Risk Management and Disaster Mitigation: A Case Study Applied to Haiti

Gestion du risque et atténuation des désastres : un exemple appliqué à Haïti

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Introduction

1 The vulnerability of the Caribbean countries due to their geographic location is compounded by the absence of economic diversity. Hurricanes as so flooding or other kind of natural disaster exert economic shocks similar to macroeconomic and other kinds of shocks. Most Caribbean countries remain very dependant upon tourism, mainly, and small range of export farm commodities such as coffee, mangoes, essential oils and sisal in Haiti. Moreover, the relatively narrow geographical parameter of most Caribbean countries means that a single natural disaster may seriously affect the entire natural territory, exerting measurable negative impacts on GDP, through various channels, including dampened fiscal revenues, loss of employment or of Foreign Direct Investment (FDI).

2 Geographically, Haiti is located in the Caribbean Sea on the Hispaniola Island shared with the Dominican Republic. Haiti occupies the western third of the island and contains spectacular mountains and a tourist coastline under a tropical climate. There is an area in the east, though, which is semi-arid due to the mountains which cut off the trade winds which carry the humidity to the rest of the island. Haiti has a rough and very mountainous terrain. There is very little fertile farmland and only a few areas have irrigation. The country is located in the middle of the hurricane belt and the nation often experiences severe storms. There are also periods of drought throughout the year and flooding and earthquakes both pose serious issues to the inhabitants of this small country. But coastal erosion and sea level rising are also serious cause for concern.
Haiti covers an area of 27,750 square kilometres. Of this area, 27,560 square kilometres comprises land, while 190 square kilometres comprise water. There are also small plains and river valleys. However, there are no navigable rivers. Artibonite is Haiti's longest river, while Etang Saumâtre is the largest lake. The most fertile valley of the country is Plaine de l'Artibonite, there are also several islands in the country which is part of the geography (Gonave, while it is inhabited by the rural people, Île à Vache, Île de Anacaona and Cayemites). Cause to its location, Haiti is vulnerable to a wide range of natural hazards. The most common and historically are tropical storms and hurricanes (Jeanne 2004, Wilma 2005, Fay, Gustav, Hannah, Ike, 2008). Reflecting a rugged physical topography, most of the population and infrastructure are located on the coast, making Haiti particularly vulnerable to strong winds. Landslides, mud and rivers floods are common features. As part of the Caribbean, other hazards Haiti is prone to be affected by are tsunamis.

Figure 1. Location of Haití

![Location of Haiti](www.travelinghaiti.com)

Economically, Haiti, is the poorest country in the place with a GNI per capita valued at US $ 560 in 2007 and a growth rate of 1,3 % in 2008 (World Bank Report, 2008). According to the 2006 census, the whole population was estimated at a little more than nine million people, life expectancy was in 2007 of 52 years with an illiteracy rate of 44 percent. About the three-fourths of the population is impoverished-living on less than US $ 2 per day, and the UN Human Development Index (HDI) ranks Haiti 154th least developed among the world’s 177 countries, still regarded as “fragile” by donors in a post-conflict context and also as a Less Developed Country (LDC) according to the UN classification. Haiti is a small open and dollarized economy featuring all the yet well known characteristics of Dutch Disease (Granvorka, 2008). Since the last two decades, and according the Haitian Association of Economists (UNDP Report, 2005), Haiti is uphold into a poverty trap. Despite a very weak recovery of growth during year 2003-2004, Haiti experienced a very
poor evolution on both the social and economic levels over the recent period, 2000-2008. It is a perpetual state of violence and instability is considered as the worst governed and undemocratic State as showed by widely used governance indicators. Since year 2000, Haiti has showed a poor economic evolution and has become increasingly politically and institutionally instable. Furthermore, its principal economic indicators have significantly worsened. The deterioration of Haiti’s economy is also rooted in the predatory policies of past Haitian governments and to some extent the misguided assistance of foreign donors and the IFI. Actually, and for time, Haiti faced great social, economic, environmental and political challenges either as to access to capital markets, good governance, economic performance, education, social development and environmental protection. For example, the forests are used for fuel and charcoal and supplies fuel for over 2 million people and most of the large rivers are used for irrigation. Because of their inability to afford fuel on foreign markets, deforestation remains the first alternative for most of consumers in Haiti. These practices are symptomatic of the lack of environmental policies.

