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YOUNG VOICES IN RESEARCH FOR HEALTH 2008

Climate change and health:
research challenges
for vulnerable populations



ESSAYS

Young Voices in Research for Health 2008
Winners of the 2008 essay competition for the under-30s

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YOUNG VOICES
IN RESEARCH
FOR HEALTH
2008

Climate change and health:
research challenges
for vulnerable populations

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For their prize, the six winners are invited to take part in the Global Ministerial Forum on Research for Health, which takes place in Bamako, Mali from 17 to 19 November 2008. Their essays also appear in *The Lancet's* online edition.

INTRODUCTION

For the third time, the Global Forum and *The Lancet* have jointly invited young professionals (under 30) working on or interested in the broad spectrum of research for health to participate in the Young Voices essay competition.

This year, young professionals were asked to share their concerns about climate change and health and to invigorate the research for health community with fresh perspectives and idealistic visions regarding research challenges for vulnerable populations.

There is irrefutable proof of climate change as a result of human activity, most notably caused by the release of greenhouse gases from fossil fuel use. Although this primary cause of climate change comes largely from developed countries, developing countries will also add to climate change as their economies grow. Moreover, it will be poor populations on whom climate change will exact the greatest toll – the same populations that already bear the heaviest burdens of infectious and chronic diseases.

The call for research and its translation into action to protect vulnerable populations from climate change is urgent and consistent with the mission of the Global Forum for Health Research, which is to apply research to the health problems of the world's poor and most vulnerable.

Out of close to 300 submissions in English and – for the first time – in French, 42 essays have been shortlisted for this compilation. The six winners are **Enrique Falceto de Barros** from Brazil, **Philippa Bird** from the United Kingdom, **Lester Sam Geroy** from the Philippines, **Rhona Mijumbi** from Uganda, **Maramé Ndour** from Senegal and **Charles Salmen** from the United States of America.

Perhaps the most striking thing about these essays is the range of climate-change effects these young writers call to our attention – from the broad and encompassing issues of culture and anthropology, displacement and migration, and social justice, to very specific situations, including post-traumatic stress disorder, the logging industry and the reshaping of primary health care systems. The essays reflect intense passion and a willingness to think outside the box. The writers have considered the challenges climate change poses for health research from a variety of perspectives. They have drawn not only from their own life experiences, where they live and how they view themselves, as individuals embedded in specific social and cultural contexts, but also from a clear recognition that they are members of an increasingly interconnected global community. The questions they ask may surprise and provoke you.

We hope you will enjoy reading these essays and that the ideas expressed will also spur many to action.

Susan Jupp
Head, External Relations
Global Forum for Health Research

Faith McLellan
North American Senior Editor
The Lancet

INTRODUCTION

Pour la troisième fois, le Forum mondial pour la recherche en santé et *The Lancet* ont conjointement invité les professionnels jeunes – de moins de 30 ans, en exercice dans la recherche pour la santé dans son ensemble, ou qui s'intéressent à ce domaine, à participer au concours “*Young Voices*” – La voix des jeunes.

Cette année, *La voix des jeunes* a permis à de jeunes professionnels de partager leurs préoccupations sur le changement climatique et la santé et d'insuffler dans cette communauté de chercheurs de nouvelles perspectives et une vision idéaliste sur les besoins en matière de recherche pour les populations vulnérables.

Il est fondamentalement établi que le changement climatique résulte de l'activité humaine, notamment du rejet de gaz à effet de serre provenant de combustibles fossiles. Bien que les pays développés soient les principaux responsables du changement climatique, les pays en développement vont aussi y contribuer, du fait de la croissance de leurs économies. En outre, c'est sur les populations pauvres que le changement climatique aura le plus d'impact – ces mêmes populations qui doivent déjà porter la plus lourde charge de maladies infectieuses et chroniques.

L'exigence pour la recherche et sa traduction en actes, afin de protéger les populations vulnérables des effets du changement climatique est urgent, et en accord avec la mission du Forum mondial pour la recherche en santé, celle-ci étant de faire en sorte que la recherche cible en priorité les problèmes de santé des populations les plus pauvres et des plus vulnérables au niveau mondial.

Sur près de 300 essais en anglais et, pour la première fois, en français, 42 essais ont été retenus pour cette compilation. Il y a six lauréats, qui sont **Enrique Falceto de Barros** du Brésil, **Philippa Bird** du Royaume-Uni, **Lester Sam Geroy** des Philippines, **Rhona Mijumbi** de l'Ouganda, **Maramé Ndour** du Sénégal et **Charles Salmen** des États-Unis d'Amérique.

Ce qui frappe le plus, peut être, au sujet de ces essais, est la variété des effets du changement climatique sur lesquels ces jeunes écrivains nous interpellent : depuis les vastes questions de culture et d'anthropologie, les migrations et populations déplacées, et la justice sociale, à des situations très spécifiques, y compris les troubles de stress post-traumatique, l'industrie forestière et la réorganisation des soins de santé primaires. Les essais reflètent une intense passion et une volonté de penser hors des sentiers battus. Les auteurs ont examiné les défis que le changement climatique pose pour la recherche en santé sous des angles variés. Ils se sont inspirés non seulement de leurs propres expériences de la

vie, de là où ils vivent et de comment ils se perçoivent eux-mêmes, en tant que personnes situées dans des contextes sociaux et culturels spécifiques, mais aussi de l'évidente compréhension qu'ils sont membres d'une communauté mondiale de plus en plus interconnectée. Les questions qu'ils soulèvent peuvent vous surprendre et vous provoquer.

Nous espérons que vous prendrez plaisir à la lecture de ces essais et que les idées exprimées stimuleront l'action chez plus d'un.

Susan Jupp
Responsable des Relations Extérieures
Global Forum for Health Research

Faith McLellan
Rédactrice en chef Amérique du Nord
The Lancet

INTRODUCCIÓN

Por tercera vez el Global Forum para la Investigación en Salud y *The Lancet* han convocado conjuntamente a jóvenes profesionales (menores de 30 años), que ya trabajan o que se interesan por el amplio espectro de la investigación en salud, a participar en el concurso de ensayo de *Young Voices* – Voces Jóvenes.

Este año los jóvenes profesionales tuvieron la oportunidad de compartir su preocupación por el cambio climático y la salud y de vigorizar la investigación en materia de medicina comunitaria con perspectivas frescas y visiones idealistas referentes a las dificultades en la investigación para grupos de población vulnerables.

Existe la evidencia irrefutable de que el cambio climático es el resultado de la actividad humana, ocasionado en gran medida por la generación de gases de efecto invernadero procedentes del uso de combustibles fósiles. A pesar de que esta primera causa del cambio climático se origina mayormente en los países desarrollados, los países en vías de desarrollo también tendrán su impacto en el cambio climático a medida que crezcan sus economías. Más aún, serán precisamente los grupos de población más pobres los que sufrirán en mayor medida los efectos del cambio climático – los mismos que ya soportan la carga más pesada de enfermedades infecciosas y crónicas.

El llamamiento a la investigación y a que esta se traduzca en acciones para proteger los efectos del cambio climático a los grupos de población vulnerables, es urgente y coherente con la misión del Foro Mundial para la Investigación en Salud, que consiste en aplicar la investigación a los problemas de salud en las sociedades más empobrecidas y vulnerables.

Se escogieron 42 ensayos en inglés – y por vez primera en francés – para esta publicación, de los casi 300 que se recibieron. Los seis ganadores son: **Enrique Falceto de Barros** del Brasil, **Philippa Bird** del Reino Unido, **Lester Sam Geroy** de Filipinas, **Rhona Mijumbi** de Uganda, **Maramé Ndour** de Senegal y **Charles Salmen** de los Estados Unidos.

Lo más impactante de estos ensayos quizás sea el abanico de efectos derivados del cambio climático sobre los que estos jóvenes escritores llaman nuestra atención –desde aspectos amplios e inclusivos de cultura y antropología, desplazamiento, migración y justicia social hasta situaciones muy específicas, como los desórdenes por estrés post-traumático, la industria de la explotación forestal y la reforma de los sistemas primarios de salud. Los ensayos reflejan pasión intensa y la voluntad de pensar por fuera del marco habitual. Los escritores han considerado los problemas que el cambio climático plantea a la investigación en salud desde múltiples perspectivas.

No sólo han profundizado en sus propias experiencias de vida en los entornos en los que viven y en cómo se ven a sí mismos como individuos inmersos en contextos sociales y culturales específicos, sino también en la consciencia clara de que son miembros de una comunidad global cada vez más interdependiente. Las preguntas que plantean pueden sorprenderle y resultarle provocadoras.

Esperamos que disfrute con la lectura de estos ensayos y que las ideas expresadas también inciten a muchos a actuar.

Susan Jupp
Directora de Relaciones Externas
Global Forum for Health Research

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Editor en Jefe Norte América
The Lancet

INTRODUÇÃO

Pela terceira vez, o Fórum Mundial para Pesquisa em Saúde e *The Lancet* convidaram conjuntamente jovens profissionais (com menos de 30 anos), trabalhando ou interessados na grande área da pesquisa em prol da saúde, a participar na competição de ensaios *Young Voices* - Vozes de jovens.

Este ano, os jovens profissionais tiveram a oportunidade de partilhar as suas preocupações sobre as mudanças climáticas e a saúde e de impulsionar a comunidade para pesquisa em saúde com perspectivas novas e visões idealistas em relação aos desafios da pesquisa destinada a populações vulneráveis.

A prova de que a actividade humana resultou em mudanças climáticas é irrefutável, especialmente causada pela liberação de gases com efeito de estufa imanados de combustíveis fósseis. Embora esta causa primária da mudança climática venha principalmente de países desenvolvidos, os países em desenvolvimento também vão agravar o problema com o desenvolvimento das suas economias. Além disso, serão as populações pobres as que vão sofrer mais com as mudanças climáticas - as mesmas populações que já suportam a carga mais pesada ligada às doenças infecciosas e crónicas.

O pedido para investigação e a sua tradução em medidas de protecção para populações vulneráveis contra os efeitos da mudança climática, é urgente e consistente com a missão do Fórum Mundial para Pesquisa em Saúde, a qual consiste em aplicar a pesquisa aos problemas de saúde das populações mais pobres e vulneráveis do mundo.

Em cerca de 300 apresentações em inglês e -- pela primeira vez -- em francês, 42 ensaios foram seleccionados para esta compilação. Os seis vencedores são **Enrique Falceto de Barros** do Brasil, **Philippa Bird** do Reino Unido, **Lester Sam Geroy** das Filipinas, **Rhona Mijumbi** do Uganda, **Maramé Ndour** do Senegal e **Charles Salmen** dos Estados Unidos de América.

Talvez a coisa mais notável destes ensaios é a gama de efeitos das alterações climáticas para as quais estes jovens escritores chamam a nossa atenção - questões vastas e abrangentes desde cultura e antropologia, deslocamento e migração e justiça social até situações muito específicas, incluindo distúrbios pós-traumáticos causados por tensão, a indústria da madeira e a remodelação dos sistemas de saúde primários. Os ensaios reflectem a paixão e a vontade intensa de pensar de maneira inovadora. Os escritores consideram os desafios que a mudança climática representa para a pesquisa em prol da saúde segundo perspectivas diferentes. Eles não só consideraram as suas experiências pessoais, onde vivem e como se vêm

a si próprio como indivíduos inseridos em contextos sociais e culturais específicos, mas também tomaram em consideração o reconhecimento claro de membros de uma comunidade mundial cada vez mais interrelacionada. As suas perguntas poderão vos surpreender e interpelar.

Esperamos que aprecie a leitura destes ensaios e que as ideias levantadas o façam agir.

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Chefe, Relações Externas
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ESSAYS



Ida Ansharyani, Indonesia

SILENT DANGER LURKS IN WATER

There is growing evidence that climate change will significantly impact on the rural populations of developing and poor countries. Rural people, who represent the majority of inhabitants in developing countries and whose livelihoods depend upon natural resources, such as water, will be affected by changes in rainfall patterns and greater weather extremes. This will put pressure on already scarce resources and affect all aspects of their lives, including their state of health.

To fulfil their daily water needs, such as for drinking, cooking and sanitation, rural people use water from various sources. Commonly they use water from wells, rivers and springs. In more remote areas, rural people depend on rain harvesting. In many places clean water is very limited. In the dry season, many people face particular difficulties in obtaining fresh water and are often forced to walk for hours to find it. River water is dwindling. The number of wells is limited and they are usually located quite far from settlements. In particular areas, due to climatic and geological conditions, water resources are indeed rare (for example, in arid or temperate regions and limestone karst¹ areas). In more developed villages pump water is provided, however, not all people can afford to access this supply.

Besides problems of quantity, water quality is a common issue in villages. Even if there are abundant water resources, poor water quality means these resources are often unsuitable for human use. It is frequently found that a river has abundant water all year round, but unfortunately the water is impure and reddish in colour, especially in the rainy season. In some places with certain geological conditions, the water contains harmful substances in high concentrations (e.g. carbonate and acid). Sometimes pump water is also unclean, especially in the rainy season. This means people who have access to pump water must look to other sources, such as spring water and wells, for clean water.

Water problems are a real threat to rural people's health. Health problems caused by poor water quality and lack of access to sufficient supplies are exacerbated by limited access to health facilities. Many villages are isolated because of poor road infrastructure. This means people have to walk for hours to reach the nearest health facility and this also prevents health officers from visiting communities on a regular basis. The facilities themselves are very limited and often inadequately staffed. The health facility in many villages is only staffed by nurses with no access to a qualified doctor. Professionally trained midwives to help mothers give birth are often not provided, so it is not surprising that mother and infant mortality is high in village communities. The perception and habits of people in rural communities can also cause health problems. Many people in rural areas believe that all diseases can be overcome with pills or vaccinations from health officers. The health officers providing

medicine and vaccinations, however, are often unqualified to do so. Many villagers are also in the habit of drinking non-boiled water and often suffer from gastroenteritis and skin diseases.

Climate change is threatening the health security of villagers. Droughts occur on a vast scale, river water dwindles and in some places there is no water. While at the same time, people use water to take baths, wash and engage in other sanitation activities. This degrades the water quality through pollution from bacteria and contamination by various substances in high concentrations. One dire impact of contaminated water on people is exceptional diarrhoea. People in villages tend to suffer from similar complaints, such as kidney problems, due to high carbonate or rotten teeth because of acid in their water. Dirty water also causes infections and is one of the major factors contributing to mother and infant mortality in villages. The increasing frequency of flooding has caused water sources to become turbid, however, people continue using the water because they have no other choice. Such conditions directly threaten people's health security. In addition, natural resources are becoming scarce, with some rural populations in developing countries struggling to survive with very limited resources. Such conditions can contribute to malnutrition.

Climate change not only affects physical health, but also creates psychological pressure on villagers. Many become stressed because they don't know what has happened or why big changes occur in their daily lives. For example, many farmers plant their seeds according to the regular planting season. They become confused when rainfall becomes unseasonably scarce or too heavy causing flooding that destroys the seeds they have planted. Unpredictable, extreme weather threatens food security in several ways; paddy fields cannot be cultivated, seeds cannot grow optimally or harvests fail. Farmers suffer considerable loss both in materials and energy. This puts more pressure on them, as the cost of their daily basic needs increase. In some places, this pressure has pushed farmers to deadlock in fulfilling their basic needs. This condition is very stressful and can lead to many health problems.

Further research into the health implications of water resources on developing communities, such as whether drinking water is safe, is urgently needed. Such research needs to be done in many places periodically and intensively because climate change has altered water resource systems across the globe. Mindful of the considerable limitations in terms of human resources and funding to conduct such research in many places, we need to find a method that enables local people to monitor the quality of their local water supply. Any monitoring system needs to be simple and user-friendly, and should be explained in laymen's terms so that local people can easily understand it. Water quality monitoring could be included in school subjects and extra-curricular activities so that rural school children are able to continuously monitor their everyday drinking water. Equipped with this knowledge, they could immediately detect any drastic changes to water quality before people are negatively affected.

At the same time there is a transfer of skills to monitor water quality, and rural communities need to be supplied with information about climate change and its threat to water resources, as well as impacts on their health. This matter becomes vital because health services and facilities are very minimal in developing and poor countries. Thus rural society ought to be provided with both the knowledge and the

tools to enable them to protect one of the most important and basic elements of living – clean and non-harmful fresh water.

Research into the psychological impacts of climate change and its influence on the health of rural societies in developing countries is also required. The results could be fed into developing health services in rural areas. It is also important to raise awareness among rural health officers of the effects of climate change on health. Local health officers are often related to or know the people they treat within their community. It is therefore vital that they are key stakeholders in the monitoring of water sources before climate change generates even worse impacts on their local communities. It is important to provide mental health clinics or services that can contribute to psychological healing for communities affected by climate change. Implicit in this healing process is the provision of correct information about the impact of climate change on their lives so they are empowered to find creative solutions to their problems.

1 Karsts are areas of irregular limestone where erosion has produced fissures, sinkholes, underground streams and caverns.

Ida Ansharyani was born and raised in a rural area in Indonesia. Ida has been close to nature ever since childhood. While studying geology, she established an environmental organization and visited mountainous areas, national parks, and other unique regions in Indonesia. Ida went on to pursue a master's degree in Environmental Science in Indonesia. In September 2008, she will undertake a community-based watershed management programme in France on a scholarship from the French government. It will allow Ida to discuss environmental issues faced by her country, as part of the global partnership network.

**Victor Gustavo Arias Ledesma, Mexico****VECTORS ARE SYMPTOMATIC OF THE DISEASE OF THIS PLANET**

One epidemiological dogma is that disease does not appear in a random way; that disease always has an origin or cause. Unique or conjugated circumstances can lead to the development of the same disease. Climate change is causing atmospheric modifications that contribute to the anomalous distribution of different diseases. One of them is malaria. Already a very important part of the Millennium Development Goals, malaria requires humanity to focus special attention to eradicate this terrible disease. Malaria continues to appear increasingly in places where it was previously not well known. Changes in regions that were previously considered malaria-free zones are particularly worrying. As we know, statistics are cold indicators of the disease's evolution. They cannot tell us what the real impact of malaria is on an individual. Although international recommendations can allow us some control of the malaria vector, such efforts will be insufficient while there are the conditions present that allow the vector to follow their vital cycle in our more vulnerable populations.

The question is, how much time must pass for us to turn around and see what is the true cause of this medical problem. This battle cannot be won while we remain unable to detect and accept the true enemy and the importance of his actions on our planet. While we are unable to stop the silent assassins of the earth, it will remain a very difficult mission for environmental health officers to help meet our minimal health needs.

We seem unable to think about the consequences of our actions or the place that we occupy on our planet. We take for granted the facilities of modern life and never think about the price our planet pays for them. We use our natural resources without thinking that many of them are not renewable. We consume ecological reserves long before these can recover. Dear world citizens, the world is an ecosystem containing life, and most importantly it is our home.

The world is sick with a high fever; a very dangerous situation that does not appear to have a treatment. This alarming situation affects all those living on this planet, and nobody is saved from the terrible effects of this pathology, neither the poor man, nor the rich; not the cleric or the agnostic. It is very important that we don't forget the cardinal symptom of this terrible pathology, the indifference of the earth's inhabitants.

Many symptoms are obvious in the pathology of our world and that is the reason for present efforts. It is clear that climatic change is creating differences in the evolution of all that lives on our planet. All species adapt and evolve to survive and this opens new doors for disease. Many diseases emerge or reappear so we are required to study them. Likewise, we must seek to understand our participation in the process

of illness in our world. In actuality, the medical profession views the patient in a multidisciplinary way. I want to exhort people to see our world in the same way. We must look for a solution in the knowledge that multiple causes contribute to the pathology. There is not always a biological origin to disease.

While our individual actions can contribute to change in the world, it is the decisions of all that can truly generate a difference. Like a chess piece on a global board, we must follow the impulse of change. We have to be smart and remember that it is of equal importance to choose the correct path for change.

As humans we can have radically different codes of behaviour, based on our own beliefs. We must look beyond these and be united in all we share. There are nations, but the earth is there for all. The day we learn to look beyond our own benefit is the day we will begin to be able to cure our planet.

Finally, it is crucial to remember that the solution is ours; this not the first time that we have heard this message and certainly it will not be the last time, until we find the way to modify our surroundings and knowledge. Please note that battles of local significance can achieve global change. With education and a joint effort the world will find a better standard of life. This principle must be taught to our children for the sake of future generations. Perhaps our eyes will not see all the fruits of change, but if we do not seed the tree to cure the world, there will not be much to see. We are not only responsible for how the world is now, but we are responsible for its long-term health.

Let us make the decision to be better humans; make the decision to really attack the disease at its origin. Let us make true our millennium objectives because the beginning has a date, but the end has not yet arrived. And the goal does not even provide a glimpse of what we might fulfil if the whole of humankind works together. Working together, we do not have limitations. Although time does not rest, our impetus will be eternal if today we make the decisions for a better tomorrow.

Victor Gustavo Arias Ledesma was born in Mexico City in 1981. He studied medicine at the Universidad Nacional Autonoma de Mexico in Mexico City. Victor is currently engaged in postgraduate studies in Epidemiology and a Master of Public Health at the National Institute of Public Health in Mexico City. His interests include the prevention of disease and effective measures to counter the impact of population pressure on the global environment. According to Victor, "We have to act individually to achieve global solutions."

**Linda Arnade, USA**

THE TORCH OF CLIMATE CHANGE

While trying to respond to the question of research challenges for the health of vulnerable populations, a flood of images came to my mind. The first was of the recent devastating cyclone that hit Myanmar. A second image was the recent tornadoes that ripped through the United States of America's Midwest and a third was the recent catastrophic earthquake to hit Sichuan, China, with a death toll of almost 50 000 people. My images were not limited to natural disasters but also vector-borne diseases, such as the recent outbreak of dengue fever in Brazil that killed a number of people.

How have these climatic-based events impacted on populations, especially vulnerable populations? First and foremost, the lives that are most likely to be most affected by the above events are the lives that are led in a path of vulnerability. For example, living in a building in China that is not earthquake-proof, suffering from a depressed immune system in Brazil due to improper nutrition, and not having access to enough technology to predict a cyclone, are variables in the lives of people throughout the world that drastically enable climate change to negatively impact their lives.

When I was living in Santo Domingo, Dominican Republic, I had a bad bout of dengue fever. Why did I survive and why did others around me, especially those from the slums of Santo Domingo, die? Was it because of my greater access to proper hygiene, nutrition and prevention education that made me less vulnerable? These inherent technological, educational and structural disparities are the many research challenges around climate change and the health of populations.

Additionally, there are ethics. For example, we could carry out a research investigation on how vulnerable populations have been affected in Myanmar, but is that the appropriate and ethical action to do? Right now, we have to address the needs of those without water, food and electricity. These needs, however, are not limited to just physical ones, but also to psychosocial ones. Many people who have been diversely affected by cyclone, tornado, earthquake, poor urban planning or vector-borne disease, also suffer from some form of trauma that can affect their overall well-being and mental health. Thus, it might be unethical to carry out a research investigation without addressing acute health needs.

A variety of research is needed to mitigate the effect of climate change on the health of the poor. First, more research should be conducted by "peer advocates", i.e. those directly affected by climate change. Secondly, there should be fewer disparities between researchers and those being researched, thus my suggestion to incorporate more local peers into the research programme. We need more research on how to predict climate change earlier and its potential effect on the health of

nearby communities. At the same time, we need more political will to accept and address that climate change does have an effect on health. We need to acknowledge that “vulnerable lives” are not less valuable; thus all research models and ethics should reflect such principles. We need to translate already existing research into sound public health programmes to mitigate the effects of climate change on health. Last but not least, we need advocacy; a call upon those to address this as a real and needed issue, not to be dropped by the wayside, but as important as the torch having made it all the way to Beijing in August 2008.

Linda Arnade’s passion is global health. Linda is a 2006 graduate of Duke University in Durham, North Carolina, USA with a degree in Public Health. She is interested in women’s health and sexual and reproductive health issues, especially women and HIV. She is currently working at the Chicago Women’s AIDS Project (CWAP) as the Advocacy and Treatment Coordinator. Linda has faith in the effectiveness of male and female condoms and contraceptives, if used consistently and correctly. In her spare time, she enjoys Latin dance, playing guitar, learning new languages, being outside and planning health rallies.

**Packiaraj Asirvatham, India****CLIMATE CHANGE AS A CHRONIC DISEASE: RESEARCH CHALLENGES FOR THE HEALTH OF VULNERABLE COMMUNITIES**

Climate change is a global chronic disease that erodes everything. The ultimate losers, however, are vulnerable communities, such as the poor and marginalized, and women and children who predominantly depend on nature and natural resources. Climate change damages the environment. The damaged environment negatively impacts people's health and their economic growth, further contributing to their vulnerability and marginalization. In this context, this essay explores the research challenges for the health of vulnerable communities critically and constructively.

The first and main research challenge is to find out how the global health research community understands their research activities for the health of vulnerable populations. The United Nations (UN) predicts that climate change will sweep people's lives through unpredicted weather conditions. The UN Food and Agriculture Organization (FAO) predicts that food security is threatened and famine will increase, with the food crisis potentially leading to civil unrest. The World Health Organization (WHO) prophesies that populations in developing countries will be easily subject to vector-borne diseases, such as malaria, because of increasing heat and immune deficiency. It is very clear that global institutions should look into the issues, research, analyse and predict future impacts to some extent. Unfortunately the need of the day, however, is not just prediction but an effective prevention strategy that will save people.

Contemporary health research is very much concentrated on finding the problem, scaling up the problem, analysing the problem and making policy recommendations. Is it appropriate? I strongly believe that health research is the hope of the world and good research starts with people and ends with people. Research that starts with people, but ends in paper is dead. Living research is initiated directly from people's problems, processed in the academic arena and ends with finding a solution to clear or decrease the effects of the problem. Now the global health research community should test out their conscience. Are we researching to merely predict what is going to happen to people or really striving to save people's lives through our preventive research? Since climate change is an unavoidable and invisible enemy it is not easy to root out, but it is possible to prevent future chaos through our collective research and participatory action.

The second main research challenge is how the global health research community proceeds in their research for the health of vulnerable communities. Most of the research that is focused on climate change, as well as its effects on humankind, concentrates on numbers rather than answers; it is confined very much to statistics and not really moving towards solutions. I personally feel that it is not important to know how many might be affected, but rather how we are going to save them using

our action-based research. Our research is technically fit, academically sound and globally valid, but what is the use of research that does not even propose an answer to the problem?

Research claims that it has a “thesis” of how our findings are really worked out with people. For me, however, solutions are not superlative ideas but transformative actions that empower people. For example, Professor Mohammed Younis, who started his microfinance venture with one rupee in a small village in Bangladesh, transformed the whole world through his action-based thesis. When we start to count heads it becomes a kind of academic exercise, but true solution seekers are committed to their cause and passionate about people. On the whole, it is very important to focus our research on solutions rather than statistics that merely understand the number, difference of percentage, proportion of the problem and the timeline of the process. Billions of people are on the frayed edge of climate change and every one speaks about it, writes about it and thinks about it. We, the health researchers of the world, however, are expected to deliver solutions to save vulnerable populations from climate change.

The third main research challenge for the health of vulnerable populations is how global health research is going to reach those vulnerable populations. Closing the gap between researchers and people is important. Climate change affects everyone but only a very few people have the rationale to understand that they have been affected by climate change. In this context, how are we going to make vulnerable populations realize that they are the real victims and ultimate losers of nature’s politics. It is not important how much we know through our research, but how much our people know through our research. Contemporary research is too often dwelling in the academic forts of scholars and policy-makers; it is living far away from ordinary people. So it is our commitment to carry our research to the people to make them understand the reality because people’s problem can be solved only by people.

Policies, working papers, status papers and research reports are good, but the findings and solutions should be communicated to the other end. For example, at the time of the south Asian tsunami, a warning message was communicated to the Indian Government, but they did not take it seriously and the result was terrible. If they had communicated effectively to their people they could have saved thousands of lives in India.

I feel it is a kind of crime to restrict knowledge and confine it at policy level. Breaking papers and sharing it with people is the ultimate need of the day. We have knowledge, brilliance of research and enormous capacity to execute solutions through our findings, but unfortunately everything is stored in one place and becomes static and unusable. Contemporary research on this basis is creating more complicated policies on the issues and never allows people to come forward and live with it. Our research should be people-centred and policy-focused and not policy-centred and people-focused, because ultimately we need people-centred policies that ensure life and dignity to all.

Climate change and the health of vulnerable populations are intertwined. The hope is that the international health research community is doing many things to save the health of vulnerable populations. In this context, I propose some ideas to enrich

contemporary health research to maintain the welfare of vulnerable communities from the evil effects of climate change. Dissemination of knowledge is important; research findings and solutions should be communicated to every one by using modern information and communication technologies (ICTs). Students, and especially youth, should be informed well about these emerging challenges. Creating health clubs in schools and colleges will be helpful. Since the fight against climate change is global, language monopoly should be removed and all information should be translated into all major languages at least in brief. Population is power, so if we reach more people then we get more action. We need more action from all parts of the world to fight against climate change. In addition, grass-roots level research should be given importance. It should not only be the think- tanks and policy-makers who are involved in research, but indigenous people, social activists and passionate students who make a difference.

Global institutions should concentrate on grass-roots level research and should promote it through their academic leadership, research expertise and seed funding. As I mentioned earlier, climate change is a strange phenomenon. To be realistic it cannot be cured but can be prevented, so we need to find prevention strategies to save people from this chronic disease. On the whole, global research institutions should reinterpret their understanding of health research and contextualize it according to local people and their health needs. Simultaneously, it has to move beyond existing procedures of research to focus on exciting statistics and innovating ideas with the aim of finding solutions for problems with great optimism. Then, what is the definition of solution in this context? To put it simply, solutions are activated ideas. We have plenty of ideas on paper, but it is time to activate all those ideas into action. To conclude, health research should reach people. It should not be conducted for the sake of funding, policy-making, politics or profit. It should be conducted for people by committed people who have great passion for human dignity and health justice. Ultimately, health research should drive people to save themselves from climate change through practical solutions and people-centred policies. When health research and people's action merge together then it will become the vaccination of climate change, sustaining life for all, and for vulnerable populations in particular.

Packiaraj Asirvatham is an ordained minister at the Church of South India Tirunelveli Diocese in India. He is passionate about health justice and health freedom, especially of the poor and marginalized. He founded the Smile Charitable Trust in his college days and intensively engaged with vulnerable communities to meet their health needs. Packiaraj won the Global Young Social Entrepreneur's award in 2007 for creating social change through his innovative leadership. In 2002, he received the Vikatan student journalist fellowship and worked as a special correspondent for a year. Recently he won the first place in the young professional's essay contest conducted by the Food and Agriculture Organization of the United Nations. Packiaraj plans to continue his research in bioethics and would like to become a policy-maker.



Kheyal Azam Khalil, Pakistan

IF ONLY WE KNEW

The 8 October 2005 earthquake has haunted the people of my country and without doubt our will to make amends was appreciated at that time. There are several stories of families who through extraordinary fortune or misfortune, found or lost a loved one. The media played its part in disseminating these stories around the world. While these narratives made the world shiver and sympathize, whatever was said about the incident in Pakistan remained unique to the region owing to our own culture.

It was 08:50 at the time of the calamity and one of the severely affected areas was a multi-storied building of residential flats (Margalla Towers). At that time, a majority of people were in the shower preparing for the new day, and hence a lot of nude bodies were recovered later. The taboo associated with this eventually led to the belief of God's resurrection upon us and the like. At that time, our school, along with other institutions, sent teams of helpers with all the aid we could find for the victims, and people were exceptionally generous. It was reported upon the return of these teams that the earthquake survivors were disoriented and uncooperative, demanding the best medical service only and refusing aid that was sent to them regarding it as beneath their standards. Such stories were perhaps not as glamorous for international dissemination and few consequently are aware of them. Before the reader forms a hasty opinion of the facts stated in my account of the sad event, I would like to explain the significance of referring to these things that were stirred may be only in our own country and nowhere else. This reaction of visibly crippled people refusing aid at a time when they needed all the help they could find, shows human tragedy in its most pitiable form and is contrary to what might have been expected. The residents of Margalla Towers comprised a wealthier part of their community. It is dreadfully ironic that wealth and power are nothing in the face of natural disasters. Their refusal to accept help in the delusion of clinging to their "dignity" made things difficult of course, but people like me could see all the more clearly the extent of their despair depicted by these actions.

The sceptics in our country, from a superstitious group of people, are content in labelling this as a rare reckoning inflicted upon otherwise privileged people. Sharing this at an international-level forum, my expectations are inevitably raised about the perception of the reader and I assume the interpretation of this superstition would be taken to be baseless and contradictory. It could be argued that the much challenged Muzaffarabad (the entire city wiped out by the very same earthquake) with poor inhabitants should not have been a very likely target of this "retribution", as being affluent was definitely not one of its "sins".

In my research about this earthquake, for the purpose of writing about it in a national magazine, one of the concepts that struck me as novel was the idea of predicting

an earthquake. I confess that I did not know that this could be done. All I was previously aware of were tornado warnings and daily weather forecasts. What I felt at that moment of discovery was a sense of purpose and utmost motivation to make a difference—a recurrent feeling characteristic of youth. The implicit fact that disastrous human affliction could be lessened or even avoided by a mere responsible course of action announced an opportunity for necessary change.

In Pakistan, a natural disaster has seldom, if ever, been forecast and dealt with accordingly. If we could associate more meaning to natural disasters than “God’s will”, perhaps the prospects of saving a million lives would be brighter. The aspiration, “if only we knew” is the strongest indicator of the need for research on the issue of climate change and its affect on human health. The establishment of an early hazard warning system after a multitude of incidents claiming thousands of lives is definitely a positive step in the right direction. However, there is a dearth of expertise and funds required for this system, especially in developing countries.

My meagre knowledge of the programmes and bodies relevant to disaster management, such as relief cells and meteorological departments comprises a long list of acronyms (such as ERC, PMD) that are supposed to be making progress in this respect. My observations, however, do not prove the existence of such an extensive array of people involved in putting things right in the case of natural disasters.

The basic drawback appears to be that such organizations focus upon post-disaster management and relief, while enhancement to early warning systems takes a back seat. In my profession, that is medicine, we are tirelessly taught that prevention is better than cure, which is why I think there is insufficient motivation by the people concerned to chalk out ways that technology can be utilized to warn people before the hazard actually takes place. More progressive parts of the world are enthusiastically pursuing the idea of reducing human interference with ecology, which is believed to be the cause of climate change in the first place. In my opinion this is a long-term goal and though important, disaster management should be given precedence to it.

Financial issues and lack of awareness are the two most prominent aspects that seem to weigh down the national policies of our country. However, there is hope in the form of institutions such as the Global Forum for Health Research and the World Meteorological Organization that encourage innovation for the improvement of conditions surrounding natural disasters.

Upon searching, one also finds a string of projects initiated after a recent natural hazard and then left to look after themselves until a reminder is issued. The implementation of various schemes introduced by the government or international community needs to be taken care of, especially in regions that are administratively deficient and facing perpetual political instability.

In taking advantage of this opportunity to voice my naive opinion and suggest what I think could be done, I am eager to recommend the formation of specific units of workers concerned with the initiation and implementation of early hazard warning systems in affected areas. The workers should be local, but employed internationally, so that they are accountable to an organization of stature, such as the Global Forum for Health Research. These projects can then be sponsored by the World Bank, Asian

Development Bank or other institutions that have the capacity to contribute. These units can also save time and resources by claiming assistance from pre-existing relevant agencies.

A story seen on television can move millions of hearts, but there is always a huge difference in being a viewer and in being a part of that story. It would be superior to shake ourselves into action now before misfortune strikes one of us in the future.

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**Enrique Falceto de Barros, Brazil**

CLIMATE CHANGE IN BRAZIL:
IS PRIMARY HEALTH CARE
PART OF THE SOLUTION?

There is no treatment without diagnosis.

