Indicators for Disaster Risk and Risk Management

Programme for Latin-America and The Caribbean

Bahamas

IDB

Inter-American Development Bank

Environment, Rural Development and Disaster Risk Management Division (INE/RND)

TECHNICAL NOTE

No. IDB-TN-790

December 2011

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Programme for Latin-America and The Caribbean

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Inter-American Development Bank

2011

Cataloging-in-Publication data provided by the
Inter-American Development Bank
Felipe Herrera Library

Inter-American Development Bank.
Indicators for disaster risks management: program for Latin America and Caribbean: Bahamas / Inter-American Development Bank.
p. cm. — (IDB Technical Note ; 790)
1. Natural disasters—Statistics—Bahamas. 2. Emergency management—Statistics—Bahamas. 3. Environmental risk assessment—Statistics—Bahamas. I. Inter-American Development Bank. Division of Environment, Rural Development and Disaster Risk Management at the Infrastructure and Environment Sector. II. Title. III. Series.
IDB-TN-790

JEL Code: Q540
Key Words: Disaster Risk Management, Natural Disaster, Public Policy, Public Investment, Climate Change

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1. INTRODUCTION

Disaster risk is not only associated with the occurrence of intense physical phenomenon but also with the vulnerability conditions that favour or facilitate disasters when such phenomenon occur. Vulnerability is intimately related to social processes in disaster prone areas and is usually related to the fragility, susceptibility or lack of resilience of the population when faced with different hazards. In other words, disasters are socio-environmental by nature and their materialization is the result of the social construction of risk. Therefore, their reduction must be part of decision making processes. This is the case not only with post disaster reconstruction but also with public policy formulation and development planning. Due to this, institutional development must be strengthened and investment stimulated in vulnerability reduction in order to contribute to the sustainable development process in different countries.

In order to improve disaster risk understanding and disaster risk management performance a transparent, representative and robust System of Indicators, easily understood by public policymakers, relatively easy to update periodically and that allow cluster and comparison between countries was developed by the Institute of Environmental Studies (IDEA in Spanish) of the National University of Colombia, Manizales. 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" of the Inter-American Development Bank (IDB).

This System of Indicators has three specific objectives: *i)* improvement in the use and presentation of information on risk. This assists policymakers in identifying investment priorities to reduce risk (such as prevention and mitigation measures), and directs the post-disaster recovery process; *ii)* to provide a way to measure key elements of vulnerability for countries facing natural phenomena. It also provides a way to identify national risk management capacities, as well as comparative data for evaluating the effects of policies and investments on risk management; and *iii)* application of this methodology should promote the exchange of technical information for public policy formulation and risk management programs throughout the region. The System of Indicators was developed to be useful not only for the countries but also for the Bank, facilitating the individual monitoring of each country and the comparison between the countries of the region.

The first phase of the Program of Indicators IDB-IDEA involved the methodological development, the formulation of the indicators and the evaluation of twelve countries from 1985 to 2000. Subsequently two additional countries were evaluated with the support of the IDB's Regional Policy Dialogue on Natural Disasters. In 2008 a methodological review and the updating of the indicators for twelve countries was conducted in the framework of the Operation RG-T1579/ATN/MD-11238-RG. Indicators were updated to 2005 and for the most recent date according to the available information (2007 or 2008) for Argentina, Bolivia, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Jamaica, Mexico, Peru, and Trinidad and Tobago[1]. In addition, Barbados and Panama were included in the program. Subsequently, in the framework of other operations of the IDB, other evaluations of the System of Indicators have been made for Belize, El Salvador, Guatemala, Guyana, Honduras and Nicaragua. This report has been made using the methodologies formulated in the Program of Indicators IDB-IDEA[2] with some adjustments that are referenced in the description of each indicator.

The System of Indicators mentioned above attempts to facilitate access to relevant information on country's vulnerability and risk by national decision makers through the use of relative indicators to help the identification and proposal of effective disaster risk management policies and actions. The underlying models attempt to represent risk and risk management schemes at a national scale, allowing the identification of its essential economic and social characteristics and a comparison of these aspects and the risk context in different countries.

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[1] Usually, the most recent values in the different databases are not definitive as they are subject to change, thus, the last considered year (that is different for each indicator) is in some cases tentative or preliminary.

[2] More information and details of methodologies can be found in Cardona (2005) "System of Indicators of Disaster Risk and Risk Management: Main Technical Report". Program of Indicators for Disaster Risk and Risk Management IDB – IDEA, Universidad Nacional de Colombia, Manizales. http://idea.unalmzl.edu.co

The proposed System of Indicators allows disaster risk and risk management evaluation and benchmarking of each country in different time periods. It assists to advance a more analytically rigorous and data driven approach to risk management decision-making. This measurement approach enables:

- Representation of disaster risk at the national level, allowing the identification of key issues relating their characterization from an economic and social point of view.
- Risk management performance benchmarking of the different countries to determine performance targets for improving management effectiveness.

Due to a lack of parameters, the need to suggest some qualitative indicators measured on subjective scales is unavoidable. This is the case with risk management indicators. The weighting of some indices has been undertaken using expert opinion at the national level. Analysis has been achieved using numerical techniques that are consistent with the theoretical and statistical perspectives.

Four components or composite indicators reflect the principal elements that represent vulnerability and show the advance of different countries in risk management. This is achieved in the following way:

1. The Disaster Deficit Index, DDI, measures country risk from a macro-economic and financial perspective when faced with possible catastrophic events. This requires an estimation of critical impacts during a given exposure time and of the capacity of the country to face up to this situation financially.

2. The Local Disaster Index, LDI, identify the social and environmental risk that derives from more recurrent lower level events which are often chronic at the local and sub national levels. These events particularly affect the more socially and economically

fragile population and generate a highly damaging impact on the country's development[3]

3. The Prevalent Vulnerability Index, PVI, is made up from a series of indicators that characterize prevailing vulnerability conditions reflected in exposure in prone areas, socioeconomic fragility and lack of resilience in general.

4. The Risk Management Index, RMI, brings together a group of indicators related to the risk management performance of the country. These reflect the organizational, development, capacity and institutional action taken to reduce vulnerability and losses, to prepare for crisis and efficiently recover.

In this way, the System of Indicators covers different aspects of the risk and takes into account aspects such as: potential damage and loss due to the probability of extreme events, recurrent disasters or losses, socio-environmental conditions that facilitate disasters, capacity for macroeconomic recovery, behaviour of key services, institutional capacity and the effectiveness of basic risk management instruments such as risk identification, prevention and mitigation measures, financial mechanisms and risk transfer, emergency response levels and preparedness and recovery capacity (Cardona 2008). Each index has a number of variables that are associated with it and are empirically measured. The choice of variables was driven by a consideration of a number of factors including: country coverage, the soundness of the data, direct relevance to the phenomenon that the indicators are intended to measure, and quality. Wherever possible it is sought to use direct measures of the phenomena that is being captured. But in some cases, proxies[4] have to be employed. In general, variables with extensive country coverage are sought, but in some cases the use of

[3] In the case of The Bahamas, the Local Disaster Index, LDI, that captures the relevance of small and moderate local disasters, was not calculated due to the lack of availability of the DesInventar database at the time of the indicators assessment and the development of this project report. This indicator should be evaluated in the nearfuture due to its relevance and in order to have a complete picture of the country's risk conditions using the complete set of indicators.

[4] Due to the lack of detailed information for coarse grain results, alternative values of related data are used to reflect, indirectly, the desired information.

variables with narrow coverage are necessary to measure critical aspects of risk that would otherwise be overlooked.

This report presents only the results for the country and detailed methodological explanations will not be found, as they are not within the scope of this report. Information related to the methodology and the previous results of the System of Indicators can be found at: http://idea.unalmzl.edu.co, where details on conceptual framework, methodological support, data treatment and statistical techniques used in the modelling are presented (Cardona *et al* 2003a/b; 2004 a/b).

2. National Context

The Commonwealth of The Bahamas is located in the Atlantic Ocean southeast of the United States, northeast of Cuba, Dominican Republic and Haiti and northwest of the Turks and Caicos Islands. It consists of 29 main islands, 661 cays and more than two thousand islets. The total land area is 5,382 sq mi (13,940 km^2 Most of the islands are flat with ridges with maximum height of 66 ft (20 m); the highest point on the set of islands is Como Hill, located at Cat Island with an altitude of 206 ft (63 m).

The climate of The Bahamas is between tropical and subtropical, moderated by the waters of the Gulf Stream particularly during November and January. Midsummer temperatures range from 74 to 89ºF with a relative humidity of 60% to 100%. In winter months it ranges from 62º to 77ºF. Rainfall varies from an average of 1.6 inches in the dry season to 7.1 inches in the rainy season. The dry season usually extends from November to April and the rainy season is between May and October.

Figure 1 presents the 2010 population estimates for the main islands in The Bahamas.

