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Natural hazards and climate change: what knowledge is transferable?

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Summary
This paper examines national government responses to hurricanes in the Caribbean, and considers what lessons can be learned for adapting to climate change. Climate change, which is expected to increase the unpredictability of weather-related hazards as well as change mean conditions, could exacerbate existing vulnerabilities. Little empirical evidence exists to guide national planners on how to adapt to climate change and there is some controversy about how to learn from past adaptation experiences, notably to hazards. This gap in knowledge is partly addressed in this paper through an investigation into the Cayman Islands' Government's response to hurricane risk over a 13 year period. Theories of policy change and hazards literature are used to explain the response strategy. Persuasion, exposure and collective action are found to be key components of the national response to hurricanes.

These processes of adapting to natural hazards are found to be similar to those required for adapting to climate change hazards. The potential for learning by analogy is explored. It is found that the natural hazards literature can be heavily drawn upon to advise national government planners for climate change preparedness, and theories of policy change can usefully frame our understanding of the institutional learning processes which need to occur to embed past lessons in current practices. In conclusion the potential for learning by analogy is useful, however only when applied in similar or identical social or cultural contexts.

Key words
Adaptation, learning, analogy, climate change, small islands, planning, Caribbean, tropical storms, hurricanes

1. Introduction

Climate change is expected to increase the likelihood of disasters either through changing the incidence and severity of weather-related hazards, or by increasing the vulnerability of human populations to the impacts of those hazards. The former could occur through changing weather conditions, such as precipitation regimes or storminess. The latter could occur through increased environmental and social pressures arising from some of the global environmental changes expected from climate change. In response to this problem, efforts are being made to explore what we can learn from past disasters and how that can help us adapt to global climate change. For example in 2002 the UNDP organised an expert group meeting in Havana, Cuba to explore explicitly integrating disaster reduction and adaptation to climate change. A growing body of literature is starting to emerge that is asking what lessons can be learned, see for example (Burton, 2002, Hay, 2002, Trotz, 2002, Challenger, 2002). Specifically lessons are sought that reveal a role for disaster management in risk reduction.

Despite this initiative some scepticism exists that useful analogies for climate change preparedness can be drawn from past disaster events. The reasons most often given for rejecting reasoning by analogy are because of different social and cultural contexts; different spatial scales of analysis; the past not reflecting the future; and disasters being an extreme case of weather and hence not useful for preparing for climate change, such as changes in mean conditions. For a review of the arguments both for and against using analogies see Meyer et al. (1998)

Nonetheless, the literature from the disasters field suggests that that a lack of preparedness for environmental hazards will always worsen the impacts of those hazards. Since Blaikie et al (1994) produced their 'pressure-release' model, most disaster experts agree that disasters are largely socially constructed. Blaikie et al, specifically suggest that a combination of root causes embedded in dominant ideologies, power relations, structures and access to resources, exacerbate dynamic pressures in communities leading to unsafe conditions with a fragile environment and local economy. They conclude that the coincidence of unsafe social conditions with a hazard (natural or man-made) leads to disasters (Blaikie et al., 1994). More recent work (Pelling, 2003, Smith, 2001), and indeed literature from other fields, including the risk literature (International Red Cross, 2002), reinforce this understanding and promote active disaster management to reduce the impacts of hazards.

Much empirical work exists to reveal the link between disaster preparedness and risk reduction, even the link between policy changes that implement disaster preparedness activities and risk reduction is widely accepted, see for example (International Red Cross, 2002, Thompson and Gaviria, 2004). However, the reasons why some governments incorporate disaster management into planning processes, and others do not, are less clear.

This paper seeks to explain how disaster preparedness can foster greater climate change preparedness. The paper first considers in section two the process of learning from exposure to hazards and where and how lessons can be learned and transferred. Section three considers a case study of hurricane preparedness in the Cayman Islands between 1988 and 2002 and reviews the processes that led Cayman Islanders to perceive that they had increased their response capacity to tropical storms. Section four highlights the key elements that led to the increase in tropical storm response capacity by the Cayman Islands' Government. Section five concludes that learning systems in social institutions can be an important element in preparedness for tropical storm risk and through analogy an important component in preparedness for climate change.

