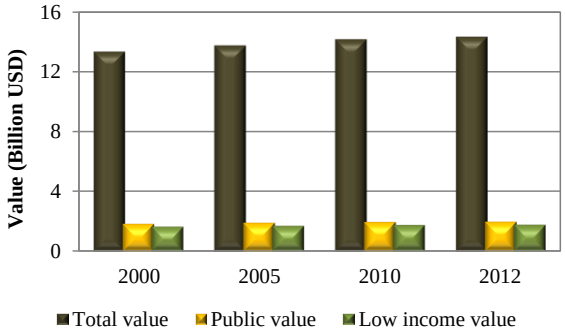


Figure 4. Exposed value, by component, in billion dollars (US$)

Table 2. Probable loss and pure premium for DDI and DDI' calculations

***L*50**	2000	2005	2010	2012
Total – Million US$	236.7	240.1	243.6	244.8
Government – Million US$	27.8	28.7	29.7	30.0
Poor – Million US$	50.2	51.1	52.0	52.4
Total - % GDP	2.61%	2.14%	1.81%	1.61%
Government - % GDP	0.31%	0.26%	0.22%	0.20%
Poor - % GDP	0.55%	0.46%	0.39%	0.34%
***L*100**				
Total – Million US$	680.3	692.5	704.9	709.8
Government – Million US$	68.0	69.3	70.7	71.2
Poor – Million US$	161.2	164.3	167.5	168.8
Total - % GDP	7.51%	6.17%	5.22%	4.65%
Government - % GDP	0.75%	0.62%	0.52%	0.47%
Poor - % GDP	1.78%	1.46%	1.24%	1.11%
***L*500**				
Total – Million US$	2 731.2	2 783.7	2 837.2	2 858.4
Government – Million US$	304.3	313.6	323.0	326.7
Poor – Million US$	785.3	809.4	833.5	843.1
Total - % GDP	30.13%	24.79%	21.03%	18.74%
Government - % GDP	3.36%	2.79%	2.39%	2.14%
Poor - % GDP	8.66%	7.21%	6.18%	5.53%
***L*y**				
Total – Million US$	30.3	30.9	31.4	31.6
Government – Million US$	3.3	3.4	3.5	3.5
Poor – Million US$	5.8	5.9	6.0	6.1
Total - % GDP	0.33%	0.27%	0.23%	0.21%
Government - % GDP	0.04%	0.03%	0.03%	0.02%
Poor - % GDP	0.06%	0.05%	0.04%	0.04%

3.3 Results - Economic Resilience (ER)

Table 3 presents possible internal and external financial resources that the government should need to access for rehabilitation and reconstruction in case of a catastrophe. These values were estimated in terms of GDP for each fund, taking as reference the available economic information. The sum of these available or usable possible funds corresponds to the economic resilience.

Table 3. Economic resilience, funds and resources for DDI calculations

Funds	2000	2005	2010	2012
Insurance premiums[18] - % GDP	0.000	0.000	3.59	4.08
Insurance/ reinsurance.50 million US$ -***F1p***	0.00	0.00	2.93	2.93
Insurance/ reinsurance.100 million US$ -***F1p***	0.00	0.00	8.54	8.54
Insurance/ reinsurance.500 million US$ -***F1p***	0.00	0.00	41.46	41.46
Disaster reserves million US[19]$ -***F2p***	0.00	74.09	65.94	60.10
Aid/donations.50 million US$ -***F3p***	11.84	12.01	12.18	12.24
Aid/donations.100 million US$ -***F3p***	34.02	34.63	35.25	35.49
Aid/donations.500 million US$ -***F3p***	136.56	139.19	141.86	142.92
New taxes million[20] US$ -***F4p***	0.00	0.00	0.00	0.00
Capital expenditure[21] - % GDP	2.21	2.21	4.82	3.12
Budgetary reallocations. Million US$ -***F5p***	120.07	148.93	390.10	284.21
External credit[22]. Million US$ -***F6p***	571.10	843.22	1 685.66	1 196.67
Internal credit Million[23].US$ -***F7p***	0.00	0.00	0.00	0.00
Cash surplus/deficit[24]. *d**- % GDP	-0.82	-3.01	-6.43	-4.16
Cash surplus/deficit. Million US$ -***F8p***	-74.3	-337.5	-867.9	-634.2
ER.50				
Total - Million US$	703	1 078	2 157	1 556
Total - %GDP	7.76%	9.60%	15.99%	10.20%
ER.100				
Total - Million US$	725	1 101	2 185	1 585
Total - %GDP	8.00%	9.80%	16.20%	10.39%
ER.500				
Total - Million US$	828	1 205	2 325	1 725
Total - %GDP	9.13%	10.74%	17.23%	11.31%

[18] Insurance Association of Jamaica.
[19] Ministry of Finance of Jamaica.
[20] Idem.
[21] Bank of Jamaica.
[22] International Monetary Fund.
[23] CEPAL.
[24] Bank of Jamaica.

3.4 Results - DDI

Based on the estimations made in the Section 3.2 and 3.3, Table 4 shows DDI for 2000, 2005, 2010 and 2012 for the Maximum Considered Event (MCE) for 50, 100 and 500 years of return period.

Table 4. DDI for different return periods

DDI	2000	2005	2010	2012
DDI_{50}	0.11	0.07	0.04	0.05
DDI_{100}	0.32	0.21	0.11	0.15
DDI_{500}	1.32	0.93	0.50	0.68

All DDI_{50}[25], DDI_{100} and DDI_{500} in 2012, the DDI values of the country indicated values lower than 1.0. This means the country is in feasible financial capacity to face losses and repair or reconstruct capital stock affected. For extreme events with return periods of 500 in 2000 was greater than 1.0, means that the country would not have enough resources to do so.

Table 5 shows DDI' values, which corresponds to annual expected loss related to capital expenditure (annual investment budget), and related to possible annual savings expressed in percentages of GDP. DDI_{CE} illustrates that if contingent liabilities to the country were covered by insurance (annual pure premium), the country would have to invest annually 2% of 2012's capital expenditure to cover future disasters. The DDI_{IS}, with respect to the amount of sustainable resources due to annual savings, indicates that for all the periods evaluated savings were negative; that is, annual pure premium value would increase the deficit.

Table 5. DDI' related to capital expenditure and intertemporal surplus

DDI'	2000	2005	2010	2012
DDI_{CE}	4.5%	3.7%	1.5%	2.0%
DDI_{IS}	^D	^D	^D	^D

^D: negative values of surplus (deficit) or lower surplus values than the expected annual loss, therefore deficit increasing

[25] Events that can occur at any moment and which have a probability of occurrence of 2% and 10% in 10 years.

Figure 5 illustrates DDI and DDI' values. The results indicate that DDI improved gradually from 2000 to 2010 but is slightly worsen in 2012 for all the return periods evaluated. This can be explained in two reasons. First, because the probable loss was increased from 2000 to 2012; or because the numerator of DDI, was increased (Table 4). The second reason is that RE, DDI's denominator (for example, especially disaster reserve fund and the budgetary reallocation due to the lower capital expenditure and the external credit – See Table 5), was decreased in the same period.