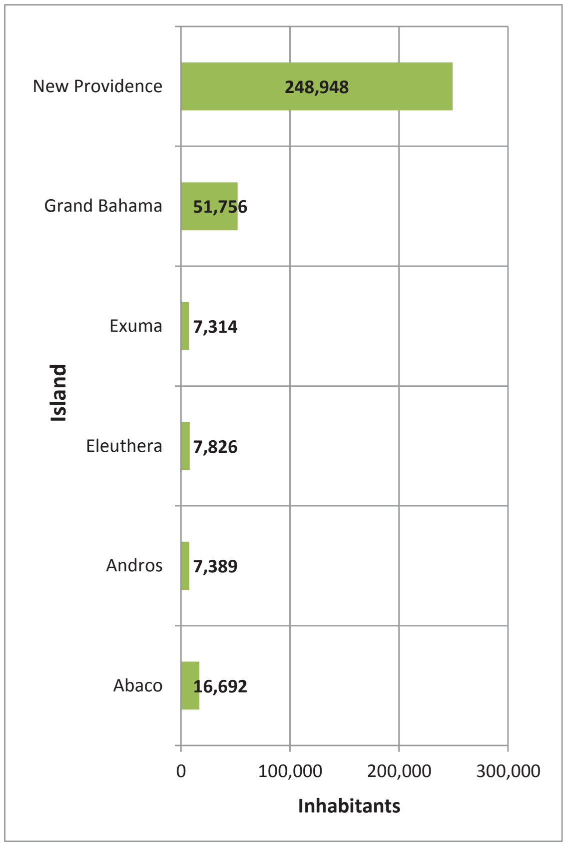


Figure 1. Population for main islands (Source: Department of Statistics of The Bahamas)

Regarding its economy, GDP at market prices of The Bahamas was USD 8.8 Billion in 2010; the third richest country in the Americas. During this period, current account and trade balance was near to -27% of GDP in 2008. The rate of inflation slowed considerably from 4.5% in 2008 to 2.1% in 2009. The unemployment rate was estimated to be in the order of 14.2% for 2009 according to the World Bank[5]. The exchange rate in 2010 was one Bahamian dollar (BSD) per United States dollar. Table 1 presents a summary of macroeconomic variables of the country. With regard to the social characteristics of the country, the literacy rate of the population over 15 years old was approximately 95.6% in 2005.

[5] http://datos.bancomundial.org/pais/bahamas

Table 1. Main macroeconomic and social indicators

Indicator	2008	2009	2010
GDP (USD billion)	8.55	9.09	8.79
Trade balance (% GDP)	-27.4	**	**
Inflation rate (consumer prices)	4.5	2.1	1.3
Unemployment (%)	8.7	14.2	**
Population living lower the poverty line (%)	9.3	9.3	9.3
Human Development Index	0.783	0.783	0.784

Sources: The World Bank, IndexMundi
**No data available*

3. NATURAL HAZARDS

Figure 2 presents the percentages of the influence area and the severity level of the different hazards in the country. Likewise, Figure 3 presents the classification by mortality risk established by the International Strategy for Disaster Reduction, ISDR. These figures illustrate the events that can be considered as triggers for the estimation of the Disaster Deficit Index, DDI. Other frequent and isolated phenomena such as landslides and floods, that are less visible at national level, are the causes of recurrent effects at the local level and may have an important accumulative impact. Appendix I presents a general description of the country's hazards.

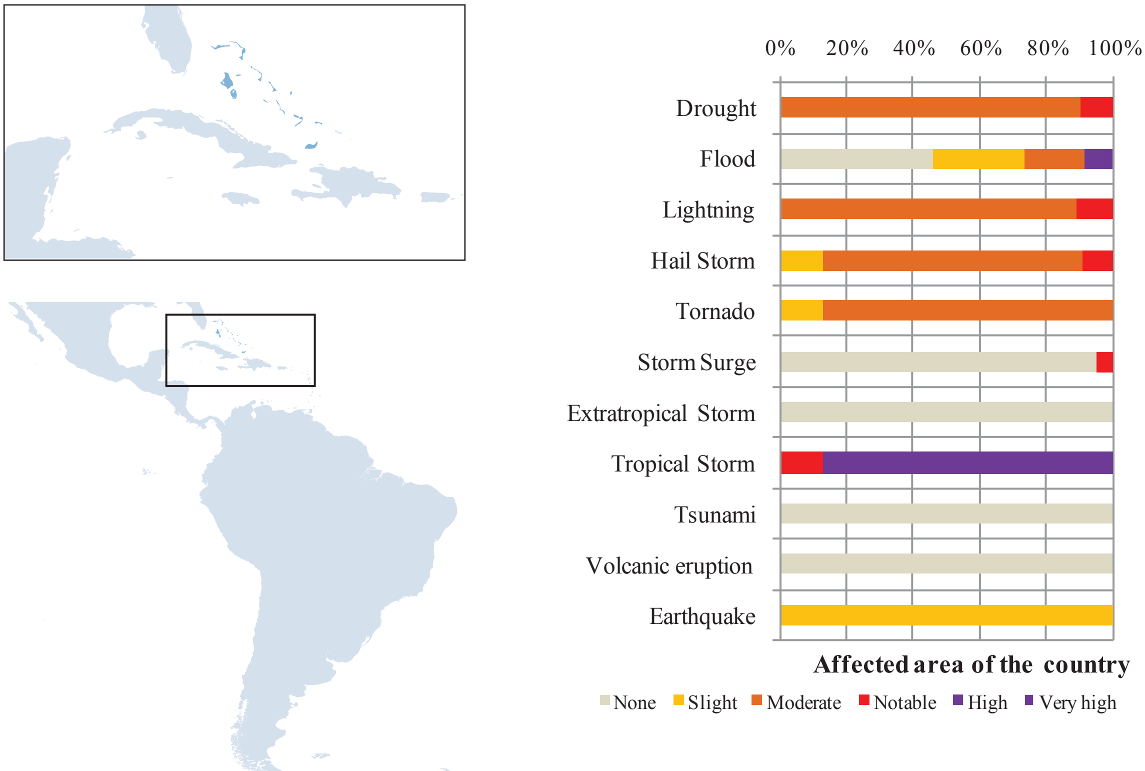


Figure 2. Percentage of the influence area by hazard (Source: Munich Re[6])

The most important natural hazards to the country are the tropical storms, lightning, tornado and droughts. These are the extreme events that would cause the major losses in the future in The Bahamas. There are other natural phenomena that have lower probability of affecting the country such as floods and storm surge; however these hazard events are able to result in significant local damage. This information is especially important for the estimation of the Disaster Deficit Index, DDI. On the other hand, most recurrent and isolated phenomena, such as landslides cause frequent effects at the local level that are not easily noticed at national level. These events have also great impacts over population, and, if they are accumulative, can be important too.

[6] http://mrnathan.munichre.com/

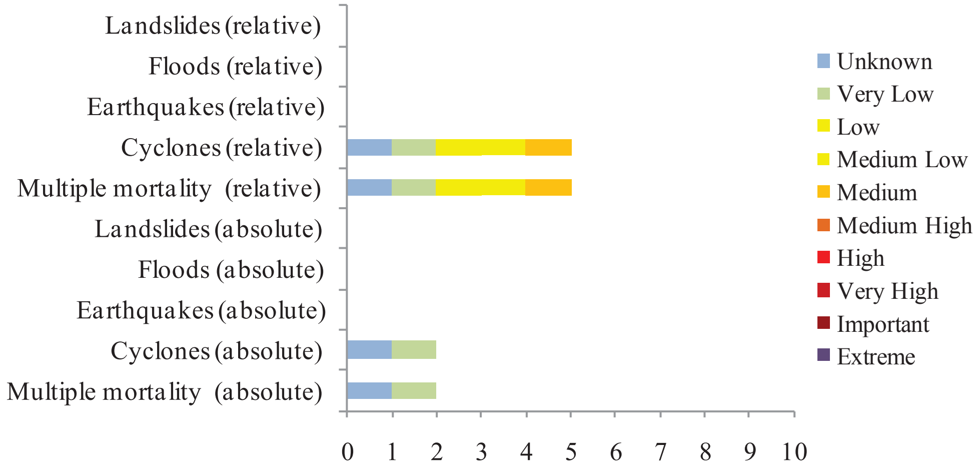


Figure 3. Classification by mortality risk (Source ISDR 2009)

The mortality risk index established by the International Strategy for Disaster Reduction – ISDR, is based on hazard modelling (tropical cyclones, flooding, earthquakes and landslides), taking into account the frequency and severity of the hazard events, the human exposure and the vulnerability identification. The absolute mortality risk index refers to the average of deaths per year; the relative mortality risk index refers to the average of deaths in proportion to the national population. Low indices of 1 mean low mortality risk and 10 is the maximum value and means high mortality risk. According to Figure 3 relative values indicate that mortality risk is medium-high concentrated due to cyclones, the other hazards do not have any participation in the relative index. Likewise, absolute mortality risk shows that cyclones are classified as very low and the other hazards do not have any participation.

4. Indicators of Disaster Risk and Risk Management

A summary of the results obtained from the System of Indicators application for The Bahamas for the period 2001-2005 and for the last available year in the databases is presented in this section. These results are useful in order to analyze risk and risk management performance in the country, based on information supplied by different national institutions.

4.1 Disaster Deficit Index (DDI)

The DDI measures the economic loss that a particular country could suffer when a catastrophic event takes place, and the implications in terms of resources needed to address the situation. This index captures the relationship between the demand for contingent resources to cover the losses that the public sector must assume as result of its fiscal responsibility caused by the Maximum Considered Event (MCE) and the public sector's economic resilience (ER).

Losses caused by the MCE are calculated with a model that takes into account, on the one hand, different natural hazards, -calculated in probabilistic terms according to historical registers of intensities of the phenomena- and, on the other hand, the current physical vulnerability that present the exposed elements to those phenomena. The ER is obtained from the estimation of the possible internal or external funds that government, as the entity responsible for recovery or as owner of the affected goods, may access or has available at the time of the evaluation.

A DDI greater than 1.0 reflects the country's inability to cope with extreme disasters even by absorbing as much debt as possible. The greater the DDI, the greater the gap. Also, an estimation of a complementary indicator, DDI'_{CE} has been made, to illustrate the portion of a country's annual Capital Expenditure that corresponds to the expected annual loss or the pure risk premium, i.e. what percentage of the annual investment budget would be needed to pay for future disasters (IDEA 2005; Cardona 2005). The DDI'_{IS} is also estimated with respect to the amount of sustainable resources due to inter-temporal surplus; i.e. the savings which the government can employ, calculated over a ten year period, in order to best attend to the impacts of disasters. The DDI'_{IS} is the percentage of a country's potential savings at present values that corresponds to the pure risk premium.