2. Learning for climate change preparedness

Learning is a simple concept involving 'the action of receiving instruction or acquiring knowledge' (Collins, 1988), however the mechanisms of learning that lead to the modification of behaviour or the acquisition of new abilities or responses, in addition to natural development of knowledge are complex and little understood. This leads us to ask, what is it that enables us to have 'insight' about specific issues? In their study of

learning processes (Clark et al., 2001a, Clark et al., 2001b) review perspectives on social learning from the fields of politics, ecology, and institutions among others. Clark et al. then define learning as critical reflection and analysis that is sustained over a period of years. Learning emerges from the use of information to produce cognitive change in understanding both the issues and the options available. Learning can be either supplied by advocates of specific positions/lessons, or demanded by those not satisfied with the current situation. Unfortunately learning is rare because it is often unwanted, as individuals and institutions are often more interested in protecting decisions already made, than thinking about what should have been done differently. Learning is also hard work as it requires sustained effort on the part of the learner and the teacher and there is rarely someone allocated to provide learning support.

2.1 Learning from experience: natural and man-made hazards

With all the uncertainty surrounding future greenhouse gas emissions and impacts, as well as the complexity of the enhanced greenhouse gas effect, the science of climate modelling and climate forecasting, see (IPCC, 2001), climate change is a difficult hazard to prepare for. Dealing with the hazards associated with climate change is made easier by deconstructing them into natural and man-made hazards. Anthropogenic climate change can be considered a man-made hazard, and the mitigation focus is on eradicating the problem, as with other man-made hazards, such as exposure to harmful chemicals or life-threatening technology. This is because the hazard (concentration of greenhouse gases) can be controlled by mitigating behaviour (reduced greenhouse gas emissions). Climate change impacts are expected to manifest in the form of natural hazards, such as hurricanes, earthquakes, floods and droughts. The adaptation management response to these is to reduce existing socio-economic pressures and to plan for the hazard.

Literature exists on both the management of human-induced and natural disasters. Much of the literature considering mitigation of man-made hazards builds on the three step approach to disaster mitigation, developed by (Kates and Kasperson, 1983), namely:
1) identify the hazards;
2) estimate the risks associated with the hazard;
3) evaluate the consequences of the derived risk (what is the likely loss).

In their thorough review of the consequences of hazards created by human economic activity, Harremoes et al., 2001, review the lessons learned by not applying this three step approach. Harremoes et al. present a series of case studies that consider man-made hazards, including: the 'ozone hole' exacerbated by human production of chlorofluorocarbons and other synthetic chemicals; man-made radiation, exposure to asbestos, benzene and others. They conclude that in each of their 14 case studies information was available at an early stage that described the potentially harmful effects of the products. In each case this information was slow to be taken up, because of a lack of trust between policy makers and scientists, because the decisions were complex and they were being made in an environment of ignorance and high stakes (Harremoes et al., 2001). They conclude that better science, better communication between scientists and policy makers, and stakeholder participation in decision making could go some way to mitigating these potential hazards.

The literature on mitigating natural hazards is slightly different as science cannot intervene with natural processes (yet) to reduce the size of the hazard; preparedness can only minimise the consequences of the hazard. A comprehensive body of literature that considers disaster mitigation offers many guidelines on reducing the consequences of hazards, see for example, (Thompson and Gaviria, 2004, Burton et al., 1978, Smith, 2001, Blaikie et al., 1994). Risk reduction for disaster preparedness as described by the (International Red Cross, 2002), involves six steps:

i) disaster preparedness and mitigation (coastal retreat, adaptation funds, international protocols)
ii) disaster planning (national disaster plans and management, early warning, evacuation, stockpiles, agency coordination)
iii) Disaster response (coordination, quick appropriate relief, local participation in assessment)
iv) Disaster recovery (assess risks during rehabilitation, local partners and procurement, risk reduction advocacy opportunity)
v) Disaster mitigation (hazard proof infrastructure crops and jobs, building codes, retrofits, land-use regulations, public awareness, insurance)
vi) Development (mainstream risk assessment, strengthen livelihoods, sustainable resource use, cross-sectoral partnerships, good governance)

This positive and successful approach has been developed from experience in the field over a number of years. Nonetheless there is still a long way to go to reduce socio-economic vulnerabilities and to reduce the losses from predictable natural hazards. While it is likely to take some time for existing knowledge to filter through to have some effect, reductions in vulnerability may come about through: better scientific information about the nature, size, frequency, and distribution of natural hazards; by making knowledge more accessible; and putting in place better systems to learn from existing knowledge (White et al., 2001). What does this mean for climate change preparedness? The lessons learned from preparing for man-made and natural hazards need to be incorporated into any climate change response strategy.