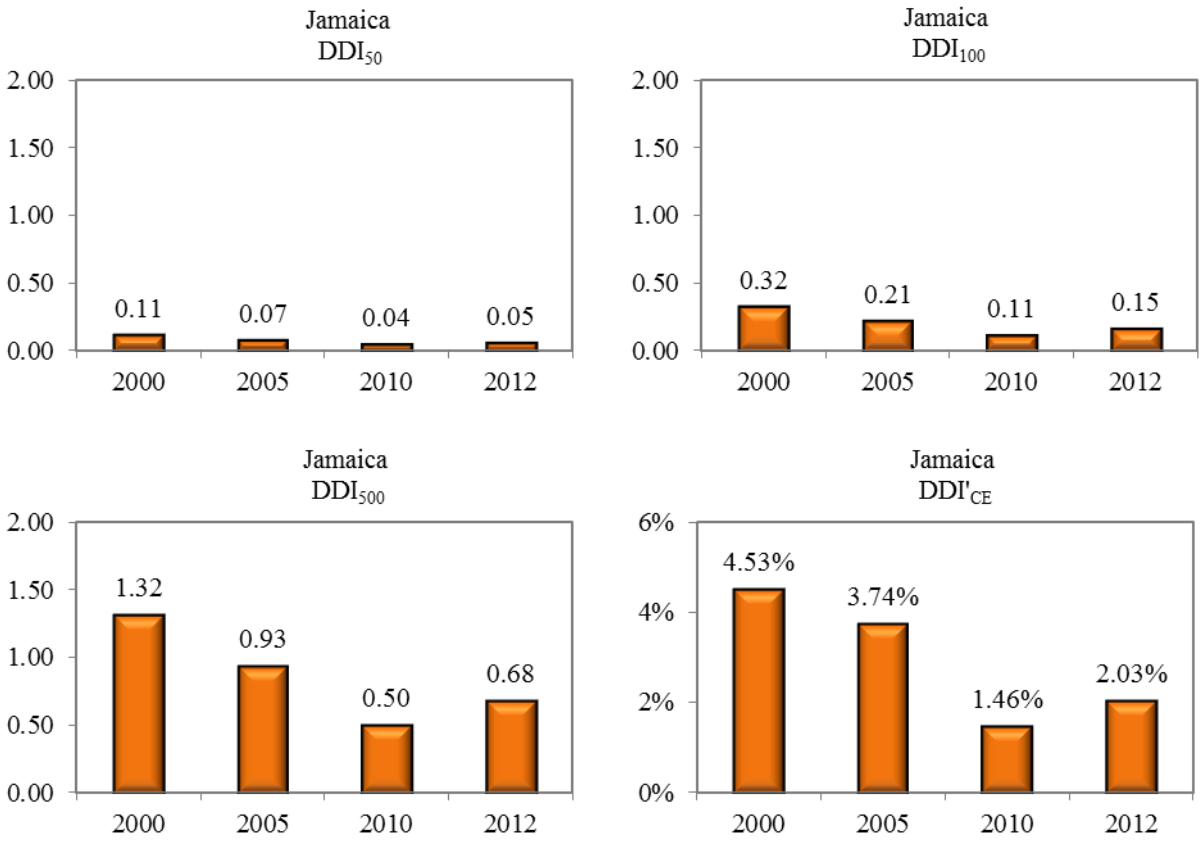


Figure 5. DDI_{50}, DDI_{100}, DDI_{500}, DDI'_{CE}

Figure 6 presents losses and economic resilience as a percentage of GDP for the different return periods for the different years evaluated. Probable losses (L) for 50, 100 and 500 years of return period did not increase significantly while possible financial resources for RE increased notably from 2000 to 2010, varying from 7% to 17% of GDP. However, this decreased from 2010 to 2012.

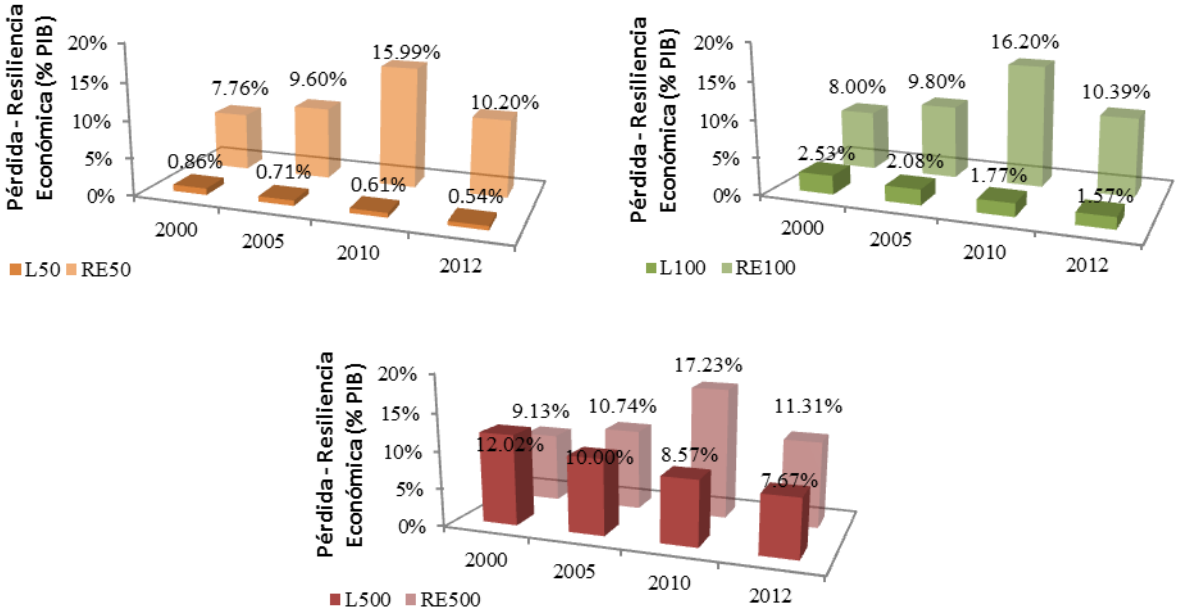


Figure 6. Losses and economic resilience in percentage of GDP for 500, 100 and 50 years of return period.

In summary, although the financial capacity of Jamaica to face disasters was in a favourable situation until 2010, this has been slightly weakened in 2012.

4. Local Disaster Index (LDI)

4.1 Methodology

The LDI measures whether small-scale disasters occur evenly in a whole country or only in some specific local areas. A low LDI value means low spatial distribution of the impact of small scale disasters. The impact of small scale disaster is obtained by three criteria or sub-indicators according to the DesInventar database[26]: number of deaths (LDI_K), number of affected people (LDI_A), and economic losses (LDI_L) in each local area (e.g., municipality). Each sub-indicator is measured from 0 to 100 scales, and the total LDI is expressed with the sum of LDI_K, LDI_A and LDI_L values. A low LDI value (0-20) for each type of effect (deaths, affected people and economic losses) and a total

[26] The DesInventar database was developed in 1994 by the Network for Social Studies in Disaster Prevention in Latin America. http://www.desinventar.org.

LDI value between 0 and 60 means high concentration of small disasters in a few regions or a low spatial distribution of their effects between the regions where they had taken place. High LDI values (greater than 50 for each type of effects and greater than 150 for total LDI) indicate that most of the regions suffer small disasters and their effects are similar in all the affected regions. High LDI values reflect that vulnerability and hazards may be wide-spreaded across the country.

An additional indicator, LDI', measures the concentration of aggregate losses at a regional level, and has been formulated in a complementary way. Its value is between 0.0 and 1.0. A high LDI' value means a high concentration of economic-losses due to small disasters only in a few regions. For example, an LDI' equal to 0.43 and 0.79 means that approximately 10% of the regions of the country will have a concentration of approximately 35% and 70% of the losses respectively.

4.2 Results - LDI

Table 6 indicates the values of LDI_K, LDI_A and LDI_L as well as total LDI and LDI' through various periods. Figure 7 illustrates LDI_K, LDI_A, LDI_L and total LDI values.

Table 6. LDI values

	1981-85	**1986-90**	**1991-95**	**1996-00**	**2001-05**	**2006-10**	**2011-13**
LDI_K	5.30	5.02	13.91	26.76	21.75	15.21	36.88
LDI_A	0.26	7.26	29.20	68.96	24.67	31.90	65.01
LDI_L	29.37	15.47	22.23	13.99	19.60	13.55	8.92
LDI	34.93	27.75	65.34	109.72	66.03	60.65	110.82
LDI'	0.43	0.79	0.53	0.86	0.31	0.36	0.11

LDI_K and LDI_L show a relatively low value, which means that the impact of small-scale disasters (especially in terms of deaths and economic losses) seem to be concentrated in only some specific local areas or parishes. On the other hand, LDI_L obtained relatively higher values especially in the periods 1996-2000 and 2011-2013, which means there is a large distribution of affected people among parishes. Regarding the LDI', the periods that presented the greatest concentration of economic losses among parishes were 1986-1990 and 1996-2000 while the other periods presented a greater geographical distribution.