4.1.1 Reference parameters for the model

Even though there is not detailed data useful for modelling public and private sector inventories, it is possible to use general information about built areas and/or on the population to make estimations of these inventories of exposed elements. This technique or proxy method allows a coarse grain assessment of the volume and cost of the exposed elements required for the analysis. The parameters for shaping a homogeneous and consistent information structure for the specific objectives of the project are shown in figures 4 and 5: (i) cost of square meter of some construction classes, (ii) built area –in each city related to the number of inhabitants– and (iii) distribution of built areas in basic groups for analysis –as the public and private components–, which would be in charge or would be fiscal liabilities of the government in case of disaster. In addition, the rest of private goods, that constitute capital stocks, are considered as well to provide a general view of the potential impact in the country.

Figure 4 shows estimations of built areas in different components and its variations in time (from 2000 to 2008). Figure 5 presents a similar graphic related to the exposed values of the whole country. The technique for country's exposure estimation, vulnerability and hazard assessment and risk models used are explained in Ordaz & Yamin (2004) and Velasquez (2009). These technical explanations are available in http://idea.unalmzl.edu.co.

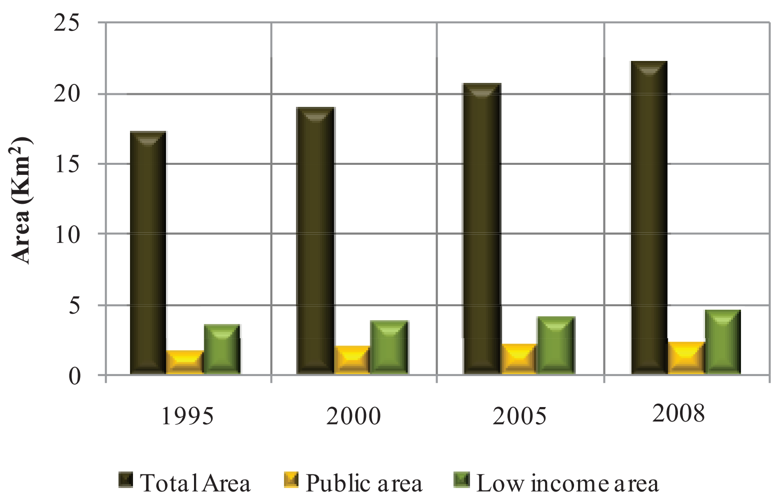


Figure 4. Total built areas by component in square km

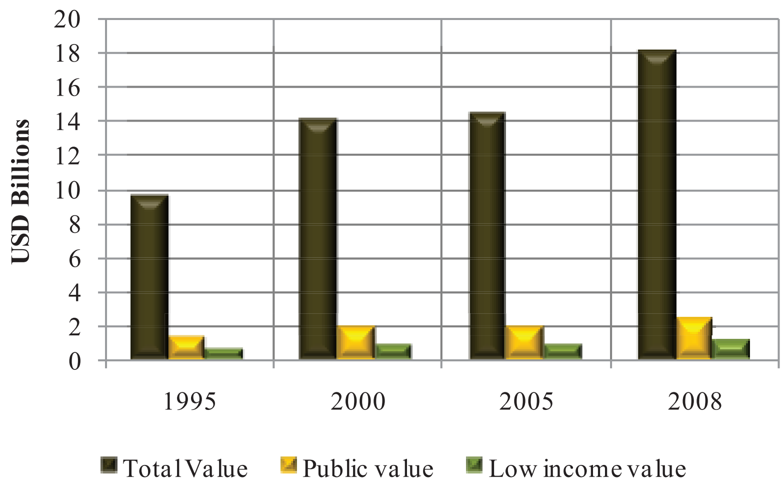


Figure 5. Exposed value by component in billion dollars ($US)

The values of the built areas include (i) total value (public and private built areas), (ii) public value (the buildings of the government and public infrastructure) and (iii) Low income value (buildings of the low-income socio-economic homeowners). Those properties mentioned above usually are the sovereign or fiscal liabilities.

4.1.2 Estimation of the indicators

Table 2 shows DDI for 2000, 2005 and 2008 for the Maximum Considered Event (MCE) of 50, 100 and 500 years of return period.[7]

Table 2. DDI for different return periods

DDI	2000	2005	2008
DDI_{50}	0.93	0.71	0.70
DDI_{100}	1.78	1.38	1.37
DDI_{500}	7.10	6.05	6.00

For extreme events with return periods of 50[8] years, Table 2 shows that The Bahamas has the capacity to cover reconstruction costs using its own funds or with the resources that the government could have accessed if it would be necessary. In the case of extreme events with return periods of 100 and 500[9] years, the country has not had this capacity. The values greater than 1.0 mean that the country does not have enough resources to cover losses

[7] Events that can occur at any time and have a probability of occurrence of 18%, 10% and 2% in 10 years.
[8] Events that can occur at any time and have a probability of occurrence of 18% in 10 years.
[9] Events that can occur at any time and have a probability of occurrence of 10% and 2% in 10 years.

and/or feasible financial capacity to face losses and replace the affected capital stock. Table 3 shows DDI' values, which corresponds to annual expected loss related to capital expenditure (annual investment budget), and related to possible saving for inter-temporal surplus to 10 years, expressed in percentages. DDI'_{CE} illustrates that if contingent liabilities to the country were covered by insurance (annual pure premium), the country would have to invest annually approximately 6.4% of 2008's capital expenditure to cover future disasters. The DDI' with respect to the amount of sustainable resources due to inter-temporal surplus indicates that for all the periods evaluated, a greater percentage of the possible annual average savings for covering the losses in the country would be necessary.

Table 3. DDI' related to capital expenditure and inter-temporal surplus

DDI'	**2000**	**2005**	**2008**
DDI_{CE}	9.05%	6.38%	6.29%
DDI_{IS}	25%	18%	18%

Figure 6 illustrates DDI and DDI' values related to capital expenditure. The graphics illustrate that the greatest values were presented in 2000. In 2005 and 2008, DDI decreased in comparison to 2000. In the same way, DDI' according to the budget of investment had high values, especially for 2000.

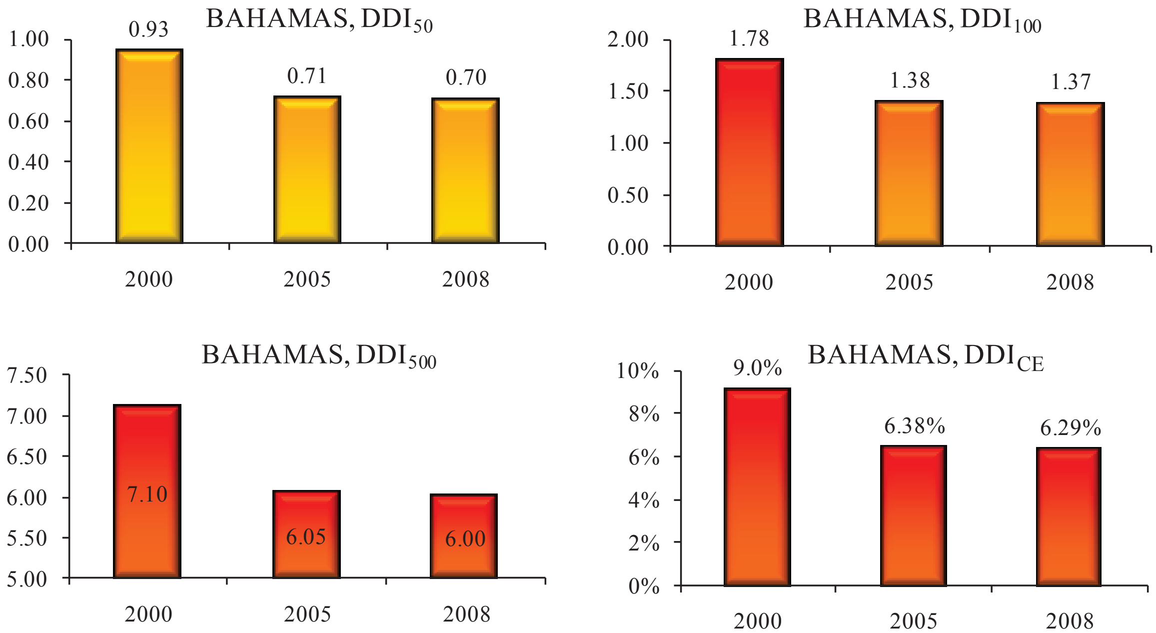


Figure 6. $\mathbf{DDI_{50}}$, $\mathbf{DDI_{100}}$, $\mathbf{DDI_{500}}$, $\mathbf{DDI'_{CE}}$

Table 4 shows the values of the potential losses for the country for the Maximum Considered Event, MCE, with 50, 100 and 500 year return periods. This estimation in retrospective took into account the exposure level of the country for 2000, 2005 and 2008. In addition, Table 4 presents the values of the pure premium or the required annual amount to cover possible future disasters in each period. The DDI and DDI' for the three years 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).

These indicators can be estimated every five years and they can be useful to identify the reduction or increasing of the potential deficit due to disasters. Clearly, values of DDI can be more favourable in the future if actions such as investments in mitigation (retrofitting of vulnerable structures) which can reduce potential losses and a wider insurance coverage of exposed elements that can enhance the economic resilience are carried out.