At an environmental level, like all the Caribbean countries, i.e., that of the Caribbean States Association (CSA) Haiti is engaged in Action 21. Nonetheless, the country has not implemented either policies or institutions dedicated to environmental concerns. One of the possible explanations is that this lack is linked to sustainable development largely associated with rich countries. At present, Haiti is involved in very day to day concerns to maintain a minimal economic level. On the other hand, it is useful to bear in mind that since year 2005, the World Bank and other international funds disbursed some US$ 350 million for different purposes such as, risk mitigation, environmental policies implementation, warning policies.... in the country.

The disasters of last summer in Haiti (fay, Gustav, Hannah and Ike, 2008) stimulated a re-examination of the country’s situation. The country experienced four hurricanes within one month. It was submerged under water which caused the destruction of access roads and as a result the cities remained isolated from each other for several weeks. Nine of the ten departments were devastated (Roc, 2008). The entire harvest were damaged (UN, 2008) and at present the country is still involved in rebuilding. All the economic sectors have been hampered and the amount of rebuilding has been estimated at around some thing like US$ 900 i.e. of GDP.

This human and economical tragedy is the price to be paid for a dysfunctional government and deforestation. Other factors, like soil erosion, water shortages, loss of biodiversity, demographic pressure, poverty and anarchic exploitation of quarries are among other key elements contributing to the ecological disaster that is Haiti.

According the Haitian Institute for Statistics (IHSI, 2007) businesses in the cities cut down over 53,000 trees a year, over 80 % of the population has no access to electricity and over 90 % of them use wood-based charcoal for their daily needs. As an irony, the Ministry of the Environment Budget accounts for only 2.1 % of the global budget (Budget of the Republic, fiscal year 2007-2008). Finally, anarchic building and exploitation of sandpits around Port-au-Prince reveals that there is no State management of spatial issues, despite recent laws aiming to close sandpits. The first impact of this is the increasing insecurity and a decrease of investment. So, an environmental strategy appears as an emergency one to spur growth first, and then eventually, initiate sustainable development. In that view, hazard management must be incorporated into the development planning process. But in fact, what are natural hazards? One could answer that they are at the same time spillovers for environment and part of sustainable development concerns as they are now
incorporable into development planning so that their impact on economic sectors can be reduced. Natural phenomena become disasters when they provoke physical and human losses at the same time. They may be atmospheric, seismic, geologic, hydrologic, volcanic and wildfire.

Recurring natural disasters, hurricanes, floods and mudslides have wrought devastation on the Haitian population. They affected more than 800,000 people. The country’s national and local institutions are weakened and the impact upon citizens and national development has been widespread.

In the GDP structure (IHSI, 2007) services, including tourism afforded for 25.3% of the total economic output. In these figures, hotels and restaurants and other tradable services are included. Tourism is not disaggregated. It is probably useful to recall that tourism is made of different activities which include hotels and restaurants of course but also recreational activities. This particular sector has suffered from the country’s political upheaval. In the 1970s and 1980s, tourism was an important industry, drawing an average of 150,000 visitors annually. Despite the 1991 coup, it has recovered slowly and the Caribbean Tourism Organization (CTO) has joined the Haitian government in efforts to restore the island’s image as a tourist destination. According to data provided by this organization, in 2001, 141,000 foreigners visited Haiti to boom up to 436,600 in 2004. Most came from North America (United States and Canada), but further improvements in hotels, restaurants, and other infrastructure are still needed to make tourism a major industry for Haiti. We make the hypothesis that funded by tourism, a public risk management policy could significantly increase GDP.

In that view, the remainder of the paper is as follows: section 1 introduces a brief geographic and economic description of Haiti including the risks to which it is vulnerable to. Section 2 reviews the literature relevant to economics of environment with a special focus on Stavins’ cost-benefit theory. Section 3 shows the channels transmission of the positive impacts of a risk strategy on GDP through tourism. Section 4 concludes.