Hippocrates

Scenario 1: In 2050, one of the worst climatic scenarios predicted by the International Panel on Climate Change (IPCC) becomes a reality. Most of the Amazon rainforest succumbs to deforestation for cattle ranching and to an unparalleled drought. As a consequence, Brazil loses its main engine for rain. The Brazilian north-eastern provinces, always semi-arid, turn to desert, forcing hundreds of thousands of environmental refugees to flee to already overcrowded southern cities.¹ A 0.3 metre rise of the Atlantic Ocean and the intensification of tropical storms causes flooding to become routine throughout this continental country of almost 200 million inhabitants, destabilizing coastal and river towns and their economies. As the mean temperature rises by 2°C, widespread flooding generates four different types of dengue viruses, causing unprecedented dengue haemorrhagic fever epidemics that the Brazilian hospital-based health-care system cannot effectively deal with. Agriculture also affected by intense climatic change and by a lack of technical expertise, suffers a productivity drop that significantly harms one of the main pillars of the Brazilian economy.

Scenario 2: In 2050, one of the most optimistic climatic scenarios predicted by the IPCC prevails. The International Climate Change Mitigation Agenda has been successfully implemented in time, reducing greenhouse gas (GHG) emissions worldwide. In Brazil, agricultural adaptation research investments yield higher productivity. Even Brazil's semi-arid north-eastern provinces, with technical help from Israel and other countries, improve their agricultural output. The Brazilian health system successfully completes its transition to a model based on primary health care (PHC). The 1°C rise in the mean temperature and resulting storms and flooding are a blow to Brazil, but its well-established infrastructure for prevention and response to natural calamities is able to manage these problems.

Unfortunately, scenario 1 is not a creation of science fiction. Global GHG emissions have increased dramatically in the past few years and they appear to be accelerating.² Thus, the “worst climatic scenario” presented in the Fourth IPCC Assessment Report actually has a strong likelihood of occurring. Brazil is very vulnerable to climate change; because of its enormous social inequality (one of the worst on the planet); because of the continuing loss of its rainforest, which is crucial for the proper regulation of its micro-climates; because of its precarious health infrastructure; and, because of its political stagnation in the face of the climate change challenge. Nonetheless, scenario 2 is also possible if

Brazil can overcome a few fundamental problems and unites with other countries to markedly reduce GHG emissions.

Brazil is faced with remarkable climate change challenges, including the reduction of its GHG emissions, the protection of the Amazon rainforest, the adaptation and modernization of its agricultural sector and intensification of a transition from a hospital-based health-care model to one based on PHC. As a resident in family and community medicine, I must concentrate my efforts on aspects of the health-care system.

As I write this essay, six colleagues from my residency programme are working on Brazil's health-care response to the 2008 dengue epidemic in Rio de Janeiro, an epidemic that has probably been encouraged by climate change.³ They have joined a National Medical Mission to reduce the deficiencies of the local health-care system. This haemorrhagic fever outbreak, which is the worst in the history of the country, has already caused 55 confirmed deaths, and much confusion and turmoil in the overwhelmed city hospitals. This epidemic may be seen as an example of things to come as the impacts of climate change increase.

The present crisis in Rio is an illustrative case study. While this city is in a health-care crisis and has incurred alarming numbers of dengue deaths, the neighbouring city of Niteroi – separated from Rio by a 13 km concrete bridge – has a relatively controlled situation, with no confirmed dengue deaths. This contrast between Rio and Niteroi has been intensively discussed, and a national consensus has been reached that the critical difference in health outcomes in the two cities is due to unequal implementation of local PHC. Niteroi covers more than 67% of its population with a PHC approach that encourages systematic mosquito prevention efforts and treats low-risk dengue fever patients as outpatients. In Rio de Janeiro, however, 92% of the population depends on a fragile hospital-based local health-care system. The structural contrasts are marked and the consequent health results are indisputable.⁴

The contrast of Rio and Niteroi teaches us that the implementation of PHC in Brazil is very uneven, and in some places tragically slow. How can we explain, that after a decade of dengue epidemics and Brazilian national funding, Rio is not adequately prepared? As someone fairly well acquainted with the Brazilian PHC model, I feel Rio's difficulties are less the result of a lack of financial support or scientific consensus⁵ and more a matter of cultural issues. Therefore, qualitative research (perhaps an anthropological approach) may be needed to elucidate the functioning of the complex cultural interplay involved. This kind of analysis might show the roadblocks and suggest ways to speed the transition to a more equilibrated and successful national PHC system. To my knowledge, there is currently no systematic research in Brazil addressing such matters.

The best way to prepare for the impact of climate change on health is by implementing a widespread PHC system, because PHC providers are the most in touch with local conditions and can adapt most quickly to changing local environmental and health-care needs. I do not know how the PHC system should respond to every need—extreme events, massive waves of environmental refugees, post-traumatic stress and changes in epidemic patterns are not the

daily concerns of PHC providers. But most health effects of climate change will develop gradually, in small steps, and PHC providers will be in the best position to notice these changes and make adjustments to manage them.

With this subject in mind, my colleagues and I are concluding a systematic review⁶ to evaluate the possible impacts of climate change on PHC in Brazil, and how PHC providers can prepare and respond to these new challenges. To our surprise, we found only 55 articles in MEDLINE on climate change and PHC, and most of these dealt only with the impact of extreme events. Also, none of these works specifically addressed the Brazilian situation. This kind of research, which aims to understand the possible roles of PHC in lessening the negative consequences of climate change, is of great importance in building a coherent and responsive national health-care system. And it may also accelerate the transition to a dominant PHC model in Brazil, as it demonstrates a central role for this model in Brazilian preparations for the main challenge of the 21st century.

This perspective on the possible strategic functions of PHC may even aid in the formulation of broader policies to mitigate climate change. For instance, when we formulate policies for primary prevention of cardiovascular diseases it may be possible to include the need to diminish our dependency on automobiles (directly reducing carbon dioxide emissions and stimulating exercise) and to diminish our consumption of red meat (reducing cattle ranching deforestation, reducing methane emissions and promoting healthier diets).

Hopefully in the end, the Rio/Niteroi case will be less a sad portrait of a country in crisis and more a strong stimulus for the continuous refinement of better health policies in Brazil, and (why not?) in the world. Despite the eminent chemist Arrhenius's predicted connection between GHG emissions and global warming at the turn of the 20th century and the current scientific explosion of evidence of global warming itself, there are still few papers dedicated to the development of practical strategies for the health sector to mitigate the negative health effects of climate change. I think the widespread implementation of a PHC model will be a necessary cornerstone for such efforts, and research specifically focused on developing PHC strategies will be needed for an optimal response.

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Enrique Falceto de Barros pursued an Environmental Studies major in the United States at Bowdoin College, in Brunswick, Maine. In 2007, he received a medical degree from Universidade Federal do Rio Grande do Sul, Brazil, where he participated in student politics for primary health-care reform, and also dedicated time to semiology tutoring and clinical research. Enrique co-authored two international papers and had a letter published in *The Lancet*. In 2008, Enrique started residency in Family and Community Medicine at the Grupo Hospitalar Conceição. In May, he volunteered as a physician to help fight the dengue epidemic in Rio de Janeiro. Enrique shared a Brazilian national award in June for the paper “Climate change impact on primary health care: protocol for a systematic revision”. He aims to help integrate environmental perspectives into Brazilian primary health care.

**Jacob Bell, USA****CLIMATE CHANGE AND
HUMAN HEALTH RESEARCH:
FACING GLOBAL HEALTH INEQUITY**

If undertaken properly, tracking climatic effects through proximal and distal antecedents to actual physiological changes in the human body should be challenging. To conceptualize such a broad health determinant, researchers often rely on their own unique intellectual perspectives. This is evident in climate change and health research: malaria researchers warn of possible effects on vector populations; water and sanitation experts describe a worsening situation for diarrhoeal illness; and, disaster relief researchers decry the lack of disaster response capacity in most countries. Reflective of the Intergovernmental Panel on Climate Change's (IPCC) projected "confidence" levels, most of these sectoral researchers avoid concrete projections and admit to the uncertainties of their employed research models. In response, there is an increasing research demand for more investigations into climate models relevant to health impacts, vector dynamics, surveillance and forecasting systems for emerging diseases and epidemics, disaster risk reduction for decreasing population vulnerability and methods for improving health-related adaptive capacity. Understandably, climate change has thus been fragmented into digestible research projects. Beyond defining the research agenda, however, shouldn't this global problem of climate change require more comprehensive action from the climate change and health research community? Such a question may be critical to successful health sector responses to climate change.

Some conclusions of the IPCC Fourth Assessment Report are presented without the bold underscoring they deserve:

In many cases, it appears that the possible negative impacts of climate change pose risks of higher total monetary damages in industrialized areas (i.e. currency valuations of property damages) but higher total human damages in less-developed areas (i.e. losses of life and dislocations of population)...'.¹

One attempt to absorb such realities, possibly considering that the very use of the IPCC report likely suggests the reader belongs to the "monetary damages" group, and perhaps contemplating how the same climate event could lead to profit loss for a European business and loss of life for a Dhaka slum-dweller. With this in mind, climate change-related health impacts begin to seem less as components of a new research agenda, and more as symptomatic needs of the same tragic reality of global health inequity.

Consider the projected climate change effects on Bangladesh: cyclones are likely to increase in intensity with a possible increase in frequency; sea level rise is likely to inundate much of the low-lying areas of the country and generate salinity in groundwater sources; extreme rainfall events (droughts and floods) are likely to

increase in frequency; and, changes in annual and inter-annual temperature are likely to affect crops, heat events and vector populations. Such projections are both imposing and full of uncertainties. The same is true for the related health impacts, which include possible increases in diarrhoeal illness, vector-borne diseases, malnutrition, death and injury from disasters, displacement and heat and cold-related illness. Again, despite the severity of these possible impacts, especially considering existing local burden of disease, the projections suffer from many uncertainties. Yet across all of these climate change affected weather events and related health impacts, global health inequity provides one almost certain conclusion: the impoverished are the most vulnerable to all of these climatic events, to all of these health impacts, and to the whole experience of climate change itself.

Health researchers fully admit the link, arguing that adaptation is most critical for disadvantaged populations and that development policies that reduce poverty are necessary components of any adaptation plan. For others, global health inequity carries such importance that climate change policies are dismissed as an ultimate distraction from the real problems of poverty. However, admitting the link between global health inequity and climate change, and identifying it, as an intersectoral commonality for the health research community, cannot be simply described as a ranking of research importance. Indeed, climate change provides the opportunity for health research to discard simplified models of poverty, health and development. It remains unknown if health researchers can rise to such a challenge.

Like the climate system itself, the health impacts of climate change are dependent on a staggering number of determinants. It is therefore no longer sufficient to, for example, model the development of an infectious disease surveillance system and measure its effectiveness in preventing illness. It must also be examined how such a surveillance system would be used by the operating government and health system, how the resulting information would be used by citizens, and how the system would innovate with new technologies, etc. It is also unrealistic to expect a health researcher to collect and synthesize this wealth of information alone, and indeed a wide range of expertise would be required to produce applicable research. Interdisciplinary research is one proposed method for such collaboration, although the free flow of health research information must first be established.

Unfortunately, health research topics and methods are often dictated by large donors, such as the World Bank, and the resulting studies may be barricaded behind pay-to-access peer-reviewed journals. For climate change research, the United Nations Framework Convention on Climate Change (UNFCCC) sponsored National Adaptation Programmes of Action (NAPA) attempts to address such restriction issues by mandating national research and adaptation plans. In Bangladesh, their NAPA largely focuses on adaptation programmes for existing organizations who deal with climate-relevant issues. Health is given only minimal attention with a suggested dissemination of adaptation information to communities vulnerable to extreme weather events, and suggested 'mainstreaming' adaptation to climate change into all aspects of the health industry.² This limited health impact consideration seems to ignore the aforementioned serious implications for climate-related health impacts in the country.

However, there are plans for improved climate-related health research, as Saleemul Huq, founder of the Bangladesh Centre for Advanced Studies, is planning to establish

the International Centre for Climate Change Adaptation and Mitigation in a private Bangladeshi university.³ It is highly expected that such national research institutions in low-income countries will provide relevant climate change and health research opportunities. However, this idea of ultimate empowerment of the least developed countries (LDCs) through the NAPA process is ignorant in its implied suggestions: that health researchers in high-income countries should focus their research elsewhere; that the tortuously slow improvement of research capacity is inevitable; and, that health researchers in high-income countries deserve their continued wealth and privilege while new research institutions in LDCs struggle to establish themselves.

Global health inequity has been acknowledged and lamented by the climate change and health research community. However, the degree of human solidarity required to promote interdisciplinary research relevant to global health inequity is wholly absent. The needed social justice extends far beyond revolutionizing methods or agendas for the latest peer-reviewed journal articles on climate change and health. Do health researchers in high-income countries purchase clothes that keep Bangladeshi children in sweatshops? Do they insist on unnecessarily driving to work and contributing to the carbon cycle that worsens the degree to which the sea encroaches on Bangladeshi farmlands and habitations? Do they work for donor organizations that pressure the Bangladeshi government to keep expenditures on health low (currently around 3.1% of gross domestic product)?⁴

It is easy to demand more research on the complexities of the climate system and its relation to health; it is easy to identify global health inequity as a principal determinant of vulnerabilities to climate change; it is easy to suggest that interdisciplinary health research should be employed; and, it is easy to pretend all of these demands require no accountability from researchers in high-income countries. It is likely that the true global lessons of climate change and health will be lost if only these easy health research reactions are undertaken.

The IPCC Fourth Assessment Report defines a new understanding of human action and the environment: humans are accountable for the problem of climate change; humans continue to determine climate change effects through their current behaviour; and, those least vulnerable to climate change's negative effects (those in high-income countries) constitute a minority of the global population. Climate change has provided health researchers with the opportunity to truly reconsider why people suffer in famine while others feast, why some die from diarrhoeal illnesses while others are merely inconvenienced, and why health research has not become predominantly interdisciplinary and more egalitarian to better tackle these injustices.

Obviously, global health inequity is not a new phenomenon, though there are some who are confident that it will not be around for long: that a simple continuation of existing models of development guarantees an eventual elimination of inequity.⁵ The health research community sometimes exercises the same thought process: that minutely altering traditional research topics and techniques is sufficient to achieve successful interventions for determinants of human illness. Global climate change disrupts these similar outlooks, as it is a public health challenge distinct from any that humanity has faced in history. The climate change projections come with only one cross-cutting certainty, that those impoverished will disproportionately suffer the negative health effects. The global health research challenge is therefore human

solidarity and social justice. The methods by which this is worked towards may differ, but the health research community must accept they share a common goal, a common challenge and a common accountability for the existing and future state of global health inequity.

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 - 5 Feachem R. Globalization is good for your health, mostly. *British Medical Journal*, 2001, 323:504–506.
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Jacob Bell was born and raised in the small fishing town of Homer, Alaska. He attended Pomona College in Los Angeles and also studied health systems in Mombasa, Kenya. Jacob participated in fundraising efforts to help implement clean water projects there. He enrolled in the post-graduate science programme in Global Health at Trinity College, Dublin in fall 2007. Here, he explored environmental health as related to global climate change and variability. Jacob's thesis investigates epidemiological evidence for the health impacts of climate change, along with adaptation strategies for the health-care sector. He was accepted in the summer of 2008 as a visiting researcher at the London School of Hygiene and Tropical Medicine to undertake this research.

**Raquel Beltoldo, Brésil****CHANGEMENTS GLOBAUX,
DÉFIS LOCAUX :
L'EFFICACITÉ DES STRATÉGIES
GLOBALES EN QUESTION**

Aujourd'hui âgée de 25 ans, j'ai grandi au Brésil en écoutant les prévisions catastrophiques sur le changement climatique. Mais cela était loin d'être une préoccupation quotidienne, il y avait des soucis plus pressants tels que ceux qui nous concernent directement, comme une voiture en panne, un ordinateur qui ne s'allume plus, et ainsi de suite.

Cela aurait pu en rester là, si ces problèmes globaux ne s'additionnaient pas eux aussi aux tracas quotidiens. En effet, l'augmentation des petits degrés annoncés par le journal télévisé ont des conséquences beaucoup plus complexes que l'on pourrait penser – conséquences sur la santé, sur la géographie des territoires avec l'augmentation du niveau de la mer, inondation et sur la sécurité alimentaire. Mais il a fallu attendre la publication du rapport IPCC 2007 pour qu'il y ait une véritable prise de conscience au niveau des médias, nous rappelant que le problème est toujours là.

L'incertitude liée aux conséquences du réchauffement a longtemps découragé les actions. En effet, les organismes concernés commencent seulement à s'organiser pour un futur incertain et difficile. L'attention du public étant déjà interpellé sur le réchauffement climatique, il nous reste alors le long chemin de canaliser les ressources pour les communautés qui en ont besoin.

Cette canalisation est toutefois une question difficile à résoudre. Elle a pour origine l'écart entre d'un côté la recherche de base, qui découvre les phénomènes ; et d'autre part la recherche appliquée, qui cherche des dispositifs pour faire face aux problèmes identifiés par la première. A mon avis, le manque d'organismes intermédiaires entre la recherche et l'action est à l'origine de cet immobilisme. En effet, les nouveaux dysfonctionnements découverts par des spécialistes exigent des réponses d'un tout autre ordre, mettant parfois en question le système de prise de décision même. C'est pourquoi je pense qu'un des défis pour la recherche sur le changement climatique est justement de trouver une configuration d'action publique efficace pour mettre en œuvre les solutions pertinentes des spécialistes.

Alors, comment peut-on penser la mise en place de mécanismes ou d'organismes pour agir au mieux sur un phénomène mondial ayant des impacts différents dans chaque communauté ? Ou encore, comment doit-on considérer les questions de santé spécifiques à chaque population ?

Je vous propose, pour essayer de mieux comprendre la complexité de l'enjeu d'analyser la question à partir de (1) la complexité du phénomène, (2) la situation des populations vulnérables et finalement, (3) quels sont les défis pour la recherche appliquée en santé publique.

Complexité du phénomène. Premièrement, le changement climatique est un phénomène complexe, dont les causes et conséquences ne sont pas toujours comprises. Cela rend difficile l'établissement d'une stratégie d'action commune, car le phénomène concerne des disciplines scientifiques diverses : la médecine, la biologie, la géographie, la psychologie etc. En dépit de l'utilité de cette multidisciplinarité pour la compréhension du phénomène, elle n'aide guère la mise en place des mécanismes intermédiaires, antérieures à l'action, permettant l'établissement d'une stratégie d'action coordonnée, unique, voire globale. D'après moi, le défi ici semble être : comment peut-on intégrer des champs scientifiques d'étendue si large pour la création d'organismes pré-action globalement coordonnées auprès des populations affectées ?

Deuxièmement, au delà des diverses disciplines scientifiques utiles pour comprendre les situations locales, ceux-ci peuvent être abordées à plusieurs niveaux : (1) depuis la prévention, en passant par (2) la diminution des conséquences jusqu'à (3) la gestion des crises installées. Ensuite, si on considère à propos du réchauffement climatique le niveau préventif, on devrait réduire les émissions de CO₂ pour freiner le phénomène ; mais comme aujourd'hui le changement est déjà en cours, les actions se sont réduites à la diminution des conséquences ; et bientôt, elles se restreindront à la gestion de la crise (prolifération des maladies transmises par des vecteurs, insécurité alimentaire et conséquences du changement climatique). L'obstacle ici me semble être la conception d'outils d'action adaptables aux niveaux pertinents pour chaque région : de la prophylaxie jusqu'à la gestion des crises.

Populations vulnérables. La vulnérabilité des populations est définie comme le degré d'exposition d'une population à des dangers spécifiques (Luers and Moser, 2006). Ainsi, la vulnérabilité est en fonction des ressources que les populations ont pour faire face aux dangers. Etant donné la complexité des risques liés au changement climatique et de leur haute incertitude, je propose une analyse des vulnérabilités à partir de leurs aspects économique-politiques, informationnels et culturels.

Vulnérabilité économique-politique : la pauvreté mêlée au manque de pouvoir contribuent à un cadre d'aliénation du système qui dissuade la citoyenneté. La difficulté ou même l'impossibilité de revendiquer, pour faire entendre sa voix, rendent ces populations encore plus exposées aux aléas. La passivité intrinsèque à ce cadre les amène à accepter des actions qu'elles ne comprennent pas ou avec lesquelles elles ne sont pas d'accord. Ainsi, tout effort dans la recherche pour une action localement efficace devrait, à mon avis, aborder les populations en valorisant leur pouvoir d'action en tant que citoyens, afin qu'ils aient leur mot à dire.

Vulnérabilité informationnelle : la vulnérabilité informationnelle est liée au manque d'information. La diffusion des informations pertinentes auprès des populations vulnérables aurait d'après moi l'avantage de les rendre actives devant l'environnement à partir de l'action consciente, rationnellement fondée. Ce renforcement du contrôle acquis permettrait une émancipation des populations vis-à-vis des organismes responsables pour la prévention des aléas. Ainsi, toute recherche auprès des populations vulnérables doit comprendre des actions pédagogiques parallèles.

Vulnérabilité culturelle : depuis des générations, l'utilisation d'un système symbolique structuré, spécifique à une population, peut rendre difficile l'ancrage

ou l'acceptation de toute nouvelle information. Ainsi, les codes culturels peuvent constituer des barrières pour la compréhension ou la mise en œuvre de certaines actions jugées pertinentes par les spécialistes. Par exemple, certaines communautés peuvent attribuer le changement climatique, comme l'augmentation des précipitations, à la volonté de dieu, face à laquelle elles ne peuvent rien faire. Alors, toute recherche de moyens d'intervention locale doit à mon avis considérer les spécificités culturelles.

Ainsi, je souligne que les populations ne sont pas toujours au courant des vulnérabilités qu'elles subissent. En effet, dès le début de toute recherche auprès des populations en danger on devrait les aider à prendre conscience de leur vulnérabilité, car le fait même de l'ignorer constitue un des plus grands périls.

Changement climatique et populations vulnérables : une position de respect. A partir des réflexions ci-dessus sur la complexité des enjeux liés au changement climatique et aux populations vulnérables, nous constatons que nos institutions ont des difficultés pour (1) résoudre des questions imprévues par leur structure et (2) faire face aux spécificités locales.

Parmi des risques globaux, les conséquences pour la santé issues du réchauffement climatique demandent un nouveau paradigme pour y faire face : il ne s'agit pas de l'ajuster aux solutions et mécanismes prévus, mais de rechercher d'autres perspectives pour sa compréhension avec des moyens alternatifs d'intervention. On observe ainsi que les institutions de recherche d'un côté et celles d'intervention (gouvernement) de l'autre ne suffisent pas pour agir face au défi climatique. La recherche en santé devrait à mon avis se pencher aussi sur ces questions organisationnelles, parce qu'elles ont à la fin des effets sur l'efficacité des services rendus aux populations.

La prise en compte des spécificités locales dans la recherche pour les organismes intermédiaires n'est pas évidente. Naturellement, le premier réflexe pour faire face aux questions globales serait de penser à une solution unique, LA meilleure solution en termes de coût-bénéfice. Pourtant, la proposition de solutions uniques semble être une erreur puisque le changement climatique est un phénomène global ayant des multiples effets locaux. En effet, le coût des solutions locales est plus élevé que celui des solutions globales, mais la question n'est pas d'ordre financière car il faut vraiment respecter les spécificités locales, sous peine de rendre inefficace toute tentative d'intervention postérieure.

Dans ce sens, la recherche d'outils d'intervention chez les populations vulnérables constituerait le grand défi en ce qui concerne l'impact des changements environnementaux sur leur santé et bien être. Voici quelques points importants qui devraient être pris en compte :

- 1 La spécificité politique de chaque pays ;
- 2 Les risques subis par les populations (santé, sûreté alimentaire, inondations) ;
- 3 Le niveau de traitement du risque (prévention, diminution des conséquences ou gestion de crise) ;
- 4 La culture de chaque communauté.

D'après moi, la recherche de ces outils intermédiaires constituerait enfin un pont entre la recherche scientifique basique (médecine, biologie, géographie et agriculture) et

l'action des acteurs politiques sur le terrain auprès des populations vulnérables tout en respectant les spécificités de chaque communauté.

Enfin, l'impuissance de l'homme devant le phénomène de changement climatique le projette dans l'angoisse de ne rien contrôler dans la nature. Cette difficulté fait émerger pourtant la solidarité et le respect, ce qui distingue l'espèce humaine des autres et qui l'unit en même temps en tant qu'humanité.

Raquel Bertoldo was born in Southern Brazil in 1982; she lived on the island of Florianopolis (State of Santa Catarina, Brazil) until she went to France at the age of 24. Licensed psychologist in Brazil, she was a research assistant at the Laboratory of Social Psychology of the Federal University of Santa Catarina, where she participated in projects on the psychosocial aspects of AIDS. In 2008, she continued her studies in France at the University Paris Descartes. Today she is conducting research in the Laboratory of Social Psychology at the University Paris Descartes in partnership with the Symlog Institute, with a special focus on social risks.

**Nandita Bhan, India****CLIMATE CHANGE AND HEALTH:
RESEARCH CHALLENGES FOR
VULNERABLE POPULATIONS**

Humanity's inability to fit its activities into that pattern is changing planetary systems fundamentally. Many such changes are accompanied by life-threatening hazards. This new reality, from which there is no escape, must be recognized—and managed.

Our Common Future,
United Nations World Commission on Environment and Development, 1987

In recent literature on development, climate change appears to be acquiring a position of unparalleled importance. Its links with most development debates is unquestionable; linkages with health however continue to be debated and discussed in various public discourses, media and research literature. Why has it taken so long to see what is obvious? What are the relationships and interlinkages between climate change and health? And what are the emergent priorities in this context?

Debate on climate change and health can only be understood when viewed within the paradigms of development and *neo-development*, growth and globalization, neo-liberalism and frameworks of inequality and contextual understanding of health burdens and realities with respect to multiple webs of causation and determinants.

Climate change mainly refers to large and irreversible changes in the earth's climate and the loss of sustainability in climatic factors, all of which can have implications on human life and lifestyle, physical environment, infrastructure, growth and development, disease and health patterns and human existence. Human health is vulnerable to the inconsistencies of the environment, due to variability in temperature, pressure and climate. The danger of climate change could be simplistically classified into two groups: greater extremes of weather and climate; and, unforeseen weather in areas of the world (i.e. extreme heat in cold areas and vice versa). Both of these changes bring with them implications for human health and disease burdens.

Health research has broadly been grouped into research on infectious and chronic diseases; the boundaries between the two have been contested with instances of tuberculosis (TB) emerging as a chronic illness. However, the distribution of diseases following the epidemiological transition has led to developed nations suffering large chronic disease burdens with growing numbers of older populations, and the developing nations fighting the burden of infectious diseases and brimming with younger populations. This balance is disturbed, however, and chronic diseases are increasingly seen in the developing world, coexisting with infectious disease and giving rise to a phenomenon popularly called the “double burden”. At the same time, inequality and deprivation within the developed world has led to the re-emergence of infectious disease like TB.

Health inequalities and their relationship with social phenomena have often dominated discussions in society and health. Inequality and how it impacts health, together with the reproduction of social inequalities in health, are seen as crucial challenges with “no easy answers”. These inequalities demonstrate quite clearly that vulnerabilities and marginalization from restricted opportunities and opportunity structures bring forth challenges. Research cannot remain insulated or immune to these questions.

Climate change introduces a new set of risks and concerns for different groups. The lack of a level playing field within nations and unequal global frameworks bring forth future risks, where existing inequities and vulnerabilities are not merely strengthened, but the gaps between opportunities available to different groups actually increase. For instance, climate change might induce several climatic and weather hazards in developing nations of south Asia. The already existing social inequalities in access and survival are bound to proliferate and lead to further poverty and deprivation for many social groups. Floods for instance, are bound to affect large populations in Bangladesh; their impact would compound, however, for the most vulnerable groups – those on low incomes, women, people with disabilities, and other disadvantaged groups that sit low on the social gradient.

Discussions on climate change and environment have used the argument of growth and the implications of climate change on flows of wealth for the world. While economic growth is a lucrative incentive for researchers and policy-makers to examine drastic changes in the environment, the relationship between climate change, development and human health is a story of human rights and of survival. Researchers and policy-makers must look beyond immediate monetary goals into long-term priorities and explore openings to deal with challenges of climate change and health.

Research into the relationship between climate change and health is largely underdeveloped. Despite the availability of sophisticated tools in science as well as medicine, the area has often been relegated, and arguments to pursue this relationship are often based on conjectures, contestable speculations and unreliable correlations. Despite the advances made, disciplines, researchers and policy-makers have largely been unable to accumulate the political will and assimilate the analytical tools into a strong body of interdisciplinary learning that would capture the range of pure medicine, public health, physical sciences and social sciences. Only with such an interdisciplinary approach can we begin to effectively address some of these questions for the future.

The first research challenge would be to gather the political will and resources to manage climate change. Climate change and the associated realities are inevitable and irreversible, and need to be intelligently managed. This can only be done with a dialogue between national governments, international organizations, industry, the research and academic community, civil society and all other related groups. Only this breakthrough and a common global mandate can generate the momentum needed to deal with the implications of climate change and its impact on health, particularly for vulnerable groups. Social justice needs to be a priority in this agenda and vulnerable groups in all societies need special attention.

The second important research challenge would be to develop rigorous research and theory on the relationship between climate change and health. Some of the

current findings have opened this dialogue, but research on climate change and health needs to involve public health practitioners and researchers from all areas. Rigour in research needs to be encouraged to be able to come up with strong policy prescriptions. The research community needs to develop its analytical tools, as well as critically evaluate what is available in order to fashion this.

Thirdly, research on climate change and health needs to prioritize areas and groups that are most affected by this relationship, irrespective of which part of the world or social segment they belong to. A humanist approach needs to be developed, accompanied by equity and social justice. Transparent policies on industry, growth and development and the implications of climate change and health within these sectors need to be encouraged. Neo-colonial frameworks in trade on health goods and services are one of the first concerns in this regard, and medical aid must be made available to the most vulnerable immediately and at the lowest costs.

Climate change is a global phenomenon; its impact and implications however are local. Much of the fight against climate change and its impact on health, particularly for the vulnerable sections of society, are a priority on the international agenda. Research on climate change and health must further develop the vision to address the critical needs of vulnerable populations, and not forget the social inequalities that arise in the context of macro interventions. Research must understand and address social inequalities in health and develop a larger mission and agenda on countering the challenges posed by climate change and its implications on health.

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Phillipa Bird, United Kingdom

CLIMATE CHANGE AND MENTAL ILL-HEALTH: ALL IN THE MIND?

There is no doubt that climate change will have a significant impact on human health. The interrelations between our environment and our health are increasingly understood. Yet potentially one of the most significant health impacts remains barely discussed, let alone understood. In this essay I will discuss the impact of climate change on mental illness worldwide and the role of the global health research community in addressing this link.

It may come as no surprise to readers that mental illness in the light of climate change has received little attention. Mental illness holds a low priority status in global health research. Furthermore, the link with climate change may at first seem tenuous and certainly not a priority. Indeed, recent mention of my concern regarding climate change and mental ill-health has been met with some surprised responses. Let me indicate the basis for my concern, focusing on the negative impacts of two predicted effects of climate change: extreme weather events and long-term climatic changes.

As a result of climate change, extreme weather events, such as cyclones and storms leading to flooding, are expected to increase in frequency and intensity. The mental health impacts of disasters, including natural disasters, have been demonstrated. In 2000 parts of my hometown in England were submerged by floodwater. I saw first-hand the impact that stress from those few days had on the mental health status of people. A study confirmed this observation: in Lewes, a nearby town, a four times greater prevalence of psychological distress was recorded among residents whose homes had been flooded.¹ A similar story was widely published in the press in New Orleans. Following Hurricane Katrina the prevalence of serious mental illness doubled.² The impact on mental health was sustained – surprisingly high prevalence of mental illness was reported in newspapers years after the hurricane. The overstretching of mental health services was also reported.

If this was the case in the United States of America, the nation that spends the most on health care worldwide, how could low-income countries with limited mental health systems possibly cope with the mental health impact of extreme weather events? Well, surely mental illness is unlikely to be the priority in the face of extreme weather events in, say, India? The scant evidence on this, points to a substantial but largely unrecorded burden of mental illness. For example, one year after the cyclone in Orissa, India over a third of adolescents were found to have post-traumatic stress disorder, major depressive disorder or generalized anxiety disorder.³ Clearly, further evidence is urgently required on the mental health impacts of extreme weather events in low-income settings, both on the immediate impact and on the enduring impacts months or even years later.

Let us now turn to long-term changes in climate. Drought and desertification are predicted to intensify in many parts of the world, leading to failing crops, loss of livestock, famine and impoverishment. International aid agencies are already preparing to cope with impoverishment as a result of the impact on people's livelihoods. The mental health impact of this is unknown. What is understood, however, is that poverty and falling into poverty are key risk factors for mental illness. There can be little doubt that the stress of failing crops, loss of livestock and impoverishment could have desperate mental health consequences. There is a need to develop an understanding of this relationship and the role of climate change in low-income contexts.

So why does all this matter? Mental illness can cause intense suffering at individual and household levels. There is increasing evidence that households with a person with a mental illness can become trapped in a vicious cycle of mental ill-health and poverty. On top of the economic consequences, mental illness is unbearably stigmatized in many countries and human rights abuses are far too common. Furthermore, mental illness has a profound impact on a range of physical health conditions, affecting HIV transmission, treatment adherence, infant growth and mortality among others.⁴

It will, of course, be the most vulnerable people who suffer the most. The impacts of climate change are predicted to be most extreme in the low-income areas of the world, where there is least capacity to adapt to its effects. And within these areas, it is the least well off who will be most vulnerable to events such as flood or drought. On top of this increased vulnerability, people living in poverty are more likely to develop mental illness. If they do develop mental illness, the poor are the least able to access services to help them and have the least resources to cushion the impact on the household. However, if we choose to take action there are ways to mitigate these impacts, for example through research on low-cost interventions to promote mental health, prevent mental illness and provide treatment and rehabilitation.

Despite the links discussed above, a quick review of the literature on the health impacts of climate change revealed little research on the impact on mental health in relation to other health conditions. This mirrors the overall paucity of research into global mental health. Yet depressive disorders alone are currently the fourth greatest cause of *disability-adjusted life years*⁵ worldwide and predicted to be the second cause by 2030.⁶ Why is it that the burden of mental illness worldwide is so consistently ignored?

A recent series in *The Lancet* called for action on scaling up services for mental disorders.⁷ As we increasingly document the visible impact of climatic changes on health, I call for the global health research community to document the impact of climate change on mental health and, in particular, the impact on the most vulnerable. Such knowledge should be used to advocate for and inform mental health policies and services worldwide. This knowledge and action is essential, alongside further evidence on the feasible interventions to promote, prevent, treat and provide rehabilitation for mental illness in low-income settings.

Documenting and addressing mental health needs now, and in the context of our changing climate, is a matter of health, as well as economics, social justice and human rights importance. It is time to provide evidence that this issue is not "all in the mind". Climate change is a further indication of the need to prioritize mental health on the global health research agenda.

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 - 2 Kessler RC et al. Mental illness and suicidality after hurricane Katrina. *Bulletin of the World Health Organization*, 2006, 84(11):1–12.
 - 3 Kar N, Bastia BK. Post-traumatic stress disorder, depression and generalized anxiety disorder in adolescents after a natural disaster: a study of comorbidity. *Clinical Practice and Epidemiology in Mental Health*, 2006, 2:17.
 - 4 Prince M et al. No health without mental health. *Lancet*, 2007, 370 (9590):859–877.
 - 5 Disability-adjusted life years (DALYs) for a disease are the sum of the years of life lost due to premature mortality (YLL) in the population and the years lost due to disability (YLD) for incident cases of the health condition. The DALY is a health gap measure that extends the concept of potential years of life lost due to premature death (PYLL) to include equivalent years of ‘healthy’ life lost in states of less than full health, broadly termed disability. One DALY represents the loss of one year of equivalent full health. (<http://www.who.int/healthinfo/boddaly/en/>)
 - 6 Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. *PLoS Medicine*, 2006, 3:e442.
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Phillipa Bird’s interests include equity in health, improving access to health care and, increasingly, mental health in low-income countries. She earned a master’s degree in Science in Public Health in Developing Countries from the London School of Hygiene and Tropical Medicine in 2004. Philippa is currently working as a Research Assistant at the Nuffield Centre for International Health and Development at the University of Leeds in the United Kingdom. In this role, Philippa works predominantly on a multicountry research project on mental health in four African nations and contributes to research on international health systems and policy.



Herbert Bonifacio, Canada

**A HEALING TRADITION: RECLAIMING
THE SEAL HUNT IN THE FACE OF
COLONIZATION AND MELTING ICE**

For the Inuit, ecology, hunting and culture are synonymous.