2.2 Policy change

Policy change can occur for many reasons, such as: public demand as a response to natural and man-made hazards; institutional evolution; socioeconomic change; cooperative behaviour; or the introduction of new technology and ideas (John, 2003). Over the past decade political theorists have moved towards three main arguments to explain why policies change:

i) policy advocacy coalitions,
ii) policy streams and windows
iii) punctuated equilibrium.

Policy advocacy coalitions emerge in response to an issue. These coalitions evolve, merge or shift overtime as issues change and coalition members change their preferences, see for example, (Sabatier and Jenkins-Smith, 1993). Policy streams and windows refer to the complex adaptive policy-making system where new policies constantly evolve. Windows of opportunity only emerge when these streams match the institutional and

political context, see for example (Kingdon, 1984). Punctuated equilibrium theory suggests that policies are stable until 'punctuated' by an external event, a person, group, or some type of catalytic change, see for example (Baumgartner and Jones, 1993). Clearly all three theories explain to some degree the process of change in disaster preparedness policies.

There is some evidence that exposure to weather-related hazards can catalyse learning about hazard impacts and hazard preparedness. Effective learning can, if driven by certain policy advocates, generate policy change. For example major floods appear to have created crises that have raised the public consciousness of environmental hazards, such as flood risk in the UK (Arnell et al., 1984). In their paper, Arnell et al suggest that the social or economic crisis created by environmental hazards can make the issue important politically, thereby motivating policy change.

3. Learning to adapt in the Cayman Islands

The Cayman Islands, see Figure 1, experience the effects of the Atlantic Hurricane Season annually from 1st June until 30th November. From 1887-1987 a tropical storm passed directly over Grand Cayman every 12.5 years (Clark, 1988). Twice since 1988 have the islands been affected by Category 5 hurricanes: in September 1988, by Hurricane Gilbert, and in October 1998 they were affected by Hurricane Mitch. The islands were also affected by a Category 4 hurricane - Hurricane Michelle in November 2000.

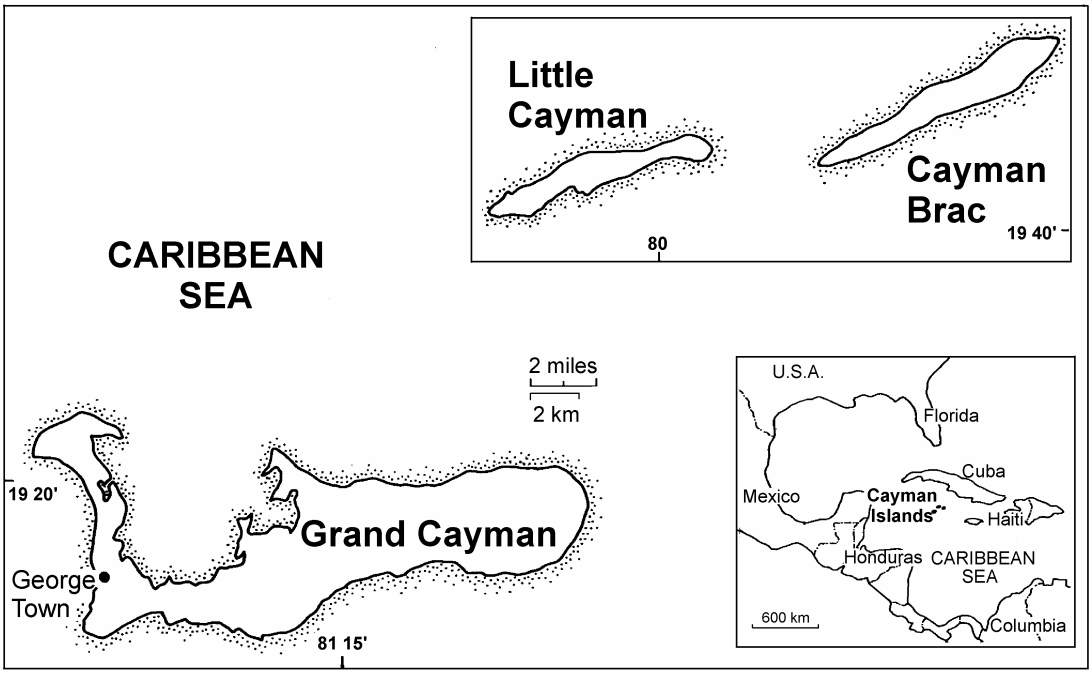
To understand policy changes relating to the Cayman Islands' Government hurricane preparedness, interviews were held with 20 heads of government departments during 2002. The aim was to identify the factors that enabled and constrained institutional adaptation within the government from Hurricane Gilbert in 1988 to Hurricane Michelle in 2000. A complete analysis of the data can be found in (Tompkins and Hurlston, 2003). A clear message came through all the interviews, the government had become better prepared for hurricanes over the period. This was clearly stated by one of the respondents.