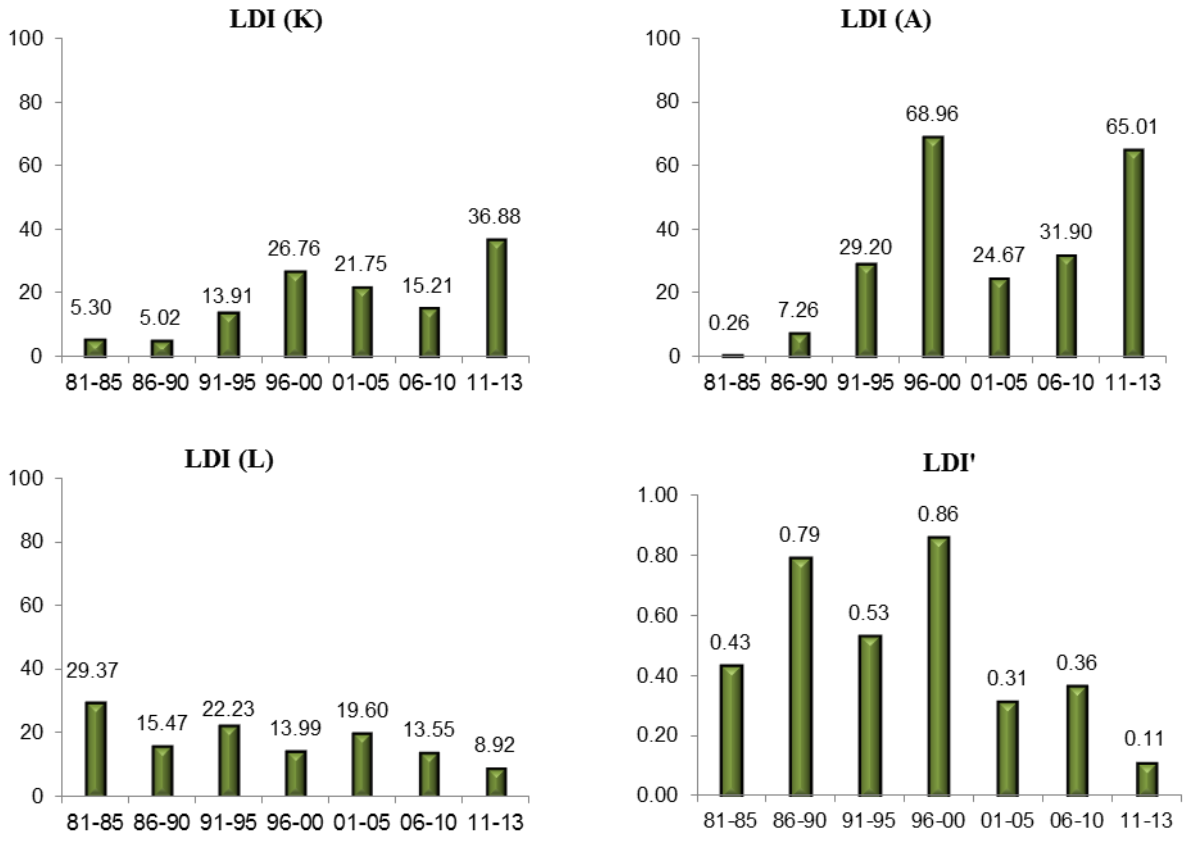


Figure 7. LDI(K), LDI(A), LDI(L) and LDI'

Table 7 and Figure 8 show the absolute numbers of total deaths, total affected people and total economic losses according to the DesInventar. It is important to notice that the number of deaths has been increasing throughout the period of evaluation. Regarding affected people, periods from 2001-05 and 2006-10 are relatively high. Economic losses were high for all the periods, especially for the 1986-1990 and 2006-2010.

Table 7. Total of deaths, affected persons and losses

	1981-85	1986-90	1991-95	1996-00	2001-05	2006-10	2011-13
Total deaths	8	48	19	23	181	124	21
Total affected persons	18	3	2,226	17	9,108	13,852	142
Total losses (USD)	472,919	10,805,542	245,477	100,130	2,308,443	6,573,000	155,332

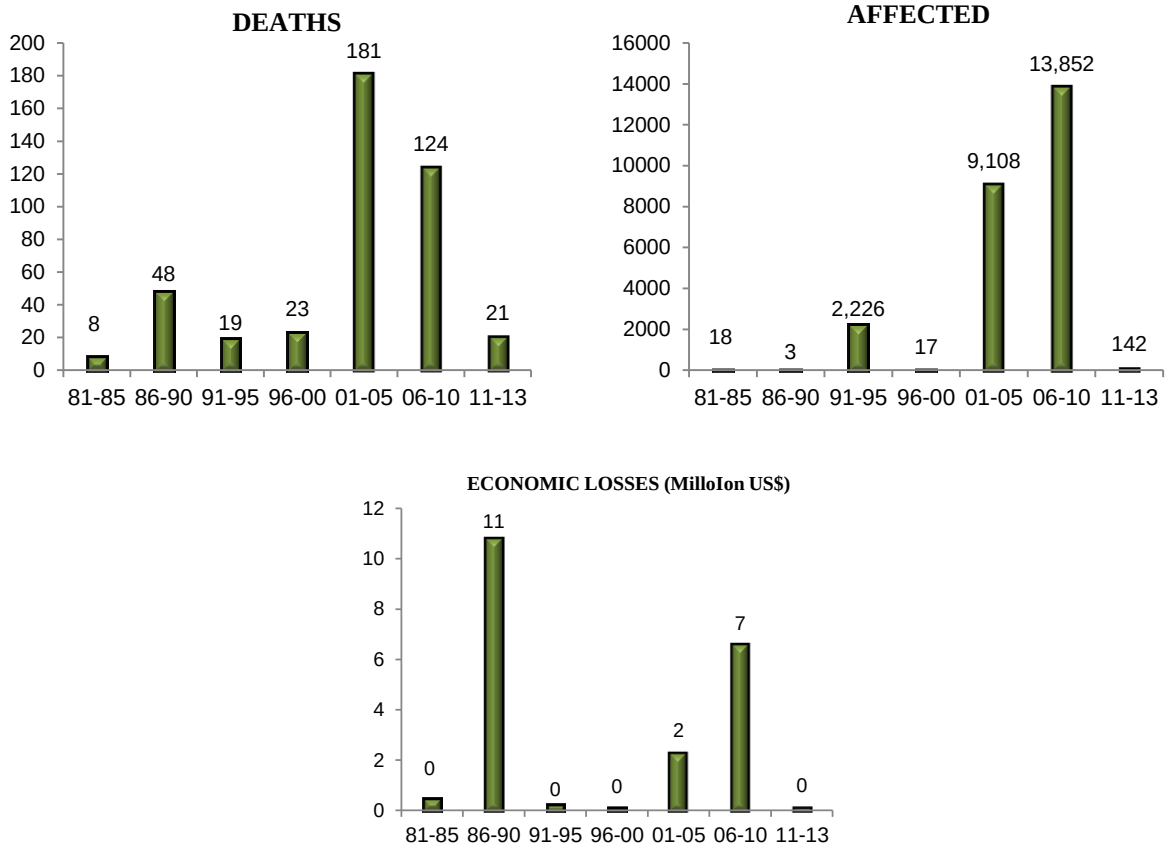


Figure 8. Total deaths, affected people and losses

In summary, the impact of small-scale disasters in Jamaica (especially in terms of death and economic losses) are observed high concentration only in some specific local areas or parishes, according to the result of LDI.

5. The Prevalent Vulnerability Index (PVI)

5.1 Methodology

The PVI measures the vulnerability condition of a country. This index characterizes predominating vulnerability conditions reflected in three aspects (or sub-indicators) which favour both direct impact and indirect and intangible impact in case of the occurrence of a hazard event. The three aspects of the PVI are: (i) susceptibility due to the level of physical exposure of assets and people that favours direct impact in case of hazard events (the sub-indicator of exposure and susceptibility, PVI_{ES}); (ii) social and economic conditions that favour indirect and intangible impact

(the sub-indicator of social-economic fragility, PVI_{SF}); and (iii) lack of capacity to anticipate, to absorb consequences, to efficiently respond, and to recover (the sub-indicator of lack of resilience, PVI_{LR}). Each of these includes eight indicators shown in 5.1.1 – 5.1.3.

With each indicator value, in combination with their respective weights which were obtained using the Analytic Hierarchy Process (AHP), the PVI value is calculated[27] ranging between 0 and 100. A value of 80 means very high vulnerability, from 40 to 80 means high, from 20 to 40 is a medium value, and less than 20 means low vulnerability. Specific target user of PVI includes institutions related to housing and urban development, environment, agriculture, health and social care, economics and planning, among others.

5.1.1 Indicators of exposure and susceptibility (PVI_{ES})

The PVI_{ES} represents the population, assets, investments, productions and livelihoods exposed to natural hazards and susceptible to socioeconomic activities. The PVI_{ES} includes the following indicators:

- ES1. Population growth, avg. annual rate, %
- ES2. Urban growth, avg. annual rate, %
- ES3. Population density, people (5 km2)
- ES4. Poverty-population below US$1 per day PPP
- ES5. Capital stock, million US$ dollar/1000 km2
- ES6. Imports and exports of goods and services, % GDP
- ES7. Gross domestic fixed investment, % of GDP
- ES8. Arable land and permanent crops, % land area

[27] see https://publications.iadb.org/handle/11319/5911

5.1.2 Indicators of socio-economic fragility (PVI_{SF})

The PVI_{SF} represents the country's conditions of poverty, human insecurity, dependency, illiteracy, social disparities, unemployment, inflation, debt, and environmental deterioration that relates to the subject of socio-economic fragility. These indicators reflect relative weaknesses and conditions of deterioration which would increase the direct effects associated with hazardous phenomena. Even though such effects are not necessarily accumulative, and in some cases, may be redundant or correlated, their influence is especially important at the social and economic levels. The indicators included in the PVI_{SF} are the following:

- SF1. Human Poverty Index, HPI-1
- SF2. Dependents as proportion of working-age population
- SF3. Social disparity, concentration of income measured using the Gini index
- SF4. Unemployment, as % of total labor force
- SF5. Inflation, food prices, annual %
- SF6. Dependency of GDP growth on agriculture, annual %
- SF7. Debt servicing, % of GDP.
- SF8. Human-induced soil degradation (GLASOD).