George Wenzel, 1991¹

Filipinos are not made for the Arctic. My daily preparation included an undershirt, polo shirt, sweater, khakis, wool socks, ski pants, scarf, ski gloves, balaclava, winter hat, winter hiking boots and full-length down parka plus or minus long underwear. It should be noted that my paediatrics' clinic at the Baffin Regional Hospital was less than two minutes away by foot. Born and raised in British Columbia from Filipino immigrants, I was not accustomed to the -40°C temperature, as was the case in Iqaluit, Nunavut. Compare this to the Inuit wearing t-shirts, jeans, light jackets, and Adidas shoes. As Sheila Watt-Clouthier, an Inuit environmentalist, says, "We don't only survive. We thrive in the cold."

While I enjoyed Nunavut's orange-hued sunsets embracing the snow-covered arctic tundra, such beauty was overshadowed by the numerous medical and social problems in the territory's foreground. The incidence of tuberculosis in the Canadian Inuit is seven times higher than in other Canadians. Inuit are five times more likely to have diabetes, three times more likely to have heart disease and high blood pressure, and 14 times more likely to have chlamydia. The rate of suicide is seven times higher in Inuit youth. The social problems that my young patients faced when they went home were equally worrisome: poverty, drug and alcohol abuse and domestic violence. Many have postulated why such problems are a sad reality plaguing many indigenous peoples in the circumpolar North. To many, they are the result of colonialism with the subsequent loss of customs and traditions. For the Inuit, their culture is a hunting culture, particularly of seal and other wildlife that is slowly being threatened by climate change.

The importance of the seal is seen by the many roles it has in Inuit life. In Inuit folklore, the fingers of the sea goddess Sedna were cut off by her angry father and turned into the whales of the ocean; her knuckles were then cut off and turned into seals. In earlier times, daily consumption of seal meat was so common that a Norwegian Lutheran missionary in Greenland modified one of the opening lines of the Lord's Prayer to "Give us this day our daily harbour seal." Besides human and animal consumption, the seal fur is used for clothing and handicrafts and industrial oil for heating. Seal hunting also provides social roles for young Inuit men whose duty is to continue hunting for the livelihood of the family. However, many traditions were gradually lost after contact with Europeans and North Americans in the 18th and 19th centuries. Christian missionaries banned centuries-old Inuit rituals performed by religious shamans and took Inuit children from their families and placed them

in residential schooling. The previously nomadic Inuit began to congregate near trading posts. Closer establishments led to easier spread of disease and death with epidemics of tuberculosis. Such disruption and changes in Inuit social patterns lead to the loss or reduced practice of many customs, such as the seal hunt and subsistence hunting.

A seal skin embargo by the European Economic Community (EEC) in the 1980s led to further collapse of the Nunavut economy. The Inuit were no longer known as a people thriving in the Arctic, but as welfare recipients. Unable to hunt, social problems in the Inuit, such as drug and alcohol abuse, depression and suicide, increased and still continue today. Many Inuit parents are not able to pass traditions on to their children and, sadly, many face the same social problems themselves. Recently, environmentalists have declared a “second hit” on Inuit culture and hunting with the effects of global warming and climate change on the Arctic. Watt-Clouthier, who has devoted her life raising awareness of climate change in the North, proudly describes and warns us, “Our entire culture [is] a hunting culture based on the ice, cold and the snow.”² According to Inuit elders, there is less snow and ice on which to travel to hunt seals, polar bears, and caribou. Previously, they were able to gauge the ice in a variety of ways, such as how the harpoon sounds and feels when thrust into the ice, the way the ice tastes. The unforgiving weather and hunting grounds long understood by elders now present more difficult and dangerous challenges to younger persons who lack such knowledge. Even the elders are having difficulty. One elder says, “The wind... you cannot predict it anymore because of the change.”³ However, the effects of global warming and greenhouse emissions on the melting northern ice are not solely limited to hunting.

The unpredictability of wind, ice and stormy weather leads to the purchase of extra supplies. Such expenses are difficult for those with limited income. Without hunting, Inuit are forced to compete with one another for jobs. Although “wage labour” may give much needed monies to the Inuit community, the reliance on such capital suggests individualism as opposed to the pluralism and symbolic nature of the sharing of seal and other country foods with community members, a value respected by the Inuit. Travelling longer distances to avoid certain areas also results in higher fuel costs. Delaying travel times results in shorter hunting intervals leading to a reduced supply of country foods. These delays result in reliance on store food and poor nutrition. This was evident in the patients I saw in my paediatrics’ clinic. Iron deficiency was prevalent in my little patients whose daily diet included chips, candy and pop. This was extremely frustrating as many country foods, such as seal and caribou, easily fulfil the dietary requirements of iron and protein.

We have a social responsibility to understand the health needs of our vulnerable indigenous populations. We must not forget the circumpolar North, where the indigenous Inuit occupy a geographical area that crosses national borders – American, Canadian and Danish – with communities spread across Alaska, Greenland, the Northwest Territories and Nunavut. Geographically and economically isolated, they are forgotten by their respective governments, let alone the global community. Although epidemiological studies investigate the prevalence of disease in such places, more studies need to ask the fundamental question “why”. For example, qualitative studies have investigated mental disorders in aboriginal populations through a “post-colonial” lens. As our own discussion shows, we have used the seal

hunt and subsistence hunting as one approach to the health problems in the Inuit. By using a culturally sensitive lens, we are able to further our understanding of the collective health issues of indigenous populations.

We need to understand the views of indigenous populations concerning climate change and this research should be participatory-based, that is, culturally sensitive research that is performed and enacted by the community itself. Transcultural psychiatrist, Kirmayer, speaks of “healing traditions” as recovering traditional methods of healing that were suppressed by the Europeans.⁴ He also notes, however, that the recovery of a tradition itself is also healing. In this sense, reclaiming the seal hunt and encouraging hunting may be seen as a way of repairing the disruption and damage to Inuit culture over the past three centuries. Not only will it reinforce community patterns and healthy living through traditional sharing of food, handicrafts and better nutrition, the seal hunt also re-establishes a role for Inuit youth, particularly males, to reclaim a responsibility that has been usurped by social problems.

The Inuit economy has faced numerous blows due to anti-seal skin protests, particularly in Europe. To many, misinformation regarding the manner in which seals are hunted is the reason behind such protests. It should be noted that seals are killed by comparable methods to other wild or domestic animals in Canada. Denying the Inuit this traditional way of life is a grave injustice. This emphasizes another valuable point concerning research in such indigenous populations and climate change – solutions should also be both culturally sensitive and respectful. Moreover, researchers need to investigate indigenous peoples’ adaptive strategies to climate change and suggest other possible options. For example, finding how to enable and encourage healthier food choices in the Inuit in the face of a reduced supply of country food. In sum, the incorporation of Inuit cultural values into research and policy implementation concerning climate change inevitably empowers the community to discuss health disparities, engages indigenous people in equal partnership, addresses and acknowledges historic and cultural trauma, and helps enact change. Such an approach is not just for the Inuit community but also for all indigenous populations and their delicate surroundings affected by climate change.

During my last few days in Nunavut I venture to Apex, a town 40 minutes away by foot from Iqaluit. I have sewing lessons with Allisee, an Inuit elder who has opened her home to teach others about Inuit clothing and crafts. Tonight there are nine women and I am the only man, perhaps the first to ever join the sewing group. Despite being nearly 30 years old, she calls me “boy” which elicits laughter from the women. While she goes from person to person, examining their various projects, Allisee warns two young women that they will have to soften dried seal skin by chewing it in their mouths to sew their kamiks or traditional Inuit boots. I am next. She squints as she examines my duffle mittens. With her bright eyes, closed fist and outstretched thumb, she gestures that my finishing stitches of black sinew are very good. I try one on. They are much warmer than the ones I brought from Vancouver.

1 Wenzel G. *Animal rights, human rights: ecology, economy and ideology* in the Canadian Arctic. Toronto, University of Toronto, 1991.

2 The National. *Challenges in Clyde River*. The Big Melt: Canadian Broadcasting Company, 2007.

3 The National. *Inuit Health*. Big Melt: Canadian Broadcasting Company, 2007.

- 4 Kirmayer L. Healing traditions: culture, community and mental health promotion with Canadian Aboriginal peoples. *Australasian Psychiatry*, 2003, 11 (Suppl.):S14–23.

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**Ben Brisbois, Canada****QUESTIONING CLIMATE CHANGE'S
BRAVE NEW WORLD AND
ADDRESSING THE HISTORICAL ROOTS
OF HEALTH VULNERABILITY**

The Global Forum for Health Research recently identified research needs for the health impacts of climate change on vulnerable populations, reflecting a growing body of literature on the subject. One recurring theme is that poor or underdeveloped countries are both most vulnerable to climate change's impacts, and also currently suffer under the heaviest burden of disease. Because these countries are historically least responsible for greenhouse gas (GHG) emissions, their higher vulnerability is said to represent an ethical crisis.¹ A counterpoint to this view holds that climate change represents an irresponsible diversion of attention and resources away from the vital provision of public health in developing countries, based on exaggerated confidence in the reliability of climate change projections.

Without denying that climate change is real and likely to disproportionately affect vulnerable populations least responsible for GHG emissions, I would like to step back from the issue to examine some of the assumptions underlying current thinking on climate change and health. The "ethical crisis" argument foregrounds populations vulnerable to climate change without discussing reasons why vulnerabilities exist. The sceptical view that climate change is a relatively insignificant health determinant instead focuses on health-affecting facets of globalization, such as urbanization and modern transport, but fails to mention globalization's inherent inequality and the market-based agenda driving it ("neo-liberalism"). Both poles in the debate therefore take the existence of vulnerable populations as a given, and fail to question the upstream factors that ultimately shape vulnerability. I will therefore argue that current research on climate change and health implicitly accepts and justifies the present-day global economic order. In this light, acknowledgement of both the proximal and distal determinants of vulnerability, and actions to address them, are researchers' foremost challenges. Overcoming these challenges would involve bravely facing up to the full range of political and economic forces shaping health (and sustainability) globally.

An example of how climatic and socioeconomic analyses have been mutually exclusive is provided by the re-emergence of cholera in the Americas in 1991, beginning in Peru. The speed of cholera's spread led to climatic factors, and related proliferation of the plankton blooms in which *Vibrio cholerae* thrives, being invoked as a causal mechanism. While such analyses employ established scientific methods, they omit important socioeconomic perspectives. It has been argued that in 1991 Peru was especially susceptible to a massive waterborne disease outbreak, due to its experience with neo-liberal economic reforms imposed by the International Monetary Fund, such as privatization and cuts to social spending.² A resulting lack of clean drinking water sources and resources for health care exacerbated the epidemic, as did then-President Alberto Fujimori's attempt to deny its existence and stave off economic slowdown by appearing on television eating ceviche (a traditional dish made of raw fish and

a possible route of cholera infection). This social background, although simplified, nevertheless carries considerable explanatory weight when viewed together with the biophysical results of climate-focused analyses. Its significance for the appropriate response to cholera and other health impacts in vulnerable populations is reflected in the words of another group of researchers:

As socioeconomic conditions conducive to cholera persist in many countries, one goal often stated in studies of climatic/environmental influences is disease forecasting. Hopefully, an understanding of disease risk related to the environment can also underscore the need for improving these conditions.³

The undermining effects of neo-liberalism on the health of populations have been well documented, and their implications for populations identified as vulnerable to climate change present research challenges. This is because, while the development and implementation of adaptation methods may seem like a natural focus of research into climate change's health impacts, uncritical participation in this process is likely to lead to band-aid solutions for problems with much deeper roots. These are not limited to structural adjustment and other neo-liberal reforms, but go as far back as the history of colonialism. It should be noted that colonialism enriched many of the countries now producing climate projections, impoverished many of those deemed most vulnerable, and fuelled the industrial revolution widely recognized as the driving force for climate change.

De-contextualized analysis of health risks due to climate change implicitly (and likely unintentionally) normalizes and legitimizes the international economic status quo created by these historical realities. General circulation models (GCMs) typically examine highly "business-as-usual" economic "storylines"; in addition, GCMs are said to be inherently de-contextualizing in that they model the effects of GHG emissions divorced from the social reality behind their production.⁴ Emissions from fighter jets and ambulances alike enter GCMs stripped of this context and reduced to their physical properties. This is, of course, both reasonable and necessary in the context of geophysical modelling. When the outputs of GCMs are incorporated back into policy-making, however, it is often without the contextual information it was necessary to jettison to achieve a workable model. Health adaptations based on GCM scenarios can thus be justified on the grounds of equity when, in fact, the baseline against which climate change impacts are measured is anything but equitable.

The Global Forum for Health Research acknowledges the futility of adaptations aimed only at climate change impacts "in the absence of a robust and credible public health system". It would be helpful to go beyond this acknowledgement to address the historical forces that have prevented the development of such health systems, and are positioned to do so in the future. Addressing the implications of these forces would not necessarily require new research so much as political will. This could perhaps be termed knowledge translation; it might also be termed advocacy. It has been suggested that health-care professionals represent an untapped vein of goodwill and enthusiasm for this fight to bring about a just society in which health is viewed as a human right.

Another model for the translation of knowledge concerning the socioeconomic determinants of health is provided by the history of Latin American social medicine.

In the mid-20th century, a generation of health-care professionals advocated, with considerable success, for social reform in an effort to fight diseases of poverty. This example also highlights the antagonistic relationship between a certain popular variant of free market ideology and the social reforms needed to improve public health and ultimately enhance resilience to climate change. A wave of coups transformed Latin America in the 1960s, 70s and 80s, replacing democratically elected leaders with military dictators. In general, these dictators reversed the reforms of social medicine in favour of privatization, deregulation and other actions designed to promote free markets. Significantly, the well-known coup that occurred in 1973 in Chile deposed President Salvador Allende, a physician and one of the leading figures of Latin American social medicine.

The Latin American example demonstrates that researchers must construct realistic and workable solutions to population vulnerability, being aware that their conclusions may challenge powerfully entrenched aspects of the status quo. A related challenge is the incorporation of these conclusions into research funding and knowledge translation arrangements. How is research to be funded if it challenges powerful economic and political interests? What hope can researchers have of seeing their work acted upon if its implications are politically unpalatable? While researchers now address these questions in advocating GHG emission reduction measures, the resistance they currently face could pale in comparison with the difficulty of confronting neo-liberal practices. In light of this, how can the longstanding dialogue between knowledge and power benefit populations vulnerable to climate change impacts? It would be naïve to think that these questions can or will be quickly and easily addressed. A good start might be for climate change and health research on vulnerable populations to avoid an implicitly ahistorical acceptance of the global economic order that structures possible health outcomes. By tracing the causal roots of vulnerability to climate change back to and beyond social conditions in vulnerable populations, research into climate change's health impacts can help to highlight and address problems in the world where the climate is changing. This will encourage researchers to address the full magnitude of the ethical crisis of climate change, with all of its ecological, economic and human health implications.

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- 1 Patz JA et al. Climate change and global health: quantifying a growing ethical crisis. *EcoHealth*, 2007, 4:397–405.
 - 2 Cueto M. Stigma and blame during an epidemic: cholera in Peru, 1991. In: Armus D, ed. *Disease in the history of modern Latin America: from malaria to AIDS*. Durham, North Carolina, Duke University Press, 2003:269–289.
 - 3 Pascual M, Bouma MJ, Dobson AP. Cholera and climate: revisiting the quantitative evidence. *Microbes and Infection*, 2002, 4:237–245.
 - 4 Demeritt D. The construction of global warming and the politics of science. *Annals of the Association of American Geographers*, 2001, 91(2):307–337.
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Ben Brisbois is currently a doctoral student in Epidemiology at the University of British Columbia in Vancouver. His research focuses on community and ecosystem-based approaches to preventing dengue in Latin America, and more broadly on the effects of globalization on health. Prior to this he completed a Bachelor of Science at McGill University in Montreal and a Master's in Environmental Studies at York University in Toronto while examining climate change and infectious disease. He has also worked for Canada's federal health and environment departments and on a development project in Guyana for the nongovernmental organization Youth Challenge International.



Claire Élise Burdet, Canada

LA VULNÉRABILITÉ DE NAÎTRE HUMAIN : LE RETOUR EN FORCE D'UNE NOTION EXTINCTE

D'emblée, dès le tout premier souffle et même avant, de naître au Canada ou de naître au Mali ne signifie pas du tout la même chose. Les obstacles à franchir pour survivre – et mieux encore pour vivre dignement – sont loin d'être équitablement répartis sur la surface de la Terre. Le cercle vicieux de la pauvreté auto-entretenu, l'implosion en taille de la population mondiale, le lourd fardeau des maladies infectieuses, les rapports de force et de domination politiques, économiques et militaires entre les différents peuples au fil de l'histoire, et bien d'autres facteurs encore ont tous contribué à ce qu'il existe aujourd'hui une énorme disparité dans ce que cela peut signifier que de mener une existence humaine.

Le quotidien de certains ne ressemble en rien à celui d'autres, à un tel point que beaucoup d'humains nantis ont oublié ce qu'est la précarité au quotidien : la faim, la maladie, le manque d'opportunités, l'analphabétisme... Et pourtant même dans les pays dits du Nord, les exemples de précarité abondent, souvent sous la forme de l'humain d'à côté. Toutefois, de façon globale, les disparités actuelles d'accès à un certain niveau de santé, aux ressources matérielles, et à une certaine dignité dans le travail et la vie font que les populations vulnérables constituent un groupe d'humains géographiquement rassemblés dans "le Sud".

Avec les changements climatiques globaux, la notion de précarité qui était désormais réservée au Sud risque cependant fort bien de s'étendre de façon un peu erratique pour inclure des populations jusque là plutôt choyées par le destin. Bien sûr, on ne peut que postuler le cours des choses. Mais les scientifiques qui se risquent à ce jeu prédisent une augmentation significative de la température de la surface terrestre de 1,5 à 3,5 degrés Celsius sur les cent années à venir. Quelques degrés de plus, qui nous font cependant facilement imaginer plusieurs conséquences sur l'environnement et sur la santé humaine.

Avec un peu plus de chaleur, bien des populations de vecteurs animaux classiquement porteurs de maladies pour les humains pourraient augmenter en nombre, et avec eux l'incidence de bien des maladies infectieuses. Ainsi une grande population de rats transmettrait plus de cas de peste, et une augmentation de certains types d'insectes signifierait une plus grande incidence humaine de la maladie de Lyme, de la malaria et de la leishmaniose. Avec quelques degrés de plus on s'attend également à plus d'intempéries (pluie, ouragans, etc.) avec des précipitations extrêmes pouvant entraîner une recrudescence dans les pathologies diarrhéiques, parmi lesquelles le choléra. Des mouvements en masse de populations entières à cause d'intempéries ou à cause de conflits engendrés par la raréfaction de ressources telles que l'eau potable seraient aussi accompagnés de l'émergence d'épidémies nouvelles en nombre important.

Les changements climatiques risquent de dicter une nouvelle géographie des maladies infectieuses. On prédit à titre d'exemple qu'en 2020 la maladie de Lyme aura progressé à 200 km au nord de sa limite actuelle au Canada, grâce à une abondance nouvelle de tiques (le vecteur de la maladie) fomentée par un climat adouci dans ces latitudes nordiques. Avec le réchauffement climatique, on pourra également assister à l'escalade des maladies en altitude, là où un froid prohibitif régnait auparavant. Les zones endémiques pour la malaria semblent par exemple déjà faire leur ascension lente le long des pentes escarpées des montagnes de Madagascar grâce à des températures plus clémentes.

Face à cette géographie changeante de la vulnérabilité humaine, et face à une vulnérabilité humaine globalement augmentée, que peut apporter la recherche pour la santé ? Où doit-elle concentrer ses efforts ? De quoi dispose l'humain pour pallier à sa vulnérabilité intrinsèque face aux maladies infectieuses ?

Tout d'abord, si la recherche veut pouvoir opérer, il lui faut de la matière à réflexion. Les systèmes actuels recensant les maladies infectieuses sont clairement insuffisants dans bien des pays. La collection des cas de maladie avérés est un outil de santé publique essentiel pour caractériser l'épidémiologie d'une maladie et pouvoir un jour prédire ses résurgences. Dans ce but, il serait souhaitable qu'autant de pays que possible augmentent dès à présent leur liste de maladies infectieuses à déclaration obligatoire afin que la migration des maladies soit clairement pistable et analysable.

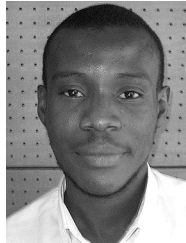
Plus fondamentalement encore, la recherche pour la santé doit élargir ses horizons et à tout prix exploiter la diversité entière de la pensée humaine. Actuellement cette recherche pâtit d'un certain "manque à gagner" : il existe une telle foison de pensée humaine, mais seule une toute petite minorité des idées atteint une transcription vers la réalité – là où les fonds financiers et la structure existent pour le permettre. C'est bien là une de nos plus grandes tragédies actuelles : que des pans entiers de pensée humaine contemporaine restent ainsi à l'état d'idées. Pourquoi n'exploitons-nous pas mieux une de nos richesses premières qu'est notre grande diversité de cultures et de modes de pensée ? Les "micro-climats humains", petits écosystèmes précaires faits de combinaisons de cultures et de langues, sont pourtant tellement propices à l'émergence d'idées originales. Je propose comme solution à la vulnérabilité humaine qui est inhérente à notre nature collective, notre première force collective : nos cultures ! La recherche scientifique visant à l'amélioration de notre santé doit incorporer des têtes pensantes qui n'aient pas toutes été formées à la même école, selon le même modèle de quête de la connaissance. Des schémas de pensée "aberrants" selon nos standards actuels sont peut-être la solution originale qu'il nous faut.

En même temps, cette même culture qui est peut-être notre meilleure arme contre les défis qui vont assaillir notre viabilité et notre santé, sera elle aussi la cible d'assauts, et pourrait dans certains cas menacer notre propre santé. Les populations circumpolaires par exemple seront particulièrement fortement touchées par le réchauffement climatique. Avec la perte de l'effet protecteur du froid, certaines traditions alimentaires (préservation d'aliments, cuissons) pourront se compliquer par la prolifération de bactéries et la transmission de maladies telles que le botulisme. Ainsi, alors que le froid protégeait ces pratiques culturelles de porter danger à l'Homme, elles lui deviendront désormais nuisibles. Ceci montre bien qu'en plus

des recherches axées fortement sur la nature biologique des maladies infectieuses, une attention toute particulière devra aussi être portée sur les pratiques culturelles influençant leur propagation – sorte d’anthropologie des maladies transmissibles. La culture se retrouve donc à la fois comme moteur important d’une recherche pour la santé originale, et à la fois comme l’objet même de la recherche pour la santé.

Avec la raréfaction de nos ressources naturelles telles que l’eau, et avec les changements climatiques entraînés par la consommation de combustibles fossiles, la reconnaissance collective que nous en sommes désormais à un point de non-retour dans l’histoire humaine semble émerger. Jusqu’à aujourd’hui dans l’Histoire, toutes les crises humaines importantes se sont doublées d’un potentiel destructeur important. Et si la clef de notre succès, et de notre survie, résidait cette fois entièrement dans notre capacité à ne pas tout détruire justement ? Pour la première fois, nous nous retrouvons dans la situation de devoir collaborer de façon très étroite, car notre santé et celle de la nature qui nous abrite ne pourront tolérer beaucoup plus de destruction. Nous sommes limités dans le temps, et dans l’espace, mais pas dans notre volonté ni dans notre créativité de trouver des solutions de vie.

Claire Élise Burdet was studying biochemistry in Canada when the “Kosovo crisis” erupted in the spring of 1999. For the first time, a humanitarian disaster had shaken her to the core. It was a personal point of no-return. Claire decided to study medicine with the idea that by working towards better standards of health, she could one day help people in distress to regain control over their destinies. After completing medical school in Switzerland, Claire worked as a junior doctor in Scotland for a year. She is currently an internal medicine resident at Geneva’s University Hospitals. Claire plans to train in tropical medicine before practicing for a year in KwaZulu-Natal, South Africa.

**Dzedzom De Souza, Ghana****CLIMATE CHANGE AND HEALTH:
RESEARCH CHALLENGES FOR
VULNERABLE POPULATIONS?**

For a long time before the discovery of disease agents, humans have known that change in climate has an impact on the epidemiology of diseases. Even though we have an idea of how environmental changes can affect health, we know nothing about the threat of changes in the pattern and intensity of climatic changes and the implications on human health. Issues about the impact of climate change on health remain controversial, as there are diverse viewpoints on the subject. But really, is there anything future research can do to mitigate the effects of climate impacts on health?

The theme for this year's Global Forum for Health Research Young Voices competition focuses on the health research challenges for vulnerable populations based on climate change. However, what is the definition of a vulnerable population? Do we mean vulnerability in terms of the rich and the poor, the developed and developing countries, rural versus urban and low-income urban versus high income-urban areas? As far as climate changes are concerned, every population is vulnerable and the extent of risk depends on the type of climatic event. Taking for example, extreme weather events such as flooding, vulnerability differs greatly from urban to rural populations. Though this may be directed to developing countries (e.g. the Mozambique floods), it also applies to developed nations like the United States of America where Hurricane Katrina caused extensive damage.

However, developing countries may be at greater risk, especially where there is a major difference between rural and urban populations in terms of health-care provision. Rural areas have less access to health-care facilities, with greater risk of disruption to local health systems. Transportation and delivery of relief items to rural populations in extreme weather events may also be difficult for logistical reasons. However, there may be a lower disease outcome in rural compared to urban areas due to high population density and the high faecal and waste contamination that is often associated with low-income urban areas. Therefore, health vulnerability in a climatic event cannot be easily assessed due to the myriad of factors that may interact to determine its outcome.

The emergence of human diseases reflects complicated relationships between the behaviour of pathogens, humans, animals and disease vectors. These complex interrelationships are the result of changes generated by population growth, social and economic development, urbanization and environment, as manifestations of anthropogenic influences on the planet. Carbon dioxide emissions and resultant global warming has been pinpointed as the major driving force in climate change. However, different levels of carbon dioxide emissions have been projected, raising questions about the certainty of these predictions. Nonetheless, as long as there is

population growth, there will be an ever-growing demand on existing resources and ultimately an effect on climate change.

There are numerous research projects that have focused on past, present and future effects of climate change on health. However, the impact of climate change on health is controversial. While studies on the global burden of disease suggest that noncommunicable diseases – “diseases of the rich” – will emerge as public health problems in the coming decades, infectious diseases (including the neglected tropical diseases) have been shown to occur more in poor populations. The majority of infectious diseases are, however, transmitted by vectors that are highly influenced by environmental and climatic changes that indirectly drive the changing epidemiology of these vector-borne diseases. The challenges in determining the impacts of climate changes on health involve a complex interaction of the geographic scale, the exposure period and the causal pathways.

While many climate-health research activities have focused on predicting future health effects due to climate or environmental changes, very few (perhaps none) have actually been applied in disease control and prevention. A simple example is how studies have shown that malaria epidemic risks increase five-fold in the year after an El Niño event. But how exactly is this information used in controlling malaria? What are the mechanisms put in place in order to reduce the malaria risks? And are the policy-makers, disease control officers and other parties involved, informed of when an El Niño event has occurred and therefore prepared to put appropriate mechanisms in place?

In order to stay in business, researchers cite all the information required and write about the possible/expected outcomes of their research work to development, all in an attempt to convince the proposal reviewers. But is what is possible always practical? Many study models exist for malaria, lymphatic filariasis and schistosomiasis, but they are not used in disease control and prevention. As much as researchers are identifying climate–health related risks, the most important research challenge for the health of vulnerable populations should be the application of research findings in making an impact on the lives of people.

A major deficit of the application of climate-health research is the use of expensive technology and data not affordable in terms of sustainability. The already overwhelmed health services in resource-poor settings can be further overwhelmed by extreme environmental, climatic and anthropogenic changes. Even though such events can be predicted from existing models, financial restraints prevent the integration of resources from various stakeholders in order to allow health services to plan more effectively in their response capacity. Notwithstanding the fact that these research works provide very useful information, simple and more pragmatic approaches should be developed based on the knowledge acquired through such studies.

Again, taking malaria as an example, it is well known that the risks of malaria transmission increase during the rainy seasons due to the dependence of its vectors on rains. Thus vector control options could be implemented at the end of the dry season, in order to significantly reduce the breeding vector population before the rains. Thus, the research challenge is to bridge the research–policy gap and emphasize how available information can be exploited to reduce health risks.

While it is widely accepted that the biggest single human influence on global climate is via the emission of greenhouse gases, we should ask who generates these gases. The majority of the population in resource-poor settings can barely afford three meals a day, let alone afford to use the kind of modern facilities that consume greenhouse gas-emitting energies. Yet, they are more vulnerable to the effects of climate change. Ironically, most climate-related research is undertaken by the rich. Unless these are aimed at assisting the poor in preparing for, and adapting to climate change, instead of assuring their own security, a better title for this paper would be: “Climate change and health: improving the security of the rich”. Realistically speaking, the effects of climate change on health will be most devastating to developed countries, and the rich in general, in relation to the re-emergence of vector-related, as well as water- and food-borne infectious diseases, and the loss of immunity to most of these infectious diseases. Examples can be given of the increasing incidence of malaria in countries where it had once been eliminated, or the increase in the levels of *Cryptosporidium* and *Campylobacter* in water.

Climate change and health: research challenges for vulnerable populations? Given the gap in comparative studies for specific diseases or for the overall health burden from climate change, the question at hand is difficult to answer. Climate change will continue to occur as a result of population growth and anthropogenic changes. The rate and severity of change, as well as our ability to determine and mitigate the likely outcomes, will determine future research challenges. However, the world has done enough academic-based research and it is time for a paradigm shift from academic-based investigations to more practical and easily reproducible development-based activities.

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Divya Dhar, New Zealand

CLIMATE CHANGE MITIGATION POLICIES: ANOTHER SOURCE OF HEALTH INEQUALITIES?

I first “noticed” climate change sitting in the middle of a technological conference called the Digital Earth Summit. If it were not for my curiosity to find out what my “hippie” friends were up to, I would never have learnt that climate change is an escalating doomsday phenomenon.

The role of us youth delegates amid the myriad of white middle-aged men from the top echelons of their countries’ scientific ladder was to generate excitement and a spirit of humanity. We were there to remind the delegates just why their research was important. We spread ourselves out and asked each delegate what they were committed to. We received an interesting array of answers. Many looked flabbergasted and asked for some time to think, whilst others seemed intellectually stimulated and thanked us for reminding them. This was a very humbling experience. My hippie friends realized that technologists do have a real concern for the state of the planet, and the will to mobilize the masses of hippies.

While all of this was interesting to observe, I could not help but feel like a pariah, somewhat of an outsider. I looked around and saw engineers, urban planners, marketing representatives, radio show hosts, marine biologists but no health professionals. Where were the doctors, health economists and public health advocates? In the course of three days, I could tell climate change was going to be the next big culprit jeopardizing human health. After sanitization and immunization, curbing the effects of climate change would save the most lives. This is a real public health issue, yet the only health representative present was one medical student, me. I vaguely recalled having been given a lecture on the adverse effects of climate change in my first year. The fact that this was a real threat had not sunk in, until now.

After the conference, I tried to find other health professionals who were involved in this field. I wanted to join forces, but I did not have the technical skills of an engineer or the knack of a media guru. I was desperate to find the missing piece of the puzzle. How did this fit into the health context? To discover the answer, I joined the School of Population Health with a focus on environmental health. Needless to say, I was told often: “we’ve never had a fifth year before”. During this attachment, I finally got to grasp the role of health in climate change.

The International Panel on Climate Change’s (IPCC) Fourth Assessment Report (AR4), entitled *Climate change 2007: synthesis report*, finally put an end to the question: “is climate change real?”.¹ It also illuminated the disproportionate burden of climate change on the developing world, the people that had made the least contribution to it. This did appear to be very unfair and the obligation placed on developed world countries to urgently fix the problem seemed just.

Increasing public awareness and the fear of incurring financial ramifications from failing to meet the Kyoto Protocol has created the political will to mitigate climate change. Governments around the world are weighing up strategies that will best reduce carbon emissions with the minimum negative economic impact. What is rarely considered is the effect of these policies on human health. For the first time I realized that negative health impacts will occur as a result of climate change but also, less obviously, through the very policies we use to solve the problem. I found this alarming.

Inequality of opportunity and outcomes exist for the most socioeconomically deprived in all societies, and these are the populations that are disproportionately affected by both climate change and its mitigation policies. They are the most vulnerable.

When selecting policies, a relevant model of health should be considered. Hancock's model of human development proposes an interrelationship between health including social factors, environment and the economy. According to the IPCC Synthesis Report, four areas are used to evaluate policies and pricing instruments. These comprise distributional effects including equity, environmental effectiveness, cost effectiveness and institutional feasibility.¹ This supplements Hancock's holistic model, which proposes environmental and economic activities that must endeavour to reduce the inequalities contributing to poorer health for those in the higher deprivation levels.²

Policies that are based on information provision are likely to cause a voluntary shift in public demand whilst having the least effect on widening the inequality gap. These policies, however, are also the least likely to generate the rapid impact that is necessary to mitigate climate change. On the other hand, price instruments are likely to have a more rapid impact in changing behaviour. Both carbon taxes and tradable quotas under emissions trading schemes generate a price for carbon. This establishes the total cost of a product.

Within New Zealand, carbon charges are likely to most directly affect the energy, transport and agriculture sectors, with flow-on effects for the cost of food and commodities.³ The Government is proposing a price instrument in the form of an Emissions Trading Scheme. This is favoured over carbon taxes as it not only sets a price on carbon, but also limits the level of emissions. This scheme will allocate emissions across sectors in the form of carbon units, hence creating a market price for carbon. These rising carbon costs, however, contribute to differential consequences across societies.

The inclusion of carbon costs in the prices of products and services is deemed to be regressive, as those in the lowest income bracket suffer disproportionately. These inequalities will impact various sectors, such as household energy and income, transport and food. People in the lowest income bracket spend a higher proportion of their income on non-discretionary expenses such as household fuel and power. Similar to the vulnerable populations of the developing world, those in the highest socioeconomic deprivation levels have the least adaptive capacity. With no discretionary income available for redistribution into spending on carbon-efficient practices and technology, maintaining their level of independence for education and workplace accessibility becomes increasingly problematic. Thus, the inequality gap only widens as positive environmental impacts are traded off with negative health outcomes.

I believe research needs to occur on the health impacts of climate change mitigation policies. This research needs to focus on whether these policies will disproportionately burden the most vulnerable. If the inequality gap is likely to increase, further research will be needed to determine assistance mechanisms that will decrease, or at the very least maintain, the original gap. These assistance mechanisms include revenue recycling and tax hypothecation.

Revenue recycling proposes the redistribution of increased revenue gained from a carbon tax to curtail its social and health impact by reducing other distortionary taxes, such as individual and corporate income taxes. A reduction in these taxes for the lower income groups and corporations increases employment and investment, and thereby produces an economic gain resulting in a double dividend. Furthermore, by encouraging a reduction in air pollution, revenue recycling also reduces respiratory illnesses, such as asthma, and associated health-care costs, hence providing a triple dividend. In Italy, the green tax reform was introduced in a revenue neutral context with most of the revenue generated by the environmental tax used to provide distortionary tax cuts or funding projects that improve energy efficiency.^{4, 5}

Another assistance mechanism is tax hypothecations, which earmark specific revenue raised to reduce inequalities. This policy proposes using revenue generated by carbon charging to reduce its regressive impact, by reinvesting in areas such as public transport and housing insulation for those in higher deprivation levels. In New Zealand, tax hypothecations were considered recently in the form of a regional fuel tax. This policy implied an increase in cost of fuel within the Auckland region by five cents per litre with the intention to reinvest most of the revenue generated into electrification of the rail.⁶ It is possible, however, to have a public transport system that causes more harm than benefits to the vulnerable populations. The rise in cost of fuel would have a disproportionate affect on the poorest, yet due to the increased distance between their dwellings and the rail route, they would benefit less from an electrification upgrade. Such projects should ensure that inequalities do not increase by preferentially benefiting lower socioeconomic deprivation groups. Hence, research into how tax hypothecations could specifically reduce inequalities should be considered.