1. Environmental Policy with regards to the Cost-Benefits Analysis/Theory (Stavins, 2004)

The essential theoretical foundations of Cost Benefit Analysis (CBA) are that benefits are defined as increases in utility (well-being) where costs are the reductions in human well being. For a policy to qualify on cost-benefit ground its social benefits must exceed its social costs, the geographical boundary for CBA is usually the national territory. There are two basic aggregation rules. First, aggregating benefits across different social groups involve to sum willingness to pay (WTP) for benefits, or willingness to accept (WTA) compensation for losses regardless of the circumstances of the beneficiaries or losers. A second aggregation rule implies that higher weights be given to benefits and costs accruing to low income groups. One rationale for this second rule is that marginal utilities of income will vary, being higher for the low income group. As aggregating over time involves discounting, discounted future benefits and costs are known as present values. Inflation can result in future benefits and costs appearing to be higher than in reality. Inflation should be netted out to secure constant price estimates. The effect of time i.e. the time it takes for the benefits of a change to repay its costs is taken into consideration by calculating a payback period. There are two CBA forms. A simple one that uses only financial costs and financial benefits and a more sophisticated one that
tends to apply a financial value on intangible costs and benefits as in the case of the cost of environmental damage by measuring willingness to pay for an environmental gain and willingness to accept compensation for an environmental loss. The notions of willingness to pay and willingness to accept compensation for losses (WTP and WTA) are grounded in the theory of welfare economics and correspond to notions of compensating and equivalent variations. WTP and WTA should not, according to past theory, diverge very much. In practice they appear to diverge, often substantially, and with WTA > WTP. Hence the choice of WTP or WTA may be of importance when conducting CBA.

According to Pearce, Atkinson et al. (2006): “there are numerous critiques of CBA”. Perhaps some of the more important ones are:

- That the extent to which CBA rests on robust theoretical foundations as portrayed by the Kaldor-Hicks compensation test in welfare economics,
- the fact that the underlying “social welfare function” in CBA is one of an arbitrarily large number of such functions on which consensus is unlikely to be achieved,
- The extent to which one can make an ethical case for letting individuals’ preferences be the (main) determining factor in guiding social decision rules. The whole history of neoclassical welfare economics has focused on the extent to which the notion of economic efficiency underlying the Kaldor-Hicks compensation test can or should be separated out from the issue of who gains and loses – the distributional incidence of costs and benefits.

CBA has developed procedures for dealing with the last criticism, e.g. the use of distributional weights and the presentation of “stakeholder” accounts. Affirmations 1 and 2 continue to be debated. Criticism, as 3, reflects the “democratic presumption » in C.B.A. i.e. individual’s preference should count” (p 17).

The argument for government intervention in the environmental realm is that natural disaster is an externality affecting individuals other than the decision makers. Incentives for private actors to internalize the costs of their actions were thought as a solution to the externality problem, (Pareto, 1896; Pigou, 1920; Kaldor-Hicks, 1939; Coase, 1960). According the Kaldor-Hicks criterion, if the objective is to maximize the difference between benefits and costs, then the related level of environment protection is defined as the efficient level of protection:

\[ \max_{q \in \mathbb{R}} \sum_{t=0}^{\infty} \left[ B_t(q_t) - C_t(q_t) \right] \rightarrow q^*_t \]  

Where \( q \) is the abatement by source \((t)\), \( B(\cdot) \) is the benefit function for source \( s \), and \( C(\cdot) \) is the cost function for the source, and is the efficient level of protection (disaster mitigation). The condition required according equation (1) is that marginal benefits be equated with marginal costs.

Cost-Benefit Analysis of Environmental Regulations

CBA relies upon the viability of reliable estimates of social benefits and costs, including estimates of the social discount rate. The value of net benefit at present (PVNB) is defined as follows:

\[ PVNB = \sum_{t=0}^{\infty} \left[ B_t - C_t \right] \cdot \left( 1 + r \right)^{-t} \]  

Where \( B_t \) are benefits at time \( t \), \( C_t \) are costs at time \( t \), \( r \) is the discount rate, and is the terminal year of analysis. A positive PVBN means that the policy has the potential to yield a Pareto
improvement. It meets the Kaldor-Hicks criterion. This criterion provides the rationale for both CBA and discounting according to Goulder and Stavins (2002).

In the environment field, cost is a measure of the value of what must be sacrificed to prevent or reduce the risk of an environmental impact. Benefits are considered as the collective WTP for reducing or preventing of environmental damages or WTA compensation to tolerate environmental damages. Hanemann (1991) includes psychological aversion to risk and loss in his theoretical explanations of CBA of environmental protection which also includes ecological impacts or material damages. In the environment field, people derive passive or none whether they want or not to preserve their own goods for future use by themselves or their heirs or not.