Table 4. Probable Loss and Pure Premium for DDI and DDI' calculations

L_{50}	2000	2005	2008
Total – Million US$	355.3	363.7	452.7
Government – Million US$	35.6	36.6	45.8
Poor – Million US$	36.6	37.7	47.1
Total - % GDP	5.61%	4.72%	5.88%
Government - % GDP	0.56%	0.47%	0.59%
Poor - % GDP	0.58%	0.49%	0.61%
L_{100}			
Total – Million US$	516.5	528.8	658.5
Government – Million US$	70.2	72.1	90.1
Poor – Million US$	82.2	84.4	105.5
Total - % GDP	8.16%	6.86%	8.55%
Government - % GDP	1.11%	0.94%	1.17%
Poor - % GDP	1.30%	1.10%	1.37%
L_{500}			
Total – Million US$	1,669.1	1,710.0	2,131.5
Government – Million US$	429.5	440.6	550.0
Poor – Million US$	586.3	601.3	750.6
Total - % GDP	26.38%	22.19%	27.68%
Government - % GDP	6.79%	5.72%	7.14%
Poor - % GDP	9.27%	7.80%	9.75%
L_y			
Total – Million US$	37.6	38.5	48.0
Government – Million US$	4.7	4.8	6.0
Poor – Million US$	4.3	4.4	5.5
Total - % GDP	0.60%	0.50%	0.62%
Government - % GDP	0.07%	0.06%	0.08%
Poor - % GDP	0.07%	0.06%	0.07%

Table 5 presents possible internal and external funds that the government needs to access at the time of the evaluation to face the losses in case of an extreme disaster. The sum of these available or usable possible funds corresponds to the economic resilience between 2000 and 2008 every five years. Based on these estimates (i.e. the denominator of the index) the DDI was calculated for the different periods.

DDI for 2008 was calculated based on the most recent available information on exposed elements. According to the available statistical information and the estimations of the consultant group, built areas and their physical values were established. Regarding the economic resilience (denominator of the index), it was estimated in terms of GDP for each fund, taking as reference the economic information that was available.

Table 5. Economic resilience, funds and resources for DDI calculations

Funds	2000	2005	2008
Insurance premiums - % GDP	0.000	0.000	0.014
Insurance/ reinsurance.50 -***F1p***	0.00	0.00	0.01
Insurance/ reinsurance.100 -***F1p***	0.00	0.00	0.03
Insurance/ reinsurance.500 -***F1p***	0.00	0.00	0.18
Disaster reserves -***F2p***	0.00	0.00	0.00
Aid/donations.50 -***F3p***	17.76	18.18	22.64
Aid/donations.100 -***F3p***	25.82	26.44	32.93
Aid/donations.500 -***F3p***	83.46	85.50	106.57
New taxes -***F4p***	0.00	0.00	0.00
Capital expenditure - % GDP	1.567	1.876	2.379
Budgetary reallocations. -***F5p***	59.51	86.72	109.95
External credit. -***F6p***	0.03	0.00	0.00
Internal credit -***F7p***	0.03	0.00	0.00
Inter-temp surplus. *d**- % GDP	0.560	0.680	0.810
Inter-temp surplus. -***F8p***	35.4	52.4	62
ER.50			
Total - Million US$	77	105	133
Total - %GDP	1.22%	1.36%	1.72%
ER.100			
Total - Million US$	85	113	143
Total - %GDP	1.35%	1.47%	1.86%
ER.500			
Total - Million US$	143	172	217
Total - %GDP	2.26%	2.23%	2.81%

Reduction in DDI values in 2005 and 2008 reflects that the country has improved its economic resilience. Nevertheless, given that most of the resources that the government could have access to are its own funds and new debt and, additionally, that government retains the majority of the losses and its financing represents high opportunity-cost given other needs of investments and other country's existing budget restrictions, disasters would imply an obligation or non explicit contingent liability that could have a fiscal sustainability impact.

4.2 Prevalent Vulnerability Index (PVI)

PVI characterizes predominating vulnerability conditions reflected in exposure in prone areas, socioeconomic fragility and lack of social resilience; aspects that favour the direct impact and the indirect and intangible impact in case of the occurrence of a hazard event. This index is a composite indicator that depicts comparatively a situation or pattern in a country and its causes or factors. This is so to the extent that the vulnerability conditions that underlie the notion of risk are, on the one hand, problems caused by inadequate economic growth and, on the other hand, deficiencies that may be intervened via adequate development processes. PVI reflects (i) susceptibility due to the level of physical exposure of goods and people, PVI_{ES} that favours direct impact in case of hazard events; (ii) social and economic conditions that favour indirect and intangible impact, PVI_{SF}; and (iii) lack of capacity to anticipate, to absorb consequences, to efficiently respond and to recover, PVI_{LR} (IDEA 2005; Cardona 2005).

The PVI varies 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.

4.2.1 Indicators of exposure and susceptibility

In the case of exposure and/or physical susceptibility, PVI_{ES}, the indicators that best represent this function are those that represent susceptible population, assets, investment, production, livelihoods, essential patrimony, and human activities. Other indicators of this type may be found with population, agricultural and urban growth and densification rates. These indicators are detailed below:

- ES1. Population growth, avg. annual rate, %
- ES2. Urban growth, avg. annual rate, %
- ES3. Population density, people (5 km^2)
- ES4. Poverty-population below US$ 1 per day PPP
- ES5. Capital stock, million US$ dollar/1000 km^2
- ES6. Imports and exports of goods and services, % GDP
- ES7. Gross domestic fixed investment, % of GDP

- ES8. Arable land and permanent crops, % land area.

These indicators are variables that reflect a notion of susceptibility when faced with dangerous events, whatever the nature or severity of these. “To be exposed and susceptible is a necessary condition for the existence of risk”. Despite the fact that in any strict sense it would be necessary to establish if the exposure is relevant when faced with each feasible type of event, it is possible to assert that certain variables comprise a comparatively adverse situation where we suppose that natural hazards exist as a permanent external factor, even without establishing precisely their characteristics.

4.2.2 Indicators of socio-economic fragility

Socio-economic fragility, PVI_{SF}, may be represented by indicators such as poverty, human insecurity, dependency, illiteracy, social disparities, unemployment, inflation, debt and environmental deterioration. These are indicators that reflect relative weaknesses and conditions of deterioration that would increase the direct effects associated with hazardous phenomenon. 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. Those indicators 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 Gini index.
- SF4. Unemployment, as % of total labour force.
- SF5. Inflation, food prices, annual %
- SF6. Dependency of GDP growth of 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[10] predisposition of society when faced with a hazardous phenomenon, whatever the nature and intensity of these events. "The predisposition to be affected" is a vulnerability condition 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, as is the case with 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.

4.2.3 Indicators of resilience (lack of)

The lack of resilience, PVI_{LR}, seen as a vulnerability factor, may be represented at all levels by means of the complementary or inverted[11] treatment of a number of variables related to human development levels, human capital, economic redistribution, governance, financial protection, collective perceptions, preparedness to face crisis situations, and environmental protection. This collection of indicators on their own and particularly where they are disaggregated at the local level could help in the identification and orientation of actions that should be promoted, strengthened or prioritized in order to increase human security.

- 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]

These indicators are variables that capture in a macro fashion the capacity to recover from or absorb the impact of hazardous phenomena, whatever their nature and severity. "To not

[10] Also it is denominated as inherent vulnerability. It means, own socio-economic conditions of the communities that favour or facilitate the occurrence of effects on them.
[11] The symbol [Inv] is used here to indicate a reverse or inverted dealing of the variable ($\neg R = 1 - R$).

be in the capacity to" adequately face disasters is a vulnerability condition, although in a strict sense it is necessary to establish this with reference to all feasible types of hazard. Nevertheless, as with exposure (as reflected by the PVI_{ES}) and fragility (as reflected by the PVI_{SF}), it is possible to admit that certain economic and social variables reflect a comparatively unfavourable situation supposing that natural hazards exist as permanent external factors without establishing their precise characteristics.

4.2.4 Estimation of indicators

In general, PVI reflects susceptibility due to the degree of physical exposure of goods and people, PVI_{ES}, that favour the direct impact in case of hazard events. In the same way, it reflects conditions of socioeconomic fragility that favour the indirect and intangible impact, $PVI_{SF.}$ Also, it reflects lack of capacity to absorb consequences, for efficient response and recovering, PVI_{LR}. Emphasis in these aspects should be made, due to the purpose of both, human sustainable development process and risk management is the reduction of these kinds of factors.

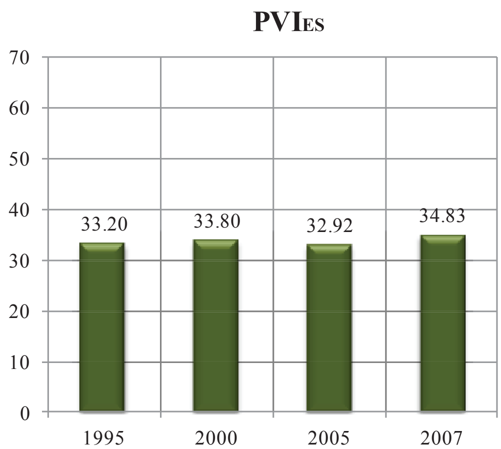
Table 6 shows the total PVI and its components related to exposure and susceptibility, socio-economic fragility and lack of resilience. It is important to point out that, for participation of subindicators which do not have a recent value, we opted using the same value in all periods[12], in order to avoid affecting relative value of indices and hopping in future the value of these subindicators will be published.

Table 6. PVI values

	1995	**2000**	**2005**	**2007**
PVI_{ES}	33.20	33.80	32.92	34.83
PVI_{SF}	31.29	29.47	28.97	28.04
PVI_{LR}	48.95	47.40	41.73	41.51
PVI	**37.81**	**36.89**	**34.54**	**34.80**

[12] In the case of exposure and susceptibility, the subindicators arable land and permanent crops (ES8) presented the same value from 2000 to 2007. In socio-economic fragility correspond to the human induced soil degradation (GLASOD) (SF8) from 2000 to 2007.