Though I do not feel alone anymore, there is still a gaping hole in the number of health professionals actively involved in the area of environmental health. Thoroughly researching the impacts of various climate change mitigation policies through the health perspective is fundamental to identifying widening health inequalities. Further research is required to assess mechanisms that would best assist those likely to suffer disproportionately. If health professionals do not raise this as an evidence-based concern, it will be largely forgotten in the race to reduce emissions and save dollars.

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3 Chapman R, Boston J. The social implications of decarbonising the New Zealand economy. *Social Policy of Journal of New Zealand*, 2007, 31:104–136.

4 Brown L. Plan B 2.0: *Rescuing a planet under stress and a civilization in trouble*. New York, WW

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- 5 Tiezzi S. *The welfare effects and the distributive impact of carbon taxation on Italian households*. *Energy Policy*, 2005, 33(12):1597–1612.
- 6 Auckland Regional Council. *Draft Annual Plan 2008/09*.

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Meghnath Dhimal, Nepal

CLIMATE CHANGE AND HEALTH:
RESEARCH CHALLENGES IN
VULNERABLE MOUNTAINOUS
COUNTRIES LIKE NEPAL

Located along the southern slopes of the Himalayan mountain range, with the lowlands in the south at 60 metres above sea level and the mountains in the north rising to over 8000 metres, Nepal harbours extreme spatial climatic variations. The climate of Nepal varies from arctic to tropical within a 200 kilometres span from north to south. This variability of climatic conditions within a short distance and limited area has blessed this beautiful mountainous country with a great diversity of flora and fauna as well as plentiful supply of water resources. In view of these, Nepal might be a unique place for studying the impact, vulnerability and adaptation aspects of climate change.

Nepal has a negligible share in global emissions of greenhouse gases (GHG). This, together with the fact that its fragile mountain ecosystem is particularly vulnerable to climate change, is why research needs to focus on adaptation rather than mitigation. A heavy reliance of the country's economy on climate-sensitive sectors, coupled with dramatic topography, fragile ecosystems and weak institutional, economic and technical capacity to deal with climatic uncertainties, make Nepal extremely vulnerable to the negative impacts of climate change.

Developed countries are mainly responsible for emitting GHGs and enhancing the phenomenon of climate change, while developing countries are most vulnerable to the impacts of climate change. Nevertheless, studies by the Global Forum for Health Research and others continue to demonstrate that health research applied to the needs of developing countries remains grossly underresourced in many areas and the term "10/90 gap" is commonly being used and has become a symbol of the continuing mismatch between needs and investments. Is it ethical? Is there equity in health research?

All parties to the United Nations Framework Convention on Climate Change (UNFCCC) are committed to submit national communications in which they outline the implementation of the UNFCCC and the impacts from climate change that they are facing. Nepal submitted the initial communication report on climate change to UNFCCC in 2004. Nepal has not yet prepared the National Adaptation Programmes of Action (NAPA) till now. Without the formulation of a NAPA, it is very difficult to develop and implement adaptation programmes.

Climate change is expected to expose millions of people to new health risks directly or indirectly. The most vulnerable to ill-health are communities living in poverty; those with a high incidence of malnutrition and a high level of exposure to infectious diseases. As with many other issues, it is also true in case of climate change that the poorest of the poor will be worst hit by this phenomenon. Therefore, we should be sensitive to this fact while designing adaptation strategies.

Research challenges for vulnerable populations. In the context of climate change, the terms developing country and vulnerable population can be taken as synonymous. One of the most urgent problems that developing countries like Nepal face is the lack of technical skills, human resource and financial capacities. This affects the ability of developing countries to conduct research on climate change and health and hinders the formulation and implementation of adaptation plans. It is often very difficult to define who is vulnerable to climate change. Moreover, it is also very difficult to speak to researchers without ample evidence. Conducting research on climate change at the local level is a challenge because it involves the complex tasks of building long-term data, data analysis and interdisciplinary investigations. These tasks are further challenged in a country like Nepal where the climatic database is comparatively weak in terms of network coverage, duration and quality. Following are the important challenges for conducting research in developing countries, reducing climate change vulnerability and increasing the resilience of vulnerable populations.

Lack of information and data. In Nepal, there is no availability of data on climate and health impacts as there are very high micro-climatic variations within a short span of time and low meteorological station coverage, as well as poor surveillance within the health system. Even if data are found, they are not of desired quality. Further, Nepal lacks an efficient data collection and management system. With numerous micro-environments in mountainous areas, it is difficult to project the changes that will occur in the coming decades.

Lack of public awareness. As climate change is a new concept in Nepal, public awareness of the issues is quite low. This lack of awareness is at every level; from grass-roots organizations to national-level institutions. As a result, it is extremely difficult to explore the impacts of climate change on vulnerable populations, as there is little or no interest from research participants, policy-makers and planners.

Lack of trained human resources. The issue of climate change is a new subject and its impact needs to be assessed across different sectors. Trained and experienced people are required to make intersectoral linkages necessary in climate change research in Nepal. However, there is an absolute shortage of such expertise. Nepal suffers from “brain drain”, with many of its well-trained and experienced researchers working in developed countries. The lack of trained human resources is a recurrent problem for developing countries like Nepal.

Lack of interdepartmental coordination. Interdepartmental coordination is lacking both between and within government ministries, making it extremely difficult to conduct the kind of interdisciplinary research required to assess climate change and its health impacts.

Low financial capacity. Nepal has low financial capacity and receives limited resources and assistance from international donors to tackle the impacts of climate change. The fund allocation for research is negligible and further inhibits Nepal’s potential to conduct operational research on the adaptation aspects of climate change. With regard to a retrospective study, there is no availability of appropriate and/or quality data.

No political priority and focus on national policy. As there is very limited research available, there are a number of uncertainties. Without adequate evidence or obvious impacts, climate change has not gained political priority and therefore receives scant attention in national policy and programmes. The absence of political commitment from the major GHG emitting countries of the world contributed to a lack of commitment from governments in developing countries. With no clear national policy on climate change, it is quite difficult to convince the government authorities to generate the funds for climate change and health research.

Geographic situation. The geographical diversity of a country or regions can create great micro-climatic variations that make it difficult to predict climate. There is also low meteorological station coverage in Nepal further limiting the collection of accurate data. Therefore, the climate of Nepal cannot be predicted using global and regional climatic modeling, giving further importance to the need for research at the micro-level.

Research methodology. There is a lack of clear and specific universal methodology for assessing the impact of climate change on vulnerable populations. The methodology used so far differs between countries and regions and is mostly suitable for developed countries. In developing countries like Nepal, where there is a dearth of climatic as well as health data, it is very difficult to correlate climate change and health impacts. Another problem is that we do not possess a baseline scenario.

The need for research and action is urgent in developing countries; otherwise they will not be able to cope with the visible impacts of climate change. Climate change and health must be a major component of the NAPA for any country. Prominence should also be given to community-level input as an important source of information, recognizing that grass-roots communities are the main stakeholders. As climate change is the major threat of the 21st century for international health security, it must become a priority in health research frameworks and be recognized by policy-makers from both health and non-health backgrounds. International political commitment is also crucial. Developing methodology to quantify the current impacts of climate and weather on a range of health outcomes is an urgent matter, particularly in low- and middle-income countries, and such development will enhance the capacity of young researchers in this field. Most climate change and health research to date has been financed and conducted in developed countries focusing on mitigation. Therefore, developed countries should provide support to developing countries for research on the adaptation aspects of climate change. Vulnerable countries urgently need the opportunity to conduct country-specific, multidisciplinary and cross-sectoral research strongly focusing on poverty and equity. The impacts of climate change are not always visible and have residual impact. Developing countries like Nepal are already overburdened by a number of health problems, and cannot therefore tolerate the impact of climate change. It is high time to initiate research on the health and adaptation aspects of climate change, generate appropriate data, identify the magnitude of the problems, influence policy-makers and planners, and prepare and implement NAPA scientifically.

Meghnath Dhimal was born in 1981 in Lekarka, Bhjopur district, eastern Nepal. Meghnath received a high school diploma from Baluwahi School in 1997 and went on to study science at the Hattisar Campus in Dharan Nepal in 1999. Meghnath received an undergraduate degree in Environmental Science from Tri-Chandra Multiple Campus in Nepal's capital Kathmandu in 2002, before completing post-graduate studies in Environmental Science at Tribhuvan University in Kirtipur in 2004. Since 2005, Meghnath has worked with the Nepal Health Research Council as an Environmental Health Research Officer. At present, Meghnath is reviewing university options to complete a PhD on climate change and health.

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Lester Sam Geroy, Philippines

THE TREES HAVE GROWN AGAIN

“There are no more trees,” Ignacio gravely said. He was driving us to the mountain district to conduct our weekly medical dental check-up at the outpost clinic.

“When we were children, there were monkeys playing on the streets,” Ignacio, our guide and driver, recalled. He was born and grew up in Malaybalay, a thriving agricultural city in the centre of Mindanao Island, Philippines. Ignacio remembered his childhood scenes very well. Malaybalay used to be a very cold place; it became the southern summer capital of the country for the Americans. It was a small town then, the capital of Bukidnon Province. On the mountains outside the elevated town were verdant forests and tropical jungles.

“Yes, monkeys were playing on the roads and we gave them biscuits. There were many birds, deer, lots of eagles, and even the tarsier, the smallest monkey,” Ignacio continued. “All these mountains were filled with pine trees cooling the air. We travelled on horseback beside the river because there were no roads. My grandfather’s ranch was big then and there were no other ranches. The people were few and the mountains have *[sic]* not been converted into rice and corn plantations.”

His description of the area just amazed me, a Manila-trained doctor who grew up in Cebu, another metropolis. It was quite difficult to imagine how these mountains were indeed jungles. He showed me where they rode on horses, where they spent hours shooting birds and deer, and even where their grandparents hid during World War II.

These memories were not of the distant past. In fact, Ignacio was a middle-aged adult. Everything changed in the 1980s and 90s when the logging industry flourished. In a few years, the trees were gone, roads were created connecting all hills and mountains to carry the pine logs that were cut, and more people settled because of the new job opportunities offered by burgeoning industries. Ignacio became a company driver. He knew how roads were built, how trees were felled, and how they were transported, processed and finally turned into plywood. The logging industry turned the town into a bustling city, bringing brains and more skills. It also made the area warmer and converted acres of forest into bare mountains.

Being their doctor, I regularly examined patients. Bronchial asthma cases were common in the area. I believe they were more common than in Manila. We always blamed the cold. “We must be thankful it is warmer now so exacerbations are less,” I would tell my patients and their families. But such a conclusion was not evidence-based. We cannot really prove in numbers that there have been fewer exacerbations because of the warmer climate for indeed we have not considered the effect of increasing pollution on these patients.

This turn of events was significant to me because of the cough complaints that I handled every day. The majority of these were common viral and bacterial illnesses. Many were allergic, chronic obstructive pulmonary disease (COPD) or pulmonary tuberculosis. They kept coming back and it was difficult and expensive to treat them. It was not a simple “Take this drug and you will be OK in five days”, but a complicated regime of educating patients in diet therapy, lifestyle change and good compliance. I even searched for alternative solutions, especially for poor families who could not afford inhalers that cost up to 30 dollars.

Effects of climate change to health have been varied. Studies confirm that pollution increases exacerbations in bronchial asthma and COPD.^{1,2} The frequent use of pesticides in surrounding agricultural zones has also increased respiratory and skin allergies.³ It was expected because pollution causes biochemical changes in air, water and soil causing reactions in our bodies during contact.

As trees have been cut, malaria cases have decreased. This was another major effect because of the disappearance of niches where mosquitoes thrive. The conversion of forest land into agricultural land and the establishment of irrigation systems introduced schistosomiasis, requiring a complete dose of environmental control, public education, prevention and treatment. Pesticides as a probable cause of cancers are not exempted from this discussion, as well as developmental delays, genetic abnormalities, malnutrition, rheumatic diseases, Parkinson’s disease⁴ and degenerative conditions. More evidence is needed to prove these.

Was the logging industry a main contributor to these diseases? Modernization, urbanization and industrialization have indeed brought changes in my country, as well as in many other parts of the world. These dramatic changes provided jobs to people, raised families and brought in better education and medical services. The economy improved along with increasing food production, better roads and reduced unemployment and poverty. On the other hand, development also introduced a new brood of diseases that are difficult to manage. Then we ask again why? And we develop new programmes to control them, but only after the families and governments have spent much to treat affected members.

It is an important lesson for those in the public health and social development field: “For every action, there is always an equal and opposite reaction,” said Newton. The development strategies of the recent past in middle-income countries were implemented without much thought to the environment and public health. All we considered was economic growth and the money that development could bring.

Will changes benefit the poor? Will development be good for the children, the elderly, the immune compromised and the chronically ill? Will minority groups have an equal share in progress? How we wish we had thought of these aspects before cutting down the trees and converting forests into agricultural land. How we wish we had been wiser before our families were forced to use steroids for the treatment of allergies and respiratory conditions. How we wish we had implemented sustainable, pro-health and pro-environment strategies before more members of our families were diagnosed with cancer.

Unfortunately, citizens and governments of low- and middle-income countries are still concerned with economic growth. Yes, the issue of climate change and being green is

part of daily discourse in high-income countries. Soon, you people of the “developed world” will be way ahead with your solar panel roofs, bio-automobiles, low-energy aeroplanes and wind farms. Then, you will look at the major indicators of the UN Millennium Development Goals and will be surprised why they are not being met. You will look back and say, “What happened? Why didn’t the low- and middle-income countries achieve it?” Then you will raise more funds and develop new programmes and strategies to aid the laggards. Back to square one! Poverty will still cripple the minorities and new diseases will emerge because growth is not sustainable. We are simply not ready to face the health consequences of climate change.

Yes, the challenge of climate change among low- and middle-income countries is different. We are still at the stage of educating people and helping our leaders make new policies geared towards environmental protection and energy efficiency. We certainly cannot afford bulk amounts of green gadgets. We need to develop strategies that will contribute to our much-needed growth but preserve our natural resources, our environment and the health of our people.

“The trees are growing healthy again,” Ignacio commented as he drove me this month. We passed by a small hill near the city where new pine trees have been replanted. They were healthy young pines about two metres tall. They looked beautiful, green and healthy. The city has made it a priority to bring back its reputation as a summer capital, a city in the forest, a cool place for relaxation along with stable economic growth and an efficient health-care system. It was a difficult task for the local government and its leaders, but they have made their first step.

It was a statement of hope. After all, we live on this planet. We played a part when things went wrong and we can share a hand to correct them. Before we formulate policies or implement strategies, we should study well, inquire and search for answers, and project long-term effects on the economy, environment and human health before it is too late.

From a public health perspective, climate change is yet another complex issue. It is more than building greenhouses, eating green foods and walking to work. It is more than green elevators, biofuel and efficient energy sources. The issue of climate change should generate policies that embrace sociocultural understanding, behaviour change, economic growth, health and environment education, alleviate poverty, increase employment, build strong transparent governments, finance an efficient health-care system, and much more. Researchers, scientists, and global, national and local leaders have a lot to tackle.⁵ We have learned many lessons and there is hope. The trees have grown again.

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3 Hoppin J. Pesticides and atopic and nonatopic asthma among farm women in the Agricultural Health Study. *American Journal of Respiratory and Critical Care Medicine*, 2008, 177:11–18.

4 Link between pesticides and Parkinson’s strengthened with family study. *Science Daily*. 29 March 2008 (<http://www.sciencedaily.com/releases/2008/03/080328070136.htm>, accessed 21 April 2008).

5 American Public Health Association. Blueprint for Climate Change (www.nphw.org).

Lester Sam Geroy graduated from the University of the Philippines College of Medicine. He worked in Bukidnon, Mindanao in the southern Philippines as a City Health Physician for two-and-a-half years in the areas of outpatient care, sexually transmitted infections and HIV. He also focused on traditional and complimentary medicine, youth health, forensics and health-care systems. Lester became interested in environmental issues through his background in biology and membership of an undergraduate ecological society. A concert pianist, Lester has organized piano festivals for community development projects and the environment. Lester also completed international health-related studies at the University of Tampere, Finland.



Victoria Hall, United Kingdom

**CLIMATE CHANGE AND HEALTH:
RESEARCH ON VULNERABLE
GROUPS OR RESEARCH FOR
VULNERABLE GROUPS?**

A timely question to ask of current research on the potential health impacts of climate change on vulnerable groups is: “For whose agenda is the research being carried out?”. This is an important question because asking why a research study was undertaken reveals what types of impact the researchers intended their findings to have. It is the assertion of this essay that much of the current research on climate change and health relating to vulnerable populations has not been conducted according to the priorities and needs of these groups themselves. In general, it has mostly been research *on* vulnerable groups rather than *for* vulnerable groups.

We must shift our focus towards researching *for* vulnerable groups, and if we are to achieve this we must change the type of research we do. This essay will therefore argue that the biggest challenge for research on vulnerable groups is to reorientate the research agenda towards generating research with the needs and priorities of these vulnerable groups as the overriding concern. Achieving this may well necessitate less emphasis on global scale epidemiological studies that seek to quantify future health burdens attributable to climate change and more emphasis on policy research that asks how we can improve the health status of vulnerable groups now.

Current data on future health impacts attributable to climate change suggests that the extra burden is likely to be surprisingly slighter than has often been assumed.¹ There are of course many methodological problems with such epidemiological studies, with key concerns of extrapolation, variation, adaptation and modification. However, if we look at the breakdown of future mortality by disease category we see that malnutrition and diarrhoea are likely to be the major categories with increased mortality.¹ These are both diseases of poverty: conditions that would be entirely preventable were it not for stark social and economic inequalities. These are diseases that result from a lack of resources and capacity to purchase sufficient food and an inability to gain access to sufficient and acceptable water and sanitation. It will be these groups, who today experience the heaviest burden of diarrhoea and malnutrition, and who will suffer from an increased burden due to climate change. Then as now the overarching cause will be the same: poverty. Despite all the uncertainties inherent in predicting the scale and scope of the future health impacts of climate change, what can therefore be asserted with confidence, is that the poorest and most vulnerable groups will suffer the most, globally.

The scale of the current burden of diarrhoea and malnutrition is a sober reminder of the gross inequalities in global health and of our failure to introduce sizeable improvements in the situation, despite extensive research in the water and sanitation fields. It is estimated that 1.8 billion people do not have access to improved water supplies and 2.6 billion do not have access to improved sanitation. There are four

billion cases of diarrhoea each year and 1.8 million deaths, most of which occur among children under five years of age.² A study that has estimated the relative risk of deaths due to diarrhoea in 2030, with projected levels of climate change in comparison to the risk if climate stayed the same as in the period 1961–1990, has reported relative risks of 1.08 in west Africa, 1.08 in east and south Africa and 1.9 in South-East Asia. An increase of around 8% on the 2004 figures would give an extra 144 000 deaths.¹ Considered in the light of 1.8 million deaths in 2004, it is clear that the effects of climate change will not change the scale of the problem; the situation we have now is in the same order of magnitude as that predicted in 2030. As such, it appears nonsensical to continue to focus on the question “how many more people will die or become sick as a result of climate change?”, given there are so many preventable deaths occurring every day.

It might be argued that figures on the future global burden of disease attributable to climate change are useful for advocacy purposes, to galvanize support for greener policies and behaviours in developed countries. However, populations in developed countries have grown accustomed to the imagery of global health inequalities. The public appears more responsive to images of catastrophic and irreversible environmental events, which are predicted to increase with climate change. Therefore, in order to raise awareness and encourage behavioural change perhaps a different approach is required. In any event, tackling the health burdens of diarrhoea and malnutrition requires action at the political, grass-roots and policy level, not the vertical programming of philanthropic efforts.

Furthermore, seeking to reduce the anthropomorphic pressures driving climate change in the hope of averting future negative impacts ignores the fact that the problems are already urgent. By focusing on minimizing climate change impacts we will not significantly improve the health of vulnerable populations. This is not to dismiss the importance of greener policies and behaviours, but it is important to recognize that these are two different research priorities.

If we are to carry out research which prioritizes the needs of vulnerable groups, then the focus must shift from epidemiological studies seeking to quantify health burdens, to research on how to develop and implement policies that improve the current situation. We need research questions that: address how the health status of vulnerable groups in low-income countries can be improved; evaluate what sustainable policy solutions are possible; and, investigate the implementation and outcome of policies when they are introduced. This will require more input from the social and political sciences in order to approach the problem from a wider perspective; to consider power differentials and social hierarchies and to address the role of public participation in agenda setting and decision-making and the accountability of decision-makers.

There needs to be a fundamental shift in the research time frame, away from a focus on future climate change impact scenarios, to the present, so that the current needs of people suffering from the same diseases get addressed. This is also important because finding solutions to current problems should help mitigate future problems. Reducing the vulnerability of current vulnerable groups should lessen the future health-related impacts of climate change. As stated above, the two key categories of mortality likely to be most affected by climate change are malnutrition and diarrhoea.

The greater mortality and morbidity through diarrhoea and malnutrition, anticipated to occur with climate change, is contingent upon the underlying causes of these two preventable conditions remaining much as they are today. By reducing the current burdens of these diseases through focusing on the underlying causes of poverty and inequality, these populations will be better able to adapt to and resist the added future strains imposed by a harsher climate.

Current research should therefore be about trying to make these vulnerable groups less vulnerable – less vulnerable to heavy burdens of diarrhoea, malnutrition and infection, and ultimately less vulnerable to the health impacts of climate change. Is this not a worthwhile research agenda to set?

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- 1 Campbell-Lendrum D et al. The global burden of disease due to climate change: quantifying the benefits of stabilization for human health. *The proceedings of Avoiding Dangerous Climate Change Conference*, Exeter, United Kingdom, 2005 (<http://www.stabilisation2005.com/programme2.html>, accessed 20 August 2008).
 - 2 World Health Organization/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (http://www.swissinfo.org/en/141_wshintro.html, accessed 20 August 2008).
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**David Heller, USA****BRIDGING THE RESEARCH-POLICY
GAP: THE CHIEF CHALLENGE FOR
ADDRESSING HEALTH EFFECTS OF
CLIMATE CHANGE IN BANGLADESH**

Many have argued convincingly that climate change will devastate Bangladesh more than any other nation. Reports on Bangladesh have further discussed the means through which processes, such as salt-water intrusion, drought and vector range expansion, may dramatically increase the disease burden from water- and vector-borne conditions, malnutrition and other causes. Yet this research, like much work in public health, was created not simply to document a problem but to effect policy changes to address it. However, the global community and Government of Bangladesh's interest in developing policies to adapt to and control this shifting disease burden is presently minimal. The chief challenge for climate change research in Bangladesh is how to convert it to specific policy change.

Sadly, the gap in this research-policy interface has been documented in countless other domains of health, in Bangladesh and elsewhere. But the civil society and health research apparatus of Bangladesh is strong enough to work in tandem with the government to address the issue systematically, using a model that has achieved reforms in health equity. To do this, it will need to increase the output of accurate local data on climate change effects in Bangladesh. More important still is the need to publicize these results in a format that policy-makers can understand. Although Bangladesh has played little role in the processes of pollution and resource depletion that fuel its current climate change crisis, its government must embrace evidence-based policies to prepare for it nonetheless. The research community's greatest challenge will be to ensure this result.

A gap between research and policy has been well documented in multiple aspects of global health. Andrew Oxman, for example, has argued "...systematic reviews and concise summaries of findings are rarely used for developing recommendations".¹ Yet few have actively attempted to bridge the gap between these two fields. One example comes from Bangladesh: the Bangladesh Health Equity Watch (BHEW), a coalition of four civil society and governmental organizations tasked both to generate research on the status of health inequities nationwide and advocate for policies to address them. In my work examining options for bridging this research-policy gap, I travelled to Bangladesh to complete a case study of the successes and challenges this group has encountered. I contend that BHEW has developed innovative new means for converting research findings to policy that could be applied to the climate change issue both to generate more useful data on potential solutions, and foster the public dialogue needed to ensure their implementation.

The Government of Bangladesh has drafted a formal plan to address the multisectoral effects of climate change, but it fails to incorporate known data on the severity of the problem and gives insufficient attention to the effects of climate change on health. Its National Adaptation Plan of Action (NAPA), finalized in late 2005, notes such potential health threats as heat stress, elevated susceptibility to infectious

disease and increased frequency and severity of flooding and cyclones. It also claims, however, that “...the extent of such impacts has not been quantitatively assessed yet”. It notes that Bangladesh’s weak health system, as well as poor public sector health spending, will likely exacerbate any such effects, and that the toll will be especially great for the “...poorest and most vulnerable”.²

The proposal, which has yet to be implemented, is a testament to policy-makers’ present unawareness of an impressive range of data on the effects of climate change on human health in Bangladesh. A 2000 study found that cholera outbreaks in Bangladesh are highly correlated with the temperature rises caused by periodic El Niño-Southern Oscillation (ENSO) shifts;³ conditions similar to the temperature rises observed in Bangladesh demonstrated in recent years.⁴ Moreover, the cyclones that have long ravaged the nation have been projected to increase in frequency and severity with such temperature shifts.⁵ This is not to say that more research is not needed; no detailed assessment has been made of the number of disability-adjusted life years (DALYs)⁶ likely to be lost in coming years with climate change projections, for example. However, there is much information already available that has yet to be harnessed for policy change. The challenge is how to ensure that such research is continuously generated and incorporated into state policies on which the people of Bangladesh, especially the lowest-income, now must depend for relief.

Fortunately the BHEW and other similar instruments, developed in Bangladesh to generate such research and transform it into policy change, offer a path through which to achieve the above scenario. By constructing a similar group tasked with the development of evidence-based, pro-poor climate adaptation policies, Bangladesh can ensure that research on the health effects of climate change addresses the needs of the most vulnerable. I describe here how such a research-to-policy action group should be organized to tackle this challenge, on the basis of the successes and shortcomings of the BHEW model.

The BHEW coalition aims to address health inequity to effect policy change through novel research on the extent, causes and potential solutions to the problem. It also aims to disseminate, publicize and institute these findings. Since 2004, the BHEW has generated four major reports on specific health inequities in Bangladesh, such as the size of the gap in immunization status across socioeconomic lines.⁷ Yet it also succeeded in helping United Nations (UN) and civil society groups in Bangladesh, such as Save the Children and the United Nations Children’s Fund (UNICEF), to gather additional data on health outcomes as a function of social class.⁸ A group tasked to adopt the same approach to climate change issues in Bangladesh could produce ample new data on the size and severity of changes in weather patterns, clean water access, or other indices associated with climate change, as well as their consequences on the health and nutrition status of these regions. It could also stratify these results to demonstrate the degree of effect on the poorest residents. Such data, alone, could be a potent weapon in mobilizing national and international action against climate change, especially because it would come from local researchers.

Yet BHEW has also piloted novel advocacy strategies that could be still more important in the generation of national policies to control climate change. An Equity Dialogue newsletter published new data from multiple sources on health inequities and disseminated this information to high-level policy-makers across Bangladesh.⁸ BHEW also developed a subgroup, the Bangladesh Health Watch, tasked specifically

with high-level advocacy on behalf of this work, and developed programmes in which young researchers could learn how to conduct such research. Furthermore, it developed an Equity Forum to bring together policy-makers, researchers, media and others to highlight political commitment to its work and to publicize it⁸, along with press conferences and newspaper advertising to draw further attention to its work.

The successes and challenges of this programme can guide the construction of a similar effort to study and publicize solutions to climate change. Newsletters, forums, advertising and press conferences work to highlight the novel data on climate change that such a group would generate from itself and others. Such strategies might also impel both the Government of Bangladesh, and perhaps the governments of the many developed nations whose consumption patterns impact upon it, to address local outcry regarding the implications of such findings. If the Bangladeshi Government were involved in such events and structures from the outset, this process would not be perceived as adversarial because it would help the State to gain credit for early, consistent and evidence-based commitment to climate change policy. Such a commitment could also help garner further donor support to assist in the implementation of such policies.

The adoption of the BHEW model to climate change in Bangladesh could generate new local data necessary to drive public commitment for addressing this challenge. More importantly, it could generate the publicity and political will through which such data becomes policy. The means through which such policy impact is to be measured remains a research challenge, but in any case the output of BHEW to date suggests this approach is a promising first step towards addressing the gap.

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- 1 Oxman AD, Lavis JN, Fretheim A. Use of evidence in WHO recommendations. *Lancet*, 2007, 369(9576):883-889.
 - 2 *National Adaptation Programme of Action (NAPA)*. Final Report. Dhaka, Ministry of Environment and Forest, Government of the People's Republic of Bangladesh, 2005 (<http://unfccc.int/resource/docs/napa/bano.pdf>, accessed 4 May 2008).
 - 3 Patz JA et al. Impact of regional climate change on human health. *Nature*, 2005, 438 (7066):30-37.
 - 4 Adger WN et al. Adaptation to climate change in the developing world. *Progress in Development Studies*, 2003, 3(3):79-95.
 - 5 Ali A et al. Climate change impacts and adaptation assessment in Bangladesh. *Climate Research*, 1999, 2:09-6.
 - 6 DALYs for a disease are the sum of the years of life lost due to premature mortality (YLL) in the population and the years lost due to disability (YLD) for incident cases of the health condition. The DALY is a health gap measure that extends the concept of potential years of life lost (PYLL) due to premature death to include equivalent years of "healthy" life lost in states of less than full health, broadly termed disability. One DALY represents the loss of one year of equivalent full health. (<http://www.who.int/healthinfo/boddaly/en/>)
 - 7 Chowdhury AM et al. *Who gets vaccinated in Bangladesh? The immunization divide*. Dhaka: Bangladesh Health Equity Watch, 2002.
 - 8 *Bangladesh Health Equity Watch*. Final Report January 2000 - June 2004. Dhaka, Bangladesh Health Equity Watch.
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Aliea Herbert, USA

GLOBAL CLIMATE CHANGE, INDUSTRY
AND VULNERABLE POPULATIONS –
AN INTERSECTION OF THE THREE
IN THE CIRCUMPOLAR REGION

Environmentalists, public health researchers and policy-makers must work with one another to strike a “Goldilocks” balance between health promotion and protection along with sustainable expansion of economies. Climate change will bring more traffic through the circumpolar countries via expansion of Arctic sea routes, potentially threatening the environment and public health of populations on five continents. Research to generate and inform dialogue on this topic will help prepare populations, policy-makers and industry for this activity boom. Applying lessons learned from global shipping endeavours will only begin to protect this vulnerable frontier, helping stakeholders adapt to new realities and protecting the populations there.

Global warming offers both opportunities and dangers. Commercial industry sees an opportunity to fill market vacancies created by global warming. Capitalizing on these and new developments, translates directly to profits. With new economic frontiers (both novel and expanded markets and industries), comes the development of health problems as a result of increased industry, increased traffic and changing population demographics. Add to this a layer of uncertainty provided by climate change, with temperature increases at the poles being more drastic than in any other region of the world, and the circumpolar region is positioned for major, yet largely undefined, changes. Dialogue and action to address potential issues early is cost effective and should be emphasized now. Lessons learned from shipping and mining industry expansion in other regions can be applied, but some issues are unique to this wilderness.

The shipping industry is gearing up to increase traffic through the Arctic Circle as polar temperatures rise and remove the largest historical impediment, ice. Where many see tragedy, this industry sees opportunity. By 2050, the Arctic summers will be ice-free, allowing for unimpeded access to northern sea routes for almost half of the year. Analysts predict routine Arctic shipping in three decades. As this route takes shape, however, more people and cargo ships will pass through northern ports bringing more than just their share of goods and services. Higher volume traffic presents threats to the environment and health of the populations; some seen previously, and others that will be unique to the circumpolar region because of its geography.

The shipping industry presents a danger to the local ecosystems, and in turn, area populations, through the introduction of invasive species. These species have the potential to devastate local ecosystems, as well as act as vectors for diseases never seen in the population’s history. One example of non-native species introduction by the shipping industry is in the (American) Great Lakes, where viruses introduced by contaminated ships ravaged fisheries. In light of climate change, invasive species introduction has yet unseen potential to affect environment and public health

in the event of an animal to human disease mutation. In the circumpolar region of the world, the effect of non-native species introduction will be catastrophic when viewed in context with the largely naive, endemic speciation, as well as the accelerating factor of rising temperatures. Other regions have demonstrated how legislation can be effective in protecting harbours, and such an approach must be considered in this case.

Identification of potentially vulnerable populations and regions as poised to experience significant changes as a result of global warming can prevent problems in the future. Cues from economic and political dialogue can help identify patterns of movement by capital investors and populations for work. Where there are jobs, people will travel. Circumpolar health systems will be taxed by increased volume brought by the expansion of the energy and shipping industries as the Arctic ice melts. Research and policy interventions are necessary now, to dampen effects of changes beginning in the region. Indigenous populations are already vulnerable and losing ground to both chronic and infectious diseases. Increased traffic in the area will further complicate their struggles.

Cooperative, collaborative research between the public health, environmental health and economic development sectors in this area of the world will support policy interventions by governments to buttress health effects as both the climate and populations shift. Vulnerability can be assessed on local, national, regional and international levels.

Taking climate change into account, business will move towards new vacuums of unmet need or opportunity and the populations to support these ventures will follow. Doing business is a key motivator for the migration of populations. Research by the Canadian Miners Union has shown that as workers migrate, they can change the health profile of a region. African-American miner migrants have higher rates of diabetes and cardiovascular disease than traditional Canadian miners. These new populations will place new strains on health systems. Additionally, booming mining towns in other regions of the world, such as Venezuela, have become hot spots for infectious diseases, such as HIV and tuberculosis. Although multinational resource mining industries have a history of maintaining the health of their employee populations and contributing to infrastructures, local populations will nevertheless be impacted as demographics shift.

This transition could lead to increased burdens on the health system if not addressed early and effectively with policy and programme development. Tiny Iceland is set to become a trans-shipment point, greatly increasing its influence in this industry and in the global economy. Future impacts of increased traffic on the small nation include burdens of rapid and unwise urban growth, drug use, prostitution and social diseases, as has been seen in other economic “booms”. In the region, Sweden’s policy model for regulations protecting against the introduction of these potential burdens is respected. Additional vulnerable populations may exist within migrant populations to this region. As industries expand, worker populations will also expand to northern Canada and Alaska. The health of these individuals must also be considered. Generally, climate refugees are thought of as the world’s poor, sea-level, equatorial populations affected by rising seas. In this case, a vulnerable population may emerge as commercial traffic capitalizes on global warming.

Finally, these industries present hazards to populations, making them vulnerable in the event of an accident. As traffic increases, the odds of an accident also increase. Policy discussions held now to regulate these industries will best protect the populations in this region, preventing future vulnerability. The infamous Exxon Valdez accident, the largest oil spill in United States of America's shipping history, has yet to be resolved after almost 20 years. Research to better define populations at risk in this area is critical in shaping such policy discussions.

Data lags behind the problems that it highlights. Important opportunities for acting to prevent harm are lost while waiting for data that indicates which populations and health systems are becoming vulnerable or overburdened. Even if we could eliminate emissions today, global warming would continue. Prevention is more cost-effective than damage control and we must prevent populations from becoming vulnerable through timely and appropriate forethought; this is the future of both environmental and public health. Environmental health translates to public health as both a canary and a catalyst, especially in situations enmeshed and amplified by climate change, such as the expansion of industry in the Arctic. Dialogues begun now will shape the policies and the future of populations in this region set for rapid, exponential changes as a result of global warming and climate change. Through research and industry dialogue, identifying populations likely to be negatively impacted in the future and preventing them from becoming vulnerable must be our goal as health professionals. We cannot wait until people suffer or die to act.

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Steven Justin Hoffman, Canada

GLOBAL HEALTH ADVOCACY FOR
EVIDENCE-INFORMED CLIMATE
CHANGE POLICIES THAT AIM
TO PROTECT THE WORLD'S MOST
VULNERABLE PEOPLE

The realist theory of international relations proposes that nation states are the dominant players in our global society. The composition of the United Nations (UN) and its principal organs no doubt reflects this worldview, as does its authority that is linked to its members' recognized legitimacy, size and unmatched capacity to raise resources. While this supposition is increasingly criticized in an age of globalization, its relevance is evident for environmental issues, which – unlike many other global challenges – are especially reliant upon national government monopoly on regulation and the legitimate use of coercive powers. Yet paradoxically, the short-term and self-interested nature of government policy-making provides little incentive for collaboratively addressing this issue. This unfortunate reality is particularly true for climate change, whereby the release of greenhouse gas emissions in one place may not carry any discernable consequences for that locale or any immediate negative effects for those to whom policy-makers are responsible.