These indicators are variables that reflect, in general, an adverse and intrinsic[28] predisposition of society to be affected when faced with a hazardous phenomenon, whatever the nature and intensity of these events is. The predisposition to be affected is a vulnerability condition (IDEA, 2005), although in a strict sense it would be necessary to establish the relevance of this affirmation when faced with all and individual feasible types of hazard. Nevertheless, in the case of exposure (as reflected by the PVI_{ES}), it is possible to suggest that certain variables reflect a comparatively unfavourable situation, supposing that the natural hazards exist as a permanent external factor, irrespective of their exact characteristics.

[28] This is also defined as inherent vulnerability. It means that socio-economic conditions peculiar to the communities favour or facilitate the occurrence of such effects.

5.1.3 Indicators of resilience (lack of) - PVI_{LR}

The PVI_{LR} represents human development levels, human capital, economic redistribution, governance, financial protection, collective perceptions, preparedness to face crisis situations, and environmental protection that captures, in a macro fashion, the capacity to recover from or absorb the impact of hazardous events. The indicators include[29]:

- LR1. Human Development Index, HDI [Inv]
- LR2. Gender-related Development Index, GDI [Inv]
- LR3. Social expenditure; on pensions, health, and education, % of GDP [Inv]
- LR4. Governance Index (Kaufmann) [Inv]
- LR5. Insurance of infrastructure and housing, % of GD [Inv]
- LR6. Television sets per 1000 people [Inv]
- LR7. Hospital beds per 1000 people [Inv]
- LR8. Environmental Sustainability Index, ESI [Inv]

5.2 Results – PVI

Table 8 and Figure 12 show the total PVI, PVI_{ES}, PVI_{SF} and PVI_{LR} corresponding to the years 1995, 2000, 2005, 2010, and 2011.

Table 8. PVI values

	1995	2000	2005	2010	2011
PVI_{ES}	49.83	45.85	51.02	36.03	37.58
PVI_{SF}	38.24	35.33	35.57	33.56	37.71
PVI_{LR}	66.93	65.73	64.33	55.97	56.90
PVI	**51.67**	**48.97**	**50.31**	**41.85**	**44.07**

[29] The symbol [Inv] is used here to indicate a reverse or inverted dealing of the variable (¬R = 1- R).

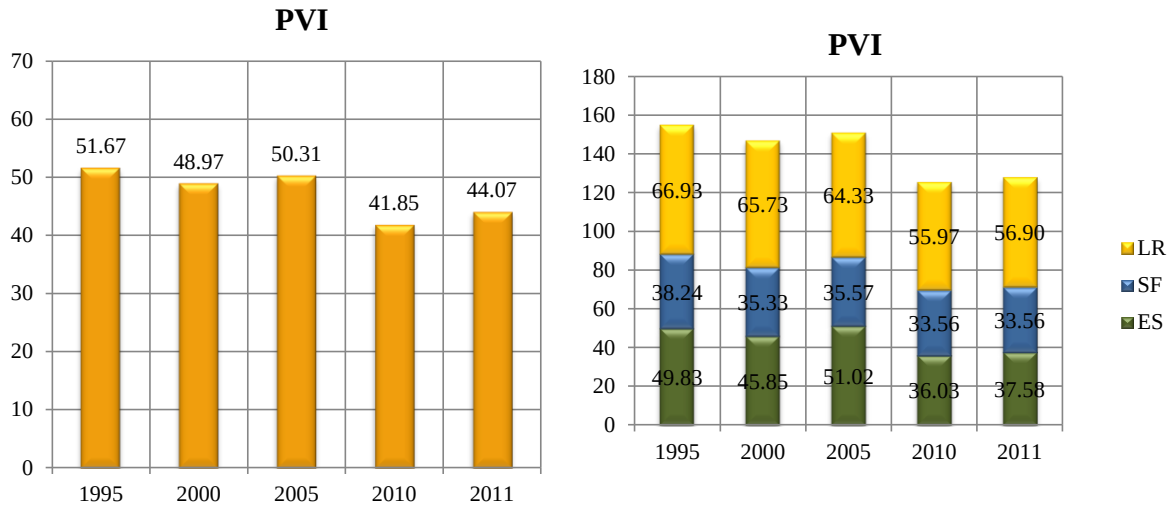


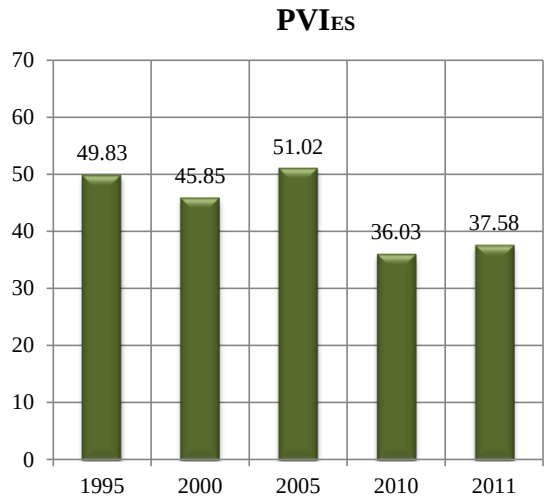
Figure 9. PVI value obtained from the average of the component indicators (left), and the aggregated format which illustrates the contribution of each indicator (right).

Figure 9 illustrates a general reduction (or improvement) in the prevalent vulnerability condition of Jamaica due to the decreasing of the three components of the index. The PVI_{ES} performed its greater contribution to reduce the vulnerability of the country, and the PVI_{LR} performed its greater influence to the country's prevalent vulnerability.

5.2.1 Results – PVI_{ES}

Figure 10 shows the original values obtained from international statistics or databases related to the PVI_{ES} and their respective weights which were obtained using the Analytic Hierarchy Process (AHP).

PVI_{ES} showed an important improvement in the period between 2005 and 2010. The imports and exports of goods and services (ES6), the gross domestic fixed investment (ES7) and the percent of arable land permanent crops (ES8) had significant improvements between 2005 and 2010. These three indicators dominate the tendency of the PVI_{ES} because the sum of the weights assigned is high (in total 60.78). The urban and population growth (ES1 and ES2) had a clear tendency to decrease (or improve) through 2005 and 2010 reducing the vulnerability exposure and susceptibility. On the other hand, the population density (ES3) in the country increased (or worsened) constantly during 1995 – 2011. This may be due to the process of residents relocating towards more populated areas.



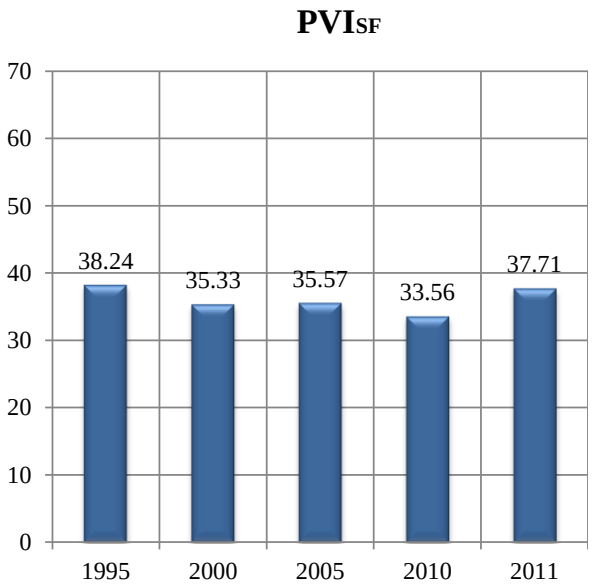
	1995	2000	2005	2010	2011	WAHP
ES1	0.81	0.58	0.47	0.21	0.30	3.03
ES2	1.29	1.05	0.81	0.19	0.35	6.31
ES3	1144.97	1195.47	1223.64	1247.09	1249.54	10.17
ES4	3.20	3.20	2.00	2.00	2.00	16.67
ES5	1309.35	1721.71	2443.69	2703.81	2845.64	3.03
ES6	111.30	96.56	101.95	80.86	84.71	20.26
ES7	28.73	26.53	31.75	20.19	21.26	20.26
ES8	26.22	26.22	26.22	20.31	20.31	20.26

Figure 10. PVI_{ES}

5.2.2 Results – PVI_{SF}

Figure 11 shows he original values obtained from international statistics or databases related to the PVI_{SF} and their respective weights which were obtained using the Analytic Hierarchy Process (AHP).