These estimates may be compared to the “Value of Statistical Life” (VSL). VSL being a convention written as:

\[
\text{VSL} = \frac{\text{MWTP}}{\text{MWTA}} \cdot \text{SRC}
\]

Where MWTP and MWTA refer to marginal willingness to pay and marginal willingness to accept, and SRC is the small risk change. So, VSL aggregates the amount a group is willing to pay for small reductions in risk. It is simply a convention, not an economic value of an individual life.

### Revealed Preference Methods of Environmental Benefit Estimation

Two methods exist for estimating the environmental benefit.

The first method, the averting behaviour one, is an indirect method based on WTP is inferred from observations of people’s behavioural responses to changes in environmental quality choices on the risk market. The key concept is WTP which represents the choice realized ex ante by the citizens between their financial resources and risk reduction. They can develop an averting or lessening choice. Practically, behaviour is measured through averting or mitigating expenditures.

In the case of our concern, i.e., tourism, WTP for all expenses linked to tourism is to draw on evidence from private options to use public goods.

The second and direct one is founded on hedonic pricing method. This method requires data on public support services with the range and capacity of those facilities. Support services might include police, sewer, water, medical facilities, rescue services, etc. In brief, it is about to know whether existing facilities can handle the visitors expected, and whether it will be profitable to make propositions for increased tourists.

By regressing the property value on key attributes, the hedonic price function is estimated as:

\[
P = \beta(x, z, e)
\]

Where
- \(P\) = using pricing (including lands)
- \(x\) = vector of structural attributes,
- \(z\) = vector of neighbourhood attributes, and
- \(e\) = environmental attribute of concern.
From equation (4) the marginal implicit price of any attribute including environmental quality can be calculated as the partial derivative of the housing price with respect to the given attribute.

\[
\frac{\partial P}{\partial e} = \frac{\partial f}{\partial e} = P_e
\]  

(5)

17 \( P_e \) measures the aggregate marginal WTP for the attribute in question.

\[
P_e = g(e, y)
\]  

(6)

18 When \( P_e \) is the fitted value of the marginal implicit price of from the first-stage equation = a vector of factors that affect WTP for including buyer characteristics. Nonetheless, other techniques exist in WTP and WTA estimations, proxies use, societal revealed preference and cost of illness or human capital measures. These techniques, according the literature, do not provide valid measures of economic benefits.

Cost-effectiveness in Environmental Policy

The objectives of environmental policies being known, economic analysis may enlighten the design of environmental policies. The key-criterion is the cost-effectiveness one, defined as the allocation of control among sources. Sources are the aggregate target achieved at the lowest cost, this latter is the allocation which satisfies the following cost minimization problem.

\[
\begin{align*}
M \sum_{i=1}^{N} C_i & = \sum_{i=1}^{N} C_i (\eta_i) \\
\text{s.t.} \sum_{i=1}^{N} |u_i - \eta_i| & \leq E \\
0 \leq \eta_i & \leq u_i
\end{align*}
\]  

(7) (8) (9)

20 Where = flooding or disaster control by source 
\( i \) (\( i \) = 1 to \( N \))
\( u \) = cost function for source
\( C \) = aggregate cost of floods control
\( \eta \) = uncontrolled flooding by source and
\( E \) = the aggregate floods target imposed by the regulatory authority.

21 If the cost functions are convex, then necessary and sufficient conditions for satisfaction of the constrained optimization problem posed by equation (7) (8) (9) are the following (Kuhn and Tucker, 1951).
Equations (10) (11) imply the crucial conditions for cost effectiveness that the sources exerting some degree of control experience the same marginal control costs (Baumol, Oates, 1988).

Some instruments for environmental policies implementation
Environment being considered as a public good, policies related to environment may also be considered as a public one. The questions are whether or not implement an environmental policy and which one. In that view government disposes of some decision tools. Among them,

The cost of business as usual
Natural hazards can damage buildings and infrastructure causing a series of direct and indirect losses. The direct losses, borne by the property owner and partially offset by insurance payments, can be approximated by the cost of repair and reconstruction. The indirect losses arise as a consequence of disruption of production and services and spread through the entire economy. An example of this is what would happen to imports and exports if a seaport were out of service for an extended period. Indirect losses are difficult to estimate and can easily exceed direct losses

Studies of infrastructure that failed due to natural hazards generally find that:
• Better design and construction could have largely eliminated the damage,
• these changes would have added 5 to 10 percent to the original project cost; and
• This added up-front cost would have been a small fraction of the cost of reconstruction.
• In other words, most damage and disruption can be prevented, and it pays to do so.