There is, however, an understanding that health issues, unlike those of the environment, are of urgent self-interest to states and they are therefore more willing to cooperate in this area. Recent events have shown that global collaboration is possible on various initiatives (especially those relating to health security, such as the International Health Regulations and global pandemic preparations), and that its success can yield significant achievements such as the ratification of binding legal instruments (e.g. Framework Convention for Tobacco Control) and the eradication of communicable diseases (e.g. smallpox). As the scientific link between climate change and human health solidifies, the opportunity to tackle this issue using the comparative advantages of a health paradigm will become available. Global health advocates must seize this opportunity to force decisive government action by taking immediate ownership of the climate change challenge and confronting it as a global health catastrophe of the first order. Early efforts by the World Health Organization (WHO) to link climate change with health security, for example, are encouraging. The organization has recently taken steps to champion this issue internationally and has declared that it is “...committed to do everything it can to ensure all is done to protect human health from climate change”.¹

National policy-makers, however, will not be compelled to make difficult decisions to protect the environment (and the health of their citizens from changes to it) unless they are provided with evidence to support them. This must entail the production of high-quality, locally applicable and policy-relevant research, as well as the effective dissemination and translation of this research to policy-makers who have the ability to act upon it. Both elements are currently being neglected.

The production of high-quality research to inform policy-making processes requires greater investment in building capacity to not only conduct research but also to

acquire, assess, adapt and apply it appropriately to each policy context. Indeed, according to the Alliance for Health Policy and Systems Research², enhancing capacity requires that international funding and development agencies support *all* aspects of evidence-informed policy-making, including: national research priority setting; knowledge generation and dissemination; evidence filtering and amplification; and, the policy-making process itself. The current focus on knowledge generation, while important, must not deter global support for the other areas as well.

Locally applicable research, on the other hand, demands that the international community finally resolve the “10/90 gap” between health needs and research investments in developing countries. According to the Global Forum for Health Research³, evidence is most relevant to policy-makers when it is generated within country and by local researchers themselves. Whereas developed countries have benefited enormously from the knowledge and technological progress achieved through research, the same cannot be said of developing countries that continue to lack basic research infrastructure and the critical mass of researchers necessary to find innovative solutions to their most pressing local challenges. International research funding agencies must also allow for national ownership of research priority setting and empower local decision-making bodies with greater control over how funding is allocated.

Finally, the need for policy-relevant research means that greater priority must be given to climate policy and health systems research, which is the type that is most relevant to inform policy-making processes. Such research is necessary for policy-makers to select and implement interventions to curb climate change-causing behaviours in developed countries, and to strengthen the governance, financing and delivery of health care in developing countries that will disproportionately suffer its inevitable consequences. Researchers must be given the resources to address questions related to the effectiveness and efficiency of interventions, as well as to address how national policy-makers can best implement them. The necessary investments by the international community in these three areas, however, have not yet been forthcoming. Urgent action is necessary if we ever hope to meet this research challenge.

Nevertheless, even if there is sufficient high-quality, locally applicable and policy-relevant research to adequately inform decisions; they will not be useful unless policy-makers are made aware of them. The importance of linking research to policy is indeed well established and particularly essential for health systems in developing countries. As the “bottleneck” that slows the full implementation of existing interventions, just one package of health interventions (if fully implemented) has been estimated to have the potential of reducing child mortality by two thirds and maternal mortality by three quarters.^{4,5} Yet studies continue to reinforce the view that policy-making for health systems is often not informed by research evidence.^{6,7,8} The same is almost certainly true for national climate change policies as well.

Bridging this “know-do” gap to address the climate change crisis thus depends upon the development of mechanisms to support evidence-informed policy-making and the facilitative efforts of global community members. International organizations, such as those within the UN system, may be uniquely situated to meet this challenge of mediating between research and policy because they are often relied upon by developing countries for technical guidance, as well as the financial support that may accompany a commitment to follow it. Yet despite this opportunity, multiple

studies now suggest that international organizations, specifically WHO and the World Bank, may not be using research evidence consistently when formulating their policy recommendations.^{9,10,11} If true, such negligence could be seen by the world as a dereliction of duty that carries consequences of global proportions. Fundamental changes would no doubt be necessary to the way in which these technical agencies operate and the value that national policy-makers place on them. Finally, efforts by these organizations to tackle climate change would be tainted and any use they make of a health paradigm to lead global advocacy efforts would be discredited.

Perhaps the saddest thing about this potentially squandered opportunity is that it is the world's most vulnerable people who will suffer the greatest. Not only will their governments have lost (what they previously thought to be) a credible source for evidence-informed guidance on which many depended, but they will also be disproportionately affected by the devastating climate changes to which, ironically, they contributed least. Indeed, the consequences of climate change will not be evenly distributed, but rather, will exacerbate existing problems that are concentrated in developing countries, such as malnutrition, extreme weather, water scarcity, heat waves and greater transmission of diseases. Furthermore, these developing countries are also the least able to afford protection for their citizens from climate change or mitigate its effects.

As our understanding of climate change as a health issue increases, it will be of utmost importance that global health leaders assume ownership of this challenge and use the comparative advantages of their paradigm to overcome it. High-quality, locally applicable and policy-relevant research will be essential, as will knowledge translation mechanisms so that policy-makers have the ability to act upon it. International organizations, which have the potential to serve as important intermediaries between climate change research and policy, must not abdicate their role in providing evidence-informed policy options. They must assume global leadership in this area by placing research at the centre of their advocacy efforts. Finally, the world's most vulnerable people must not be forgotten as they will suffer the most devastating consequences of climate change and are the least able to confront such consequences.

It is clear, according to UN Secretary-General Ban Ki-moon, that "...our collective [climate change] efforts can foster social and economic development for the world's poorest peoples, improving their health systems and their lives".¹² Climate change no doubt requires global collaboration among researchers, global health leaders and national governments on a scale that may never have been necessary before. Placing science and knowledge translation at the centre of intensified efforts by the international health community may indeed be the key to our planetary survival. While the words of the UN Secretary-General may give us hope, the consequences of failure have never been so great. Perhaps we must envision a future in which global health leaders are prominent advocates for evidence-informed climate change policies that aim to protect the world's most vulnerable people. This future, fortunately, need not be too far away.

1 Margaret Chan, WHO Director-General, 7 April 2008.

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- 12 UN Secretary-General Ban Ki-moon, 7 April 2008.

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Amjad Idries, Sudan

ADDRESSING CLIMATE CHANGE AND
ITS HEALTH IMPACT:
IS IT ONE OF THE PRIORITY AGENDAS
IN DEVELOPING COUNTRIES?

In a nation like Sudan, internal ethnic conflict in many areas, such as Darfur, represents one of the main features influencing the country's demographic map. As a result of these conflicts, the demographic situation in Sudan is extremely challenging for both civilians and government every single day. About four million people in my country are considered displaced citizens due to these conflicts. When we look at their daily lives, we realize that the limit of their goals and dreams is simply being able to access enough food and find safe shelter and security against a range of threats. In addition to these four million, a further 11 million live below the poverty line; not to mention the health status of all these people, which is contributing to a disease burden map that consumes most of the available governmental resources.

As you can imagine, Sudan's very complicated social and health situation means that the position of the global climate change issue sits low in priority on the national agenda. The prioritization of building consensus at all civilian and political levels of the importance of this issue in state executive plans – in the areas of environment, climate and health – therefore remains a persistent question.

In this context, I am dealing directly with Sudan because it is my country and I have a good understanding of its situation; however, let us view this issue from a different and broader perspective. The specific situation in many developing countries in Africa, Asia and Latin America may vary, nevertheless they are all the same with regard to people suffering from problems that affect their lives in a direct or indirect way, i.e. problems that increase stress in their daily lives.

I might be among the proportionally few, lucky people with the opportunity to acquire a good education that, in turn, enables me to understand the issue of global climate change and its implications for people, especially in developing countries, and how it will affect the economies, health and social aspects in these countries. In this context, I think about the millions of my brothers and sisters of my generation around the world who would consider this issue as beyond their concern, or even, more likely, beyond their knowledge or awareness. Their lack of access to education and knowledge lends an ethical dimension to this kind of issue because a lot of people do not know or understand the consequences of the phenomenon of climate change.

I thought about all these ideas when I discussed this issue with one of my friends a year ago. This friend is a colleague who is working in North Darfur State. He summarized his opinion of this issue in these words: "Do you think, my friend, that I could really be concerned if the government decides in this critical period of our history to allocate some resources or even to orient the public about the climate changes? Or will I be more interested if this attention was oriented to protect my

grandmother and grandfather in the far west Darfur as, in fact, they are neediest to this consideration because they are under risk in every hour, simply because they haven't any safe home?"

Many nations are unaware that peoples and governments in developing countries consider climate change to be the result of the policies of industrial and developed countries, and that all the issues that are arising from climate change should be the focus of (and solved by) developed countries. In general, I totally disagree with this because I think that in order to attain real solutions for this issue we have to ensure that there are lobbies representing all affected groups (and those who could be affected), and that they should act to ensure the availability of minimum guarantees for stopping the continuing growth of this crisis to even more complicated levels.

It is obvious that political support for global issues is an important factor in achieving success in any of the interventions aimed at protecting against the impacts of this phenomenon, especially citizens' health in general and particularly for those who are suffering from complex conditions under the burden of disease, poverty and insecurity. Climate change and its effects did not attract any significant level of attention until it started to appear within the political agenda of developed countries, whose leaders had come under pressure from environmental protection groups and international organizations led by some concerned bodies in United Nations agencies. In our Arab and African countries, this issue was clearly not a priority for countries' leaders. In fact, most of the recent relevant studies found that these countries appeared at the bottom of the list of countries that care about placing this problem in the national policy agenda or even among public opinion polls.

Still, this situation represents a big challenge for all countries and organizations. Climate change affects the health and security of all the world's peoples, in different countries and across continents, with different levels of awareness and different health and social situations. One of the important essential issues that needs to be studied is how the continuation of this phenomenon will affect health, especially the impact of disease globally. By focusing on countries that are characterized by high morbidity and mortality due to some major killer diseases, a clearer picture of the world's disease map will emerge. Again, still another question could be asked in the name of climate change impacts: could these recent changes, or changes expected in the future, have any concrete effect in the appearance of new unknown diseases and/or alternating the magnitude or severity of now-existing common diseases?

If we look closely at these issues, we can well understand that there is a valid reason for concerns raised about the capacity of health systems in developing countries to meet the demands of climate change impacts in the middle and long term. This is especially important, as the efficacy of health systems under the current circumstances is questionable, particularly in terms of capacity to respond to recent natural disasters that have been linked to climate change. Such natural disasters include floods, acidic rains, tsunamis and mega-hurricanes. There has also been a remarkable increase in atmospheric temperature in different areas on earth, and the impact of these climate change events can affect and complicate health status in disastrous ways.

All these issues will lead our citizens to question their leaders and governments, especially about their plans to protect people's health from the impacts of climate

change, which is set to become a reality and not only a matter of predictions. People will want to know how their lives and health can be protected and what position these issues will occupy within the agenda of any public leader in government. Furthermore, people will want to know how precautionary plans will be implemented. This is critically important when we consider that in some countries a considerable number of people do not even have access to basic health care in terms of the prevention and treatment of common diseases.

Health research in the area of protecting human health in general, and especially with regard to the impacts of climate change, might be one of the very important strategic tools that could be used by countries in the process of anticipating and responding to this phenomenon. Good research could help determine the best strategies for implementing plans in this context, in a way that will match the situation in each country according to its internal environment, socioeconomic situation and affected populations. Certain major issues will become the responsibility of our health research system, to determine what kind of support is needed to equip those health systems for different climate change scenarios. Research data of this kind needs to feed into national health plans and include participation from civil society organizations. Moreover, the media is a valuable tool that could contribute to raising the level of public orientation and awareness of climate change. Media focus will help garner support for the initiation of research and the development of the policies and decision-making required to implement the measures necessary to protect the health of people around the world.

Amjad Idries is currently a doctoral student in the Faculty of Pharmacy at the University of Khartoum in Sudan. He works as a pharmacist in the federal Ministry of Health as Health Planning and Development Department Manager. In 2007, Amjad obtained a Fellowship of the Institute of Professional Managers (FIInstPM) and a IDipMBA in the United Kingdom. Amjad is interested in health system research and has conducted five national studies on the subject as a team leader in Sudan. He collaborates with several United Nations agencies in multisectoral partnership programmes in various areas of health. These efforts are undertaken in many states in Sudan, including the troubled Darfur region, and in the south. Amjad supports the concept of public-private partnerships in health care and promotes this policy option for developing countries.



Stephen Kariuki, Kenya

A BLURRED VISION

As far as health issues are concerned there are always international forums and meetings taking place around the world; debate on how to deal with health issues and, as always, pampered solutions on paper that rarely find their way to the people who need them most.

Firstly, we know few countries ever meet their health targets partly because health is not always a priority on their agenda. So every time there are international meetings, leaders from mostly developing countries come up with figures to show donor countries an improvement has occurred compared to the previous meetings. This is to make sure that donor funding continues uninterrupted. What do you do to countries that do not meet their targets? Reduce donor funding – of course not – or give hardline conditions to governments to comply? Whichever you pick, the end-user will be the loser.

One might argue that governments are better equipped to distribute funds since they know where best to apply the required resources. True, but what is the use of spending millions of dollars on research and statistics that pile up into millions of papers and result in few solutions. For example, a country is given more than US\$ 10 million in donor funding and only 50 000 treated mosquito nets are given out to 3 million people living in poverty. How do we tackle such situations?

The governments of developing countries should take the initiative in encouraging and funding successful student health-care projects. In developed countries, young people participate significantly in government issues and policies and also in the private sector. They are given a chance to contribute ideas and solutions to queries facing them and their country. Back at home in developing countries the only time they need youth participation is in the casting of votes to elect them back to parliament.

It is also sad to see international organizations doing little to engage youth in their projects. For example, a health clinic is built in a remote area by a nongovernmental organization (NGO), with the usual no questions asked as long as the job gets done and the NGO can report back home. However, after a few harsh climatic conditions, like blazing heat from the sun, the walls start giving in and cracks appear. After a torrential downpour the facility is submerged. Questions arise; someone somewhere did not do his work. Probably true, but it is an ignorant approach. If they were to approach local architecture students with this project, not only would the facility be on higher ground, but it could also be self-sustaining (i.e. using the weather to its advantage like using solar energy for electric lighting, collection of rainwater for its patients and so on). Students in health-care studies do plenty of research on what could be improved or initiated in health care so if the government collaborated with them we could achieve a lot.

The dissemination of information and campaigns undertaken by developing country governments is laudable, but they tend to be limited in number and not very convincing. Informing people on better ways of preventing disease and improving nutrition should not only be done when a certain season characterized by disease is near or on a certain international day. This typical behaviour aimed at gaining political kudos is commonly done by governments in developing countries. For example, governments should not wait for World Malaria Day to launch nationwide campaigns. Informing vulnerable populations should be done not once a year, but three to four times a year. Nationwide campaigns tend to alienate vulnerable populations from the larger population. The media, together with government and corporations, should demonstrate the will to involve the whole population. They should not wait for a disaster to occur. For example, floods in most countries occur at predictable times so governments can ask for volunteers to help in evacuations, buy certain essential products, give treated mosquito nets to infants, etc.

The next solution is infrastructure, infrastructure and infrastructure. To have any positive progress in health, governments should heavily invest in roads as the quickest way to penetrate remote areas. Due to ever changing climatic conditions more natural disasters are occurring frequently. Even if the government has enough resources in a situation where the roads are washed out or flooded, they are unable to get resources to needy people. Prevention is cheaper than the cure, so governments can improve the health situation for their people by simply enhancing existing infrastructure, like building dykes in areas prone to floods, or taking on neo-technology in the construction of roads, like the use of cement instead of tarmac because it is longer lasting and better weather resistant. Urban planning should be viewed from a broad national perspective, rather than just concentrating on the productive areas of a country. Road networks open up towns to prosperity. Most vulnerable populations living in poverty lack basic requirements such as education, health care, clean drinking water. Industries create employment for the local community thus the decentralizing of major towns is the way to go.

When it comes to slums where disease outbreaks are common, the upgrading of shanties cannot help in bettering slum dwellers' lives. They live with less than a dollar a day. This brings me to my fourth solution: community-based groups or foundations. This is not new, but what is the purpose of teaching a man to fish if he cannot even afford to buy the fishing tools? When governments are sensitizing the public to proper prevention methods and nutrition patterns, they should also encourage and fund community-based projects. Most NGOs and foundations in developing countries are run by foreigners. Supporting community-based organizations will help the community to stop relying on handouts. In areas where HIV is prevalent there tends to be a high number of orphans. The government should encourage the opening of local orphanages by providing financial incentives or looking for a prospective donor. The orphanage should also be an education centre in entrepreneurship training and skills to give it a lifeline. Where community-based projects are successful they can be replicated in other areas with similar circumstances and conditions. Governments should not wait for foreigners to do their work for them. The way they woo foreign investors should be the same way they woo local foundations.

Democrat presidential candidate, Senator Barack Obama, has promised the citizens of the United States "...universal health for all". Such a vision may seem impossible,

but like all great leaders he at least has a vision. The vision is there already and all it needs is the proper usage of weaponry and tools to catapult it to great heights.

Stephen Kariuki recently finished a diploma in Hotel and Catering Management at the Regional Institute of Business Management in Nairobi, Kenya. Before that Stephen studied architecture at the University of Nairobi for three years, but was unable to complete his degree because of financial problems. During his university studies, Stephen did volunteer work with the Centre for International Voluntary Services. This non-profit organization deals with environmental clean-ups, setting up medical camps, fund-raising, self-help efforts and community development projects. Stephen is currently searching for employment.



Henry Ko, Australia

**HIGH-TECH, LOW-TECH AND
BACK-TO-BASICS SOLUTIONS
FOR HEALTH RESEARCH**

I love a sunburnt country,
A land of sweeping plains,
Of ragged mountain ranges,
Of droughts and flooding rains.
I love her far horizons,
I love her jewel-sea,
Her beauty and her terror –
The wide brown land for me!

From “My Country” by Dorothea Mackellar (1885–1968)

It’s a sunny, hot and dry hillside dotted with yellow–brown patches of bushes and scrubs in rural Australia. I’m standing here looking out at the patchwork of farmland in the plains below. It’s far from Australia’s outback region, one of the most isolated and toughest environments in the world that the majority of Australians tend to shy away from, but rural Australia is tough nonetheless. It’s hard to imagine at the moment how access to anything, especially health care, for rural and remote communities could equal that of urban communities. As a child growing up in rural Australia, I remember that one of the most beautiful poems about this island continent was “My Country” by Dorothea Mackellar. It captured the essence of the environment – both its tenderness and its toughness. I’m not sure if climate change was high on the political agenda in her day, but her words hold a light to how climate controls our lives, especially for people like me, who live or have lived in regional, rural or remote Australia.

In Australia approximately 31.5% of the population lives in remote regions and rural areas.¹ Access to health research outcomes and services, its suitability for our needs and the economic sustainability of supplying it to us have been problems in the past, and with climate change I envisage it will only get more difficult unless innovative solutions are developed quickly.

Only in recent years have we understood how intricately dependent we are on the land, water and weather to provide sustenance and a home for us. Our well-being is dependent on the quality of the biosphere we live in. Those who have had a rural upbringing know that “Mother Nature” controls our livelihood. We know this from the day we are born to the day we die. Urban communities are now more acutely aware of the problems of food production security, the effects of disease transmission and the impacts of changing demographics on health research and health service provision. I truly believe it is time for agricultural and environmental research to share centre stage with biomedical research in improving human health outcomes.

Climate change is challenging food production security in our vast land. Reduced land quality has resulted in reduced grazing land for animals and agricultural crops. Salinity and poor topsoil conditions have also reduced the quality of farmable land. Record-breaking droughts, and then unexpected floods and storms have further made the predictability of farming harder. Add to this the unexpected and relatively sudden changes in seasonal weather, which may be attributed to El Niño and La Niña, and there is a grim picture for the vulnerable farmers and populations who reside in our rural and remote countryside.

Disease transmission is also another climate change issue. Rural and regional areas in Australia depend heavily on livestock to make a living. Australia is lucky that it is an island and has stringently enforced quarantine protocols that prevent diseased animals and plants from entering our ecosystem, and ultimately affect the health of the community. Animal and plant diseases are also a constant threat to our food supply. The most recent threat to our livestock was from equine influenza. The security of our food supplies also depends on preventing an outbreak of avian influenza and Newcastle disease that is a threat to our country's birds, poultry and even humans. Ensuring that we remain free of bovine spongiform encephalopathy, one of the few countries in the world to remain so, has been another important biosecurity aim. For biosecurity, prevention is the primary solution to remaining disease-free and healthy. Research into "techno-prevention" tools, such as advanced detection systems, quarantine protocols and high-tech animal and plant tracking systems, are high priorities.

But not all threats from climate change are due to climate and organisms – they can be economic as well. In recent years the need for alternative energies has meant that soft commodities have become valued economic elements, with their prices rocketing upwards, due partly to the trade-off for them to be used either as food or for bioethanol production. This causes rising food prices, which again has affected those least able to afford price rises – populations with low incomes, especially those living in rural and remote regions who have already been hit hard by poor agricultural and environmental conditions.

Forget the "techno-cures" of super-expensive, big breakthrough vaccine or blockbuster drugs, climate change and extreme weather patterns will change the health research playing field. Even though I believe that research into biomedical techno-cures can help, they are not the main solution to addressing both the "10/90" divide and climate change. These techno-cures include laboratory-grown meat. If climate change makes land no longer farmable, if there is a biosecurity breach in our animal livestock, or if demand in meat far outstrips the supply of livestock (especially from countries such as China and India that are increasing their dietary protein intake), this could be a solution to satisfy demand. Imaginative groups such as SymbioticA, from western Australia, have made this idea a reality through public scientific art installations of their laboratory-grown meat. Agricultural biotechnology research may encourage improved population nutrition due to the consumption of fruit and vegetables engineered with vaccines, micronutrients or macronutrients, as well as crops that can grow and thrive in harsh environments.

Renewable resource technologies, such as solar power and geothermal energy, are seen as solutions to ease global warming. Recent focus has also been on recycling,

water management and wind power. All these are aimed at improving the standard of living as well as easing the burden on our environment. If these technologies become economical, effective and widespread enough, we could see remote and rural areas being able to reliably and sustainably generate energy for powering hospitals and medical clinics. Other amenities currently lacking in these communities could be powered, such as water purifiers, sanitation and sewerage-processing facilities, which would improve the health of people living in these areas.

Rural and remote health services have been underfunded and underresourced for a long time and have not gotten the same attention as urban areas. In times of extreme weather conditions, an important rural service like the Royal Flying Doctor Service of Australia may find it hard to reach people. Electronic health, or e-health, could improve access of some health services. Even though it may not be a substitute for the flying doctor service, what telemedicine can do is bring some health services, such as doctor consultations, to isolated homes via satellite transmission.

I have participated in debates between the supporters of techno-cures and those of more holistic low-tech solutions. I attended the First World Forum on Science and Civilization at the University of Oxford, as well as the World Life Sciences Forum BioVision in Lyon, France, where the theme was the life sciences contribution to the United Nations Millennium Development Goals. I believe going for the scientifically exciting techno-cures to improving health may not be the wisest move. All too easily we forget to consult history for what really advanced humanity's healthy society is – being able to pump in clean water and drain out and treat wastes from inhabited areas. A professor of civil engineering once told me that this was the one major thing that improved humanity's health. It was not complex biomedical techno-cures. It was low-tech civil and environmental engineering. We should not dismiss low-tech solutions. The economist Jeffrey Sachs, speaking at BioVision, maintained that using bednets could drastically reduce the incidence of malaria. As a bioengineer and health researcher, I see this as a simple, economical and elegant solution to preventing a disease. Similarly, in the face of global climate change, using water tanks to store clean water is a simple and economical tool for water-scarce regions. Teaching environmentally friendly practices like water conservation and skills in sustainable farming may help improve community health and nutrition.

Even though I have left the dry sunburnt rural and remote countryside of my youth, I truly believe that combining research efforts for relevant techno-cures and robust low-tech solutions can improve health outcomes for the people who live there. Climate change, and the dramatic physical, economical and social environmental impacts it brings to all parts of our society, may finally force us to re-evaluate the priorities and strategies for health research from techno-cures to more holistic sustainable low-tech approaches that challenge the “10/90 gap” as well as environmental problems. I can only hope that re-prioritization happens quickly before more droughts, storms, floods and unpredictable weather destroy the land and communities that I grew up with.

1 Regional population growth, Australia, 2006–2007. Australian Bureau of Statistics (<http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/3218.0Main%20Features32006-07?opendocument&tabname=Summary&prodno=3218.0&issue=2006-07&num=&view=>; accessed 30 April 2008).

Henry Ko is a doctoral student in tissue engineering and biomaterials at the University of New South Wales in Australia. He is also a project officer in systematic reviews at the National Health and Medical Research Council (NHMRC) Clinical Trials Centre at the University of Sydney. Henry has been actively engaged in public communication of science while examining sociocultural factors and policies affecting health services and attitudes towards emerging health technologies. In 2007, he was a BioVision.Nxt Fellow and attended the World Life Sciences Forum – BioVision and the United Nations Children’s Fund (UNICEF)-BioVision Children’s Forum. More recently, he has been a health consumer representative with the Consumers Health Forum of Australia.

**Namrata Kotwani, India****EVERY LIFE IS PRECIOUS:
AN EQUITABLE AGENDA FOR HEALTH
RESEARCH ON CLIMATE CHANGE**

With riches has come inexcusable waste. We have squandered a great part of what we might have used, and have not stopped to conserve the exceeding bounty of nature... We have been proud of our industrial achievements, but we have not hitherto stopped thoughtfully enough to count... the fearful physical and spiritual cost to the men and women and children upon whom the dead weight and burden of it all has fallen pitilessly... There can be no equality or opportunity, the first essential of justice... if men and women and children be not shielded in their lives... from the consequences of great industrial and social processes which they cannot alter, control, or singly cope with. Society must see to it that it does not itself crush... its own constituent parts.

Woodrow Wilson
(Inaugural Address, 1913)

Those of us who have grown up in democracies, especially those in erstwhile imperial colonies, are taught to value highly the principle of political equality. In sentimental moral language, we learned to assert that each one counts for one and that every life is as precious as another. Our childhood civics lessons repeatedly recalled the story of increasing human freedom through the centuries – the victory over want and political tyranny. The 20th century was depicted as the glorious final tableau in a play that chronicles human development, an era in which the fruits of political freedoms and human technical ingenuity accrue to all of us. Minor hiccups only add temporary suspense; our upward trajectory sways ever so slightly during passing wars, recessions or natural disasters. Even developing nations appear to be shedding their awkward stage-fright at last, slowly warming to their role in this uplifting drama of human progress. As a health researcher, I am pleased to note that medical knowledge and proficiency also had an important role in this final scene. Polio, smallpox, cholera and plague retreat in industrialized nations. The promise of antibiotics and vaccines, coupled with economic prosperity and agricultural bounty, led to unrestrained declarations about the imminent end of disease.

But of course, everyone knows that even a convincing play is just fiction. Our scientific knowledge and innovative capacity does not yet shield us from the vagaries of nature, especially broad-scale climate change. In fact, according to the Fourth Assessment Report released by the Intergovernmental Panel on Climate Change (IPCC), it is highly likely that human activities themselves are inducing climate change. Every year, 150 000 deaths occur due to climate change, mostly among the poverty-stricken. Consequently, human equality also seems like an unfulfilled theoretical ideal. In reality, it is apparent that current political status

quo has led to an inequitable and unjustifiable distribution of the benefits and harms of industrial, scientific and economic development. Researchers agree that the greatest burden of climate-sensitive diseases is borne by regions that bear the least responsibility for causing climate change and are also least prepared to adapt to and prevent health risks.

The ethical challenge of climate change – as critical as its scientific dimensions – is that the poorest bear its most severe setbacks. In addition to the global disparities in prosperity and health, it appears that the impact of climate change will also be disproportionately distributed between populations in the developed and developing world. According to a World Health Organization (WHO) assessment, pockets of significant poverty such as sub-Saharan Africa, coastal regions along the Indian and Pacific oceans, as well as large urban cities, are most vulnerable to the health consequences of climate change. Consider Africa, the continent that has some of the lowest per capita emissions of greenhouse gases (GHGs) implicated in global warming. Many African countries, however, are disproportionately vulnerable to climate-sensitive health risks such as infectious diseases, malnutrition and compromised sanitation. This is not merely bad luck, but unfairness. Poor populations have the least ability to cope with climate change because of constrained access to material resources and information, and because of their lower average levels of health resilience and underdeveloped institutional and legislative capacities.

Health researchers are faced with a quandary in responding to climate change—advocating development for strengthening vulnerable populations is a double-edged sword. On the one hand, we contend that the most significant improvements in key health indicators such as life expectancy, infant mortality, maternal mortality and incidence of preventable diseases will not be largely driven by economic growth, increased consumption and higher living standards. International consensus that socioeconomic development is a crucial determinant of health was cemented at The Declaration of Alma Ata in 1978. However, greater opulence for the world's poor nations will enlarge their ecological footprint and exacerbate climate change, so that it becomes comparable to that of typical industrialized nations. Currently, people in North America, western Europe, Japan and Australia consume resources, like oil and metals, and produce wastes, like plastics and GHGs, at an average rate that is 32 times higher than in developing countries. Fairness requires a feasible development plan for the poor, rather than continuing material deprivation and economic marginalization in the developing world.

Although climate change comes with its own potential catastrophic consequences, such as lost biodiversity, stressed terrestrial and ocean food-producing systems and depleted freshwater supplies, it is merely symptomatic of a larger sustainability crisis that our planet faces. Human demands have exceeded the earth's "biocapacity" since the 1970s, and are currently about 25% above the planet's sustainable capacity. A world that contains 6.5 billion humans and myriad other life forms cannot be sustained at this level of environmental impact. By the end of the century, average global temperatures are expected to rise between 1.4°C and 5.8°C. Warmer temperatures are associated with greater variation in the hydrological cycle, leading to more droughts and floods. Gradual climatic changes affect water and air quality, crop yields and cause human displacement – modifying complicated local ecological dependencies. A 2007 Oxfam briefing

paper posits that the number of weather-related disasters has quadrupled over the past 20 years. Climate-sensitive diseases, such as cholera and Rift Valley fever in Africa and dengue in Latin America and south Asia, have re-emerged. These outbreaks threaten to derail social investments. Competition over deteriorating natural resources may lead to debilitating conflict among population groups over freshwater or arable land.

The biggest challenge for health researchers now is to channel their scholarship towards explicitly addressing inequity in climate policy. For policy-makers and communities that balance a number of competing development priorities (such as reducing poverty, increasing agricultural productivity, improving health or safeguarding environmental and cultural resources), a more flexible health impact assessment (HIA) can be a valuable decision support tool. The HIA framework allows us to evaluate the health effects of various policies and projects as well as the distribution of these effects within the population. Several developments that may reduce the health risks of climate change may lie outside the purview and expertise of the health sector. For instance, millions of premature deaths could be averted in Africa alone in the next quarter century with appropriate policies towards the supply of energy for household use, by switching to cleaner fuels. How do we evaluate if this is an intervention worth adopting, given its cost and various social effects? Let us consider one such HIA scenario. Scholars observe a relationship between increased malaria and new roads built on recently cleared forest land in the Amazon. Using an expanded HIA framework, community members as well as experts in health, meteorology, land-use, economics and agriculture can decide whether clearing forests for roads is a net positive for the community, or whether alternative development projects such as ecotourism may bring greater overall benefit.

Health action must simultaneously fulfil several community needs. So far, cost-effective strategies that allow impoverished communities to protect health remain underresearched. For resource-poor settings, prioritization is a critical issue because resources must be targeted at the most serious risks. Should we recommend building a quick cyclone warning system or a health-education programme on flooding-related infectious diseases? Even in rich nations, climate change mitigation will be more viable if it is cost-effective and produces ancillary benefits. Mass-transit systems, urban design that promotes bicycling and walking and energy-efficient buildings, for example, are promising projects that reduce GHG emissions, air pollution, public health costs and long-term infrastructural costs.

Resourceful and equitable stewardship of resources held in common is the moral imperative for those of us who lead easy lives. The rich cannot indefinitely insulate themselves from the immediate dangers that befall the poor. In his haunting poem, *Judgement at the Court of Gaia*, John Latham imagines what the ravaged earth says to humans who have mended their ways, but only after facing the devastation of climate change:

yes, survivors are emerging from the ooze, crawling
from what's left of our forests, though I fear their wounds
won't heal. But your failure to acknowledge lives forever
lost disgusts me...

As health researchers who have an inkling of the price the poorest among us will pay for climate change, our inaction may be inexcusable.

Namrata Kotwani was born in India, went to college in the United States, and has just completed a pre-doctoral fellowship in Bioethics at the US government's National Institutes of Health (NIH). She has previously written about improving primary care for the poor, protection of human subjects in clinical research and media coverage of medical findings. Most recently, she worked on the REACH project at the NIH, where she elicited the preferences of more than 400 low-income adults in Washington, DC, in order to demonstrate the feasibility of developing customized packages of health-related socioeconomic services. Namrata has been inspired by this experience and plans to pursue an academic career focused on designing policies grounded in empirical evidence to achieve ethically justifiable distribution of resources.

**Daniel López-Cevallos, Ecuador****THE DISMANTLING OF PUBLIC
HEALTH INFRASTRUCTURE:
A NATURAL DISASTER?**

A few days after I came back from a much gratifying stay in Ecuador to work on my research and visit family, the rainy season started with particular force in the Ecuadorian coastal region. In a matter of days the government declared a state of emergency. It had not rained like this in a decade. A month later, flooding had affected a quarter of the population, which resulted in an increase in respiratory illnesses, diarrhoeal infections and dengue. It is evident now that changes in our climate are causing large and more frequent disasters that require, I argue, a public health approach. However, it is the systematic undermining of public health structures that poses a tremendous threat to human health, especially when facing a changing climate. I propose that public health systems need to be in place to adequately respond to these catastrophes. Specifically, there needs to be a focus on primary health care, a consideration of broader socioeconomic and environmental effects and a rethinking of development models. Otherwise, the dismantling of public health infrastructure could very well be considered another “natural” disaster attributable to climate change.

Primary health-care services are essential in granting equitable access to basic health care. As an entry point into the broader health-care system, they can provide comprehensive and integrated care to address the health-care needs of the population. However, health-care reform (and more broadly, public sector reform) in regions, such as Latin America, has hindered the ability of such a comprehensive primary care structure to provide what was promised ever since The Declaration of Alma Ata in 1978. In the Latin American context, various authors have questioned the promised benefits of structural reforms and found no empirical support to the usual claim that these reforms “reduced poverty” and “enhanced growth”.^{1,2} In other words, “business as usual” is not an option. From a policy perspective, it is necessary that public health authorities ensure universal access to primary health care and reinforce the entire health-care system, instead of selective vertical strategies. Such reforms should include strong health information systems that can guide short- and long-term planning efforts.

Natural disasters such as Hurricane Katrina in 2005 or the flooding of the coastal region in Ecuador in early 2008 reveal that the poor, in particular, require effective public health systems. Strengthening the public health infrastructure means that preventive, health-promoting, and well-being policies and actions need to be considered. Ultimately, in an increasingly interconnected world, more effective public health systems will benefit us all, rich and poor alike. A global society requires us to consider multiple factors that affect population health. As I have mentioned, any initiative with the aim of promoting the highest welfare level must consider issues ranging from education, housing, security, social justice and equitable access – to politics, economics and migratory movements. Transfer of information and experiences between populations will build local capacity and tailor technology to community-specific needs.

Climate change deserves a special place in the agenda of national health authorities, not only because of its health consequences but also for its socioeconomic and environmental implications. Policy-makers, particularly in low-income countries, may consider that tackling climate change diverts resources that are needed to deal with more “immediate” problems. However, policies oriented towards climate change are in close connection with those towards poverty, food security, health, education, etc. Public health policies in low-income countries must look not only for an equitable distribution of resources, or an increase in basic services coverage, but also a socialization of community (including indigenous) practices. In the context of primary care, building community capacity (self-determination and reliance) is a basis for any attempt to truly promote practices that go beyond the individual, and consequently ensure that essential health is available to everyone in the community. This will in turn empower community members to take part in decision-making processes. For a decision-making process to have strong support, it is necessary to promote interdisciplinary dialogue. This is a key element in consolidating the role of public health and its collective purpose.