> *"In 1988 prior to Gilbert we did our first Hurricane Preparedness Exercise. We were disorganised because it was our first attempt. It took us 16 hours to get 70% of the hurricane shutters onto the government buildings complete. Even so this exercise helped us when Gilbert hit. Even though we weren't as effective as we are now, we were better prepared than we were before we did the preparedness exercise. Since then we have held an exercise every year. We can now protect all Government buildings in 6 hours. The Andrew's, Gilbert's, Michelle's and Mitch's have helped to keep us focused and prepared."* (Tompkins and Hurlston, 2003).

The respondents noted that the change in institutional capacity manifested in a variety of ways: through changes in constitutional order and laws, and through changes in organisational structure. Two important regulatory changes occurred in the same period: notably: an enhanced Building Code in 1995/6; and changes to the Development and Planning Regulations. The new Building Code, based on the South Florida Building Code, increased construction standards to ensure new buildings are designed to withstand

hurricanes. The new Development and Planning Regulations moved coastal set back for waterfront property from the low water mark to the high water mark island-wide, and in the Hotel/Tourism zone the set back was increased from 100 feet to 130 feet.

Figure 1 The Cayman Islands



Supporting and guiding the laws, are several policy and planning documents, including: the National Hurricane Plan (since 1989) and Vision 2008[1]. An example of the change in importance of hurricane preparedness can be seen in the inclusion of Strategy 15 in Visions 2008. Strategy 15 states:

> "We will support comprehensive contingency planning for natural and man-made disasters and incidents to ensure the preservation of human life, protection of property and economic recovery of the country." (Government of the Cayman Islands, 1999)

It is proposed that this is achieved through the promotion of six key actions:

1. establish a formal Emergency Management Agency to coordinate all emergency management;
2. establish a National Disaster Fund for post-disaster recovery;
3. create/modify legislation to support the prevention and mitigation of natural disasters;
4. create/modify legislation to support the prevention and mitigation of man-made disasters;
5. implement a disaster management study;
6. prepare a comprehensive full disaster economic recovery plan.

Plans without implementation are useless. Hence it is the degree to which policies such as these are adopted that will mark their success or failure. Changes in organisational

[1] Vision 2008 lays down some fundamental principles for development including: open and accountable government; infrastructural development plans; growth management objectives; disaster management; as well as objectives regarding planning for the environment, the economy and health of the population.

structure have supported these changes. The two most significant include: the creation and later expansion of a formal Department of Environment; and the creation and mainstreaming of a National Hurricane Committee. The Department of Environment evolved from the small conservation-oriented Natural Resources Unit with 4 staff in 1988, to a department with 26 staff, integrated into the development planning process and a prominent profile within the Ministry of Tourism, Environment, Development and Commerce by 2002. An equally important development that took place was the development and mainstreaming of a central organising body for the Cayman Islands hurricane preparedness and response activities – the National Hurricane Committee. This permanent, yet informal, body[2] currently comprises 13 sub-committees and is chaired by the country's Chief Secretary (National Hurricane Committee, 1999). Starting with a small group of volunteer civil servants, the National Hurricane Committee now engages members of the public, private sector contractors, religious groups and NGO's as part of its activities to mainstream the concept of hurricane preparedness.

4. Key elements in the adaptation process in the Cayman Islands

The processes of change in the Cayman Islands reveal evidence of several drivers of policy change. Advocacy coalitions were in action, policy windows clearly appeared and the policy equilibrium was punctuated through exposure to storms.