Market reduction function
Market creation establishes markets for inputs or outputs associated with environmental quality in the sense that it facilitates the voluntary exchange of rights and thus promote a more efficient allocation and use of scarce supplies (Howe, 1997). Information programs and product labelling requirements have been demonstrating that well-informed producers and consumers can help foster market-orientated solutions to environmental concerns (Hamilton, 1995; Koran and Cohen, 1997).

Government subsidy
Government subsidy reduction represents also a market-based tool. Subsidies can provide incentives to address environmental policy. But, if they can help in improving environmental quality, they can at the same time, be spillovers. By increasing profits in targeted sectors, they can contribute to new entries on the targeted markets, and thus, lessening environmental quality. Rather to internalize the cost of prevention, it externalises it.

To conclude this section one might say that if CBA appears as an idealistic method for environmental policy estimation, nonetheless, it reveals some limits. As a matter of fact, the access to data is often problematic and too many times, CBA strays out the general characteristics of the project. Estimation may be partial, above all if it is about evaluating...
a damage related to a particular event. The sensitivity analysis is often dampened by uncertainty about damages, equipments costs and failings. Otherwise, the subjective perception of risk (citizens perception Vs experts perception), cannot lead to fiscal equity in CBA and at present, only the financing organisations use CBA. In Haiti, due to its “fragile” situation, many multilateral funds are dedicated to that particular matter as 80 % of the State budget is depending upon the international community with funds for a wide variety of programs.

2. CBA applied to environmental policy in Haiti: will tourism spur growth? A hypothesis

The environment often displays characteristics of a public good, and in this case there is open access. These public goods aspects of the environment are sources of social utility, but they appear to command a price of zero in the market. Even when prices exist, they reflect administered powers rather than market forces, and environmental impacts are one source of missing markets (i.e. externalities). So, when evaluating a policy, the environment must be treated as a free production factor, even if real costs may be involved. An example is the use of a given territory by tourists. In an Environment Impact Assessing (EIA), the costs appear in CBA.

The Cost-Benefit Analysis (CBA) is a tool used to choose the most appropriate option or to rank projects. The decision is based on expected economic costs and benefits. The analysis process involves the measurement of the expected impacts, the effects of time, income distribution and potentially irreversible consequences. According Adam Smith, “the market knows”. That means that the market will allocate resources in the ways that would maximize profits and welfare for the society in its whole. Events, and unsurprisingly natural diseases and their spillovers, come and recall us that the market does not always know. So, to balance between costs and benefits for welfare, we need to implement methods. Among them is CBA which is a tool also applied in the Environmental sphere to analyze the effects of regulation.

CBA process must follow steps which are not described here. Instead of that, we describe, within a formal frame, how CBA applied to environment assessment can spur growth by impacting tourism positively. We also show that CBA leads to determine the maximum of tourist entries required for avoiding externalities. Thus, we are in the frame of a typical social CBA because costs and benefits to society as a whole are looked at. The other CBA kind is the financial one.

In the following, the aim is to implement an environmental policy to nurture tourism. A priori, this policy should cost nothing to the State as the tax is directly collected for the Government either at arrival or departure by the authorities upon each tourist. As mentioned previously, tourism is integrated into the services sector and this latter afforded for 25, 3 % in GDP for 2007. In Haiti, it is very difficult to obtain updated data. Ours are provided by CTO, and the most relevant relate to year 2004. According the Haiti Business Directory for 2007, the country has 67 hotels and restaurants as a net total of 1758 rooms spared between mountain, sea-side and urban categories. The main tourist ones are sea-side located.

The question is, will tourism do for the country what we want done? We suppose that a fiscal tax dedicated to environmental policy financing is provided by tourists’ themselves. This tax might be collected either by the hotels or by the Airport and Port Authority and
applied upon each visitor entry. It also might be included into the travel cost. We use a cost-benefit technique balancing cost against benefits to show the estimated net effects on GDP. We first draft a CBA based upon the environmental tax, then we show the transmission channels through the multiplier according to tourist expenditures in 2004, and finally, we compare with the expected multiplier gained from CBA.