A common agenda between governments, civil society and international cooperation agencies needs to be established. Cooperation is key in any intersectoral approach, and particularly so in the intersection between public health and climate change. It is necessary to avoid overlapping of jurisdictions and duplication of activities that waste always scarce resources. Low-income countries have to play a central role in this process because of their greater vulnerability. I believe it is necessary that government officers ask themselves: is this plan locally generated or is it externally imposed? Only then will they be able to establish horizontal cooperation processes.

Challenging the mainstream development paradigm is not an easy task. Besides, various attempts of change have been quickly assimilated into its framework. How about the paradigm of urbanization, creating huge population centres that ironically have eroded local connections and community cohesion? Yet, urbanization has been portrayed as the “inevitable” path to development, including health. I strongly disagree. I consider that it is always relevant to revisit more integrated, participatory and decentralized approaches to improve people’s social and economic status, especially through programmes enmeshed in local systems with active and effective involvement of the population.

I believe that the solutions to our current climate and health crises depend on our ability to contextualize development. The current situation reveals that the so-called “western” model is not sustainable. Experts agree that industrial revolution is a major contributing factor to the rapid increase of carbon dioxide concentration in our atmosphere. Precisely, it is the carbon dioxide emissions of populous countries, such as China and India, which are rising due to their adherence to the same development trajectory (i.e. model) of western economies. But is there a different path? Is it about surrendering development aspirations or rethinking the process? In terms of development, it is not only a question of what it is but also a question of how to develop. In this context, sustainability is a major component.

Are the solutions in the hands of governments, politicians, multinational corporations, the United Nations system or the peoples of the world? Sustainability of development efforts, including strengthening of public health infrastructure, requires the active

participation of democratic governments (and ultimately, the people who elected them). They remain as representatives of the people's interests before those of other parties (e.g. transnational corporations, International Monetary Fund, World Trade Organization, World Bank). There is an urgent need for us to realize that we all "sail in the same ship", to recognize that we all suffer and will continue to suffer the consequences of ailing planetary and human health systems. Therefore, there is no place for simplistic or individualistic solutions. Yet, the moment of action is now. We cannot wait until the next "natural" disaster arrives.

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- 1 Fort M, Mercer MA, Gish O. *Sickness and wealth: the corporate assault on global health*. Cambridge, Massachusetts, South End Press, 2004.
 - 2 Correa R. *The Washington consensus in Latin America: a quantitative evaluation*. Meeting of the Network on Inequality and Poverty (NIP). Madrid, GRADE, 2002.
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Robert McSweeney, United Kingdom

CLIMATE AND INFECTIOUS DISEASE: A QUESTION OF VECTORS

For a climate scientist, epidemiology presents a problem. The understanding of ocean, land and atmospheric interactions, combined with ever increasing computing power, has brought about substantial advances in the ability of climate models to simulate past, present and future climate. Yet despite these advances, climate modeling has yet to make a substantial contribution to providing early warning systems for many important vector-borne infectious diseases.

Disease vectors are the scourge of many developing countries; mosquitoes, midges, black flies, among others, spread debilitating diseases through both human and animal populations. The human cost of disease morbidity and mortality is an obvious and distressing consequence. Malaria alone causes at least one million deaths every year.¹ Disease in livestock damages the livelihoods of farmers and associated trade-bans damage national economies. Clearly, control of disease vectors is the key to successful reduction in disease incidence and the millions of lives lost every year.

Yet early warning systems are not the panacea to vector-borne infectious disease. Where infectious disease is endemic, this is inherently a social, economic and political issue, best tackled by prevention and cure. However, where climate does become a factor on the fringes of these endemic regions, disease outbreaks are driven primarily by extreme climate events. In these situations climate science can be used to give warning of impending outbreaks. These regions are also primarily those that are at risk from expanding vector habitat brought about by climate change.

Climate and health are inextricably linked, and this is no less true for infectious diseases. Disease vectors depend on suitable habitats to breed, which in turn depends heavily on climatic conditions. Unlike the human body, small vectors do not have in-built thermometres; they do not have the ability to stabilize their own body temperatures within a range of exterior conditions. Instead, their temperatures are determined by the surrounding conditions, limiting the regions of the world in which they can survive and breed. Their breeding patterns are also dictated by climate. The majority of flying vectors require water in some form in which to lay eggs; black flies, for example, require fast flowing water while mosquitoes need still water. Therefore, availability of habitat for breeding is dependent on what drives rainfall in a region. Currently, climate variability is driven primarily by inter-annual variation and climatic phenomena such as the El Niño-Southern Oscillation (ENSO). Yet as the global system continues to warm throughout the century, we will begin to experience more extreme rainfall events, and it is these events that provide the standing water required for breeding of mosquitoes, the primary vector for many infectious diseases.

So, what prevents an accurate projection of future climate for vector habitats? The first and most glaring of these problems is that we do not know what is going to happen. We have finally reached the stage where the vast majority of the scientific community accept climate change as a man-made disaster in waiting. Yet, we are still none the wiser as to how the global community will tackle the problem, and hence the scale of climate change that we will have to cope with. The latest Intergovernmental Panel on Climate Change (IPCC) report projects that global temperatures will increase between 1.8°C and 6.4°C in the 21st century², yet a warming planet is just the tip of the iceberg (excuse the pun). How this translates to variations in rainfall, the main climatic driver of vector habitat, is even more undecided. Take west Africa as an example; rainfall in the Gulf of Guinea is driven by the movement of the Inter Tropical Convergence Zone (ITCZ), the west African monsoon, the African Easterly Jet, the Tropical Easterly Jet, ENSO and the Madden-Julian Oscillation (MJO). Understanding how all these climatic phenomena will respond to a changing climate is not to be taken lightly.

So predicting climate change itself is the first problem. Unfortunately, this is followed swiftly by the next: how do you bring together the combination of physical and socioeconomic factors? From the point of view of the climate scientist, epidemiology creates a huge number of variables to add to the existing climate ones. Combining the physical variables of the climate system with socioeconomic factors of land use, population and exposure, muddies the already fairly murky waters of prediction.

The challenge here is the need for more interdisciplinary research that crosses between climate, epidemiology and development. However, interdisciplinary research is difficult. When covering such a breadth of subjects, inevitably some aspects of the research are curtailed for brevity or time constraints. An interdisciplinary researcher must be confident of their knowledge on both climate and health to do justice to each side of the subject. Interdisciplinary research is also inhibited by the structure of funding bodies. Where each field of research has its own funding body, there can be a reluctance to share funding for interdisciplinary studies. This could be addressed by issuing funding from a central point, rather than via each individual discipline.

So, let us assume that you have the funding and the willingness for a climate and health research project, the next question is: what data do you use? One of the most prohibitive issues with analysing climate and disease outbreaks in developing countries is a lack of data. Poor health surveillance systems restrict the recording and dissemination of disease outbreak data. Where data are available, they are often incomplete, which makes statistical testing virtually impossible. This is compounded by a lack of meteorological stations, causing a dearth of locally observed weather data for analysis. The obvious solution is investment in data collection systems in developing countries and increased penetration of local weather stations. However, for researchers, successful health surveillance and data collection also depends on the dissemination of that data. It needs to be accessible around the world, without cost and unrestricted by bureaucracy.

With the data challenges between climate and epidemiology, there also lies a challenge of timescales. At present, climate extremes are dictated by the bounds of inter-annual variability. On longer timescales, towards the middle and end of the century, climate change will become the dominant factor. However, the time in between is less clear. Decadal-scale climate prediction is a combination of natural variability and the

impact of climate change, and this is much more difficult to predict. Unfortunately, for epidemiologists wishing to plan and develop health policy for the coming decades, the decadal scale is very important. In the field of climate, this “decadal gap” is widely regarded as a neglected area in urgent need of improved understanding.

Climate change is set to be humankind’s biggest challenge of the 21st century. While mitigation is finally on the political agenda, we are nevertheless committed to a certain amount of warming through past actions. Developing countries, having high exposure, high sensitivity and low adaptive capacity, are the most vulnerable from its impacts. The challenge of preventing infectious disease outbreaks will not only remain, but become more difficult, and solutions harder to come by. Understanding the relationships between climate change and disease vectors should be foremost in our research. It holds the key to saving millions of lives.

1 Centers for Disease Control and Prevention. Malaria. (www.cdc.gov/malaria, accessed 12 May 2008).

2 *Climate change 2007: synthesis report. An assessment of the Intergovernmental Panel on Climate Change*. Geneva, Intergovernmental Panel on Climate Change, 2007:103.

Robert McSweeney holds a master’s degree in Engineering Design and Appropriate Technology from the University of Warwick in the United Kingdom and a postgraduate degree in Climate Change from the University of East Anglia. His interest in climate and health began with his undergraduate project on the effect of El Niño on incidence of cholera. This continued in his Master of Science research, where he chose to analyse the climatic influences on seasonal rainfall in Kenya and associated outbreaks of Rift Valley Fever. Robert is now employed as an environmental scientist for the consultancy firm Atkins, working predominantly on climate change impact and adaptation assessment. Robert also volunteers with the United Kingdom-based nongovernmental organization Tearfund, contributing to its climate change research.

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**Rhona Mijumbi, Uganda****CLIMATE CHALLENGES:
LET US ALL RETURN TO ALMA ATA**

‘Ekkub’omunaku telikya! And we would burst into laughter; we were young and the world was young too. Now I have grown up, the world has grown too, and I have come to understand and put in perspective this proverb from Buganda (the central part of Uganda). Directly translated, *‘Ekkub’omunaku telikya!* means: when it starts raining on the poor man, it just will not stop. It gives an impression that the rain falling on the poor is harsher compared to that falling on the rich. When I was a child we used this for those times or days when everything just seemed to go unrelentingly wrong, and for some reason it was always hilarious, if it did not involve you. I have grown up and this no longer seems to apply to anything hilarious, it only seems to apply to hardships. The misfortunes befalling the world just don’t seem to stop or come to an end – poverty, disease, war, crime, hunger and now climate change. Without climate change, the health of the disadvantaged was already a challenge and so 60 years ago the world put their hearts together at Alma Ata to find health for all by the year 2000. In that year 2000 the world renewed its efforts in New York at the dawn of the new millennium with the Millennium Development Goals (MDGs), aiming to eradicate extreme poverty and improve the health and welfare of the world’s poorest people within 15 years. Funding, research, capacity building and a lot more are all being scaled up to meet these goals and make the world a better place. But the challenges do not stop coming in; just like the harsh rain that falls on the poor.

Just after we thought we had identified the main issues causing dire poverty and set goals and targets to get rid of them, climate change is here and with it comes a whole set of new problems threatening health and human security. Research into old and new interventions will be needed. Vulnerable populations are still in trouble and they present new challenges for researchers. With extreme weather and natural disasters like flooding, they will continue to be displaced from their homes and well-established population habitats. Displaced people are difficult to involve in research, even if that research will eventually help them. Such people are also prone to new problems during displacement, all of which complicates research. Researchers will be now faced with a resurgence of old diseases like cholera. These were problems that we were beginning to pop champagne about, but we will need to revisit them and pull out our old guns to take care of them. These old guns will have to be given a new polish with the new global trends in mind.

As we fret about old problems, new ones will be taking the scene as well. Because of the over-production of some species (harsh weather actually supports some species), and later, migration of these to more comfortable places, new and strange vectors will and have begun to appear in different places, bringing along disease. Research and finding solutions for these is not always easy. Some answers take decades and lots of input. In many of the disadvantaged areas, there is no structure

for surveillance and so diseases will be noticed only after they have already made a disastrous impact on the area and population. Rates of mortality will escalate. Even with surveillance systems present, they often require upgrading and the situation at times is overwhelming as experienced during the Asian tsunami. And because of harsh seasons that are not synchronized, the seasonal growth of plants commonly used as foods will be interrupted and these foods will no longer be available. This means more people will go hungry and the cost of food will be higher. This will make the entire cost of living higher too. Vulnerable as the disadvantaged populations already are, they will be plunged into further poverty having lost their social and economic livelihoods. This has severe implications for the fight we have already set for ourselves to eradicate poverty through our MDGs. We shall need to come up with more ideas to take care of populations that face these disasters and policy-makers are waiting on researchers for good evidence so they can develop urgent policy.

There are other issues that researchers still need to find answers to. What happens to the demography trends and the projections for different populations? Will these stand in the face of climate change or shall we need new facts and figures? So while we need answers to new problems, we need to revisit the old ones too.

We also need to find ways to halt further damage to the climate, especially with vulnerable people in mind. How do we deal with issues like the dumping of hazardous waste, industrial pollution, urban crowding and so on, especially in developing countries? Without intending to, developing countries have become and will continue to be havens of some of the factors that uncontrollably and unnecessarily assault the environment. How do we help them halt the dangerous and seemingly easy path they are already treading?

Climate change is the result of decades of assault on the environment, meaning that what we are experiencing now is due to what was done far back in time. That also means what we do now determines what will be experienced in decades to come. Until a few years ago, the hullabaloo about climate change was exactly that to me, hullabaloo. I did not think it was something I needed to worry about, let alone something I could do anything about. In fact it was all that complicated ozone layer stuff that somebody else was supposed to take care of. I later discovered that I could do something too depending on the car I chose to drive, how I responded to calls for tree planting, how I shared the information I had, and other actions. We need to know that we are all important when it comes to the environment. All our actions, small as they may seem, are a big part of the puzzle that eventually leads to or prevents further climate damage.

Everybody is and should be responsible for their environment. Everybody is a researcher in this effort, especially research for knowledge; knowledge is the power with which we can achieve more than we ever thought. Armed with our knowledge, the reality of working with limited resources will be one to contend with. It will call for prioritizing of resources – human, financial and material. Researchers, especially in the social sciences, will have to advise us on how to deal with the diversity in this global village. Solutions are not as straightforward as they used to be; mobility has led to diversity and to impacts on the environment. How do we deal with the ever-diversifying issues and not lose what we gain from them?

There is a lot of work to be done and how to divide up the roles is the challenge. It is not a time for pointing fingers and apportioning blame, but a time that calls for the Alma Ata spirit of unity in fighting a common enemy. The challenges are many, not only for researchers and vulnerable groups faced with increasing disadvantages, but for you and I. We shall all need to return to Alma Ata to take care of the environment and the challenges it is throwing at us – to stop the rain that will not stop tormenting the poor man.

Rhona Mijumbi completed Bachelor of Medicine and Bachelor of Surgery degrees at Mbarara University, Uganda in 2002, before embarking on a one-year internship. She worked as a volunteer with the Department of Neurosurgery in Mulago National Referral Hospital, Uganda, then later as a medical officer and research assistant with the Pediatric Infectious Disease Institute, Uganda on HIV research. In 2006, Rhona joined Makerere University for a master's in Clinical Epidemiology and Biostatistics before receiving a scholarship from the Australian Government's overseas aid program (AUSAID) to pursue a Master's in International Public Health at the University of Queensland, Australia in January 2008. Her main interest is health policy and she is currently working on international health worker migration and introductions to medical geology.



Amita Mukhopadhyay, India

RESUSCITATING MUMBAI FROM
SICKNESS, SLUMS AND CALAMITIES
TO SECURE SOCIAL CAPITAL

There are flood and drought over the eyes and in the mouth, dead water and dead sand contending for the upper hand. The parched eviscerate soil gapes at the vanity of toil, laughs without mirth. This is the death of the earth.

TS Eliot (1888–1965)

The memory of my going under is as vivid today as if I had just been pulled out – not onto dry land, only into water that was three rather than six feet deep – because on 26 July 2005 there was no dry land to be found in Mumbai.

I started that fateful day by ignoring the heavy rainfall. I had work in the afternoon at a maternity clinic in Dharavi, Asia's largest slum, and at 16:00 I found myself knee-deep in water with no transport in sight. A rickshaw driver eventually saved me with a lift to the bus station. My overloaded bus crawled along for hours, but finally quailed before a torrential stream. Reckless and sick of waiting, I attempted to cross and was swiftly dragged away towards certain death. Then incredibly, I hit a submerged motorbike. I held tight and was shortly rescued. Others were not so fortunate. Hundreds died. Thousands lost homes and possessions. Sewage contaminated every drinking water source. Angry crowds retaliated against relief workers who (naively) ordered people to drink only boiled water – there was no water and no fuel to boil it with.

Half of Mumbai's inhabitants live in slums, mostly shanties clustered on hilltops. Rainfall-triggered mudslides caused massive fatalities compared to the more scattered deaths among wealthier people. The following months saw unprecedented hospital admissions for gastroenteritis, malaria, dengue, leptospirosis and skin infections in people who had spent as many as 18 hours in the polluted water.

Government aid largely consisted of drug distribution at relief camps where doctors had to manage hundreds of slum-dwellers all at once, leaving them no time to elicit symptoms or explain drug reactions. The organizers (usually elected leaders) refused to let a single disgruntled voter leave without their "free medicines". These camps did nothing to lessen disease incidence – hospital admissions and deaths remained at a peak for several months. In fact, such insufficiently thought out interventions may even have contributed to drug resistance as hundreds of people consumed incomplete and unnecessary antibiotic courses.

"Terrible Tuesday" (944 millimetres of rain in 24 hours) has been attributed to global warming and climate change, compounded by an unprepared and overloaded urban

infrastructure. Below are a few illustrations of this fact:

- Ill-equipped meteorology departments could not provide sufficient advance warning of the disaster.
- The outdated storm water drainage system (inefficient in normal rainfall) failed utterly when confronted with a deluge of such dimensions.
- Systematic destruction of mangroves has been followed by unregulated construction with no regard for sewerage or rainwater harvesting.
- The Mithi River, once a broad natural conduit, has been encroached upon until it now resembles an average-size gutter.
- Every year, thousands of people come to Mumbai in pursuit of a better life. Yet they find that the greatest necessity, housing, is unaffordable. Slums proliferate at the expense of trees and coastal swamps, thus destroying the city's natural defences.

Predictably, once the emergency abated, the blame game began. Mumbai became the “victim” of hordes of outsiders – migrants who spawned slums and choked drains with plastic. In reality, though, the impact of climate change in India is far more insidious and profound than can be judged by the sporadic disaster. Year after year, summers get warmer, rivers dry up and the monsoon becomes more unpredictable. Farmers beset by crop failures and debts, commit mass suicide. Food prices soar. Starvation prevails. Migrants put up with unhygienic, overcrowded slums, alienation from their homelands and harassment by xenophobic politicians, all for the sake of a full stomach.

Intergovernmental Panel on Climate Change (IPCC) chairperson, Dr Rajendra Pachauri, has stated that the poorest of the poor will be the worst hit by global warming. In his December 2007 Nobel lecture, Dr Pachauri predicted that we have until the year 2015 to reduce global greenhouse gas (GHG) emissions if we wish to stabilize increasing temperatures. This seems impracticable given certain major polluter nations' refusal to limit emissions. Bioethanol was initially lauded as the solution, but recent studies have shown that biofuel technology actually increases atmospheric GHGs and perpetuates hunger as farmers grow fuel crops instead of food grains.^{1,2} While industrialized nations battle out the niceties of the Kyoto Protocol and take their own time to implement energy saving measures, indigent societies that ironically have contributed least to climate change suffer its unabated effects.

I begin to realize that our most urgent research priority is not the reversal of global warming (decades away and requires commitment from the highest echelons of world leadership), but the protection of rural and urban poor from famine, drought and extreme weather. I envision a three-tier goal hierarchy, designed to enable best use of available funds and evolving from immediate mitigation strategies to sustained human development linked with environmental protection.

In the *short term* (0–2 years), we need enhanced disaster prediction and evacuation systems in tandem with inexpensive, vernacular enabled mobile phone technology so that even the poorest communities can have advance warning through text messaging. Authorities should divert funds from relief camps and ex-gratis payments (which usually do not reach intended beneficiaries), into augmenting urban drainage and water supply systems. We need research on

maximizing the efficiency of waste-digester plants utilizing the colossal amounts of garbage that a city produces. The resultant gas output can partially replace fossil fuels in vehicles and ensure uninterrupted power supply to health centres, where outages can be disastrous.

Medium term (3–10 years) research goals must focus on stable and affordable housing for expanding migrant populations. Relocating slum-dwellers into high-rise accommodation fails because maintenance work is too expensive for them, and individualistic apartments create isolation from community life. The chawl buildings in Mumbai, home to generations of working class citizens, with elongated, medium-rise architecture and common open verandas affording plenty of opportunity to socialize, would be ideal if space were abundant. I suggest that satellite townships are gradually built up around the main city area, with participatory action research involving community members, especially women (to whom housing amenities are most essential), to design affordable and acceptable accommodation that is also sanitary and disaster resistant. We must assiduously avoid the evolution of ghettos, and we will have to ensure access to shops, entertainment, schooling, health care, sanitation, security and greenbelts, along with premises for the small industries that make slums important contributors to gross domestic product. The communities themselves will fill these new employment avenues. Dedicated trains and buses from the townships, financed on a cost-sharing basis between the community and government, will ensure affordable, accessible transport to city workplaces.

The cold chain is always a casualty in disasters. Children – the most vulnerable – are laid open to attack from vaccine preventable diseases. Developing heat-stable vaccines is therefore a vital research priority.

Groundwater levels have risen in states with compulsory rainwater harvesting. Innovative irrigation techniques such as the Chandraprabhu raingun have become local successes.³ Research into scaling-up their efficiency and countrywide application will help mitigate the effects of drought, and perhaps staunch the flow of migrants.

In the *long term* (10 years and more) increasing local action by citizens' groups may achieve what political summits have not. The solutions to global warming are already present; but the pressure of public opinion will ultimately compel nations with the largest carbon footprints to limit emissions in the interest of populations worldwide.

For two months after the Mumbai flood, I worked at Bainganwadi, possibly the city's most neglected slum. Squalid shacks, dark and ill ventilated, were surrounded by cesspools; dogs and pigs rooted in weeks-old garbage and a putrid stench was everywhere. Migrants formed the bulk of the population. I dealt with malnourished children, anaemic adults and complete ignorance of hygiene. Every day brought fresh cases of high fever and diarrhoea. I had trouble believing that I was still inside Mumbai.

Some may label this plan to overhaul a mega-city's infrastructure as over-ambitious, and our efforts impotent. I seek inspiration in the words of Mahatma Gandhi, who believed that "...whatever we do may seem insignificant to us, but it is most important

that we do it". The alternative is to condemn millions to an inhuman existence. If Bainganwadi is to become a historical memory, then, following the Mahatma's footsteps, "We must be the change we wish to see in the world."

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- 1 Scharlemann JP, Laurance WF. Environmental science. How green are biofuels? *Science*, 2008, 319 (5859):43–44.
 - 2 Fargione J et al. Land clearing and the biofuel carbon debt. *Science*, 2008, 319 (5867):1235–1238.
 - 3 Basil P. The Chandraprabhu raingun success. Bangalore, *India Together*, 2004 (www.indiatogether.org/madhyam/issueXVIII-2/mdh-raingun.htm, accessed 9 May 2008).

Amita Mukhopadhyay graduated at the top of her class with a Bachelor of Medicine and Bachelor of Surgery and earned a Gold Medal for the highest marks in Ear, Nose and Throat (ENT)-Ophthalmology. She was also awarded the "Dr V N Panse Prize" for achieving the top grade in the Medical Doctor (MD) Community Medicine examination. Amita completed a three-year MD residency in Dharavi, the largest slum in Asia, in the suburbs of Mumbai, India, which provided hands-on experience in national health programmes, community health care, curative services, disease surveillance, disaster relief and child sexual abuse prevention. She also executed an epidemiological study of stroke for her dissertation. Amita is currently employed as Assistant Professor at Chettinad Health City, Tamil Nadu, India. She aims to help future doctors understand and practice the principles of public health.

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Marame Ndour, Sénégal

VERS UNE INITIATIVE MONDIALE DE SAUVEGARDE FACE AU CHANGEMENT CLIMATIQUE ET POUR LA JUSTICE ENVIRONNEMENTALE ?

Le changement climatique, loin de constituer une donne abstraite tend à devenir une réalité de plus en plus palpable, ne serait-ce que sur le plan des négociations politiques internationales. Cela laisse présumer que l'impact de la dégradation de l'environnement sur la santé humaine est pris en compte de manière croissante sur le plan scientifique.

Face à cette thématique aussi importante que complexe, le premier défi semble être celui de la mesure. Comment mesurer l'impact du changement climatique sur la santé des populations vulnérables ? Le premier défi consisterait à « donner corps » à ce que certains pressentent et observent déjà : la prégnance de multiples nouveaux risques pour les populations pauvres et exposées aux effets de la dégradation de la qualité environnementale.

En effet, à notre sens ce premier impératif sera exigé étant donné que la décision politique repose, face à une telle problématique, sur l'expertise scientifique. Il sera nécessaire de démontrer de manière factuelle la gravité de la situation et de la mesurer.

Un deuxième défi non moins important est celui d'une plaidoirie réussie. Il s'agit de « désamorcer » les controverses politiques sous-jacentes à ce genre de problématique. Comment faire comprendre aux décideurs et aux plus riches de ce monde qu'il est de leur intérêt de considérer sérieusement l'impact de la dégradation de l'environnement sur les plus pauvres sans tarder ? Comme c'est le cas lorsqu'on est face à d'autres problématiques dites globales, la prise en compte de la situation et des besoins des populations les plus pauvres relève de projections tardives et instrumentales.

Si les débats sur le changement climatique ainsi que les négociations s'y rapportant font florès, si la prise de conscience d'une nécessité d'agir a fait jour, des contradictions prévisibles ont surgi non seulement sur la fin mais également sur les moyens.

Ces contradictions nourrissent ce qui pourrait constituer une pomme de discorde entre les nations dominantes dans la mondialisation économique, les nations dites émergentes et pauvres qui subissent cette dernière. Un clivage est né entre ceux qui sont davantage exposés et ceux qui sont largement responsables du changement climatique et qui néanmoins se font les voix de la raison face aux premiers. Leur mot d'ordre désormais est de prendre en compte l'environnement dans les politiques de développement. Il s'agit de ne pas répéter les mêmes erreurs. Mais se pose un dilemme d'action collective non seulement au sein des pays riches mais également des nations qui ont entrepris de faire décoller leurs économies à tout prix. Ces

dernières leur rétorquent : comment pouvons-nous nous hisser à votre niveau si nous bridons d'ores et déjà notre croissance au nom du respect de l'environnement ?

Nous nous trouvons devant une configuration somme toute cynique : les plus riches sont ceux qui ont le plus d'impact sur le changement climatique tandis que les plus vulnérables sont ceux qui en subissent le plus les conséquences. Aussi le second défi consistera à faire une plaidoirie et à produire de la nécessité : celle de mettre en œuvre des politiques correctrices des effets mesurés. Eventuellement, en démontrant à quel point cela peut hypothéquer tous les efforts entrepris par ailleurs pour aider ces pays à se développer et à accéder à un meilleur état de santé.

Un troisième défi consistera à prioriser les risques et à définir des solutions. Pour y parvenir un moyen parmi d'autres consisterait à reprendre le concept de justice environnementale. Ce dernier, souvent mobilisé à une échelle nationale, devra être transposé à une échelle internationale. Ce concept est très utile car il nous renvoie à celui d'inégalités environnementales, or c'est précisément ce dont il s'agit : une inégale exposition à la dégradation de l'environnement, de la qualité de vie et bien entendu aux risques naturels.

Que faire face à ce genre d'inégalités difficilement réversibles à moyen terme ? La recherche en matière de santé au profit des populations les plus pauvres peut d'ores et déjà être effectuée en fonction des impacts mesurés. Il s'agit désormais de systématiquement lier le facteur environnement au facteur santé, les deux étant indiscutablement liés. La santé est perçue et traitée comme un « champ » à part qui néanmoins touche à tous les autres aspects de la vie et surtout l'environnement. En effet, quand il est question de santé, on traite inévitablement d'environnement (santé environnementale : pollution air/eau, « chimie verte » ; assainissement, lutte anti-vectorielle ; sécurité alimentaire ; catastrophes naturelles etc.). Le changement climatique peut compromettre l'accès à :

- une alimentation suffisante (variations du climat trop fortes entraînant de mauvaises récoltes dues à la sécheresse ou aux inondations), équilibrée/variée (biodiversité menacée : baisse de la diversité des espèces cultivées) et saine (non-toxicité : pesticides, résidus chimiques...)
- une eau potable ; la qualité de l'air ; des habitats salubres, non pollués, non exposés à des catastrophes naturelles.

Autrement, elle favorise certainement :

- des variations marquées de température, synonyme par exemple de canicules, d'inondations, de propagation et de persistance de maladies vectorielles telles que la malaria, de recrudescence des épidémies de choléra...

Des solutions devront être dessinées à tous ces nombreux niveaux : aussi bien, par exemple, en terme de sensibilisation et de formation qu'en terme de recherche de molécules innovantes pour guérir des maladies émergentes ou réurgentes.

Par ailleurs, un mécanisme financier mondial – un Fonds mondial de sauvegarde face au changement climatique et pour la justice environnementale – alimenté à partir d'une taxe prélevée sur les pays qui polluent le plus pourra être mis en place afin de financer les recherches et leur opérationnalisation au profit des populations affectées. Au-delà du principe moral sous-jacent à une telle approche, l'intérêt de

cette solution réside dans le fait qu'elle est faisable de manière pratique et qu'elle peut répondre à l'urgence de la situation. Tandis que des mesures pour renverser la tendance du changement climatique ne font non seulement pas encore l'unanimité mais les retombées ne seraient pas visibles dans l'immédiat. S'attaquer à ce chantier constitue en outre une chance inouïe de réconcilier développement et respect de l'environnement pour les populations vulnérables. Il est utile et cohérent de considérer le facteur environnemental désormais dans toute politique de développement et pourquoi pas d'initier une troisième voie d'accès au bien-être économique et social plus soutenable pour tous ? Pour ce qui est de la santé, l'idéal et le défi ultime pour la recherche seraient dans cette optique de favoriser le retour à une vision holistique de la santé ainsi qu'à une approche respectueuse de l'équilibre naturel dans la prévention et le traitement des affections.

Maramé Ndour was born in Dakar, Senegal in 1979. She holds a Master's in Economics and International Relations and a Master's in Political Science Research. She is currently preparing a thesis (PhD) at the Centre for Political Research of the Sorbonne University (CRPS) on the subject of the World Health Organization and access to medicines. Her research topics are: access to medicines, intellectual property and the impact of public-private partnerships for health. Since 2001, she is a member of REFDAF, a network of associations established in Senegal. She participates in the creation of original projects aimed at developing social entrepreneurship for women.

**Llemar Nicholson, Jamaica****THE CARIBBEAN AND GLOBAL WARMING: TOO SMALL TO FACE SUCH A BIG PROBLEM**

The good news is we know what to do. The good news is we have everything we need now to respond to the challenge of global warming. We have all the technologies we need, more are being developed, and as they become available and become more affordable when produced in scale, they will make it easier to respond. But we should not wait, we cannot wait, we must not wait.

Al Gore, speech at National Sierra Club Convention, 9 September 2005

I grew up hearing graphic accounts of the great Hurricane Gilbert. Understandably, I too wanted to experience a hurricane and understand its great mystique. However, an experience of hurricanes Dennis and Ivan among others and a realization of what they can do to an already ailing country are sobering. It is easy to consider global warming as a problem of large nations who have induced it upon themselves. The stark reality is that the majority of nations that feel the strongest impacts of climate change have very little to do with the current global shifts in climate patterns. It is dangerous to assume that the entire world is equally equipped to tackle health challenges posed by climate change. Small islands have been accredited with less than one per cent of all the greenhouse gas emissions that are pushing up temperatures and increasing climate variability globally. Despite this, small island states are the most vulnerable to the impact of climate change.

It is ironic that the most devastating effects of global warming are suffered by developing countries, which have made the least contribution to greenhouse gas emissions. These disasters have done crippling damage in recent years due to increased frequency and intensity. The risk of flooding is greatest on small islands where at least 60% of inhabitants live within 50 km of a coastline. Health risks from lack of fresh water and increased sewage exposure are more prevalent on the isolated islands. Climate induced diseases, such as dengue fever, acute respiratory infections, malaria and asthma, are on the rise and are an increasing threat to the poorer island states that have less to spend on health and health research.

Economics has crept into yet another global issue, with resources being skewed towards larger and more developed nations. The technologies and funding necessary to conduct scientific research into the many health risks posed by global warming are woefully lacking in smaller nations. This inequality only serves to further worsen the situation. It is the realization of this inequality that has forced small islands to refuse signing an agreement on global warming designed to replace the Kyoto Protocol. The ineffectiveness of the Kyoto Protocol is well known as it does not cater to developing nations and the United States are unwilling to conform. The need for aid to fund research into the largely unexplored implications of climate change on

small islands has become more apparent with the increase in severity of hurricanes that have affected the Caribbean, causing massive damage and further stressing already pressured economies.

Hurricanes have long been a burden to small islands. Every hurricane season brings with it the possibility of a catastrophic impact from these storms. However, in the past 10 years the danger has become more of a reality due to the increased frequency and intensity of hurricanes. The economic and physical damage caused by storms such as Dean, Gilbert and Wilma have severely affected human life. Research into the link between ocean temperatures and the intensity of hurricanes is difficult to execute effectively. Proving that ocean temperatures can cause hurricanes to intensify faster is difficult, but it is said that ocean temperatures may be rising even faster than air temperatures. Theoretically, finding a link between climate change and the intensity cannot explain the increased frequency.

It is easy to dismiss any link between increased intensity and frequency of hurricanes and global warming as a cyclical occurrence. It is difficult to prove because of a lack of data over a sustained period. Conversely, it is undeniable that hurricanes have been more intense and 2004 was a record year in both frequency and amount of major storms. It could be argued that the people who say there is no correlation between the two are seeking an opportunity to distract attention from the reason behind global warming. Downplaying the implications of climate change is simply a tactic to continue to be free to pollute and exacerbate the problem. It is debatable how concerned larger, more developed nations are about smaller countries like those in the Caribbean.

Unfortunately, research into the impact of hurricanes is limited until there is a deeper understanding of the role of hurricanes in the general circulation of the atmosphere and ocean. The technical knowledge required to advance this knowledge is currently insufficient in the Caribbean due to inadequate human resources and financial capital. The economies in the Caribbean already devote their resources to maintaining social stability and compete with larger more developed countries. Currently, there is too much uncertainty and not enough is known about climate change and the effects of natural disasters such as hurricanes. It is imperative that Caribbean leaders act swiftly to increase awareness and develop strategies to improve the manner in which climate change is investigated.

The way forward for assessing the impact on health involves gathering enough data about likely social displacement and sanitation risks from lack of access to clean water. Also, mental health will be adversely affected, as there is the likelihood of loss of property with increased flood and wind damage from more intense storms. This is a largely unavoidable occurrence and the machinery must be put in place to respond to such eventualities. The utilization of funds has been so tightly scrutinized in the Caribbean that it is going to be a topic of contention once the public hears that money is going into researching climate change. It is therefore the responsibility of Caribbean Community (CARICOM) leaders to heighten citizen awareness of the implications of a more active hurricane season on the economy and their lives.

Sadly, allocating more funds to climate change means less is devoted to health and the maintenance of health facilities. The strategy most likely to sell this budgetary

change is the promotion of the long-term benefits to more informed citizens. The blatant fact is that the Caribbean has to look outside the region for assistance, as the expertise and funding is unavailable here. Dependence on larger nations has to be overlooked in the interests of the region to ensure that the best is being done to uncover the truth about climate change. Overlooking the challenges posed by global warming to low lying islands has the potential to be catastrophic. The potential damage from a hurricane that has been intensified by global warming would be likely to severely hamper development and health. The disruption to regular existence in the Caribbean by hurricanes is serious and worrying.

The Caribbean has already put forward an initiative by the Caribbean Community Climate Change Centre (CCCCC) targeted at identifying the most viable strategy in the interim and towards the future. The establishment of rules that will govern how the region approaches greenhouse gas emissions has been critical. Importantly, the leaders have recognized that the public has to be involved and be aware of the problem for any plan to be successful. Caribbean leaders have become mindful that motorists play a large role in carbon dioxide emissions and thus how we use energy is critical. The identification of the problem has given rise to more informed decisions being taken. There still remains much work to be done and time is limited. Hurricanes will not wait on leaders to prepare; it is a natural occurrence that requires urgent attention.