4.1 Advocacy coalitions: emergence of the National Hurricane Committee

In the Cayman Islands the typical small island resource constraints that lead government agents to multi-task and to rely on small networks and volunteers can be seen in a positive light as they contributed to the development of the National Hurricane Committee and a strong committee ethic among civil servants. The voluntary nature of the groups and the informal social support networks that developed in the Cayman Islands are increasingly being noted in the literature on building informal local level resilience to disasters, see for example (Berkes and Jolly, 2002), and (Paton et al., 2001).

Many respondents attributed the increased effectiveness of the Cayman Islands' Government to hurricane risk to changes that were advocated by the National Hurricane Committee. When asked to consider what had led to these successes almost all respondents identified the same characteristics: the participation of committed volunteers; small group size; inclusivity across government departments; and a willingness to consider any approaches that might work. The role of a motivated leader (in the form of the Fire Chief) was highlighted by most respondents as central to increasing the profile of the hurricane risk issue in government and in engaging individuals across a wide range of departments. Several noted that strong leadership of the NHC, the diligence with which the original members of the NHC had established the committee, and the hard work and effort they had invested had motivated others to participate.

Willing participation and active support of the National Hurricane Committee in its hurricane preparedness by volunteers in the civil service, has contributed to the islands taking hurricane risk seriously. All of the preparedness activities take individuals away

[2] There is no formal legislation establishing the National Hurricane Committee.

from their other duties and responsibilities within their departments, but it is recognised that these activities now play an important role in development planning and disaster preparedness in the Cayman Islands. This change in perspective has lead to the prioritisation of hurricane preparedness and response above other priorities.

4.2 Punctuated equilibrium: crisis as catalyst?

Catalytic events, such as the Hurricane Gilbert's, Mitch's and Michelle's were noted by most respondents as important dimensions in raising the public profile of tropical hurricane threats. Most mentioned the importance of hurricanes in influencing policy change in formal government institutions, see Box 1.

Box 1 Raised awareness as a result of exposure to weather hazards by sector

Construction: "A lot of the new school buildings are being built to the South Florida Building code which took into account the hurricanes like Andrew which devastated Miami." Respondent 7, 020626

Development planning: "The Development Plan is reviewed at least once every five years. It was a coincidence that this current review is taking place after Michelle. However Michelle did raise awareness about the issues, particularly about the need for increased water front set backs." Respondent 2, 020705

Financial impacts: "The losses from Michelle were approximately $40 million to the country, the claim for government is not yet settled, but the government losses could be in the region of $16 million." Respondent 5, 020704

Health care: "Before 1987 we only had a general 2 page document about what the government would do in the event of a hurricane, not who would do what. In 1988 Gilbert hit, and we learned a lot of lessons about health services preparedness. For example, the health centres that are down in the districts, even before the hurricane season we have clearly identified which staff will be allocated to these centres, and what the centres should contain. That way … we have a clear direction, this is better than before." Respondent 15, 020711

Infrastructural development: "One of the lessons learned came from our observation and assistance in helping the recovery in Honduras from the devastation of Hurricane Mitch. As a result we now have a heightened awareness of the possible impacts….That is why PWD commissioned a report on wind and wind borne debris." Respondent 5, 020704

Source: (Tompkins and Hurlston, 2003)

As the last comment in Box 1 suggests, policy change can be built on lessons learned from the exposure of other regions to similar hazards. By supporting other nations that have experienced severe hurricane impacts, the Cayman Islands have themselves learned indirectly about the potentially devastating impacts of tropical hurricane impacts and the need to be prepared. Exposure to hurricane impact appears to have been an important, but not sufficient criteria, in raising the profile of hurricane risk in the Cayman Islands. More important is exposure coupled with deductive reasoning that links the hazard to the impacts suffered, as well as linking this reasoning to future repeat events.

While many people within the government have made this causal link, this deductive reasoning is not universal. Often short term economic development or even post-storm reconstruction leads to maladaptive decisions, such as building in flood-prone areas, which compromises longer term sustainable development objectives. One respondent pointed out that there are several examples where this link has not been made:

> "After Hurricane Michelle the whole beach had disappeared. It's a good example of beach erosion. There you see the interaction of nature and man and you see who wins. They have put up walls they have brought down scientists. They have put up groynes and artificial sea balls. It doesn't work, the sea simply keeps eroding.." Respondent 7, 020626.