Figure 7 shows non scaled subindicators values that compose PVI_{ES} and their respective weights which were obtained using Analytic Hierarchy Process, (W_{AHP})



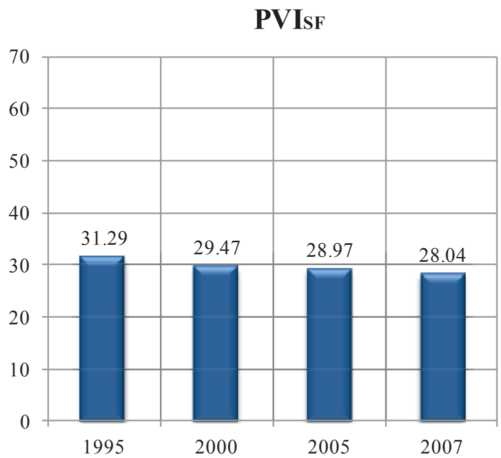
	1995	2000	2005	2007	W_{AHP}
ES.1	1.84	1.47	1.25	1.22	2.18
ES.2	2.13	1.72	1.51	1.46	16.64
ES.3	140.48	152.25	162.59	166.64	2.63
ES.4	19.08	15.69	13.03	13.03	33.36
ES.5	605.77	981.07	1338.65	1585.62	13.74
ES.6	104.47	95.14	101.99	113.44	14.11
ES.7	27.66	35.54	34.21	38.69	7.45
ES.8	1.00	1.10	1.10	1.10	9.89

Figure 7. PVI_{ES}

Vulnerability due to exposure and susceptibility in the country was relatively constant in all the periods. There is a slight decrease in 2005 but the index increased again for 2007 reaching the greatest value of all the periods evaluated. The decrease in 2005 can be due to the slight changes presented in the population growth (ES1), urban growth (ES2), poverty population (ES4) and gross domestic fixed investment (ES7). Nevertheless, decreasing in 2005 was not relevant due to other indicators presented a slight increase and others did not change. In the last period (2007) the increase in the value of the total index was due to higher values in population density (ES3), capital stock (ES5), imports and exports of goods and services (ES6) and gross domestic fixed investment (ES7).

It is worth noting that during the periods of evaluation there is a decrease in the population growth (ES1) and urban growth (ES2) and a constant increase in population density. This can reflect the migration phenomena of the country to populated areas.

Figure 8 shows non scaled subindicators values that compose PVI_{SF} and their respective weights which were obtained using Analytic Hierarchy Process, (W_{AHP})

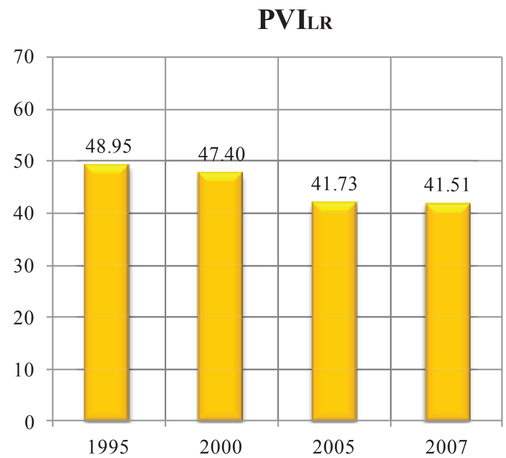


	1995	2000	2005	2007	W_{AHP}
SF.1	15.63	13.53	11.60	11.60	27.39
SF.2	56.44	52.81	50.26	49.02	12.51
SF.3	50.83	49.68	51.33	51.05	16.29
SF.4	10.83	10.52	10.20	7.88	18.45
SF.5	2.07	1.61	1.59	2.49	2.12
SF.6	3.34	2.02	1.52	1.59	12.83
SF.7	7.87	6.73	6.81	7.50	7.27
SF.8	23.72	25.89	25.89	25.89	3.15

Figure 8. PVI_{SF}

Vulnerability due to socio-economic fragility in the country had a gradual decrease during the periods evaluated. The majority of the indicators presented a decrease during all the periods with exception of the human-induced soil degradation (SF8) that presented an increase from 1995 to 2000. The slight reduction in the total index in 2005 and in 2007 is due to the decrease of the majority of the indicators. Nevertheless, some indicators such as: social disparity (SF3) and debt servicing (SF7) in 2005; and inflation (SF5), dependency of GDP growth of agriculture (SF6) and debt servicing (SF7) in 2007 increased. These changes probably did not allow the total index presented a better performance.

Figure 8 shows the figures of non scaled subindicators that compose PVI_{LR} and their respective weights which were obtained using Analytic Hierarchy Process, (W_{AHP})



	1995	2000	2005	2007	W_{AHP}
LR.1	0.82	0.83	0.85	0.85	15.46
LR.2	0.88	0.83	0.84	0.85	15.46
LR.3	10.32	9.17	9.74	10.09	11.59
LR.4	0.64	0.74	0.73	0.72	26.19
LR.5	1.10	13.39	2.02	2.07	2.45
LR.6	0.82	0.87	0.90	0.91	6.84
LR.7	3.60	3.50	3.30	3.20	12.72
LR.8	52.06	52.06	52.41	52.41	9.29

Figure 8. PVI_{LR}

Vulnerability due to lack of resilience is the inverted or the opposite meaning of resilience or capacity, obtained for the subindicators selected. The index presents a gradual decrease through the years of evaluation; this indicates that resilience is decreasing with the time. The subindicators do not have a constant behaviour, some of them grow and the other decrease for the different years. Anyway, the slight negative changes make the total index reflects greater values.

Figure 9 shows total PVI obtained with average of its component indicators, and its aggregated presentation in order to illustrate their contributions.

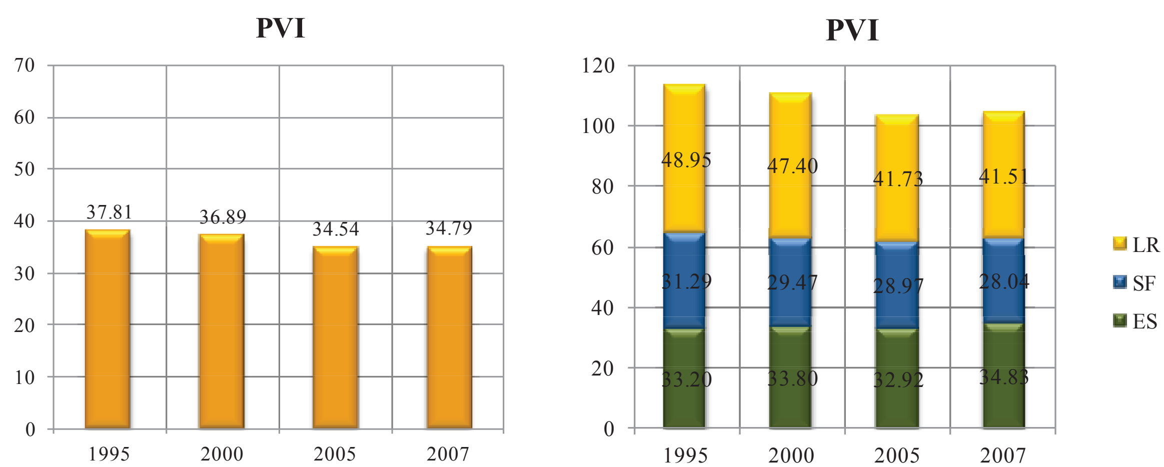


Figure 9. PVI

PVI figures illustrate that prevalent vulnerability is approximately constant and do not show notable changes through the years. Comparing the three indicators, the lack of resilience is the indicator with the greatest contribution to prevalent vulnerability. In comparison to the other countries of the region, The Bahamas has medium vulnerability due to lack of resilience; the Prevalent Vulnerability Index (PVI) value is high and the indicator of lack of resilience is the indicator with the greatest contribution to the country's vulnerability.

PVI illustrates relationship between risk and development, either because the development model adopted reduces it or increases it. This aspect makes evident the convenience of explicit risk reduction measures; because development actions do not reduce vulnerability automatically. This evaluation can be useful to institutions related to housing and urban development, environment, agriculture, health and social care, economics and planning, to mention a few.

4.3 RISK MANAGEMENT INDEX (RMI)

The main objective of RMI is measurement or performance of risk management. This index is a qualitative measurement of risk based on pre-established levels or desirable targets (benchmarking) towards which risk management should be directed, according to its level of advance. For RMI formulation, four components or public policies are considered: Risk identification (RI), risk reduction (RR), disaster management (DM) and Governance and financial protection (FP).

Estimation of each public policy takes into account 6 subindicators that characterize the performance of management in the country. Assessment of each subindicator is made using five performance levels: *low, incipient, significant, outstanding and optimal,* that corresponds to a range from 1 to 5, where 1 is the lowest level and 5 the highest. In this methodological focus each reference level is equivalent to a "performance objective", thus, it allows the comparison and identification of results or achievements towards which governments should direct the efforts of formulation, implementation and evaluation of policies in risk management.

Once performance levels of each subindicator have been evaluated, through a non-lineal aggregation model, the value of each component of RMI is determined (IDEA 2005; Cardona 2005). The value of each composed element is between 0 and 100, where 0 is the minimum performance level and 100 is the maximum level. Total RMI is the average of the four composed indicators that represent each public policy. When value of RMI is high, performance of risk management in the country is better.

4.3.1 Institutional framework[13]

The Government of the Bahamas established the National Emergency Management Agency (NEMA) to coordinate the preparedness, response to and mitigation of emergencies on a national level through collaboration, cooperation, coordination, between government and non-governmental agencies. NEMA is headed by a public officer holding the office of

[13] www.cdema.org/

Director. The Director is assisted by a number of public officers appointed or assigned to NEMA and other persons whose services have been engaged by, or who have volunteered their services to NEMA.