Admittedly, the situation in the Caribbean has not yet reached a critical stage. The onus is therefore on CARICOM leaders to find the best way forward to cope with health challenges likely to be posed in the event of a devastating hurricane. Despite limitations in terms of funding and a lack of sufficient data, the region must recognize that the resources available are better spent preventing a health crisis than seeking to recover from one. It is unfortunate that the region has to face this threat due to years of neglect by larger nations, but the blame cannot be solely placed there and we too have contributed and have to tackle the situation with a proactive approach.

Lleamar Nicholson was born in 1988 in St Andrew, Jamaica. In 2003, Lleamar was diagnosed with Crohn's disease while in high school. He was unable to attend classes regularly, but managed to complete his studies at home. Lleamar finished the first year of a Bachelor of Science degree in Economics and Mathematics at the University of the West Indies at Mona in Jamaica. He has continually struggled with his illness but is hopeful of returning to school after a one-year hiatus. Lleamar intends to use his love of writing and mathematics to overcome obstacles in his life and in the lives of others.



Igembe Nkandala, United Republic of Tanzania

FOOD: THE REAL PUBLIC HEALTH ISSUE OF THE FUTURE

It is no longer a debate. The world climate is changing fast. While there are some health advantages associated with some of the changes, it is generally agreed that there are more adverse health consequences than beneficial outcomes. For instance, it is understood that more people will be at risk from diseases, such as malaria, haemorrhagic fevers and cholera. The incidence of allergic disorders as well as cancers is set to increase. Global changes will be accompanied by regional changes. Ecosystems, such as those of the Amazon and the Congo Basin, will inevitably change, with detrimental outcomes. Most of these local changes result from unregulated human activities done in the name of development, without regard to environment, health, sustainability or the future. These are all issues that have to be discussed if one is to talk about climate change as it relates to health. However, I want to focus on one matter that I think is of paramount importance, especially for developing countries like my homeland, the United Republic of Tanzania. It is the matter of food.

The heading above might be misleading. Food is already a problem. The world has started to experience rising food prices. Shortages and issues of access have already caused unrest in a number of countries such as Egypt and Côte d'Ivoire. However, I am afraid the food issue is only going to increase in the future – the near future, as the climate is changing. The challenge is the rate of change. Climate has been changing since the beginning of the planet, but when that change occurs at a rate we cannot cope with, problems arise. That is why I am speculating a bigger food problem in the near future. Let me be clear from the start, I am not saying it will happen, but it could happen. No one is really sure about the dynamics of climate change. There are so many unknown variables, so much uncertainty. However, it is established that it is happening now. And we have to be prepared for the consequences.

You do not have to work in a hospital for a long time in my country before you realize the impact of malnourishment on morbidity and mortality. Anaemic pregnant women are not uncommon in antenatal clinics, mostly due to nutritional anaemia. In a place where blood transfusion services are still immature and with a backdrop of HIV infection, these women pose a serious challenge when they arrive in late pregnancy with severe anaemia. More than 50% of under-five deaths are partially accounted for by malnutrition. These are just two examples of the current situation. I am concerned about the future situation. Here you have two of the most vulnerable groups, women and children, who of course make up the largest percentage of the population in most developing countries. From my very little experience, they also are the most commonly hospitalized patients and they account for the majority of mortalities. And malnutrition plays a significant part in those mortalities.

Unpredictable weather patterns impact negatively on food cultivation, which is mainly subsistence farming. In the absence of irrigation such farming is likely to be unproductive. Climate change is also expected to be associated with adverse events such as droughts and floods. In my country, Lake Tanganyika has already experienced a decrease in the fish population as a result of higher temperatures. The outlook then is that more children and women will become malnourished. We have to be prepared.

Traditionally, we have not done very well in disease prevention and health promotion. I do not mean to blame anybody; it is both a national and international failure. For instance, it took years before United Republic of Tanzania set up an HIV control programme. The whole of Africa responded very slowly to the HIV epidemic. Similarly, in many other areas our interventions have been too slow and the problems have therefore become unnecessarily big. It is now imperative that we do not make the same mistakes in dealing with the potential negative health impacts of climate change. This does not only apply to United Republic of Tanzania. I believe it applies to all, especially other developing nations.

I think we need to look at the capacity of health systems to deal with the health issues that will arise. There are many aspects, including the prevention and control of new and re-emerging diseases, cold chain management, referral systems and drug supplies. These capacities are all likely to be influenced by climate change. Health systems will, however, function well in populations of well-nourished people and situations where health workers are equipped to address malnourished people. For instance, the low-osmolar oral rehydration solution (ORS) is not widely available in many parts. This has implications in the nutrition of children. Are all health workers aware of the different rehydration solutions for malnourished children (such as ReSoMal)? Are there local resources that can be used in the absence of ORS or ReSoMal?

There might be nothing much we can do as individual health workers to tackle the basic causes of malnutrition, but there is a lot we can do to confront underlying and immediate causes. Most of the research has been done to investigate the effects of nutrition on health. As a medical student, I had been involved in one such study. Efficient and effective interventions have also been researched and implemented. There are therefore known effective interventions. However, as health problems are set to increase with climate change, I think these interventions might prove inadequate. It might be wiser to research more ways to address the problems.

New sets of skills will be required to deal with health issues related to poor food supply. We must develop the necessary knowledge to enable our health systems to prevent, treat and rehabilitate. In the context of rising population, some have gone only for the numbers. I do not see a future only in the number of workers and facilities, but also in their quality. We would rather have fewer, but more effective facilities and programmes.

Technology cannot be left out in improving the capacity of our systems to adapt to the challenges of climate change. There is an obvious need for innovative, yet simple and affordable technologies for use by health and other systems. Strengthening of information systems will be invaluable to successfully coping with change. We

know the change is likely to be erratic. Experiences in one nation would prove useful to another should the same or similar weather events occur. It might also be worthwhile to communicate with regard to food policies so that they are harmonized in such a way that insufficiency in one country could be offset by ample supply in a neighbouring country.

There are gender issues to consider when one discusses food supply. Disparities might be exacerbated by food insecurity due to climate change. Is it possible we will be seeing fewer girls going to school in the near future? How are we prepared to tackle this?

In the United Republic of Tanzania, studies are being done with a view to introducing rotavirus and pneumonia vaccines. These studies may not have been related to climate change when they were started, but I am sure they will help since diarrhoea and pneumonia are likely to increase with climate change. And these in turn will help in part to reduce nutritional problems. But there are other diseases, such as haemorrhagic fevers and malaria. Someone has to investigate ways to control these diseases in the conditions that are likely to come. For instance, we had an outbreak of Rift Valley fever last year. Nobody mentioned climate change, but I think it played a part. We have never experienced an outbreak before. Is it time to investigate if we should routinely immunize our animals against the disease? People starved because they depended on meat for food. All these things have to be addressed in coping with climate change.

In conclusion, I want to emphasize the impact climate change might have on morbidity and mortality through reduced food supply. It may not be possible at the moment to predict the severity, or if shortages will happen at all. Women and children will most likely be hard hit. A body of knowledge is therefore required to enable our health systems to cope. Such knowledge will be very helpful as we strive to reach the Millennium Development Goals, especially those related to child and maternal morbidity and mortality. Interventions will need to embrace gender and cultural factors, methods of treatment, infectious disease control and even family planning. Technology is needed in appropriate places and skills imparted to appropriate people. While research has usually been funded externally in most developing nations, governments might be spending public money wisely if they fund research that enables them to effectively plan and prepare for the future.

Igembe Nkandala has just finished the fourth year of medical school and is now doing an elective research project on infant feeding practices in the context of HIV infection. He studies at the Muhimbili University of Health and Allied Sciences in Dar es Salaam, Tanzania. Previous research efforts include the fields of nutrition and malaria. Igembe is looking forward to specializing in cardiothoracic surgery or internal medicine in the future. He is currently an editor of the journal of the medical students.



Sophie North, United Kingdom

FACTS AND FIGURES:
THE DIFFICULTIES OF QUANTIFYING
THE HEALTH IMPACTS OF
CLIMATE CHANGE AND
THE VALUE OF DOING SO

Most articles on climate change start by bombarding you with terrifying facts and figures. A two degree centigrade rise in temperature will expose an extra 40–60 million people to malaria in Africa, 10 million more people to coastal flooding and 15–40% of species to extinction.¹

I recently attended an exhibition on climate change where such alarming facts and figures were showered at each visitor. I left the exhibition feeling overwhelmed and frustrated. Most facts and figures about climate change come with little explanation on how they are determined or their link to reality – thus making them seem relatively arbitrary and uninformative.

Following this exhibition, I went to a lecture aimed to convince health professionals that climate change is the biggest public health issue of our time. To do this, the main speaker repeatedly quoted that 150 000 people die every year as a result of climate change. When I queried the speaker about how this figure was derived he admitted that he did not know. This made me further question how such figures, which are constantly used in climate change discussions, are formed and what their value to society is.

It is indisputable that climate change will have impacts on health. This essay will look at how to quantify these impacts. It will discuss the reasons for quantifying mortality figures for climate change before exploring how this is currently done, and the limitations to this approach. The essay will conclude that there is a severe lack of research and data on the impacts of climate change in terms of morbidity and mortality. This is due to the vast difficulties of calculating such figures alongside a lack of political will. However, better data here will be immensely valuable. It may not only provide the impetus for global and local leaders to further put climate change on the agenda, but also help the development of more effective policies to mitigate the impacts of climate change.

The value of quantifying the impact of climate change has been repeatedly demonstrated. For example, the Stern Review², which quantified the impact of climate change on global economics, had great importance in terms of bringing climate change to the attention of global leaders and policy-makers. Through quantifying the cost of climate change, the Stern Review raised awareness that climate change is not just an issue for environmental scientists but affects everyone and every level of development. Data on climate change in terms of its impact on health and mortality may build on the “step forward” made by the Stern Review, and provide further impetus to policy-makers to prioritize climate change. Such information may help focus policy-makers by indicating which areas need urgent addressing in order to prevent disease and death from climate change-related events.

Currently, there are many models on the environmental changes, which are happening, and will continue to happen, due to climate change. However, there are very few models looking at how these environmental changes are affecting health, including mortality. There is no official climate change “death toll” and the only figure universally used is that published by the World Health Organization estimating that more than 150 000 people died in 2000 due to climate change.² This model came from a single study, which looked at only four ways in which climate change can cause death – through a single strain of malaria, diarrhoea-type disease, malnutrition and flooding.³ In the wake of scientific evidence that climate change is causing increasing and huge impacts on our current environment, this figure seems vastly limited, inadequate and out-dated. There appears to be equally few clear, and similarly limited, quantitative figures, such as disability-adjusted life years (DALYs)⁴ for morbidity associated with climate change.

Perhaps the key reason for this dearth of data on the morbidity and mortality associated with climate change is that quantifying such a vast issue is immensely difficult. To begin with there are difficulties in directly attributing health issues to climate change. Some areas, such as increased mortality from heat waves, are easier to attribute directly to climate change. However, such direct effects are generally less considerable than the many indirect effects, such as morbidity and mortality associated with more famines, shortages of water and more waterborne diseases. These indirect reasons for mortality may not be attributed solely to climate change, but due to a complex mixture of social, economic, political and environmental factors, including climate change. These multiple variables clearly make quantifying any figure for climate change extremely difficult. However, these variables should not be used as a reason for not attempting to calculate such figures. There are many estimates on mortality due to poverty – where a similar interplay of variables exists. Poverty estimates tend to be recognized as limited, yet they still offer valuable backing to policy and movements such as the Millennium Development Goals. There is no clear reason why climate change estimates could not do the same.

Another difficulty of estimating the mortality attributed to climate change is the complexity of including potential public health safeguards in a model. For example, some populations will to some extent be protected from specific impacts, such as malaria or flooding, due to public health services. Including these populations in a model further complicates an already complex equation. Positive health benefits of climate change, such as less winter mortality in the United Kingdom due to less cold spells, also complicate this equation.

Furthermore, there is no control group with which to compare – as there is no country or population that is not affected by climate change and all populations are affected differently. The huge geographical scale of climate change, and the fact that its impacts are very heterogeneous, makes it difficult for researchers to know where and how to base models and to generalize results. Not only is the geographical scale a relatively new area for researchers to deal with, but the time scale is also beyond the remit of most researchers. Climate change is a past, current and future problem with the situation continually changing – thus no model can be static, and predicting any estimates for future morbidity and mortality will be challenging and uncertain.

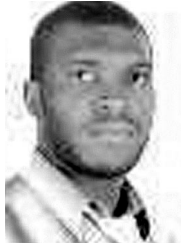
In addition, the global skill base for calculating and working on these difficult equations may be limited. People working in the health sphere have generally been slow to engage in the climate change scene. With so many global health crises needing attention, health policy tends to prioritize saving lives here and now. It is only recently that climate change is being seen as a current urgent crisis that needs working on now – rather than a future issue.

This is just a tiny insight into the difficulties of calculating morbidity and mortality figures surrounding climate change. There may also be a number of political reasons suppressing research in this area. Respected data showing that climate change – and indirectly the industrial lifestyle of the western world – is causing people ill-health and death, makes inaction not just unacceptable but criminal. This puts both global leaders and individuals leading highly polluting lives in a much more uncomfortable position. No longer will they be praised for action – rather their inaction could be seen as a crime, even manslaughter.

In conclusion, there is a major lack of recent research and quantifiable data on the impacts of climate change on morbidity and mortality. Better data here could support the impetus for leaders to further put climate change on the global agenda and also be of vital use to policy-makers working on where to focus mitigation activities. However, there are vast difficulties to quantifying the health impacts of climate change. These difficulties include the fact that it is very difficult to directly attribute morbidity and mortality to climate change – rather climate change is often one part of a complex web of social, political and environmental factors fuelling poor health. The heterogeneity of the effects of climate change and the geographical scale and time-frame of the problem also make research in this area very challenging. Despite these difficulties, it is essential that multifaceted models are developed to form some, if limited, quantifiable figures for the impacts of climate change on health. These models have immense potential to highlight that climate change is not just an environmental or economic issue but also a public health issue urgently requiring the engagement of those working in and out of the health sphere.

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- 1 Stern N. *Stern review on the economics of climate change*. Cambridge, Cambridge University Press, 2006 (http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm, accessed 24 March 2008).
 - 2 *World Health Report*. Geneva, World Health Organization, 2002 (<http://www.who.int/whr/2002/en/index.html>, accessed 25 March 2008).
 - 3 Lewis S. It's time for a body count. *The Guardian*, 26 February 2008 (<http://www.guardian.co.uk/commentisfree/2008/feb/26/climatechange.carbonemissions>, accessed 25 March 2008).
 - 4 DALYs for a disease are the sum of the years of life lost due to premature mortality (YLL) in the population and the years lost due to disability (YLD) for incident cases of the health condition. The DALY is a health gap measure that extends the concept of potential years of life lost (PYLL) due to premature death to include equivalent years of "healthy" life lost in states of less than full health, broadly termed disability. One DALY represents the loss of one year of equivalent full health. (<http://www.who.int/healthinfo/boddaly/en/>)
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Osamwonyi Obasogie, Nigeria

**DEGENERATING ENVIRONMENTAL AND
CLIMATIC PROBLEMS OF THE NIGER
DELTA AND ASSOCIATED HEALTH
PROBLEMS: A SYNOPSIS**

In Nigeria, climate change is already wreaking havoc and has the full potential to induce events of cataclysmic proportion in the oil-rich Niger Delta region. Changes in the climate of the Niger Delta are as much externally influenced as internally generated through massive pollution from oil production, which has greatly affected the lithosphere (land), hydrosphere (water), atmosphere (air) and the entire biosphere – all key areas that are come into direct contact with human populations and are crucial to their survival.

Hydrosphere and atmosphere interaction. Water bodies, like rivers and large streams, have become dumping sites for waste, such as effluent and high temperature water used for cooling in production processes. In addition they are also frequent recipients of oil spills. As a consequence, aquatic life in most fresh water sources of the Delta has been exterminated, with only tough species of fishes like the bowfin (dog fish) and the mudskipper remaining in sizeable numbers. These water bodies are being transformed into decomposing pits exuding offensive smells. They represent a great threat to human health and a ready source of waterborne disease-causing pathogens. Sadly enough, it is the creeks that most of the people still largely depend on as their water source. Because of anaerobic and microbial life in these waters, an imbalance in the ecosystem has arisen. These water bodies are now emission sources for oil based primary pollutants to the atmosphere through the interactive means of evaporation, where they become oxidized hydrocarbons – secondary pollutants and active components of photochemical smog. Persistent photochemical smog would obviously have devastating effects on the inhabitants. Constant exposure can lead to death; the most recent example being the recorded deaths of 4000 people in London in 1952 from smog inhalation. The population most affected were the aged and children who could not help themselves. It is worth noting that it is currently impossible to ascertain how many such fatalities have occurred in the Niger Delta region.

Atmosphere, hydrosphere and lithosphere interaction. Waste emissions from oil companies contain sulfur (IV) oxide and sulfur (VI) oxide. These are emitted straight into the atmosphere and when it rains, as it does all year round in these parts, sulfurous and sulfuric acids are formed resulting in acid rains. Nitrogen (IV) oxide and carbon (IV) oxide also produce similar results, evident in damage to buildings, especially zinc roofs that have rusty appearances within short periods of time. Even more disastrous is that such rain water either falls directly into the water bodies or flows in from surface run-off from land and waterbeds below the soil. This decreases the water pH turning water bodies acidic, destroying the fry of fish and killing adult fish. On land, acid rain causes excessive leeching that in turn moves macro plant nutrients far beyond plant roots, resulting in extermination of vegetation (this is

aside from the effects of heavy deforestation). For example, coconut trees that are common in these areas die out within 10 years of planting, 40 years shorter than their normal lifespan. Essentially there is loss of arable land and cash crops, coupled with a reduction in fishing.

Gas flaring. The region still accounts for the flaring of 24 billion cubic metres of gas annually, which pitches Nigeria second to the Russian Federation. Gas flares contain the dangerous and toxic flue gases mentioned previously. In addition, incomplete combustion causes emission of carbon (II) oxide that causes fatalities due to blood poisoning and asphyxiation when inhaled because they replace haemoglobin, an oxygen carrier. Carbon (IV) oxide is a constituent of these flared gases, itself almost solely responsible for the greenhouse effect (the other being methane that is also present in these emissions). Flared gases cause higher temperatures. Residents close to areas where gas is flared have attested to this fact, however it remains to be determined how many people have developed lung-related diseases, eye defects or dermatological disease through exposure to such stack gases, or who have developed cerebral meningitis from the rise in temperature.

Radioactive waste and fires. Recent reports have indicated that some abandoned oil wells contain radioactive waste. Usually such wells have “formation water” – water mixed with crude oil. There is potential for this formation water to seep into wells meant for drinking water. Even if contaminated water is not consumed, close human contact to these radioactive wastes, even in trace amounts, is fatal. Radioactive wastes are heavily carcinogenic, like benzene and other particulates from gas flares. The level to which people are aware of this issue is a matter that needs addressing. Settlements in close proximity to the oil wells are at particular risk. When there is a blow out, land becomes unusable and fire ensures the oil wells burn without cessation. I personally observed attempts to control the fire that engulfed well-head 13 in Ogoni land (Rivers State). The well-head, which had not been operational since 1993, was sabotaged in August 2006. It took four months to get under control, with unfathomable devastation to the ecosystem and perhaps latent damage to human health. Furthermore, it would be wise to conduct research to ascertain if there is any correlation between exposure to these pollutants and infertility.

Research challenges. Oloibiri ought to be in modern day Bayelsa state in the south-south Nigeria region for this is where extraction of oil first commenced in commercial quantities in 1958. What most people do not know today is that this area is no longer inhabited by people. If you have communities that are folding up and becoming transient it behoves one to ask how to account for the inhabitants as they migrate? Are they reintegrated into other communities or abandoned? Are their health challenges documented; to begin with do they have access to health facilities? Such questions do not have positive answers and they beg for one or many positive answers. Most people in these areas are heavily impoverished and poverty fosters illiteracy, this leads to lower economic status, which in turn serves as a catalyst for the spread of disease. Health they say is wealth, and if people are unwell they cannot work. So despite its large population, Nigeria will generate little economic activity.

Many people in these areas are unable to access hospitals if they become unwell. This is because there may be no hospital in the vicinity, they do not have the funds or there is no means to physically get there. Such health cases are commonly

unreported and/or undocumented, especially for populations living in the creeks area. More recently, the escalating spate of sporadic violence by aggrieved peoples of the region makes certain areas, most notably the creeks, a no-go zone. So how does one carry out research with local communities whose lives are being threatened and who cannot adequately convey what is wrong with them? How would timely diagnosis be proffered if life is at stake? It is also worth asking if all pregnant women get prenatal and postnatal care. Are all children properly vaccinated and immunized? These questions can only be answered if accurate population data is available on specifics, like how many women (pregnant or otherwise) and children live in the epicentres of this great environmental tragedy? You might also want to ask whether data obtained during the 2006 Nigerian census included population details for those living in the less accessible areas of the Niger Delta, and if so, whether such data was enumerated accurately? Future realistic population projections cannot be made without comprehensive and accurate data. Accurate and practicable population data complements health research, and without it, research is difficult to undertake and if undertaken, its results would simply be hypothetical, inconclusive and non-representative of the target group(s). These are a few of the challenges to health research for vulnerable groups in the Niger Delta region of Nigeria.

Domiciling biofuel plants in the Niger Delta, especially those that produce ethanol from cassava, could further increase pressure on land use and induce more excessive flooding than what occurs currently. This would lead to displacement of people from their land, especially if sustainable farming techniques are not used. Projections estimate that such biofuel refineries can provide ready jobs. While this may seem commendable, it is worth emphasizing that cassava in processed form is a staple diet in most homes across the nation, especially in the Niger Delta. Consequent food shortages and higher food prices would lead to more malnourishment, reducing the resistance to disease of women, children and the aged. For the region to overcome this imbroglio, the ecosystem needs to be rehabilitated so that its inhabitants can earn a living through means passed to them by their ancestors, namely fishing and farming. Through the teaching of best practice the people of the Niger Delta could potentially turn these traditional livelihoods into larger scale enterprises and thereby increase the value of their trade. Proponents of this argument cite the fact that this region fetches the nation four billion US dollars annually. Why not, they ask, plough half of this profit back into repairing the devastation and reversing the above trends? That is reasonable and would require no research to attest to its efficacy.

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Osamwonyi Obasogie was born in 1983 in Nigeria. He has always loved to write. He is currently studying Chemistry and is expected to graduate this year. He has studied scriptwriting in the past and written educational films for the United Nations Population Fund (UNFPA) in Nigeria. He wants some day to work in humanities.

**Sant-Rayn Pasricha, Australia**

CLIMATE CHANGE AND NUTRITION: HEALTH RESEARCH MUST ADAPT QUICKLY TO MEET THE PROBLEM

Even as climate change finally emerges as perhaps the issue of our times, the fourth Intergovernmental Panel on Climate Change (IPCC) report, released last year, paints a grim picture: warming is much worse than previously predicted and the likely consequences for ecosystems, water security, agriculture and health will be significant. The report bleakly concludes that major impacts “...cannot be avoided”.

Only 17 years earlier, the first IPCC report ambiguously concluded that although “...human activities were substantially increasing greenhouse gases”, observed climate changes could represent “...natural climate variability”. The report generated widespread criticism from polluting industries and countries and only weak agreement for reform at the first Earth Summit. But by 1995 the second IPCC report predicted, with strengthened confidence, a rise in global temperatures and sea levels, concluding that, “...there is a discernible human influence on global climate.” Though the Kyoto Protocol was conceived in 1997, it took seven more years to be enacted. The third IPCC report released in 2001, even as Australian and United States of America leaders turned their backs on the Kyoto Protocol, concluded that climate change had already occurred, was occurring due to human activities, would continue to occur and that human systems were already being affected. Even as Al Gore’s breakthrough film was being released, the then Australian Prime Minister, John Howard, stated he remained “...sceptical of ... Doomsday scenarios” and that there was a “...lot more time” to see what happens.

In Australia, we had been experiencing an endless drought. In the cities we were showering over buckets and our lawns were turning brown, whilst on the farms the crops were failing year after year, the topsoil was blowing from the cracked ground and debt was blowing away the farmers. As pennies started dropping in cinemas around the country – this drought was not a chance event – we changed our vote and politicians began to understand.

Within two decades, climate change has evolved from a controversial scientific theory to a salient global reality. Yet throughout those years – governments, industry, indeed most ordinary people – ignored the unfolding story because nothing had been “proven”. Put simply, the data was inadequate to sway opinions based on ideology, commercial interest and inertia; evidence could not influence policy. When it comes to dealing with the consequences, we cannot afford to make the same mistake.

With high confidence, the fourth IPCC report emphasizes that climate change will impact most profoundly on health in underdeveloped countries, and particularly amongst the most impoverished within those communities. Heat waves, infectious disease and malnutrition are particularly likely to devastate these populations.

Efforts to “make poverty history”, to curb the health consequences of socioeconomic deprivation, are likely to be eroded. And so research efforts intended to understand and improve the health problems of the poor must incorporate consideration of the influence of global warming.

Food production is likely to be a major casualty of climate change. Although in some high latitude areas, cereal crop production may increase, around one billion people in Asia are exposed to “...risks from reduced agricultural production potential”. Production of staple cereals is likely to decline in south Asia. Diminished food production may result in increased food prices, which could diminish accessibility of nutritious food for both the urban and rural poor. Already, Australian exports have diminished, global rice trade is slowing and Asian food prices are rising. Meanwhile, recent droughts have decimated the national cattle herds of African countries; more than half of Ethiopia’s cattle stock was lost during a 1998 event.

A literature search on the US National Library of Medicine’s online archive, PubMed Central (PMC), for “climate change” and “nutrition” currently reveals fewer than 50 articles. Research is needed that links the medical consequences for the individual that will occur with altered nutrition. Altered nutrition would potentially be due to changes in diet because of changed access to food and diminished food security, generated by changes in agricultural practices and yields, in turn produced by specific changes in temperature, humidity, rainfall and soil content (all due to regional and global climate change). Although authors agree in general terms that the consequences for nutrition are likely to be immense, estimations of specific nutritional deficiencies and syndromes are required to enable planning for specific pre-emptive prevention and control interventions at specific sites.

For example, might climate change cause anaemia? Consider the theoretical consequences of a reduction of a nation’s herd. As cattle numbers drop, meat prices rise. Those with limited purchasing power would be unable to obtain fresh meat. Within family units, adult men would perhaps be most likely to continue to consume meat, whilst children and women, already at risk of iron deficiency, may have an exacerbated risk of anaemia as their iron consumption falls. Meanwhile, subsistence farmers may find their private herds impossible to feed and sell their livestock, diminishing their meat consumption. Reduced productivity amongst adults, a consequence of anaemia, may further impair agricultural output. Iron deficiency anaemia increases the risk of maternal death and impairs childhood growth and development, which in turn diminish economic potential.

In another scenario, diminished cereal yields may result in increasing land use to produce these staple crops, at the expense of other locally grown vegetables, such as leafy greens. Exclusive cereal consumption, with high phytate content may exacerbate iron, zinc and other micronutrient deficiencies. Zinc deficiency is associated with increased childhood mortality and undergrowth. Vitamin A deficiency, folate deficiency and their consequent syndromes could also result from reductions in dietary quality.

This sequence reflects only one of many possibilities: protein energy malnutrition, micronutrient deficiency, feto-maternal malnutrition and even widespread famine may each conceivably result. Specific sequences will vary, with different “syndromes”

occurring in different locations, based on the individual terrain, agricultural activities, diets and population, as well as the specific local climatic alteration (such as increases in rainfall, reductions in rainfall, susceptibility to extreme events, or all of these).

Research to identify how climate change is likely to influence the nutrition of the world's poorest is urgently required to identify the scenarios likely to occur in specific locations amongst specific communities. Such research will require interdisciplinary collaboration between medical, nutrition, agricultural and climate specialists. *The Lancet* could commission a landmark review article: "nutritional consequences of climate change for the world's poor" to be co-authored by eminent scientists from across these fields, exploring currently understood connections, identifying the gaps and setting the research agenda.

The new research will require analysis of distinct geographical zones, involving analysis of connections between climate, agriculture, diet and current nutrition and medical status. Areas experiencing deviations in usual climate could be studied: how have agriculture, food production and security, diet and subsequent medical conditions been influenced by the altered conditions? At what scale? These findings could be extrapolated. But global climate changes and the consequences will be heterogeneous; changes in Indonesia might not reflect what will happen in India, Mozambique or Peru. Thus selected sites must represent a cross-section of high-risk environments.

But techniques in health research are currently ill equipped. Basic and epidemiologic biomedical research methods are inherently retrospective, hypothesis driven and experimentally focused processes. The concept of modelling remains at the margin. Projection is generally regarded as level III evidence; a hypothesis awaiting a trial. These study techniques have immense strength and authority. Our capacity to understand and treat illness has improved exponentially, and the weight of medical evidence persuades governments and industry to invest billions of dollars (in developed countries, around a tenth of the gross domestic product) on drugs, diagnostic tests and doctors. Our research pulls strings. But we need to adapt the tools of modelling and projection, to enable us to both conduct this research and understand it.

There are mitigating interventions already available. At a medical level, simple iron/folate tablets can enhance haematological status. Home-based fortification with micronutrients is being trialled for young children. Centralized and community fortification of salt, flour and rice is available. Improved agricultural techniques, including optimal irrigation, pest control and crop rotation, can be taught to farmers. However, current delivery of these interventions is often inadequate, and the situation is shifting. If we plan our future remedies based on a static vision of global nutritional epidemiology, we will remain behind.

Thus, as we learn how nutrition will be affected, research must advance interventions at the medical, nutritional and agricultural levels. Allopathic, food-based and farm-based solutions will each have a role in the mix of solutions. Health related needs include improved fortificants, optimized micronutrient delivery systems, and low cost, culturally appropriate therapeutic foods.

Finally, research into the nutritional impacts of climate change may serve a broader purpose. When global warming was essentially an "environmental" issue, it was

largely ignored (as though saving the planet for the planet's sake was not enough). As the consequences for human lives become clear, the impetus to reduce greenhouse emissions will strengthen. The projected impact on nutrition may also help define the upper "safe" limit of warming, thereby guiding emission targets.

But we must learn from the experience of climate change science. We cannot wait for the level one evidence before we prepare for the consequences. Too many people will have suffered by then.

Sant-Rayn Pasricha completed his medical degree in 2001 at The University of Melbourne, Australia. He is undertaking specialist medical training in clinical and laboratory haematology. In 2007, he completed a master's degree in Public Health, including a research project exploring iron deficiency anaemia among rural women in Viet Nam. He has taken a year-long break from his training in 2008 to work in Karnataka, India, where he is conducting a field study to understand the biological, dietary and socioeconomic factors behind the enormous burden of anaemia in rural children. He hopes to focus future research on scientific and public health aspects of nutritional haematology.

**Tiffany Pennick-Walters, USA****THE CLIMATE OF MENTAL HEALTH
AFTER NATURAL DISASTER:
A PICTURE OF INCOMPLETE HEALTH**

Imagine a 13-year-old Venezuelan girl mourning the loss of her mother after torrential rains and mudslides kill tens of thousands of people and reduce her home to a pile of rubble. Picture a 28-year-old father clinging to a tree in Sri Lanka in order to save his life after tsunami waves claim over 200 000 lives. Envision a 67-year-old woman standing in her attic in the lower ninth ward of New Orleans, Louisiana with water up to her chin for five days after Hurricane Katrina strikes the *Big Easy*. These pictures, vivid and inconceivable, are only still frames of natural disasters that have devastated communities within the past 10 years. Each picture shows much more than the destruction of a natural disaster. We also see the reality that those left behind must face.

The massive devastation of natural disasters has been experienced worldwide, regardless of age, gender, geography or ethnicity. As the body count continues to rise, it is evident that the connection between climate and natural disaster spells out an unprecedented need for immediate action. Simply put, “Mother Nature” is infuriated and we are to blame. In the universal hunt for world power, we have managed to contribute significantly to global warming, which influences precipitation, polar meltdown, rising sea levels and tectonic activity.¹ As a result our planet has responded in the form of increased tornadoes, heat waves, earthquakes and hurricanes that have come to obliterate all those that stand in their path. In the aftermath of a natural disaster we find the possibilities of several public health threats, including West Nile virus, gastrointestinal ailments and traumatic injuries. However, with insurmountable loss of life, possessions and peace of mind, there is also the immense reality of the community suffering from various mental illnesses. The Center for Disease Control and Prevention’s Policy on Climate Change and Public Health lists mental illness as a predictable health effect of climate change and extreme weather events.² However, the fact remains that mental health is still not given the proper attention necessary to ensure a picture of complete health after disaster strikes. Complete health is the necessary physical, mental and social well-being of all individuals.

The separation of physical and mental health is an ongoing public health debate. In 1999, United States Surgeon General David Satcher’s report on mental health cites that physical and mental health are indeed inseparable entities.³ Good mental health affects interpersonal communication, work productivity and overall personal welfare. In the face of natural disaster, mental health is crucial to the continuum of the community as a functioning unit. The high prevalence of post-traumatic stress disorder (PTSD), chronic depression, substance and alcohol abuse and suicide after a natural disaster should indeed be a major public health concern if our true goal is to restore complete health to devastated communities. What should also be a major concern is that a large portion of those devastated by these disasters are part of the most vulnerable population of all – individuals with low socioeconomic status. Poverty is a worldwide

issue. Even in developed countries such as the United States of America, there are more than 37 million individuals living in poverty.⁴ It is no secret that poor people are more likely to have less education, more disease, inadequate health care and fewer resources to handle an unexpected catastrophic natural disaster. This is true no matter where they live. The social effects of poverty are damaging all by themselves. When poverty meets natural disaster we find complete and total pandemonium. A prime example of this chaos is the desolation caused by Hurricane Katrina along the Gulf coast of the USA on 29 August 2005. With 2500 people dead or missing, more than 400 000 people displaced, approximately 25 billion dollars in damage, and still no one to hold accountable for the five days of absent relief or response, the effects of Hurricane Katrina are profoundly apparent today, almost three years later.

As a behavioural scientist and health educator, I facilitate several health curricula throughout low socioeconomic communities in the USA, Caribbean and South Africa. The Healthy Minds, Healthy People project seeks to serve the mental health needs of survivors of Hurricane Katrina and Rita who have relocated to Atlanta, Georgia. The intervention was created by young public health professionals who are interested in empowering survivors to seek the mental health care that is necessary to find healing and comfort in their new environment. What we have found in the past year is that hurricane survivors are in need of so much more than our curriculum can offer. The stories of loss, resilience, displacement and disappointment create a heavy dose of reality for those of us that only witnessed the devastation while flipping the television channels in between our favourite sitcom. A recently published study found that Katrina survivors were actually experiencing an increased prevalence of PTSD and rate of suicide two years after the hurricane.⁵ Likewise, we have also seen survivors who do not suffer from severe mental health illness, however, they are battling a host of related social issues such as unemployment, housing and cultural stigma that has created more of a reason to pick up a bottle or cry yourself to sleep every night.

While it is true that the federal government has allocated millions of dollars for mental health professionals to provide crisis counselling and to increase mental health care for hurricane victims, the fact still remains that many Katrina survivors did not receive adequate mental health care after the hurricane, and are still not receiving the care they need today.⁶ We must begin to ask why. Furthermore, there is a lack of empirical data that supports the specific theories, strategies and interventions that will mitigate the mental health needs of individuals who have been affected by catastrophic natural disasters. While we know that barriers such as lack of community partnerships and bureaucracy exist, we still have a great need for research at the federal, state and local levels that will intentionally examine public health infrastructure specific to mental health and natural disaster, especially in populations with low socioeconomic status. These are the individuals who get left behind when disaster strikes because they have no resources to simply pick up and move.