PVI_{SF} value was relatively similar with only slight variations in all periods. This slight-variability is related to the behaviour of debt servicing (SF7) where there is relatively higher weight assigned. On the other hand, Human poverty (SF1) in the country showed an increasing trend (or worsened) especially during the years 1995-2005.



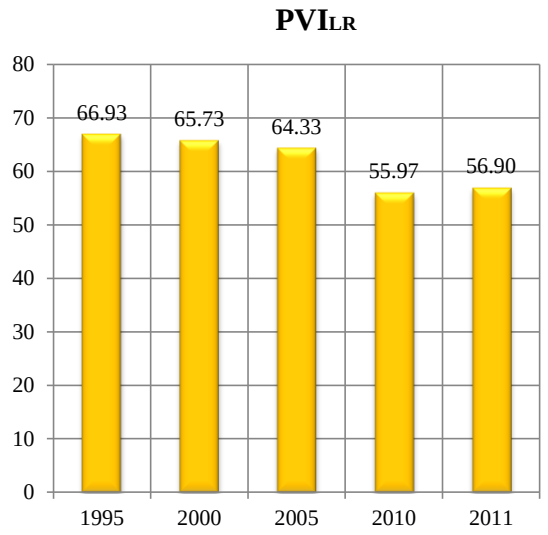
	1995	2000	2005	2010	2011	WAHP
SF1	11.80	13.20	14.30	14.30	14.30	19.12
SF2	70.04	68.41	64.36	58.48	57.07	4.57
SF3	36.40	37.91	42.20	42.20	42.20	12.08
SF4	16.24	15.54	10.90	12.40	12.70	13.27
SF5	19.91	8.17	15.30	12.61	7.53	7.97
SF6	9.02	6.69	5.69	0.25	9.80	8.89
SF7	11.48	8.77	9.98	9.21	11.87	18.19
SF8	33.24	33.24	33.24	33.24	33.24	15.91

Figure 11. PVI_{SF}

5.2.2 Results – PVI_{LR}

Figure 12 shows the original values obtained from international statistics or databases related to the PVI_{LR} and their respective weights which were obtained using the Analytic Hierarchy Process (AHP).

From 1995 to 2005 most of the subindicators reflect small changes in their values, after which the PVL_{LR} had an important reduction due to the increase of the social expenditures on pensions, health and education (LR3), and the insurance of infrastructure and housing (LR5), improving the conditions that cause lack of resilience.



	1995	2000	2005	2010	2011	WAHP
LR1	0.73	0.74	0.74	0.73	0.73	20.79
LR2	0.72	0.74	0.73	0.73	0.72	6.84
LR3	4.33	5.66	9.99	11.54	11.57	16.56
LR4	0.52	0.52	0.48	0.49	0.50	11.63
LR5	1.21	1.23	0.74	2.64	1.80	10.45
LR6	0.59	0.71	0.70	0.75	0.76	4.43
LR7	2.22	1.12	1.70	1.80	1.83	10.05
LR8	42.34	42.34	44.70	44.70	44.70	19.25

Figure 12. PVI_{LR}

6. The Risk Management Index (RMI)

6.1 Methodology

The RMI measures the country's performance of risk management. The "performance" of RMI includes both the national and local institutions related to DRM and communities. This index consists of four components that are necessary for public policies on DRM: Risk identification (RI), Risk reduction (RR), Disaster management (DM) and Governance and financial protection (FP).

Each component or public policy is evaluated with 6 sub-indicators that characterize the management performance in the country (See 6.1.1 – 6.1.4). Assessment of each sub-indicator is made using five performance levels: *low, incipient, significant, outstanding and optimal,* which corresponds to a range from 1 to 5 based on the pre-established levels (targets) or desirable referents (benchmarking) [30].

[30] see https://publications.iadb.org/handle/11319/5911

With specific weight settings in each of the four components through a non-lineal aggregation model (a unique calculation including fuzzy-sets and centroid evaluation methodology to adjust subjectivity of the interviewer raised by the linguistic interview), the RMI measures its value (or each country's DRM performance) from 0 (minimum) to 100 (maximum). Total RMI is the average of the four composed indicators that represent each public policy.

6.1.1 Indicators of risk identification (RMI_{RI})

In order to understand the risk, the subject of risk identification needs to recognize the hazard and risk existence, dimension it (measurement) and represent it by means of models, maps and indices that are useful for decision making of stakeholders and individuals. Concretely, this should include the evaluation of hazards, the different aspects of vulnerability when faced with these hazards, and estimations regarding the occurrence of possible consequences during a particular period of exposure. On these bases, the indicators that represent the RMI_{RI} are the following:

- RI1. Systematic disaster and loss inventory
- RI2. Hazard monitoring and forecasting
- RI3. Hazard evaluation and mapping
- RI4. Vulnerability and risk assessment
- RI5. Public information and community participation
- RI6. Training and education on risk management

6.1.2 Indicators of risk reduction (RMI_{RR})

Risk reduction refers in this study to the actions necessary for avoiding or reducing the economic, social, and environmental impact due to an eventual hazard phenomenon. RMI_{RR} implies the importance of development planning to reduce existing risk conditions through corrective and prospective interventions. The aspect of risk reduction should also include both structural and non-structural measures. The indicators that represent risk reduction (RR) are the following:

- RR1. Risk consideration in land-use and urban planning
- RR2. Hydrological basin intervention and environmental protection
- RR3. Implementation of hazard-event control and protection techniques
- RR4. Housing improvement and human settlement relocation from prone-areas

- RR5. Updating and enforcement of safety standards and construction codes
- RR6. Reinforcement and retrofitting of public and private assets

6.1.3 Indicators of disaster management (RMI_{DM})

Disaster management refers in this study to providing appropriate post-disaster response and recovery including the intervention of both public institutions and communities. In other words, the RMI_{RM} seeks the effectiveness in terms of the organization capacity and the planning operativity in case of disasters. The indicators that represent the RMI_{DM} are the following:

- DM1. Organization and co-ordination of emergency operations
- DM2. Emergency response planning and implementation of warning systems
- DM3. Endowment of equipment, tools and infrastructure
- DM4. Simulation, updating and testing of inter-institutional response
- DM5. Community preparedness and training
- DM6. Rehabilitation and reconstruction planning

6.1.4 Indicators of governance and financial protection (RMI_{FP})

Governance and financial protection is fundamental for sustainable development and economic growth. This implies, on one hand, co-ordination between different social actors necessary for implementing DRM by different disciplinary approaches, values, interests, and strategies. On the other hand, governance depends on an adequate allocation and use of financial resources for DRM. The indicators that represent the RMI_{FP} are the following:

- FP1. Interinstitutional, multisectorial and decentralizing organization
- FP2. Reserve funds for institutional strengthening
- FP3. Budget allocation and mobilization
- FP4. Implementation of social safety nets and funds response
- FP5. Insurance coverage and loss transfer strategies of public assets
- FP6. Housing and private sector insurance and reinsurance coverage

6.2 Institutional framework for DRM in Jamaica

Jamaica has a solid institutional framework and there are several laws related to supporting disaster risk reduction. Especially the Office of Disaster Preparedness and Emergency (ODPEM) implements some important studies of hazards and designs mitigation measures at the national level. OPDEM conforms the National Disaster Committee especially for disaster preparedness.

At the subnational level (parish level) there are the Parish Disaster Committees including local government, private sector and NGO representatives which mirror the National Disaster Committee in its composition. These structures are focused on disaster preparedness.

There is some progress in the incorporation of DRM planning instruments e.g., the Vision 2030, a national development plan, that incorporates DRM and CCA objectives in the Socio-economic development Policy Framework.

Jamaica is a member of State of the Caribbean Disaster Emergency Management Agency (CDEMA) which coordinates DRM policies and actions on behalf of the Caribbean Community (CARICOM). ODPEM leads DRM national policy according to the Disaster Preparedness and Emergency Management Act (1993) which provides operational and administrative procedures for reducing disaster risks. The other legally binding provisions, such as the Kingston and Saint Andrew Corporation Act (1931), the Defence Act (1962), the Fire Brigade Act (1988), the Country Fire Act (1942), Parish Councils Act (1887), Water Resources Act (1995), Town and Country Planning Act (1958), National Solid Waste Management Act (2002), Public Health Act (1974), National Resources Conservation Authority Act (1991), the Parochial Rates and Finance Act (1900), the Kingston City Corporations Act (1923), the Poor Relief Act (1867), the Municipalities Act (2003) and the Buildings Act (2011), provide support to the main legal authorities.