Considering the poverty of our data, we use a rough-and-ready model. In Haiti data are not available over a long period of time. Ours are coming from two different sources, CTO and IHSI for the same period but remain not comparable. That is the reason why our CBA is rough-and-ready and also why we extrapolate future impacts.

A CBA proposal including an environmental tax applied to tourism

We consider a tax collected by Authorities either at arrival or departure which can be formalized by \( P \times f(t) \) where \( P \) is the nominal level of the tax and \( f(t) \) is the arrival or departure flow at time \( t \).

The tax generates costs such as commissioning to collectors, corruption. The equation (1) describes the fiscal benefit which is the amount of tax collected minus the costs supposed to be fixed at first hypothesis, it is of the following form:

\[
FB(t) = F(t)P - C(t);\quad C(t) = C
\]

(1)

The fiscal benefit is invested into environmental actions and specially into risks management. It may be communication, training, flooding warning... Then, it could be supposed a very rational hypothesis based upon work or utility function of tourist decision as they are sensitive to environment and specially risk averse. So, a link between flow of tourists and the environmental plan may be established. This link is very simply formalized by equation (3):

\[
F(t+1) = f[BFB(t)]
\]

(2)

\[
F(t+1) + f(t) = \alpha BF(t)
\]

(3)

Which says that tourist flow at time \( t-1 \) is a function of benefit invested at time \( t \). We posit a simple and linear relation equation (4).

\[
\frac{F(t+1)}{\alpha} = BF(t)
\]

(4)

\( \alpha \) measures the efficiency of communication related to the environmental plan and about the fact that tourist feel secured in the country.

Reporting equation (3) into equation (1) \( \frac{F(t+1)}{\alpha} = BF(t) \) we obtain equation (5) which is a discrete differential equation.
It is transformed into a continuous differential equation

\[
P(t+1) = \alpha F(t) - C
\]

(5)

By derivation of \( F \) we obtain

\[
\dot{F} = \frac{dF}{dt} = [\alpha P]F(t) - \alpha C
\]

(7)

\[
\dot{F} = 0 \Leftrightarrow \frac{\alpha C}{\alpha P - 1} = F(t)
\]

(8)

we obtain the final equation which is of the form of a differential one of the following form:

\[
\dot{F} = [\alpha P - 1]F(t) - \frac{\alpha C}{\alpha P - 1} F(t)
\]

(9)

which can be solved by equation (11)

\[
\frac{\partial r_i}{\partial r_i} - \lambda \geq 0
\]

(10)

\[
r_i \left[ \frac{\partial r_i}{\partial r_i} - \lambda \right] = 0
\]

(11)

In this very simple model, Benefits and Costs grow with the tax level implemented. Although idealistic it is quite unrealistic cause the tourist flow cannot grow indefinitely. In such a case, the tax generates spillovers instead of well being because the tourist is too important. More important, via this simple model we show that this environmental policy is twofold: it develops security for people while enhancing growth through tourism. This transformation of CBA allows us to show that risk management is an economic tool as well as a political one in the realm of well being.

In order to eliminate the exponential flow and its probable negative effects as mentioned above, the model has been complexified into a system of equations where costs progress with the tourist flow, and where they are also limited by \( C \), which is in fact, the maximum of tax to be collected, equations (12) (13).

From equation (8) becoming now equation (12)
Equation (13) is a differential system showing the equilibrium point where the flow must stop growing.

\[ F = 0 \Leftrightarrow \frac{\alpha C}{\alpha F - 1} = F(t) \]  \hfill (12)

\[
\begin{bmatrix}
\dot{F} = (C_F - 1)C(t) - \alpha C_t \\
\dot{C}(t) = \frac{C}{g(F(t))}
\end{bmatrix} \quad g > 0
\]  \hfill (13)

At equilibrium \( F \), the flow is fixed. It does not grow exponentially, avoiding thus environmental problems linked to expanded flows. The cost maximum is a tool at Government’s disposal to manage the tourist flow.

In the following Tabs. We illustrate our CBA when \( F \) has been affected with different values. They show the progressive character of a family of flow curves for a given \( C \). It is due to the differential equation which is unsteady. The curves (Tab. 1 and Tab. 2) leave a point to explode from that very point, and cost is scaled.