There is also an Advisory Committee of NEMA composed of representatives from relevant Government Ministries and Departments and from the private sector. The Committee meets to discuss means to mitigate the impact of disasters, including hurricanes. Each of the Government Agencies is also responsible to prepare a Disaster Preparedness Plan which details the steps the agency takes in preparing for and responding to a disaster whether natural or man-made.

The Advisory Committee of NEMA also focuses on the importance of being properly prepared for a hurricane or other disaster.

The Government's disaster management programme has been linked to the urban renewal initiative in Nassau. Regarding emergency preparedness and response, the Ministry of Health and Environmental Services counts with the Health Emergency Plan that is activated before hurricane landfall and staff deployed with emergency supplies to all the islands to be present in a state of readiness. Likewise, the Red Cross, The Bahamas Defence Force and the Police Department have programs, however they require strengthening and institutionalization through appropriate legislation. In addition, the Draft National Disaster Plan sets out the Basic Plan, Emergency Support functions for the key response and support agencies, the Recovery Function and Standard Operating Procedures for the National Emergency Operations Centre. Notwithstanding, it is important to focus an integrated disaster risk management approach, where proposals not only in emergency preparedness and response can be considered but also actions in other areas of risk management such as risk identification, risk reduction and financial protection. At present, the Bahamas does not have the requisite legislation that guides the development and implementation of disaster risk management plans that includes these latter activities.

On the other hand, The Bahamas has been involved in regional disaster risk management initiatives that that could assist the country to make better progress in disaster risk management. As a member of CDEMA, the Caribbean Disaster Emergency Management Agency, the Bahamas has embraced the Caribbean Community (CARICOM)- endorsed regional strategy and framework for Comprehensive Disaster Management , the objective of which is to strengthen national and community level capacity for mitigation, preparedness and coordinated response and recovery to natural and technological hazards and the effects of climate change. . The country has also been the beneficiary of different projects carried out by various agencies in the Caribbean. These include the Organization of American States (OAS) (one of the first international organizations to focus on disaster mitigation in the Caribbean), the European Community Humanitarian Office (ECHO), which has provided support for prevention, mitigation and preparedness operations, the Caribbean Development Bank (CDB),which with the support of USAID, established a Disaster Mitigation Facility for the Caribbean to help member countries to adopt disaster mitigation policies and practices, and the Inter-American Development Bank (IDB), which has adopted a policy on disasters for a more comprehensive and proactive approach in risk reduction as well as post-disaster recovery.

4.3.2 Indicators of risk identification

- The identification of risk generally includes the need to understand individual perceptions and social representations and provide objective estimates. In order to intervene in risk it is necessary to recognize its existence[14], dimension it (measurement) and represent it by means of models, maps, indexes etc. that are significant for society and decision makers. Methodologically, it includes the evaluation of hazards, the different aspects of vulnerability when faced with these hazards and estimations as regards the occurrence of possible consequences during a particular period of exposure. The measurement of risk is relevant when the population recognizes and understands it. In that way, the results can be the basis for risk intervention. The indicators that represent risk identification, RI, are the following:

[14] That is to say, it has to be a problem for someone. Risk may exist but not perceived in its real dimensions by individuals, decision makers and society in general. To measure or assess risk in an appropriate manner is to make it apparent and recognized, which in itself means that something has to be done about it. Without adequate identification of risk it is impossible to carry out anticipatory preventive actions.

- 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

4.3.3 Indicators of risk reduction

Risk management, on the whole, aims to reduce risk among other objectives. In general, this requires the execution of structural and non structural prevention-mitigation measures. It is the act of anticipating with the aim of avoiding or diminishing the economic, social and environmental impact of potentially dangerous physical phenomena. It implies planning processes but, fundamentally, the execution of measures that modify existing risk conditions through corrective and prospective interventions of existing and potential future vulnerability, and hazard control when feasible. 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

4.3.4 Indicators of disaster management

Disaster management should provide appropriate response and recovery post disaster and depends on the level of preparation of operational institutions and the community. This public policy seeks to respond efficiently and appropriately when risk has been materialized and it has not been possible to impede the impact of hazardous phenomena. Effectiveness implies organization, capacity and operative planning of institutions and other diverse actors involved in disasters. The indicators that represent the capacity for disaster management, DM, are the following:

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

4.3.5 Indicators of governance and financial protection

Governance and financial protection is fundamental for the sustainability of development and economic growth in a country. This implies, on the one hand, coordination between different social actors that necessarily are guided by different disciplinary approaches, values, interests and strategies. Effectiveness is related to the level of interdisciplinarity and integration of institutional actions and social participation. On the other hand, governance depends on an adequate allocation and use of financial resources for the management and implementation of appropriate strategies for the retention and transference of disaster losses. The indicators that represent governance and financial protection, FP, are the following:

- FP1. Interinstitutional, multisectoral 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

4.3.6 Estimation of the indicators

RMI results have been obtained from detailed opinion surveys completed by national experts and representatives of various institutions related to risk management. Thus, this index reflects performance of risk management based on evaluations of academic, professional and officials of the country. Results for 1995, 2000, 2005 and 2010 are presented below.

Table 7 shows total RMI and its components, for each period. These are risk identification, RMI_{RI}, risk reduction, RMI_{RR}, disaster management, RMI_{DM}, and governance and financial protection, RMI_{FP}.

Table 7. RMI values

	1995	2000	2005	2010
RMI_{RI}	12.01	24.37	26.43	31.85
RMI_{RR}	21.75	22.47	25.02	25.93
RMI_{DM}	11.76	17.21	27.55	48.15
RMI_{FP}	5.247	8.26	11.7	13.11
RMI	12.69	18.08	22.68	29.76

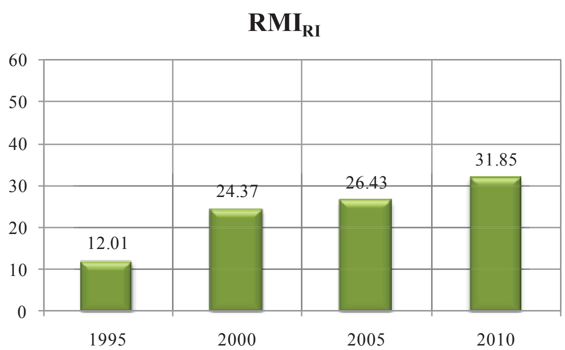
Indicators of risk identification (RI)

Figure 10 shows the qualification of subindicators[15] that composed RMI_{RI} and its respective weights, obtained using Analytic Hierarchy Process (AHP).

Management related to risk identification shows a notable progress from 1995 to 2010. The better performance from 1995 to 2000 is due to the improvement in level from incipient to significant of the indicator of hazard monitoring and forecasting (RI2); and the improvement in level from low to incipient of systematic disaster and loss inventory (RI1). In 2005, the slight advance presented in the risk identification is due to the change from low to incipient of the vulnerability and risk assessment (RI4) and the training and education in risk management (RI6). The progress in 2010 is due to changes in the performance levels for hazard evaluation and mapping (RI3) from incipient to significant. Nevertheless, while in 2005 the two subindicators (RI4 and (RI6) that indicated progress also had relatively important weight, in 2010 there was a more notable advance in the Index (RMI_{RI} increased from 24.63 to 31.85) although the growth was manifested in only one subindicator (RI3). Progress is slow in the beginning, but once risk management improves and becomes sustainable, performance and effectiveness also improve[16].

[15] Numbers in tables mean: 1: *low,* 2: *incipient,* 3: *significant,* 4: *outstanding* and 5: *optimal*

[16] More information and details of methodologies can be found in IDEA (2005). "System of Indicators of Disaster Risk and Risk Management: Main Technical Report". Program of Indicators for Disaster Risk and Risk Management IDB – IDEA, Universidad Nacional de Colombia, Manizales. http://idea.unalmzl.edu.co

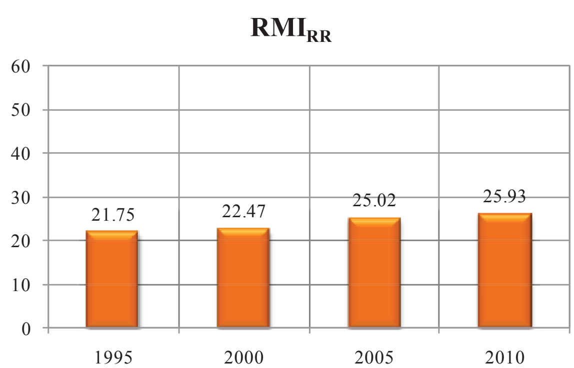


	1995	2000	2005	2010	Weight
RI.1	1	2	2	2	13.56
RI.2	2	3	3	3	18.14
RI.3	2	2	2	3	15.06
RI.4	1	1	2	2	20.95
RI.5	2	2	2	2	15.13
RI.6	1	1	2	2	17.16

Figure 10. RMI_{RI}

Indicators of risk reduction (RR)

Figure 11 shows the qualification of subindicators that composed RMI_{RR} and its respective weights, obtained using Analytic Hierarchy Process (AHP).