6.3 Results - RMI

RMI results have been obtained from the interviews to, among others, ODPEM, the Meteorological Service, the National Environmental and Planning Agency, the National Spatial Data Management Division, Ministry of Local Government, the Earthquake Unit of the University of Western Indies, the Jamaica Defence Force, Ministry of Transport Works and Housing, the National Land Agency, and Ministry of Finance. Results for 1995, 2000, 2005 and 2008 were made from previous

evaluations in 2009, and additionally, the results for 2010 and 2013 (for this update) were made based on the interviews in 2014.

Table 9 and Figure 13 show the total RMI value and each of RMI_{RI}, RMI_{RR}, RMI_{DM} and RMI_{FP}.

Table 9. RMI values

Index	1995	2000	2005	2008	2010	2013
RMI_{RI}	41.35	57.37	41.35	50.35	39.04	43.31
RMI_{RR}	34.45	34.45	17.21	32.32	24.43	25.19
RMI_{DM}	50.37	51.80	51.25	51.25	47.96	51.25
RMI_{FP}	36.61	36.61	14.21	21.09	21.09	22.6
RMI	40.69	45.06	31.01	38.75	33.13	35.59

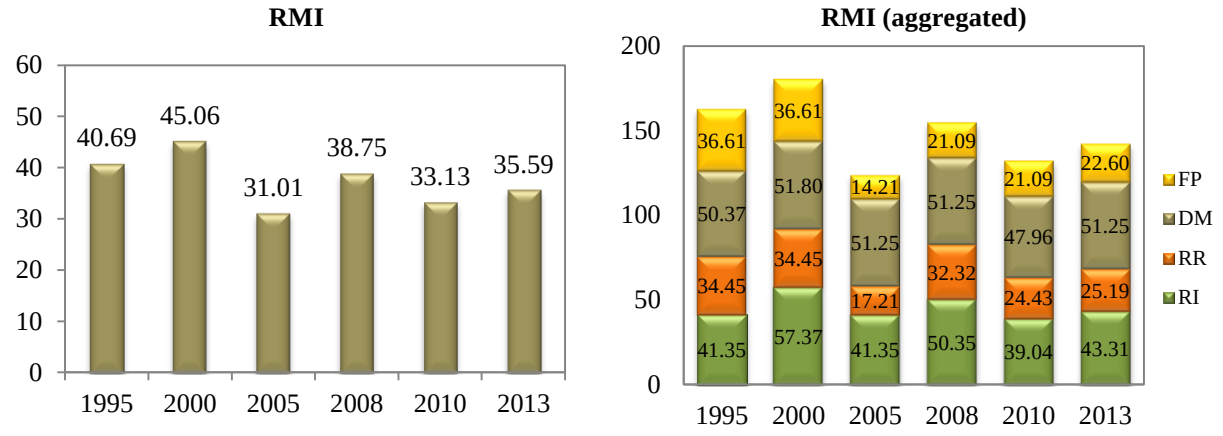
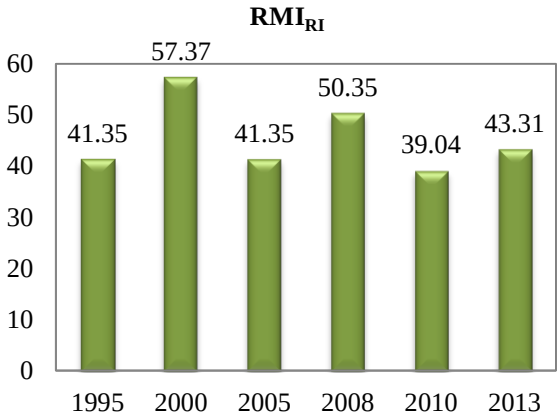


Figure 13. RMI average and aggregated by components

These results indicate that disaster risk management in Jamaica, in general, has had a similar performance since 2005 with only seen minor changes. The RMI country's average represents a current insufficient level of performance. This implies there is still much work to do for the national/local institutions and communities for effective disaster risk reduction.

6.3.1 Results - RMI_{RI}

Figure 14 shows the results of[31] RMI_{RI} with its respective weights obtained using Analytic Hierarchy Process (AHP). The results show a slight improvement between 2010 and 2013. The status for each sub-indicator is described below.



Ind	1995	2000	2005	2008	2010	2013	Weight
RI1	3	4	3	3	3	3	5.78
RI2	3	4	3	3	3	3	23.29
RI3	3	3	3	3	3	3	20.35
RI4	2	2	2	3	3	3	12.63
RI5	3	4	3	4	2	3	25.25
RI6	2	3	2	3	2	2	12.69

Figure 14. RMI_{RI}

The systematic disaster and loss inventory (RI1) has kept a significant performance level since 2005. OPDEM registers disaster damages and losses of every disaster event from 2004 based on the UNECLAC methodology[32], and it has its own disaster catalogue dated back to the early 19th century, as well as its own assessment reports after major events. There is still a lack of multi-hazards catalogues as current catalogues are mainly on hydro-meteorological events. The Mines and Geology Division of OPDEM is mainly involved in cataloguing the event. Since Hurricane Gilbert in 1988, the country established a systematic estimation and registration of economic loss inventory for some sectors, viz, agriculture, health, road infrastructure and housing, especially when caused severe damage. National Environment & Planning Agency (NEPA) documents the hazard events. There are other organizations which operate more in a sectorial level. Planning Institute of Jamaica (PIOJ) is the responsible for collecting information related to sectorial damages.

[31] Qualification is linguistic and it does not use defined numbers. The meanings of the numbers in the tables are: 1: *low,* 2: *incipient,* 3: *significant,* 4: *outstanding* and 5: *optimal*

[32] http://www.cepal.org/en/publications/handbook-disaster-assessment.

The hazard monitoring and forecasting (RI2) has also kept a significant performance level since 2005. There has been great progress from 2010 to 2014 on installation of the hazard monitoring equipment at national level and the majority of hazard monitoring systems are being automatic especially for hydro-meteorological hazards. Nevertheless, the equipment does not cover all the territory nor for all the hazards. There are automatic warning systems for tropical cyclones and hurricanes due to climate change related international funds.

Hazard evaluation and mapping (RI3) has kept a significant performance level since 1995. Detailed and advanced hazard evaluation were made especially for hurricanes. Earthquake hazard maps are prepared based on probabilistic ground motion models; storm surge and landslide hazard maps are developed using advanced statistical/mathematical modelling; and flood hazard maps are also based on mathematical modelling. Earthquake micro-zoning maps have recently been carried out for Kingston and Ocho Ríos with projects funded by the World Bank. Advanced methodologies are being applied only in some selected communities or regions.

Most projects for hazard evaluation and mapping rely on international funding (including the funding through IDB, World Bank and CDB). OPDEM's strategy includes assessments on urban-coastal areas and since 2010, some risk assessments and hazards maps in coastal towns were developed using probabilistic risk assessment methodology. There are landslides and inundations hazards maps based on probabilistic techniques, but not based on high quality data. Only some locations in Kingston have seismic zoning maps, which was carried out last year by the Earthquake Unit of the University of West Indies. The result of this study was published but not yet referenced for the development planning.

The vulnerability and risk assessment (RI4) has kept a significant performance level since 2008. Some improvements have been made from 2010 to 2014 especially related to the analysis of the physical vulnerability of some essential buildings including hospitals. Vulnerability and risk assessment was developed for selected communities with respect to floods, storm surges and possible hurricane winds. Rapid visual screening of some critical facilities for earthquake hazards was conducted in Kingston and St. Andrew. Since 2009, one of the strategic objectives of OPDEM has been conducting multi-hazard risk assessments and, since then, they have been trying to quantify losses. OPDEM uses a methodology developed mainly by ITC (Netherlands), as well as methodologies developed by FEMA. For the first time, OPDEM completed one detailed risk assessment using probabilistic risk assessment techniques in Annotto Bay (St. Mary parish).

Vulnerability risk assessment started in 2010 in Jamaica. However, not all studies are based on probabilistic techniques, and not all the essential buildings and life lines are assessed in terms of vulnerability analysis.

Public information and community participation (RI5) shows an incipient performance level in 2010 and then improved as significant level in 2013. Since 2009, ODPEM started the Building Disaster Resilient Communities (BDRC) program. Since 2010, 20 communities were trained and supported for the development of disaster management teams and community disaster management plans. This project became a regular program for ODPEM since 2010. Nevertheless, public information is mainly focused on preparedness and emergency response. Some improvements are seen over the period between 2010 and 2014, especially in the last two years with social media tools. Activities are mostly held during the event or prior to hurricane season. Dissemination of bulletins is made to stakeholders and communities, and varies according to the event; for example, in the case of droughts, not too much due to the length of the event. NEPA is heading in this direction for climate change, developing different materials, although the extent to which this material is presented to the public is still unknown.