Tab. 1. – Hypothesis 1

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![Graphical representation](image-url)
Based upon the multiplier method we also calculate the tourist receipt. In order to show the multiplier effect of flow coming from the environmental policy. The first figure gives us the multiplier coming from a US$ 116 expenditure in 2004 according CTO data. At first round it is of US$ 58, and at 2nd round it is of US $ 13.
According this hypothesis, at first round, within a 3 years delay after the risk policy has been implemented, we found US$ 69.5 dedicated to local purchases. At second round and sub sequents, we got US$ 15.28 against US$ 13 in the previous frame without any environmental policy implementation. The variation rate is of 18% in positive.

To conclude this section one might say that the public sector can play an important role in reducing losses from future disasters by examining that will be cost effective from the residents’ perspective and the tax payers. Considering the environmental tax paid by tourists it may serve as a signal given by the Governement for reducing inequalities in the use of a public good and the increase of the population’s well being. Tax may contribute to develop a feeling of security perceived both by the residents and those outside such as not only tourists but also foreign investors. Finally, from the view point of good governance, it also may be a strong signal towards the international community given by Haiti still considered as the worsened governed country in the hemisphere.

Recommandations and Concluding Remarks

The geographic location of Haiti and the siting of tourism near the beaches make the country vulnerable to any natural disasters. Hurricanes and storms during summer 2008 have highlighted the challenges associated with reducing losses. They have been evaluated at about US$ 900 million. The temporary closing of hotels, roads repairing among others, meant fewer visitors to Haiti leading to loss of income not only in tourism but also in all the different sectors of the economy. As a matter of fact, the vulnerability of the tourism sector and others are not confined to their own capital stock. Other kinds of damages do affect the economy when they apply to roads, airports or harbours. Regarding Haiti one might be tempted to think that much of the damages were the consequences of deforestation, anarchic building, heavy urbanization in Port-au-Prince, e.g, and no warning or risk mitigation process.
Dealing with risks in decision-making processes is everywhere, and moreover in the Caribbean, the cornerstone of policies aiming at sustainable development. The concept of risk is central (Bouma and al, 2005) and it has to be incorporated into the estimation of social and economic effects.

A risk assessment approach applied to flooding

The risk management has a very clear and define objective: change the risk exposure for more sustainability. One faces a context which is both uncertain and antagonistic. And decisions have to be taken within that very context. Thus two questions, at least, arise. What is risk? What must we do? In order to answer these questions one must consider various aspects. They are social, economical, technical, financial, political and institutional at the same time within a social CBA framework where at final psychologic and subjectivism do influence the decisions. In a few words, it is about to bargain between efficiency and equity.

Social constraints

The importance of the damages is expressed either in number of deaths or in sums amount linked with the probability of risks occurrence. So, the typical problem is how to estimate the value of one human life (VSL) (Stavins, 2004). Several questions come on the ground. How to deal with moral objections? How to operate between individual and group risk? A disaster generating 10 000 deaths could be more severe than ten times 1 000 deaths as it could imply a greater social upheaval. If the State is in charge of the common well being, the agents need to be informed. They apply for transparency. So, the question is the following: is protection a public concern? When does it become a full private matter?

Economical aspects

These aspects are part of a typical economical process where probabilities given by the scientists are used to calculate a damage yet avoid and updated during the implementation year. Data required are those related to the damages linked to each sort of risk with a probability rule for each of them. Statistic rules used include an actualization rate. As an example, suppose a risk leading to a damage \( D \) with a given initial and yearly probability of \( p \), liable to occur each year at time \( t \). The actualization rate is given by \( i \), and the probable updated damage at year 1 is given by the following equation:

\[
D_p = \sum_{n=1}^{\infty} \frac{p(1-p)^{n-1}}{(1+i)^n} D
\]

In such a case, the lack of data is problematic. Thus, dialogue with the different agents is crucial. At least, when the Total Economic Value (TEV) is found, it provides an all-encompassing measure of the economic value of any environmental asset. It does not encompass values such as intrinsic ones. Benefits correspond to the measures aiming at risk reducing. Costs are the investments linked to the measures implemented and they include functioning expenditures. The cost-benefit relation may also be determined according different ways. By comparing damages dismishing when a risk occurs, by testing scenarii or by applying economical tools.