Even with public education, some respondents felt that, at present, policies are made that ignore internal advice and that lead to developments which may not adhere to planning guidelines or the overall direction of the Islands. This suggests that the current policy equilibrium requires additional catalysts to embed risk management more formally into government planning.

4.3 Policy streams and windows: persuasion

While hurricanes themselves can act as catalysts for change, persuasion, in the form of command by the state, education, moral argument, the conviction of a strong leader, the motivation of a popular champion, or profile raising international conventions can re-direct streams of thought and dialogue thereby creating the space for new policies to emerge, see (Young, 2002).

Several changes have occurred in the Cayman Islands that have changed the context in which policy decisions about risk are made. At the national level, the National Hurricane Committee has become an influential agency. Internationally, the United Nations Framework Convention on Climate Change has come into existence. Locally, dialogues about risk have changed as a result of changing perceptions about terrorist threats since September 11th 2001. The institutional context has changed since 1999 when the UK government launched its White Paper 'Partnership for Progress and Prosperity: Britain and the Overseas Territories', which set out the policy on the UK Overseas Territories. The White Paper has been implemented through various initiatives such as the production of Environment Charters in the various UK Overseas Territories. As the political context has changed windows of opportunity for changes to the Cayman Islands' Governments risk management policy have emerged. For example, September 11th 2001 clearly provided an important window of opportunity to consider risk management. With regard to hurricane risk in the Cayman Islands many respondents felt that persuasion from the various sources had played an important role in coalescing support for the government response, thereby supporting policy change towards hurricane risk.

5. Learning for climate change hazards

Most respondents described the policy changes that have occurred within the Cayman Islands' Government towards hurricane preparedness either as a production of organic evolution or explicit planning. The combination of hurricane-induced crises as catalysts,

coupled with advocacy by a respected committee, clearly contributed to the increased effectiveness of the Cayman Islands' Government response to storm risk.

It is difficult to isolate specific driving forces as most respondents recall differently the motivation for the changes. Irrespective of motivation, respondents were very clear about the factors they perceived to be in place that have improved the Cayman Islands' Government storm management, see Box 2. These factors include: education and information about hurricane risk; risk management practices; clear roles and responsibilities; inclusion and integration across government departments.

Box 2: Perceptions of the key elements in planning for hurricane preparedness

Alertness/awareness of risk: "There is a constant state of alertness and preparedness for hurricanes." Respondent 4, 020627

Clear roles and responsibilities: "Our role is to provide coordination and communication as necessary in the event of a natural disaster." Respondent 7, 020626

Flexible decision making processes: "Coastal vulnerability mapping based on several factors, with the discretion built in for the decision makers is what is needed in planning for the future." Respondent 3, 020708

Inclusion: "The NHC has been so successful because it has included all the different sectors and the civil servants. It doesn't matter how good any individual is on their own success comes from working together." Respondent 9, 020627

Integrated approach: "There is good structure, not just within this organisation, but it ties in with the overall national structure. The NHC takes over the running of the country in practical terms. Somehow we all tie into that network. Respondent 13, 020710

Learning based approach: The plan that you see today is a lot better than the one we had a one year ago, and the one from one year ago is better than the year before. We use our experience every year from actual events to make our plans better. Respondent 13, 020710

Preparedness exercises: "These people are very serious, they do an annual exercise - it showed last year, with the three hurricanes in a row, these people were doing their things day and night. Things were alright. I think given the circumstances they did an awfully good job." Respondent 13, 020710

Risk management: "The risk management approach started in 1994 with an insurance and risk management study that identified our possible losses and what this might do for our image..... In response to this we set up a risk management advisory committee which advises EXCO on risk management." Respondent 5, 020704

Support network: "We have a good organisation here so we have back up and we provide back up." Respondent 7, 020626

How can this knowledge be embedded in the institutions so that it can be translated into preparedness for climate change? The survey respondents identified that for learning to occur, information and knowledge would have to be both supplied, or 'externally pushed' as well as meeting their demands through 'internal pulling', see Box 3. The pushing forces may come from external intervention, impact information and public education or awareness programmes. However there also needs to be the demand for learning from those dissatisfied with the current state of affairs, this could be in the form of inclusion of

meteorologist and climate scientists in decision making, industry/government partnerships, or greater political consensus about climate change as a policy issue.