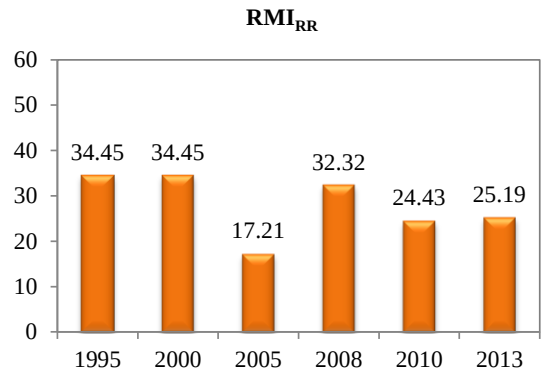
The training and education on risk management (RI6) shows an incipient performance level in 2010 and 2013. At the primary level, there are some courses on introduction to hazards and disasters in the schools. These are not on risk management but more on hazard identifications and impacts. NEPA carries out activities in schools about environmental conservations. There are also specialized courses in the University of West Indies on Risk Management and also a Bachelor of Science degree (B.Sc.) in geography that takes into consideration risk management issues. Since 2010, there has been an increase in climate change and disaster reduction awareness, and the public and students seem to have a general idea of risk.

6.3.2 Results - RMI_{RR}

Figure 15 shows the results of RMI_{RR} with its respective weights using AHP. The results indicate no mayor improvements in the risk reduction of Jamaica. The status for each subindicator is described below.

The risk consideration in land use and urban planning (RR1) has kept an incipient performance level since 2000. There are several Acts for Land Use Planning and different agencies with

different mandates but there is no law that prevents people from occupying places at risk. Nevertheless, there is a progressive formulation of land use regulations in various cities, not all of which are taking into account hazards and risks. There is a disaster risk reduction proposed bill, so the country is in the process of putting the legislation in place, although this bill is being debated and has not been enacted yet. The planning framework is one of the main challenges in Jamaica as there is no national legislation that specifies it. Under the Town and Country Planning Act, zoning is allowed for a specific use. Other agencies are conducting development planning such as ODPEM, UDC, and others; in their plans, some risk management considerations have been taken into account, but it depends on the parishes and local authorities to manage it, as there is no national legislation for this. So, there is some legislation but application and implementation is still a challenge.



Ind	1995	2000	2005	2008	2010	2013	Weight
RR1	2	2	2	2	2	2	30.01
RR2	3	3	2	3	3	3	16.85
RR3	3	3	2	2	2	2	8.66
RR4	2	2	2	2	1	2	13.46
RR5	3	3	2	3	2	2	17.88
RR6	1	1	2	2	1	1	13.14

Figure 15. RMI_{RR}

The development of a Manual for Land Planning with best practices for land use (RR1) is planned to be finished by 2014. The proposed Disaster Risk Management and Emergency Management Act includes new legislative arrangements for natural hazards in development planning. 'No Build Zone' legislation soon to be promulgated into law. New Development Orders for some parishes include natural hazard as a critical component in development/physical planning. Land use planning is included in the development orders[33], even though the majority of local government of the country is under preparation of development orders.

[33] A development order is the legal document used to guide development in the area covered by the order. More information at: http://www.nepa.gov.jm/new/services_products/subsites/planning/index.php

The hydrological basin intervention and environmental protection (RR2) shows a significant performance level since 2008. The country approved the Watersheds Protection Act in 1963 and its amendment was approved in 1991. This piece of legislation provides protection to watersheds and areas adjoining watersheds and, by that means, promotes the conservation of water resources. Jamaica is considered a watershed and for management purposes it is divided into smaller units. The Act makes provision for conservation of watersheds through the implementation of provisional improvement schemes whereby soil conservation practices are carried out on land.

The implementation of hazard-event control and protection techniques (RR3) has kept an incipient level of performance since 2005. Implementation of hazard-event control is normally done in selected areas, especially when damaged by flood or hurricane.

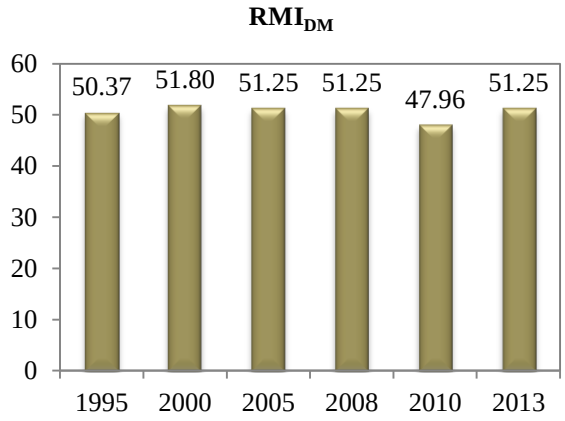
Housing improvement and human settlement relocation from prone-areas (RR4) shows a low performance level in 2010 and an incipient level in 2013. Relocation of settlements takes place infrequently when a community is dislocated by a natural event such as flooding or a hurricane. There is no legislative framework at present to deal with urban settlements in hazard prone areas. There was a relocation of some 20+ families that were affected by Hurricane Sandy in 2010.

The updating and enforcement of safety standards and construction codes (RR5) shows an incipient performance level in 2010 and 2013. There is a building code of the country but it is promulgated as a “building bill” which means that it is a non-obligation technical instrument. Since 2010, reviewing and consultation on the new code has taken place. The board has taken into consideration the risk management issue for this new code.

The reinforcement and retrofitting of public and private assets (RR6) shows a low performance level in 2010 and 2013. Structural retrofitting for buildings are not being performed. Jamaica’s earthquake risk resistance code came up after the 1907 earthquake. An updated code was published in 1983 as a policy document but it is not enforced. Since then, some earthquake resiliency was incorporated in buildings but no retrofitting has been carried out. There is a lack of experts in Jamaica to take responsibility on this subject. More training is needed for engineers especially in the national university. Nevertheless, some retrofitting activities have been done in some hospitals and schools. There are plans to expand the program with international support (e.g., financed through the World Bank) for rapid scanning of buildings vulnerability (risk assessment). Retrofitting is primarily done after an event.

6.3.3 Results - RMI_{DM}

Figure 16 shows the results of RMI_{DM} and its weights obtained using AHP. The results indicated no important improvement in Jamaica in terms of disaster preparedness over in the last decades. The status for each subindicator is described below.



Ind	1995	2000	2005	2008	2010	2013	Weight
DM1	5	5	4	4	4	4	31.51
DM2	3	3	3	3	3	3	22.12
DM3	2	3	3	3	2	3	11.93
DM4	3	3	3	3	2	3	13.64
DM5	3	3	3	3	3	3	14.78
DM6	1	2	2	2	2	2	6.011

Figure 16. RMI_{DM}

The organization and coordination of emergency operations (DM1) has kept an outstanding performance level since 2005. ODPEM has a long history and a record of excellence in the coordination of emergency operations. Since 2010, there has been an improvement in the level of coordination of emergency operations: they are getting more defined, particularly at local level.

The emergency response planning and implementation of warning systems (DM2) has kept a significant performance level since 1995. Protocols and operational procedures are clearly defined, and there is an ongoing improvement in early warning systems with telecommunications. Advanced early warning systems (e.g. flood early warning), however, need to be improved. Some scenarios for earthquake emergency response planning are being developed. Significant number of emergency response planning has been prepared.

The endowment of equipment, tools and infrastructure (DM3) shows an incipient performance level in 2010 and a significant level in 2013. In addition to the national emergency storage[34] located in Kingston, there are other four regional emergency storages. Resource inventories have been established since 2010 and located in public and private sector organizations so that each parish would be able to call for support in case of an emergency. Cooperation is usually provided by the national and local agency. There are some sectoral emergency operation centres which try to coordinate and support at national level. ODPEM has improved their emergency operation equipment.

The simulation, updating and testing of inter-institutional response (DM4) shows an incipient level of performance in 2010 and a significant level in 2013. Simulations are organized at national level and implemented at local level. All the parishes have simulation exercises. There have been testing of emergency and contingency plans but not all simulations are centrally coordinated with all the agencies involved. National simulation exercises started in 2011 focused first on hurricanes, and then on earthquakes. By this 2014, there should be another one focused on landslides.