Technical aspects

Studies (Tinbergen, 1959; Van Danzig, 1959; Van Ast and al., 2003) reveal that a decision-making process need to be considered when assessing a risk approach. This latter, applied
to flooding or any one else must go on the six following steps that we do not fully describe in this paper:

- Inventorization of the effects to be monetarized,
- Selection and use of valuation methods,
- Use of discount rate,
- Acknowledgement of non-monetary values,
- Presence of limiting conditions,
- Risk attitude of decision-makers.

Each of these steps is operationalized by formal and/or informal rules, and the result of the process will depend upon step 1. But more important, risk and its perception can influence the outcomes of techniques that allow imputing a value on the possible consequences of flooding (step 2).

Regarding flooding, one must observe the swellings of the rivers, one must also analyse the environmental and functional values, evaluate and quantify the environmental goods such as the tourist and/or wet areas, in brief consider the dynamic between soil and rivers.

**Financial, political and institutional aspects**

Financial means to fund an Environmental Impact Assessment (EIA) are well known by all the Caribbean countries. They relate to credit, loans or emergency funds provided either by the different World Bank funds or by IDB for both *ex ante* and *ex post* measures. But it is also well known that to be efficient the more efficient structures have to be determined within a CBA perspective. That also means that when it is about to define whether risk reducing is or not a public concern it is time to drive concertation by including the private sector through public-private partnerships clearly identified.

To conclude this paper we could say that the Caribbean countries are all of them deeply concerned by risk and disaster management which relate to geography, economy and external dependency. Haiti of course faces the same problem and if we would make one recommendation, on one hand it would concern the recurring problem related to property rights. This must be prioritized through a strong legal and organizational framework as an effective and efficient EIA depends upon it. On the other hand, such an attitude could be perceived both by residents and foreigners as a strong signal towards governance and participative democracy.

But two measures appear critical:

- First reinforce statistics institutions. When trying to implement environmental policies, long data time series are of high importance. As an example, for evaluating flooding risk occurrence in the future one needs to observe the past floods events over decades. They will serve then for establishing probabilities in intensity and time occurrence also based on GIS maps.
- Secondly, define a strong and formalized property rights for lands. It is useful for identifying owners who, eventually, could be involved either in an environmental policy or in agricultural policies. This last measure is of great importance to make foreign investors feel secure when investing in the country.

At least, we must say that property rights are fundamental to the environment and as such must not be an additional charge but a mean to nurture the endogenous growth. But behind economics, we find behavioural management. Risk management must be envisaged as a win-win game for the economy and the environment. That is what we tried...
to demonstrate by the relationship between tourism for financing environment, and environment for nurturing growth.

BIBLIOGRAPHY


Natural hazards do have impacts on development. Of heavy consequences on both the human life and the economic development these impacts are critical in most of the Caribbean islands in general and specifically in Haiti. Thus, there is an urgent need to implement strategies aiming at reducing risk for lessening losses. By implementing well designed risk management strategies vulnerability can be reduced, and as a consequence, investment and employment can be protected. Even so preparedness to sustainable development is at the global Agenda, with regards to the specific case of Haiti, we assume that, at present, the country is not at all involved in such a long run strategy. Government attention is focused on immediate urgencies to be solved. By questioning the particular case of tourism, we show the positive impact of risk management strategies on growth using a Cost-Benefit Analysis (CBA).

Les catastrophes naturelles ont sans conteste des impacts sur le développement. Ces derniers, qui occasionnent de lourdes conséquences à la fois sur la vie humaine et le développement économique, sont préjudiciables dans la plupart des îles des Caraïbes et plus particulièrement en Haïti. Ainsi, il devient urgent de mettre en œuvre des stratégies visant à réduire les risques afin de minimiser les pertes occasionnées. En établissant des stratégies de gestion des risques bien conçues, la vulnérabilité des pays peut être réduite, et, par conséquent, l’investissement et l’emploi protégés. Même si le développement durable est à l’ordre du jour à l’échelle mondiale, il semble que ce ne soit pas le cas d’Haïti à l’heure actuelle, le pays n'étant pas du tout impliqué...
dans une telle stratégie à long terme. L'action du gouvernement se focalise sur la résolution des urgences immédiates. En s'interrogeant sur le cas particulier du tourisme, nous montrons, en utilisant une analyse coûts-avantages, l'impact positif des stratégies de gestion des risques sur la croissance.

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Geographical index: Haïti
Mots-clés: gestion des risques, mitigation des catastrophes, économie de l’environnement, croissance
Keywords: risk management, disaster mitigation, economics of environment, growth

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