	1995	2000	2005	2010	Weight
RR.1	1	1	2	2	27.19
RR.2	1	1	1	2	16.44
RR.3	1	2	2	2	10.13
RR.4	1	1	2	1	13.65
RR.5	3	3	3	3	18.58
RR.6	1	1	1	2	14.01

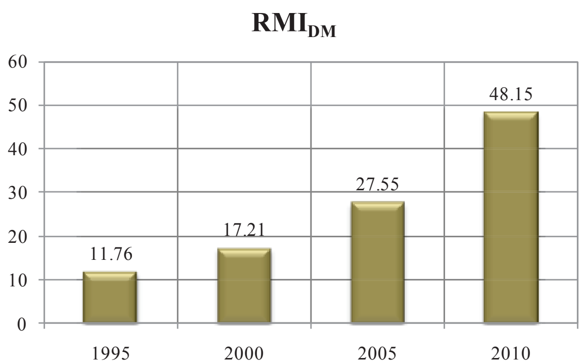
Figure 11. RMI_{RR}

Results in management related to risk reduction RMI_{RR}, indicate that the country has not had outstanding progress during the years of evaluation. From 1995 to 2000, the slight advance in RMI_{RR} could be particularly due to the progress from low to incipient in the implementation of hazard-event control and protection techniques (RR3). In 2005, the advance from low to incipient was presented in the risk consideration in land use and urban planning (RR1) and in the housing improvement and human settlement relocation from prone-areas (RR4). Between 2005 and 2010, progress occurred and is reflected in the hydrographic basin intervention and environmental protection (RR2) and in the reinforcement and retrofitting of public and private assets (RR6); however the housing improvement and human settlement relocation from prone-areas (RR4) decreased in its performance (from incipient to low). The combined effects did not allow theRMI_{RR} in

2010 to manifest a greater level of progress. As mentioned above, the minor advance in the index is due to the levels of performance of the subindicators, that presented a change, are not very important. Taking into account that risk management is non linear, the small advances are not significantly reflected yet; reason why it is necessary to try to achieve improvements in the different actions of risk reduction.

3.3.6.3 Indicators of disaster management (DM)

Figure 12 shows subindicators qualifications which composed RMI_{DM} and its respective weights, obtained using Analytic Hierarchy Process (AHP).



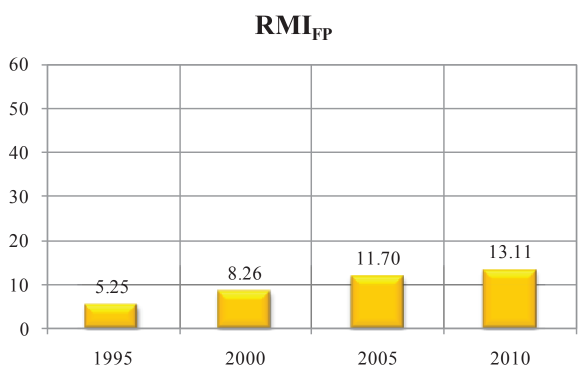
	1995	2000	2005	2010	Weight
DM.1	2	2	3	4	20.93
DM.2	2	2	2	3	25.30
DM.3	1	2	2	3	11.57
DM.4	1	2	2	3	15.52
DM.5	1	2	2	3	16.44
DM.6	1	2	2	2	10.24

Figure 12. RMI_{DM}

Management related to disaster management RMI_{DM}, indicates that the country has had a remarkable progress during the years of evaluation. From 1995 to 2000 the advance was mainly due to the improvements from low to incipient of the majority of the subindicators: Endowment of equipments, tools and infrastructure (DM3), the simulation, updating and test of inter institutional response (DM4), the community preparedness and training (DM5) and the rehabilitation and reconstruction planning (DM6). The progress detected in 2005 is only due to the growth from incipient to significant of the organization and coordination of emergency operations (DM1). The notable increase that can be observed for this year can be explained in terms of the relatively important weight that is assigned to this subindicator as well as the performance level of performance (significant), which that makes the effectiveness better reflected. A similar situation is presented in 2010, where the performance level reached in the disaster management subindicators is very notable. Improvements in 2010 can be seen in the increases in the subindicators organization and coordination of emergency operations (DM1) that increased from significant to outstanding; and emergency response planning and implementation of warning systems (DM2), endowment of equipments, tools and infrastructure (DM3), simulation, updating and test of inter institutional response (DM4) and community preparedness and training (DM5) that increased from incipient to significant. The subindicator that did not present any change since 2000 was the rehabilitation and reconstruction planning (DM6).

Indicators of governance and financial protection (FP)

Figure 12 shows subindicators qualifications which composed RMI_{FP} and its respective weights, obtained using Analytic Hierarchy Process (AHP).



	1995	2000	2005	2010	Weight
FP.1	1	1	2	2	26.23
FP.2	1	1	1	2	12.20
FP.3	1	1	1	1	16.77
FP.4	1	1	1	1	12.72
FP.5	1	1	1	1	12.53
FP.6	1	2	2	2	19.54

Figure 13. RMI_{FP}

Management related to governance and financial protection showed very slight progress from 1995 to 2010. The improvement in the total indicator in 2000 is due to the advance from low to incipient in the housing and private sector insurance and reinsurance coverage (FP6). Also, in 2005 the RMI_{FP} improves due to the better performance (from low to incipient) in the interinstitutional, multisectoral and decentralizing organization (FP1). The advance in the last year (2010) is the result of the change in the performance level from low to incipient of the reserve funds for institutional strengthening (FP2). The subindicators of budget allocation and mobilization (FP3), implementation of social safety nets and funds response (FP4) and insurance coverage and loss transfer strategies of public assets (FP5) did not show any advances in any of the years evaluated. . The low values of the indicator of governance and financial protection RMI_{FP} is due to the minimum advances in the respective subindicators.

Estimation of the total RMI

Figure 14 shows the total RMI value obtained from the average of the component indicators and its aggregated version with the objective of illustrating their contributions.

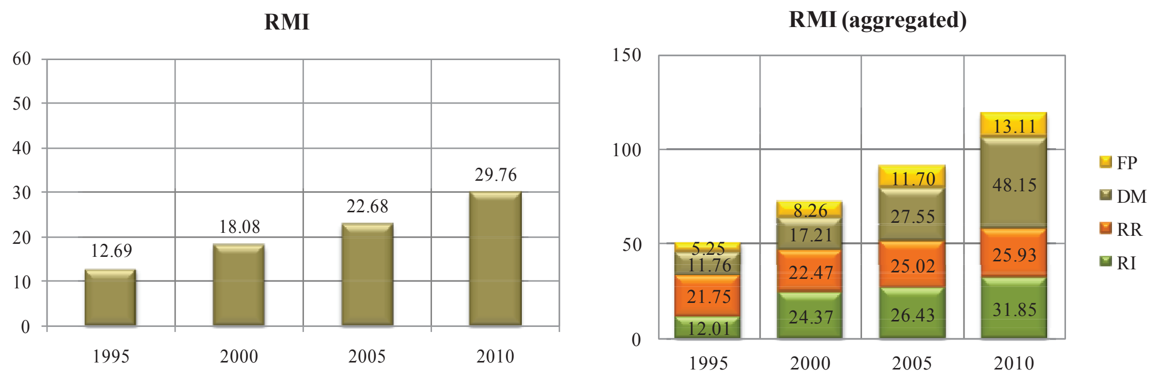


Figure 14. Total RMI

In the RMI graphics one can observe a gradual advance in disaster risk management, in general, between 1995 to 2010. The indicators with the greatest progress were the RMI_{RI} and the RMI_{DM}. The other two indicators, RMI_{RR} and RMI_{FP}, showed less advances over the periods of evaluation. The RMI_{FP} is the public policy that shows the lowest performance in comparison with the other public policies. In comparison with other countries of Latin-America and the Caribbean, The Bahamas has a medium risk management qualification. This implies there is still so much work to do in order to achieve better performance levels in risk management.

Table 8 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 1995 and 2010. In summary, the table shows that during the period 1995-2010 there were important advances in risk management in The Bahamas. The indicator with the greatest improvement was the disaster management (DM) with the best progress in the organization and coordination of emergency operations (DM1). The endowment of equipments, tools and infrastructure (DM3); simulation, updating and test of interinstitutional response (DM4); and the community preparedness and training (DM5) also showed an important change (40 points), that contributed to the DM being the public policy with the best performance.

The other public policy where the performance is noticeable is the risk identification (RI). The change from 1995 to 2010 is important and it was due to the advances in the hazard monitoring and forecasting (RI2) and hazard evaluation and mapping (RI3) with a change of 28 points. The only subindicator that did not present any better performance was the public information and community participation.

Table 8. Differences between first and last period (1995 and 2010) for RMI subindicators functions performance

1995	**RI.1**	5	**RR.1**	5	**DM.1**	17	**FP.1**	5
	RI.2	17	**RR.2**	5	**DM.2**	17	**FP.2**	5
	RI.3	17	**RR.3**	5	**DM.3**	5	**FP.3**	5
	RI.4	5	**RR.4**	5	**DM.4**	5	**FP.4**	5
	RI.5	17	**RR.5**	45	**DM.5**	5	**FP.5**	5
	RI.6	5	**RR.6**	5	**DM.6**	5	**FP.6**	5
	RMI_{RI}	12.01	**RMI_{RR}**	21.75	**RMI_{DM}**	11.76	**RMI_{FP}**	5.25
	RMI	12.69						
2010	**RI.1**	17	**RR.1**	17	**DM.1**	77	**FP.1**	17
	RI.2	45	**RR.2**	17	**DM.2**	45	**FP.2**	17
	RI.3	45	**RR.3**	17	**DM.3**	45	**FP.3**	5
	RI.4	17	**RR.4**	5	**DM.4**	45	**FP.4**	5
	RI.5	17	**RR.5**	45	**DM.5**	45	**FP.5**	5
	RI.6	17	**RR.6**	17	**DM.6**	17	**FP.6**	17
	RMI_{RI}	31.85	**RMI_{RR}**	25.93	**RMI_{DM}**	48.15	**RMI_{FP}**	13.11
	RMI	29.76						
Change	**RI.1**	12	**RR.1**	12	**DM.1**	60	**FP.1**	12
	RI.2	28	**RR.2**	12	**DM.2**	28	**FP.2**	12
	RI.3	28	**RR.3**	12	**DM.3**	40	**FP.3**	0
	RI.4	12	**RR.4**	0	**DM.4**	40	**FP.4**	0
	RI.5	0	**RR.5**	0	**DM.5**	40	**FP.5**	0
	RI.6	12	**RR.6**	12	**DM.6**	12	**FP.6**	12
	RMI_{RI}	19.84	**RMI_{RR}**	4.18	**RMI_{DM}**	36.39	**RMI_{FP}**	7.86
	RMI	17.07						

Regarding the risk reduction (RR) the changes were slighter, nevertheless some advances can be observed in the risk consideration in land use and urban planning (RR1), hydrographic basin intervention and environmental protection (RR2), implementation of hazard-event control and protection techniques (RR3) and the reinforcement and retrofitting of public and private assets (RR6). The others did not present any recognized advance from 1995 to 2010.