Community preparedness and training (DM5) has kept a significant performance level since 2000. ODPEM provides regular community training activities geared towards emergency response, which has been ongoing. There are parish disaster coordinators who carry out the trainings. However, most of the training programs were executed under a specific request from the parish or under specific projects; training with the communities is not frequent in all parishes, as it takes place on an annual basis. The courses are not running frequently. The parishes that will be participating in the courses are not defined, and neither are the funds that these activities will receive. Nevertheless, there was an increase in the number of communities reached since 2010.

Rehabilitation and reconstruction planning (DM6) has kept an incipient performance level since 2000. There is some planning for recovery measures, particularly with the Government's Disaster Fund and the Caribbean Catastrophe Risk Insurance Fund (CCRIF). The private sector is doing some planning for recovery. From a national perspective, there are diagnostic procedures established for infrastructure and community recovery. Resources are received after the event.

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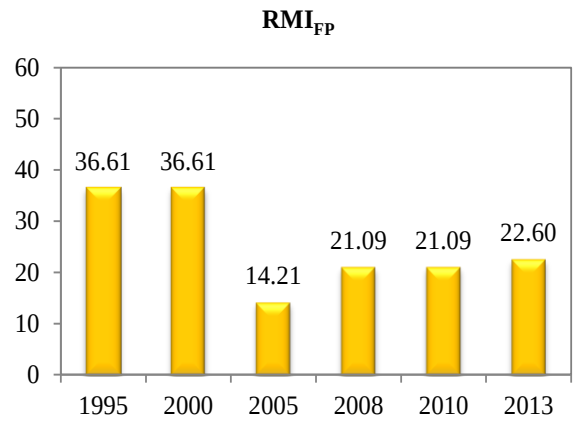
[34] Based on the National Emergency welfare & shelter plan (page 11).
http://www.odpem.org.jm/Portals/0/ODPEM%20Pdf/National%20Disaster%20Relief%20Policy.pdf

There are some provisional recovery measures in national disasters. ODPEM has a National Recovery Plan; however, there are not sufficient plans at the public service level that are integrated, tested and updated.

6.3.4 Results - RMI_{PF}

Figure17 shows the results of RMI_{FP} with its respective weights, obtained using AHP. The results show few important improvement in the governance and financial protection in the last years in Jamaica. The status for each sub-indicator is described below.



Ind	1995	2000	2005	2008	2010	2013	Weight
FP1	3	3	2	2	2	2	9.71
FP2	3	3	2	3	3	3	9.71
FP3	2	2	1	1	1	2	22.57
FP4	2	2	2	2	2	2	16.76
FP5	1	1	1	2	2	2	9.13
FP6	3	3	2	2	2	2	32.13

Figure 17. RMI_{FP}

The inter-institutional, multi-sectoral and decentralizing organization (FP1) has kept an incipient performance level since 2005. The Disaster Preparedness and Emergency Management Act (1993) is the current legislation. Inter-institutional, multi-sectorial and decentralizing organization is limited.

The reserve funds for institutional strengthening (FP2) shows a significant performance level since 2008. There is a National Disaster Fund which is administrated by ODPEM. There is an annual budgetary allocation to the fund. In case there is a major disaster, supplemental resources will be provided by additional budgetary support through the re-allocation of resources and donor assistance. The fund is not always sufficient at the moment of a disaster. When there is a disaster and support from international partners is needed, international organizations may need to complement to support emergency operation in a timely manner.

The budget allocation and mobilization (FP3) shows a low performance level in 2010 and an incipient level in 2013. There is budget allocation for risk reduction. ODPEM is responsible for DRM, especially for the mobilization of resources in the event of a disaster. Other key agencies such as the National Works Agency, and the National Solid Waste Management Authority may need to mobilize resources not only for emergency operation but also for ex ante investment for reducing the risk.

The implementation of social safety nets and funds response (FP4) kept an incipient performance level since 2000. The government has the PATH programme (the Programme of Advancement Through Health and Education) which targets the poor and provides a grant every month to get a check with a certain amount.

The insurance coverage and loss transfer strategies of public assets (FP5) shows an incipient performance level since 2008. Not all public assets are insured. All government agencies are encouraged to purchase insurance but it is not mandatory. The Government has tried to promote insurance coverage and there have been trainings on its importance.

The housing and private sector insurance and reinsurance coverage (FP6) also had an incipient performance level since 2005. Regulation of the insurance industry controls over solvency and legislation for insurance of house loan and housing sector.

Table 110 presents, in a more illustrative form, the changes of the performance levels of the indicators that composed the aspects of the four policies related with risk management, between 2010 and 2013.

In summary, the previous table shows that during the period 2010-2013 just 5 out of 24 subindicators involved in this evaluation have changed. The improvements have been concentrated (28 points) in 3 components: public information and community participation (RI5); the endowment of equipment, tools and infrastructure (DM3); and the simulation, updating and testing of inter-institutional response (DM4). Other components present minor improvements (12 points); they are: the housing improvement and human settlement relocation from prone-areas (RR4); and the budget allocation and mobilization (FP3).

Table 110. Differences between the first and last period for RMI subindicators functions performance
Values of the performance functions of subindicators

2010	**RI1**	45	**RR1**	17	**DM1**	77	**FP1**	17
	RI2	45	**RR2**	45	**DM2**	45	**FP2**	45
	RI3	45	**RR3**	17	**DM3**	17	**FP3**	5
	RI4	45	**RR4**	5	**DM4**	17	**FP4**	17
	RI5	17	**RR5**	17	**DM5**	45	**FP5**	17
	RI6	17	**RR6**	5	**DM6**	17	**FP6**	17
	RMI_{RI}	39.04	**RMI_{RR}**	24.43	**RMI_{DM}**	47.96	**RMI_{FP}**	21.09
	RMI	33.13						
2013	**RI1**	45	**RR1**	17	**DM1**	77	**FP1**	17
	RI2	45	**RR2**	45	**DM2**	45	**FP2**	45
	RI3	45	**RR3**	17	**DM3**	45	**FP3**	17
	RI4	45	**RR4**	17	**DM4**	45	**FP4**	17
	RI5	45	**RR5**	17	**DM5**	45	**FP5**	17
	RI6	17	**RR6**	5	**DM6**	17	**FP6**	17
	RMI_{RI}	43.31	**RMI_{RR}**	25.19	**RMI_{DM}**	51.25	**RMI_{FP}**	22.60
	RMI	35.59						
Change	**RI1**	0	**RR1**	0	**DM1**	0	**FP1**	0
	RI2	0	**RR2**	0	**DM2**	0	**FP2**	0
	RI3	0	**RR3**	0	**DM3**	28	**FP3**	12
	RI4	0	**RR4**	12	**DM4**	28	**FP4**	0
	RI5	28	**RR5**	0	**DM5**	0	**FP5**	0
	RI6	0	**RR6**	0	**DM6**	0	**FP6**	0
	RMI_{RI}	4.27	**RMI_{RR}**	0.76	**RMI_{DM}**	3.29	**RMI_{FP}**	1.51
	RMI	2.46						

6. CONCLUSIONS AND RECOMMENDATIONS

Jamaica is a country which shows a general advance in DRM over the recent decades. This advance is reflected in RMI and in the progressive reduction of risk indicators as DDI, LDI and PVI. When comparing indicator tendencies, it can be concluded, that the system of indicators shows consistent results. It is important to disaggregate indicators and identify subindicators or aspects for improving and achieving a greater advance in risk management. This kind of identification should be done by competent entities and sector officials in charge of each considered aspect.

It is important to indicate that risk management officials established the weights applied and carried out the evaluations for most countries. These evaluations would appear to be overly generous when compared to those undertaken by local external experts. The latter appear to be more objective. While we have used the evaluations of national officials in this study, external evaluations are considered to be very pertinent. Perhaps, with time, they will become more desirable, particularly if undertaken in a coordinated and concerted fashion, thus eliminating status quo factors.

From these results, it is possible to conclude that in Jamaica there was an increase of DDI from 2010 to 2012, but these values are lower than the ones reported previously. The PVI has been also increasing slightly in the last years but these values are lower than the previous evaluations. The RMI shows a slight improvement between 2010 and 2013.

Making the comparison of trends in indicators it is possible to conclude that the system of indicators presents results generally consistent or appropriate to the reality of the country. In any case, it is important to disaggregate these indicators and identify areas where improvements can be made through actions, projects and specific activities that the central government can make with the participation of different sectoral agencies, municipalities and communities, and, thus, achieve a further progress and greater sustainability. Decision makers and stakeholders, besides identifying weakness indicators, must take into account other characteristics that are not revealed or expressed with the evaluation obtained. Indicators provide a situational analysis from which it is possible to extract a set of actions that must be done without details for a strategic plan, which should be the next step. The aim of the indicators system is helping to formulate general recommendations for planning.

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