Box 3 Learning from storm preparedness to take the climate agenda forward

External intervention: "We are starting from the premise that no one knows anything. I am in the middle, neither an economist nor a climate scientist, just an environmental manager trying to get the point across, I am not speaking from any level of expertise, so it is difficult to get any credibility when talking about this issue. This is why I think we need outside intervention to raise awareness." Respondent 3, 020708

Impact information: "Some concise information, coordinated through a government department, on what we are planning for." Respondent 17, 020705

Include climate scientists in decision making: "..the climate scientists should be involved (they) are the ones who understand intimately what is going on. A problem with a lot of the climate research is that it has been moved out of the scientific arena, and a lot of governments are taking on how to respond in agencies separate from the met services in their countries." Respondent 11, 020710

Industry/government partnership: "Government will have to lead by example and put money aside, and to prove that it will keep the money aside for rebuilding if it is needed. If the private sector feels the money will be spent on other things they won't contribute." Respondent 2, 020705

Longer term planning: "The idea that we are only dealing with today and tomorrow be damned has got to stop." Respondent 3, 020708

Public education/ raising awareness:
"What we need is education and respect for the environment….that acts as a buffer against bad weather. We have campaigns in school and we try and fund nature related tourism projects…..things like this keep people's eye on the ball with respect to the environment. It reminds them that people will travel here to see nature and that's why we should pay attention." Respondent 6, 020708
"Because climate change has socio-economic impacts, it has ….implications for sustainable development. This issue is much larger than most people are aware. That is why we need education. Education and awareness raising are the first steps." Respondent 11, 020710
"We are trying to raise public awareness about the risk of hurricanes at the moment. In addition to the TV and newspaper we produce the National Hurricane Handbook annually….we could do more but resources are limited." Respondent 7, 020626

Political consensus: "People are sceptical because of the US's position versus the European position. Until there is consensus we won't be able to get the heads of Department to direct resources to solve these issues." Respondent 17, 020705

Many respondents recognised that, irrespective of the social and policy learning that occurs, effective institutions that fit within the local social and cultural context, rather than being externally imposed are critical. For this reason, respondents suggestions about how the Cayman Islands' Government could take the climate agenda forward are of particular interest. Respondents, building on their own local knowledge, suggested that legislation should be modified to build in climate change risk, particularly to:

- mitigate against specific climate impacts such as sea level rise;
- modify laws for construction of roads and buildings to increase their ability to withstand every day weather;

- create a Disaster Fund for relief in situations of extreme weather; increase the minimum elevation for developments on reclaimed land to prevent future flooding;
- develop a national energy policy.

Many of these suggestions have already been championed in Vision 2008, the government's policy planning document (Government of the Cayman Islands, 1999). Other suggestions relate to raising the profile of climate change, for example by creating an inclusive network that is driven by scientific understanding of climate change to facilitate learning about the issue; and developing new regulations or organisational structures to manage future hazards.

6. Conclusions

Lessons for responding to climate change can be learned from both man-made and natural disasters. Man-made disaster literature can drive an understanding of how best to mitigate climate change, and natural disasters can provide numerous lessons on how best to adapt to climate change. Using this analogy means that for some types of future climate change, notably where extreme events are likely to mirror past extreme events, or extreme events which occur in other similar parts of the world, there is no need to reinvent the wheel – lessons can the transferred. The question is how to transfer the lessons.

Useful means of understanding motivations for policy change can be found in main stream political economy, three main explanations: policy windows, punctuated equilibrium and advocacy coalitions. These theories can be used to identify appropriate times in the policy cycle to introduce new concepts or ideas to ensure that they have greatest effectiveness, to develop links between policies to ensure their survival, and to use advocacy coalitions to support the policies. This study suggests that the conditions that enabled policy change to occur for hurricane preparedness are appropriate (in the same context) for policy change to develop for climate change preparedness. These conditions stem from windows of opportunity that emerge as a result of exposure to a hazard or from persuasion from internal or external sources. Once the opportunity has arisen three steps seems important (again in this context): individual cognition, informal group action, supporting formal institutional change. At present it is not possible to know if these lessons apply to the Cayman Islands only or if they are transferable to other islands in the Caribbean or to other social, political and cultural contexts.

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