The financial protection (FP) is the public policy that least progress has presented. Change of 12 points in the interinstitutional, multisectoral and decentralizing organization (FP1), the reserve funds for institutional strengthening (FP2) and housing and private sector insurance and reinsurance coverage (FP6) have been presented. Nevertheless, the advances were not very significant in these topics.

5. CONCLUSIONS

DDI illustrates economic implications of a catastrophic event; PVI accounts for susceptibility and aggravation factors of the direct effects of the disasters due to deficiencies in development; and RMI points out what has been achieved and what is intended to do for improving risk management.

From these results it is possible to have as conclusions that in The Bahamas there was a decrease of DDI from 2000 for the different return periods evaluated (50, 100 and 500). The PVI is since 1995 basically the same but with a slight diminish. In the case of RMI the country has not presented notable progress. The estimation of the indicators of disaster risk management for The Bahamas shows that the country has improved its performance in all the topics related to risk management. Even though, it is still necessary to keep a constant work and effort in the country to achieve sustainability.

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. Overall, it is important to disaggregate these indicators and identify areas where improvements can be made through actions, projects and specific activities that can make the central government with the participation of different sectoral agencies, municipalities and communities, and, thus, achieve a further progress and greater sustainability. Decision makers and stakeholders, in addition identifying weaknesses 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 indicator system is helping to formulate general recommendations for planning.

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APPENDIX I

NATURAL HAZARDS OF THE COUNTRY

AI.1 HYDROMETEOROLOGICAL HAZARDS

The Bahamas' Caribbean coast is a territory which has been much affected by hurricanes.

Below is presented the information on hurricanes which have had the most impact on The Bahamas territory in the Atlantic hurricane seasons.

Nassau Hurricane (1926)

Image of the track of the Nassau Hurricane

Nassau Hurricane, also known as San Liborio Hurricane was a category 4 storm that passed through The Bahamas at its higher intensity. It caused one of the most severe storms that have affected Nassau. It developed between July 22nd and August 2nd 1926. The peak wind speed (1 minute sustained) recorded was of 220 km/h and the lowest pressure recorded was of 975 mbar.

The hurricane tore off a large amount of roofs in Nassau and also affected with heavy damage Eleuthera, Andros and Exumas islands. There are associated 287 direct fatalities with this storm.

Great Andros Island Hurricane (1929)

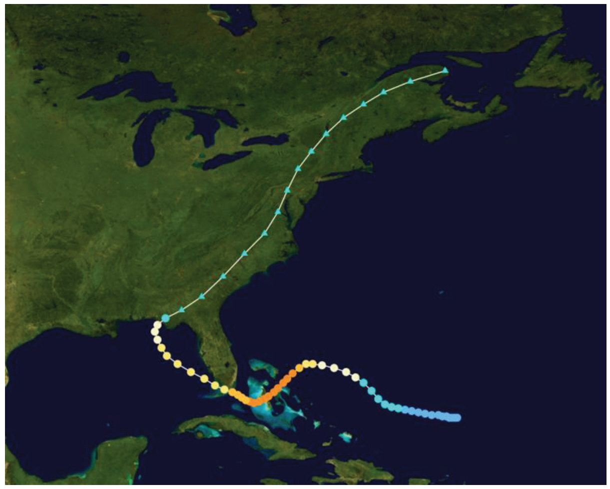

Image of the track of Great Andros Island Hurricane

Great Andros Island Hurricane was the only major hurricane of the 1929 hurricane season. Most of the caused damage was concentrated in The Bahamas where the hurricane stopped with high intensity for an extended period of time. The lowest pressure recording is from Nassau and reade 938 mbar; the same station measured peak wind speeds of 264 km/h.

10 deaths were reported in Andros Island and also 24 were declared missing; more than 60 houses were declared completely destroyed because of the wind and also the storm surge.

The Bahamas Hurricane (1932)

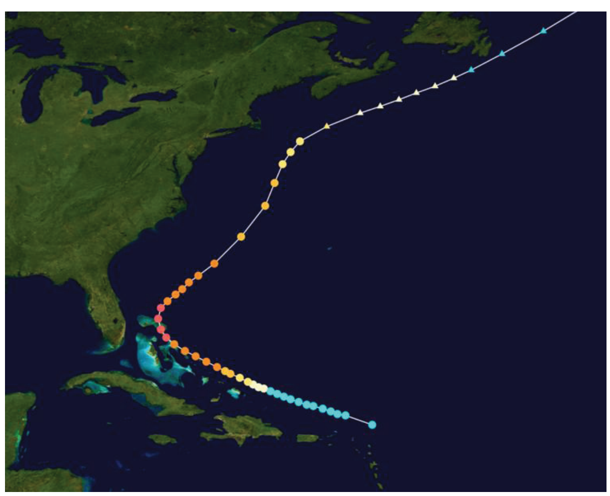

Image of the track of Bahamas Hurricane

The Bahamas Hurricane was a category 5 storm that struck The Bahamas at its higher intensity. Most of the caused damage was concentrated on Abaco Islands. At those islands, the recorded pressure was below 931 mbar. The storm started on August 30th and dissipated on September 13th 1932. Peak wind speed recorded was 260 km/h.

Hurricane Andrew (1992)

Satellite image of Hurricane Andrew

Image of the track of Hurricane Andrew

Hurricane Andrew (1992) was a category 5 storm that affected North Eleuthera, New Providence, North Andros, Bimini and Berry Islands in The Bahamas. The damage was estimated in USD 391 million (net present value at 2011), because 800 houses were destroyed. The highest wind speed recorded was 240 km/h at Berry Islands.

The hurricane also spawned tornadoes at Eleuthera Island and storm surge caused several damages on roads and docks along the coast.

Hurricane Wilma (2005)

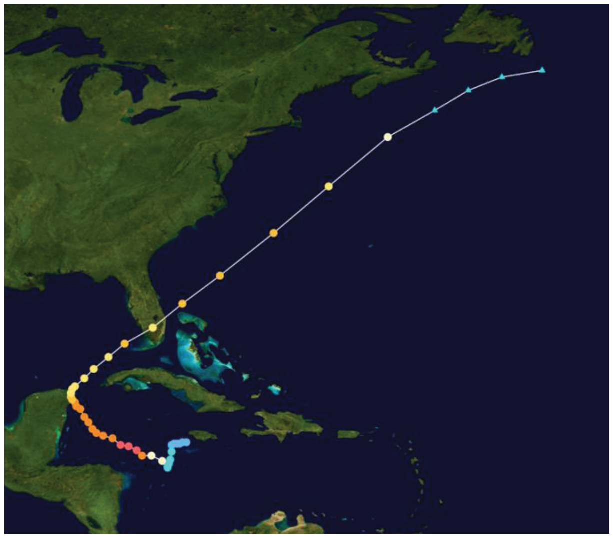

Image of the track of Hurricane Wilma

Hurricane Wilma belongs to the destructive 2005 Atlantic Ocean hurricane season with Category 5 on the Saffir-Simpson scale and sustained wind speed higher than 300 km/h with lowest pressure recordings of 882 mbar.

Most of the damaged caused by the hurricane in The Bahamas occurred on the western portion of Grand Bahama, being Freeport the most affected city. There, Wilma had a very high wind speed and also a powerful storm surge that destroyed buildings and flooded coastal plain areas. More than 400 structures were affected, especially commercial infrastructure which had to be reconstructed.

Bimini, Berry and New Providence Islands were also affected even though the reported damage was concentrated in waterfront houses.

Hurricane Irene (2011)

Irene Hurricane was a category three storm with a peak wind gust of about 140 mph at the height of the storm and localized heavy rains of up to 13 in fell in the area. The extreme winds damaged at least 40 homes on Mayaguana Island and dozens of homes on Acklins were completed obliterated. New Providence and Grand Bahama presented smaller impacts due to the Hurricane remained offshore. Although physical damage was extensive, there were no fatalities on the islands. According to local officials, Irene was the worst tropical cyclone to hit The Bahamas since Hurrican Floyd in 1999.

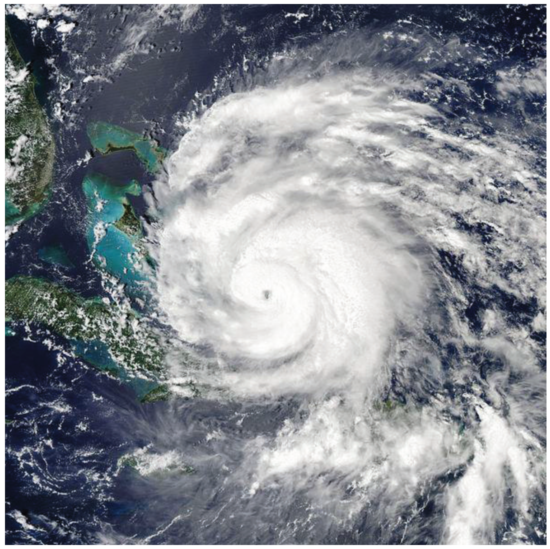

Image of Hurricane Irene