We have also found a tremendous need to explore the social determinants associated with mental health and natural disaster. For many of our participants mental health is literally on the bottom of the totem pole of their list of needs. There are basic necessities that are of greater concern for them. For instance, it is impossible for a single mother of three young children to be concerned about her mental health when she has not worked in six months because employers will not hire her when they find out that she is a Katrina "refugee". Her primary concern lies with feeding her children and finding

a job. Even if she is suffering from PTSD or depression, her perceived need for mental health services is cloaked by a host of other factors including her need for survival and her own stigma of mental illness and treatment. In order for us to provide the best quality of care for this mother and her children, we must be prepared to address the majority of these needs prior to the disaster. It is absolutely necessary to have working systems, strategies and interventions in place before catastrophe happens, in order to ensure the complete health of those who have been deeply impacted. Creating curriculums and marketing campaigns that teach community members what to do in time of natural disaster is of the utmost importance, especially for those poor people who are likely to be left behind or displaced without proper resources. This is a worldwide issue that needs immediate worldwide attention.

It is up to researchers on all levels to begin to answer the myriad of questions that exist. Answering more research questions that speak to issues of access to mental health and socioeconomic status, culture, gender and race is imperative to bridging the gap that is apparent today. Issues surrounding dissemination of resources, response time, survival skills and perception of need after a natural disaster will also help to save lives and recreate thriving communities. Using research to learn from our mistakes in order to ensure that such upheaval never happens again is essential. Sharing research findings with governments around the world is equally as important to make certain that the complete health needs of all survivors are secured.

There is an African proverb that reads, "Disease and disaster come and go like rain, but health is like the sun that illuminates the entire village." It is my sincere hope that next time natural disaster strikes our planet, wherever it may be, the public health workforce will be ready to bring out the sun that will finally illuminate a picture of complete health.

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With a post-graduate degree in Public Health, Tiffany Pennick-Walters is currently a Manager of Research Projects for Emory University Rollins School of Public Health in Atlanta, Georgia. Tiffany develops, implements and evaluates several HIV risk reduction curriculums throughout the United States of America, the Caribbean and South Africa. In addition, Tiffany develops and implements community-based programmes, including the Healthy Minds, Healthy People Program, which seeks to link survivors of the 2005 Gulf Coast Hurricanes with necessary mental health services and resources. Tiffany's ultimate aspiration is to become a medical doctor, focusing on preventive medicine and public health.



David Edward-Ooi Poon, Canada

THE UNNECESSARY DICHOTOMY

There is a peculiar romance associated with global warming. The passion found on the battlegrounds against climate change forges a love story, an attraction between the idealistic eager and the latest trend towards the betterment of society. Anti-establishment before, anti-Walmart yesterday, the rush to fight the next world threat seems simply an excuse to jump onto the latest bandwagon, supporting a cause for the sole purpose of having one.

Such was my cynicism before another love found me.

We in the medical field are often under the impression that the human condition is under our sole control. However, the girl I began dating, a civil environmental engineer, showed me that the scope of health extends far beyond medical school. The role that the word “civil” placed upon her profession allowed her to cover much that disease epidemiologists attempt to address: the treatment of water and the creation of sanitation systems to curb the effects of waterborne diseases. Her interest in “environmental”, on the other hand, I attributed to a transient interest in the aforementioned topic *du jour*.

Through her studies, I realized this connection was not only real, but crucial. As the environment responds to our growing presence, water shortages affect more countries. Without a consistent source of renewable, non-polluted fresh water, water sanitation becomes more energy-intensive and difficult to establish. As evidenced by the staggering number of deaths that occur daily due to a lack of access to clean drinking water, it dawned upon me that the environment is not only a topical, but a health issue as well. Like Shakespeare’s Romeo and Juliet, these two seemingly separate entities have fates that are deeply intertwined.

One would expect nations to invest heavily in research on what is essentially environmental epidemiology. However today, government policy places climate change as being counter to economic growth. I see this as largely due to the pervasive public perception that a choice must be made between a sustainable environment and the continued development of a nation. Perpetuated by corporate special interests, or perhaps a lack of evidence presented to the general public, this dichotomous ideation proves problematic. With government funds split between environmental issues and pressing financial ones, such as health care, the greatest challenge facing research in climate change and health is overcoming the “either/or” assumption, the emphasis of one or the other in lieu of symbiosis.

Ignoring this connection has already had severe consequences. In 2000, the World Health Organization estimated a 2% increase in overall deaths from malaria, diarrhoeal

diseases and malnutrition due to climate change. Given that these diseases already rank among the largest causes of death in the developing world, this translates into an additional 151 000 deaths per year, and is projected to at least double by 2030. Likewise, in the so-called “western world”, the vector for Lyme disease, *Ixodes scapularis*, has taken advantage of the warmer climate and is projected to colonize many cities in Canada where previously the environment was unsatisfactory for the vector. Heat waves in France and the United States of America have led to increased temperature-related deaths in the elderly. There have been recent riots over food supply in South America, and with impending shortages worldwide. All countries are vulnerable to the effects of climate change on health and have much to gain socially and economically through environmental protection.

One can imagine that through preventing the illnesses created by the declining state of the environment, money could be saved in health-care costs—not only with direct savings, but with increased productivity. It is here that we can find the proverbial “Holy Grail” of research into climate change and health; the assessment and proof of the economic viability of a plan that is mutually beneficial to both the environment and community health. Economist Sir Nicholas Stern detailed the link between climate change and other economic markers in his famous report released in 2006.¹ Regardless of such findings and as evidenced by the lack of government commitment at the Bali Earth Summit that same year, it seems existing research is unable to sway policy. Similarly, reports from the United States Environmental Protection Agency found that in reducing air pollution, health-care costs would be significantly reduced by lower numbers of asthma and cardiac-related morbidities. Yet, this form of primary prevention does not exist in Canada, a country where roughly a third of provincial budgets is spent on health care due to a vested interest in profiting from our lucrative oil/tar sands. This symbolic rejection of environmental protection for economic motives seems short-sighted at best, yet is seen commonly worldwide. Until this stigma is overcome, policy will continue to support either climate-related initiatives, or costly social services like health care.

This is where the barriers to research in environmental epidemiology are set. For research to be successful, there are typically two needs: political will and resources. Given the media attention and a virtually limitless wide-eyed army rallying for it, there is a clear interest in environmental sustainability. Yet, the Bali Earth summit failed because of the perceived economic fallout of change. Health care too is a topic of interest to policy-makers and the public alike. One can only assume that monetary reasons also impede the improvement of public health, as evidenced by the alarming prevalence of fatal infectious diseases in low-income countries and inaccessible care in richer nations. As long as the climate and the people remain separate financial concepts, so will resources intended to improve each. Therefore despite a clear interest in both aforementioned subjects, support for research into improving the environment and health will be divided. What is needed is a measurement tool to recognize the value each has to the other.

Currently, the arguments of reduced growth due to investment in the environment are based on numbers surrounding the gross domestic product (GDP), the annual cash flows associated with goods and services produced and provided in a country. The genuine progress indicator (GPI), however, calculates “growth” more in terms of community development, taking into account indicators, such as health, safety and pollution, in addition to the GDP of a nation. A country that profits greatly from oil sales will show increases in GDP, but score poorly on GPI if there is an equally large

decrease in community development indicators. Adoption of the GPI would help expand a spectrum of debate that currently allows only simple “either/or” dichotomies, thus addressing that barrier to research funding. In prioritizing GPI as a more important measure of a country’s development than GDP, solutions to address health and climate change concerns would be pursued and consequently researched. This would interest politicians wishing to invest in popular strategies and would also address the public misconception of environmentalism and expensive health services as irreconcilable foes battling for limited resources. Indeed, the GPI metric would demonstrate how economic development for environmental sustainability would yield far greater societal rewards than does the traditional GDP-driven mode of relentless (and unsustainable) growth.

From the perspective of GPI, the establishment of government subsidies to encourage alternative energy research is useful as an economic model to solve unwarranted “environment versus profit” dilemmas. In light of the rising price of crude oil, the USA invests in environmentally friendly policies to increase the availability of eco-friendly energy, like wind power. This became a possibility once leaders noticed the link between saving money on gas and saving the environment. Similarly, subsidies for research on environmental impacts on health care would be beneficial for governments looking to reduce medical expenditures. In each of the above cases, the GPI would likely increase due to the economic savings and reduced environmental impact. Identifying these beneficial links is a direct result of research, provided the initiative to overcome the barriers is funding it. Now, cleaner power sources are being sought primarily in reaction to a severe shortage of fossil fuels. Knowing this, the study of environmental epidemiology becomes all the more imperative. We cannot wait for an equivalent human crisis to necessitate an environmental policy for our health.

This requires government and private sector research bodies to be proactive, as our honeymoon from global catastrophe is beginning to end. Love one day turns into hate the next day when misunderstanding supersedes fact. The unnecessary dichotomy that forces a choice between the world or its inhabitants is one such impression that must be abandoned in favour of genuine progress. This paradoxical acceptance of the status quo has left the entire world’s population vulnerable to the fluctuating state of the planet we ruin. As scientists have funds divided into two arbitrarily separate fields, they are left unable to pursue research in an area that may benefit both. The health of our populations depends on the health of our planet; investing in our environment would be investing in us. It is here we see how research into climate change and health are so similar to Romeo and Juliet – one simply cannot live without the other.

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David Edward-Ooi Poon was born in the small Canadian prairie city of Regina, capital of Saskatchewan province. Unpopular among his peers, David found solace in observing the world from an outsider’s view. His willingness to see his surroundings objectively catapulted him through his third year of medical school. But his paralyzing fear of blood forced him to branch out in other directions. David went on to invent “Economic Flags” – an award-winning educational game that teaches the impact culture has on global economics. Combining these seemingly separate interests allowed David to use his invention to show students the delicate relationship between the environment, economy and human health.

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**Charles Salmen, USA**

RETHINKING HEALTH FOR
OUR GLOBAL ORGANISM:
THE OBESITY FAMINE, RURAL
INFECTION AND CLIMATE CHANGE

Now I am terrified at the Earth, it is that calm and patient,
It grows such sweet things out of such corruptions,
It turns harmless and stainless on its axis, with such endless successions of
diseas'd corpses,
It distills such exquisite winds out of such infused fetor,
It renews with such unwitting looks its prodigal, annual, sumptuous crops,
It gives such divine materials to men, and accepts such leavings from them at last.

from "This Compost" by Walt Whitman

Our distraught organism. In his 1856 edition of *Leaves of Grass*, Walt Whitman speaks reverently of a vibrant, serene planet capable of transforming even death and contagion into beauty and new life. Yet, after a century and a half of unrestrained consumption and pollution, the Earth no longer remains so "calm and patient." In the face of alarming international health challenges and the serious prospect of global climate change, neither should we. In an era of rapid transition, we must reassess climate change as both an escalating "cause" and unprecedented "consequence" of modern disease burdens. This is not a time for panic sirens, but for sensitive research that seeks to mitigate the impact of emerging disease patterns on the status of worldwide ecosystems and direct activism for millions of threatened people.

I believe that new research paradigms for disease–human–environment interactions are necessary to revitalize movements for social justice. As medical scientists and activists, we need to start thinking of our world literally as a living "organism" and focus on re-establishing symbiotic relationships between human populations and our distraught planet. We must appreciate that oppressive socioeconomic forces and deteriorating physical environments contribute to illness as much as any pathogen. We must see that diseases do not occur merely inside the containers of our skin; they ripple through an organic web of social and ecological relationships. It is time to stop thinking of disease in strictly biomedical terms; we must tackle sickness as a function of the complex interaction between microorganisms, social structures and ecosystems that are straining under the intense pressure of human activity. Most importantly, we must recognize that the health effects of climate change will almost certainly be experienced first in bodies of the poorest inhabitants of our planet, and embrace the urgent necessity to prioritize research for vulnerable populations. I believe that when we expand our awareness of our global organism, we begin to see that the well-being of an individual human being anywhere is fundamentally connected to the well-being of humanity everywhere.

Connecting signs. We often talk of the vicious poverty cycle whereby people get sick because they are poor and they stay poor because they are sick. When we recognize ecological connections, I believe we will see another vicious cycle – people will get sick as our climate changes, and our climate will deteriorate further if people are not healthy enough to protect it.

Rudolf Virchow, an original advocate of medicine as social justice, wrote in 1848 that, “...epidemics are like large sign-posts from which the statesman of stature can read that a disturbance has occurred in the development of his nation that not even careless politics can afford to overlook”. In an age of globalization, we need to look beyond the politics of separate nations and realize that sign-posts are popping up all over our world. To start, we need to challenge the assumption that infectious and non-communicable diseases exist independently on opposite ends of the economic spectrum. If we let ourselves think that infections like HIV, tuberculosis or malaria are only problems for poor countries, while chronic illnesses like diabetes, atherosclerosis or obesity are mainly problems of excess for the developed world, we may fail to see that new disease transitions are taking place in the 21st century that are increasingly connected through climate change. For example, we should not shy away from addressing unexplored relationships between the rise of metabolic syndrome in industrialized nations and infectious disease incidence in the developing world.

It is frequently asserted that climate change may lead to widespread famine. Yet, what if global warming itself was an indirect consequence of new types of famine? Famine is described in terms of “nutrition insecurity” – not merely a lack of calories, but the absence of micro/macronutrient balance and the cultural, economic and political structures necessary for individuals to lead nutritious lifestyles. If we assess these structures within industrialized environments, it may make sense to start thinking of obesity epidemics as a function of nutrition insecurity. While mouths may ingest more than enough calories, a nutritious lifestyle is increasingly difficult for poor people to afford throughout the developed world. Moreover, widespread obesity is a sign-post of a population-level energy imbalance that has global impact.

We are seeing less active bodies that are increasingly reliant on fossil fuels to get around, and a profusion of nutrient-poor, high-energy “junk” diets from an aggressive commercial food industry rooted in large-scale industrial agriculture. Gaia theorists, like James Lovelock, describe Earth as a living entity, and argue that “agro-business” is a major threat to the bionetworks that regulate our atmosphere. Industrialized consumption necessitates monoculture cropping, excessive irrigation, chemical fertilizers and pesticides and vast herds of livestock that degrade ecosystems and generate as much greenhouse gas as any power plant. Countless cars, sprawling cities, big business beef and addictive televisions connected to massive electrical grids not only lock people into oppressive “obesogenic” environments, but contribute to the deterioration of our biosphere.

We need research to critically dismantle the socioeconomic engines of “obesity famine” that are simultaneously driving climate conditions for conventional famine and infection in poorer countries thousands of miles away. We are already starting to appreciate their potentially devastating impact through hotter temperatures, drier seasons, rising vector habitats, disappearing farmlands and expanding deserts within the tropical latitudes of the developing world. In sub-Saharan Africa for example,

where local ecosystems have supported small-scale pastoralism and farming for generations, the health of remote populations is closely tied to the sustainability of their environments.

Last year, I spent six months in western Kenya, working with an HIV control programme called Academic Model for the Prevention and Treatment of HIV (AMPATH). My team helped coordinate testing and awareness campaigns in rural villages, schools, prisons and factories. Each day we were confronted with poignant reminders that the roots of this syndrome extend far beyond its “causative” virus. HIV spreads when breadwinners are forced to travel to distant cities to earn wages, and when women are forced to make desperate economic choices with their bodies and breastfeeding babies. It confounds antiretroviral treatment when patients lack nutrition to boost their immune systems. Sign-posts are emerging in overcrowded hospital wards, alleys filled with orphaned street children, on barren farms and in burgeoning slums.

Yet, HIV is not only killing millions of people and weakening thousands of local economies; it is forcing dire populations to accelerate dangerous changes to their stressed environments in order to squeeze out enough to survive. Infectious disease and destitution are taking a huge environmental toll in terms of deforestation, uncontrolled waste and urban concentration. In this positive feedback loop, “green” living itself is unsustainable for populations just trying to stay alive.

Expanding the cause. Many non-western cultures blur the boundaries between individual, society and the environment. Many “traditional” ethno-medical systems understand diseases as expressions of broader social and cosmic forces. Perhaps biomedical research can take a lesson here. We tend to think of disease in terms of microorganisms that attack individual bodies. Yet, diseases not only sap strength from our persons, they tremble the foundations of our communities and reverberate across the ecosystems of our planet.

What if, instead, we thought of diseases more broadly as less evolved relationships of unequal energy consumption, when organisms selfishly exploit resources even if it means weakening or killing their host systems? We may recognize that the way human populations compete for the Earth’s resources and recklessly discharge waste is remarkably similar to the way a maladaptive parasite feeds off its host. We may recognize that the inequitable distribution of health care in our societies is not merely an unfortunate economic circumstance, but the pathology of a global disease that literally weakens our world. We must challenge the Malthusian rhetoric of those who suggest that modern epidemics are a “cure” for overpopulation. Not only does this type of thinking lack humanity, it’s patently false. When populations are unhealthy, environmental damage increases exponentially.

The fact is, in both the developing and developed world, when people are sick, be they undernourished or overweight, plagued by plasmodia or plugged with plaque, they are unable to prioritize universal environmental concerns over immediate bodily needs. But today’s health research must prioritize both.

We need to combat parasitism on medical, economic and ecological scales to rejuvenate the equilibriums that poets like Whitman once celebrated. As global health activists, we must embrace the challenges of climate change as our most compelling

arguments to finally galvanize the international resolve we need to improve the quality of lives worldwide. We should not view climate change as an inevitable disaster, but an opportunity – a cause that truly unites everyone in our organism.

Charles Salmen grew up in the mountains of western Colorado in the United States of America. He studied English Literature and Arabic as an undergraduate at Duke University in Durham, North Carolina. Following graduation, Charles volunteered for six months in Eldoret, Kenya in the Community Mobilization Department for the Academic Model for the Prevention and Treatment of HIV/AIDS. As a Rhodes Scholar, he is currently pursuing a master's degree in Medical Anthropology at Oxford University. Alongside his research passions relating to infectious disease, human ecology and social justice, Charles is developing an innovative HIV counseling and testing pilot for remote island communities on Lake Victoria. Charles is interested in family medicine and will attend the University of California, San Francisco medical school in 2009.



Daniel Savignon-Marinho, Brazil

**BEFORE THE ICE MELTS:
GLOBAL WARMING AND ITS IMPACT
ON THE DYNAMICS AND ECOLOGY
OF NEGLECTED TROPICAL DISEASES**

One of the first innovations of humankind was the use of heat to cook food. This innovation, based on the power of heat, allowed our ancestors to cope with health threats present in raw foods. The climate changes of today, particularly global warming, by changing the ecology and dynamics of neglected tropical diseases may take us in the opposite direction, spreading old and new health threats among the marginalized and poor populations of tropical countries. They will probably be the first ones to suffer the effects of this new global reality.

During the past few centuries, natural resources from developing countries were exploited for the industrial development of rich countries, which were able to distribute these riches among their citizens, at the expense of poor countries. Recently, instead of remaining as suppliers of natural resources needed for the economic growth of developed countries, developing countries have become important suppliers of quality food and alternative sources of energy. This change has the potential for improving the welfare of their citizens, while at the same time moderating the climatic impact of the economic activities of developed countries.

The increase in temperatures of developing countries, mostly due to the economic development of the industrialized countries, has the potential to spread and increase the incidence of neglected tropical diseases, historically a major barrier to the social and economic development of these developing countries. These diseases, with rare exceptions, are restricted to the tropics and their transmission and spread depend, in most cases, on insects as vectors.¹ Insects constitute the most abundant animal species in diversity and quantity, and their reproduction and growth is favoured by increasing ambient temperature.² This increase in the number of insect vectors in developing countries is facilitating the transmission of several neglected tropical diseases. Ancient scourges, such as dengue fever, malaria and Chagas disease, could re-emerge with total force, delaying again these countries' dreams of prosperity and development.

As some species of insects are agricultural pests that destroy crops, especially grains, this increase in insect populations could also contribute to malnutrition in developing countries. Underfed, these populations will become more susceptible to the spread of serious forms of neglected tropical diseases. A "cycle of fragility" to tropical diseases could therefore result from the combination of two consequences of global warming: higher probability of transmission due to increased insect populations and a decreased capacity of immunological defences in individuals, due to malnutrition.

Will these people be condemned to pay a double price for the development of others? Against this background, the classical strategies of communicable disease control

such as the elimination of vectors, or prevention of their contact with humans, has again become a top priority. We should reinstate the legacy of the great public health workers and leaders of the past, taking into account that we can now harness the power of biotechnology and nanotechnology to improve existing interventions, or develop new tools for the control of vectors of neglected tropical diseases. As climate changes will also make it more difficult to get abundant supplies of potable water, environmental protection during the combat of insects must ensure preservation of drinking water as a top priority.

Developed countries may also suffer from the consequences of the above factors in their health and in their economic growth such as difficulty of getting quality food at low prices, increasing native insect populations, or invasion by exotic species of insect vectors. A recent and frightening example occurred recently in Canada, when beetles destroyed great quantities of trees causing a production of gases similar to a forest fire, due to the rotting of the dead trunks.³

Industrialized countries may also face the migratory flow of people from areas more affected by global warming.⁴ We already know today that these migrants are natural reservoirs of the neglected tropical diseases. In this new worldwide context the investment on research and development in neglected diseases treatment and prevention should not be addressed with just the same old lens of humanitarian aid to help susceptible populations; it also has to include strategies and plans of action aimed at controlling global propagation of these diseases.

Developed countries should invest seriously in this area not by just funding research and development in these diseases, but also by building win-win partnerships with developing countries, which should become equal partners and participate in the research, development and deployment of products and interventions capable of positively impacting on the necessities of public health of vulnerable populations.

As health workers we should mobilize ourselves so that populations historically more susceptible to neglected tropical diseases do not become the first to pay the toll of health consequences from climate change and global warming. Most orthodox recipes for economic “development” have worsened the divide between the rich and the poor instead of resulting in equity and social justice; it is our challenge to cope with climate change in a radically different way.

1 Disease portfolio. UNICEF-UNDP-World Bank-WHO Special Programme for Research and Training in Tropical Diseases, (<http://www.who.int/tdr/diseases/default.htm>., accessed 21 August 2008).

2 Connor S. Insect explosion ‘a threat to food crops’. *The Independent*, 12 February 2008 (<http://www.independent.co.uk/environment/nature/insect-explosion-a-threat-to-food-crops-781016.html>, accessed 14 May 2008).

3 Kurz WA et al. Mountain pine beetle and forest carbon feedback to climate change. *Nature*, 2008, 452:987–990.

4 *Human Development Report 2007/2008*. United Nations Development Programme (<http://hdr.undp.org/en/reports/global/hdr2007-2008/>, accessed 14 May 2008).

Cruz Foundation in 2005. As a pharmacist, Daniel's main interests are the development of effective and safe medicines, the evaluation of medicine utilization and the increase in access to medicines for those in need. In order to achieve these goals, Daniel has worked on research and development at public Brazilian pharmaceutical laboratories and as a clinical pharmacist. Currently, he works as a Science and Technology Analyst at the Centre for Technological Development in Health at the Oswaldo Cruz Foundation.



Renzo Sotomayor, Peru

CLIMATE CHANGE AFFECTS THE ANDEAN PEOPLE'S RIGHT TO HEALTH

Climate change affects everyone in the world, but not everyone in the same way. Try to imagine: you are a third world farmer, you have a pregnant wife and five children, you cultivate cacao or potatoes, and you have some cows or llamas. Be aware that these plants and animals represent you and your family's supply of food; all your income because you will sell them at the local market and they also represent an exchange opportunity – potatoes for fruits or meat for leather – an ancient Andean practice called “trueque”. Imagine too that you live in a community of about 50 families located at a height of 4000 m (13 000 ft). There is no water, sanitation services or electricity, and it is a five-day walk to town. Neither newspapers nor public authorities come to your community. When you wake up every morning, you look outside your stone and wooden house and see the green mountains and their peaks covered by white snow. An extraordinary and beautiful scene, believe me. In other words, you survive in an adverse environment, far away from war, economic recession and public services. But now, climate change, whether you understand what it means or not, will reach you. And you already have started to notice it, because each time the winter is colder, the dry season is more prolonged and the sun hurts your skin.

When I listen to presidents, authorities and experts talk about climate change, they mention the natural disasters, the air pollution and the rising sea level. But I wonder what specific impacts of climate change will be experienced by these highland communities that do not have any idea of what is going on. They may think it is God's will and try to solve these natural phenomena by payments to the earth or to the mountains (called “Apus” in the Andean vision of the world).

If the dry season is longer, more intense or more often, plants and animals will become sick; a sick animal produces less (i.e. milk or meat) or will not survive. Remember, they are the only support of your Andean family, so if they do not survive, neither do you and your family. In dry seasons I have seen horses on the prairie that look like living skeletons; now imagine in what condition Andean children would be? In almost all communities, malnutrition, growth failure and kwashiorkor are already quite prevalent. How many percentage points will these conditions rise through the effects of climate change?

Now imagine that a frost suddenly kills all your plants, all your past four-month investment of time, work and savings. Without your agricultural production, you and your family are (more) condemned to poverty, hunger and elimination. Under this situation, families decide to pass from three meals to one, or give priority to the animals. Also, if temperatures go down it reduces an animal's capacity to reproduce; miscarriages increase and newborn animals die.

I wonder how many children will wash their hands at these extra low temperatures before each meal or after using the bathroom. I cannot imagine a pregnant woman living in her home, at -10°C , walking to the health centre for birth control or giving birth, almost naked, in a cold and inadequate health facility. These are simple and practical problems that health systems should take care of. All these negative situations may force you to decide to move to the city, and become one of the thousands that beg on the streets and live in the slums.

The negative effects of climate change for the Andean people – the reduction of income, insufficient food, inadequate shelter, inadequate infrastructure of health services and a more adverse climate – are contributing to increasing cases of chronic and acute malnutrition in children and women (always the most vulnerable), underweight newborn babies, diarrhoea, respiratory diseases, etc. These impacts are starting to affect all the indicators that the global community has been trying so hard to improve over the past few decades. So, climate change is now another determinant of health.

Climate change does not just affect health; it also affects education and the economics of the Andes, condemning vulnerable people to continue living in poverty. Ultimately, climate change affects the whole human development of a country, and in this case, affects the entire human development of the Andean region. That is why this issue should be a top priority for national governments, supra-national organizations, and bilateral and multilateral cooperations. All of us are vulnerable to climate change, but we have to recognize that there are some among us that are more vulnerable.

I believe to date no relevant progress has been made in the fight against poverty-related diseases in remote and inaccessible communities. However now, humanity is not just failing the poor but actively harming them. Do not forget that climate change is caused by human activity.

The countries that are connected by the Andes have a terrible history of civil conflict and death. I wonder if this new stress on the poorest people of the region will create new and fresh civil conflicts, and if the politicians and authorities have even taken a moment to think about it? Remember that we are in the most inequitable region of the world, so the negative effects of climate change can fuel civil protests.

Lamentably, these highland communities are not in your imagination, but they really exist and represent millions of people all around the world. So, they need the attention of both the developing and the developed world. If this situation continues to advance, as is the consensus, the highland populations will not disappear suddenly from a natural disaster, they will be facing a slow and quiet extermination. There, where they have always been, very far from us, where we cannot see or hear them suffering.

This new health challenge arising from climate change affects the entire Andean region; it does not respect national borders. The health and well-being of people is always the result of a political decision; so, in the first place, we need a regional reflection process that put us in the driving seat for an *Andean regional declaration on climate change and highland populations*, and this, in turn, should feed into an *Andean regional plan of action*. It is not just the responsibility of health authorities;

our response should involve political and technical authorities at the highest level in each country. And also, the door must be open for civil society participation, particularly of leaders from the communities affected. The farmer that lives at 4000 m is very concerned about his family's future and we should listen to him carefully.

A greater evaluation of the impact of climate change on human health is also necessary, particularly among vulnerable populations like those in the Andes. We need effective policy and the mobilization and allocation of resources.

Health is a fundamental human right, recognized in numerous international instruments, indispensable for the exercise of other human rights. Every human being is entitled to the enjoyment of the highest attainable standard of health conducive to living a life of dignity. So, as expressed above, climate change goes against the right to health of the Andean people and jeopardizes regional health security.

Renzo Sotomayor is a young Peruvian physician. At San Marcos Medical School he discovered his passions: health policy, management and human development. Renzo became a teacher's assistant for several years and conducted public health research. He then became involved in advocacy for the human right to health. He has worked for multilateral organizations for almost four years. Renzo now works for the United Nations in the Peruvian Andes, where poverty is omnipresent. His personal and professional goal is to assist his home region, Latin America, in developing a health system, accessible to all citizens, that contributes to human development.



Kirvis Janneth Torres Poveda, Colombia

**CAPACITY OF DEVELOPING COUNTRY
GOVERNMENTS WHEN FACING
THE EFFECTS OF CLIMATIC CHANGE
IN VULNERABLE POPULATIONS**

One of the great threats to the well-being of society is climatic change, that is, the global variation of the Earth's climate due to the variability of the forces of nature and human activity. This change was perceived initially in the middle of the 19th century, but it was only at the end of the 20th century that it became an issue of worry, giving rise to actions that have had a limited effect. Climatic change is affecting the basic elements of human life at a worldwide level: access to water provision, food production, health and environment.

Regarding the impact of climatic change on human health, the following outcomes have been documented: thermal stress that will increase the risk of death in the extreme age groups; and, extreme climatic episodes (like storms, floods, droughts and cyclones) that could directly cause loss of lives and injuries, and indirectly, loss of shelter, displacement of population, pollution of water sources, major decreases in the production of food (with consequent extreme hunger and malnourishment), majors risks of infectious disease epidemics (including diarrhoea and respiratory ailments), and damage to the infrastructure of health services. More specifically, the quality of already polluted air in urban zones will be further reduced with the increase in temperature and ultraviolet radiation. These phenomena will, in turn, increase the formation of ozone at ground level, a polluting agent with adverse effects on the respiratory system. Vector-borne diseases will also increase due to changes in annual precipitation, which, along with the climatic variability, will modify the geographic scope and seasons for the transmission of these diseases. There will also be an increase in infectious diseases transmitted by bad quality shallow waters and of poisoning by biotoxins through the consumption of fish and seafood affected by changes within the marine environment. Finally, food provision will also be modified and, thus, affect the nutrition and health of vulnerable populations in developing countries.¹

The most vulnerable ecological and socioeconomic systems are those that have a greater sensitivity to climatic change and a smaller capacity to adapt to it. Sensitivity is the degree in which a system will respond to a given change in the climate, while vulnerability defines the extent to which climatic change can damage or affect a system. This depends not only on the system's sensitivity, but also on its capacity to adapt. Vulnerability to climatic change affects specific groups and regions, such as children (from foetuses to teenagers), women (especially pregnant and breastfeeding women), the elderly, ethnic and cultural minorities, and poor people living in rural areas in tropical and subtropical countries.

These countries show all levels of vulnerability:

- physical, the existence of large groups of people living in zones of physical risk;

- economic, due to the inverse relation between per capita income at national, regional, local or population level and the impact of extreme physical phenomena;
- social, determined by the degree of poor organization and lack of internal cohesion of communities under risk that prevents effective mitigation or response to disasters;
- political, due to the high degree of centralization that prevails within the decision-making levels of governmental organizations, as well as weakness regarding levels of autonomy to make decisions at a regional, local and community level;
- technical, in relation to the inadequate construction techniques used for building and for basic infrastructure in risk zones;
- ideological, relating to the way certain populations conceive the world and the environment where they live, which limits their ability to act suitably against the risks that nature presents;
- cultural, expressed in the way individuals see themselves within society and as local, regional or national groups;
- educational, which relates to the training that the population receives on ways to respond;
- individually, as a family and as a community in the face of the threat or occurrence of disasters;
- ecological, the way in which development models favour the destruction of environmental reserves; and,
- institutional, reflected in the obsolescence and rigidity of institutions, especially legal ones, where bureaucracy, the prevalence of political decisions, and the prevalence of personal interests prevent suitable and agile answers to the existing reality.

In order to mitigate the impacts of climatic change on these populations, basic infrastructure for public health practice (programmes, services and follow-up systems) must be strengthened and supported. Governments, as forms of organized social response, are the ones that must enhance and coordinate the capacity of the affected communities to adapt and change their behaviour collectively, in order to be able to face the stress due to climatic change. Adaptability is the degree to which populations can adjust to or anticipate major changes at an environmental level. A successful adaptation requires technological advances, institutional adjustments, availability of financing agencies and exchange of information. It is clear that this process is influenced by the availability of financial resources, the transference of technology as well as cultural, educational, management, institutional, legal and regulatory practices, both at a national and international level.

Therefore, to reduce the impact of thermal stress, several things are necessary: suitable urban planning in cities at medium and high latitudes, systems of early alert, as well as new clothing options and resting patterns. In order to reduce the impact of extreme climatic episodes, the construction of shelters against storms is necessary, along with systems of early alert and effective ways of dealing with forced migration. To control air quality, there should be controlled emission systems, pollution alerts and better systems of public transportation. For the control of vector-borne diseases, sustainable programmes of surveillance, prevention and control are required, as well as programmes on sanitary education. Finally, to control diseases transmitted through polluted water, systems to achieve better water quality are needed, along with efficient

treatment and cleaning systems, boiling water alerts, programmes to promote hand-washing and other hygienic behaviours, such as the use of pit latrines.

Worldwide, there are promotion programmes to enhance national capacities for adaptation to climatic change, but some geographic systems and places have better capacity than others. Vulnerability to change is increased when the adaptive capacity decreases. The economic level and institutional resources in some regions, may condition the adaptation capacity in underdeveloped countries, where the deficiency of such resources is more common and hence, population is more vulnerable to the negative impacts of climatic change.

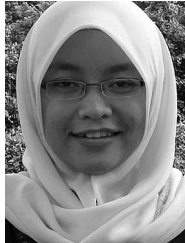
For the governments of developing countries, the process of adaptation, which involves investment in prevention infrastructure for densely populated areas exposed to tides, will have indirect effects on economic activity, such as involuntary adjustments of monetary, fiscal and tributary policies and the increase of external debt. International help, a reduction of the total amount of the debts, or the creation of contingency funds, are ways to find alternative solutions. Additionally, those countries whose economies depend mainly on agriculture or forestry will undergo economic instability. Solutions such as the promotion of agricultural practices that are resistant to drought, and a more efficient use of water resources imply great investments that surpass many of these nations' budgets.

Adaptation policy addressing the effects of climatic change in vulnerable populations must: strengthen national and regional plans, where the intention is to fortify and update systems of early alert of extreme climatic events through a national network; redesign the infrastructure in high-risk zones; establish a compensation fund for victims of climatic change; urge the state to gather existing information and support research to obtain a diagnosis of the situation and to disseminate such information, especially within threatened communities; evaluate the regional negative impacts of climatic change and look for appropriate strategies to mitigate and adapt to them; and, include the vulnerability caused by climatic change as an issue in the planning policies at municipal, provincial and national levels.

The present challenge is to transform the political and economic model that favours climatic disaster, and to improve the capacity of governments in developing countries to provide an organized social response to climate change and its effects. This would help reduce the vulnerability of exhausted communities and enhance social equity.

1 World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP). Intergovernmental Panel on Climate Change (<http://www.ipcc.ch>, accessed 23 April 2008).

Kirvis Torres Poveda was born in Bogotá, Colombia in 1978. She earned a degree in Bacteriology and Clinical Laboratory, and a Master's in Microbiology, with a specialization in management of public health. Currently, Kirvis is a doctorate student in the Sciences of Public Health programme studying infectious disease at the National Institute of Public Health in Cuernavaca, Mexico. She has worked in three lines of research: emergent microorganisms in foods, occupational and environmental health, and currently in the control and prevention of cancer. She has been a professor of microbiology, methodology of investigation and epidemiology and manager of surveillance in public health programmes.



Wan Raihana Wan Aasim, Malaysia

CLIMATE CHANGE AND
HEALTH RESEARCH:
TOWARDS THE EMPOWERMENT
OF DEVELOPING NATIONS

Charles Darwin once said, “It is not the strongest of the species that survives, nor the most intelligent, but the one most responsive to change”. Over the years this has constantly been proven to be true as inhabitants of the earth, animals and humans alike, continually strive to adapt and survive in an ever-changing world. Now, in the 21st century, we are facing one of the greatest challenges the human race has ever known: our rapidly changing climate. As the world’s climate is the context for all life on earth, such changes will naturally have a far-reaching and profound impact on our lives. In recent years, a multitude of catastrophic events directly linked to our changing climate have been identified and documented. Extreme weather events, such as hurricanes, floods and heat waves, have been occurring in increasing frequency with significant loss of lives, property and livestock.

Our addiction to the burning of fossil fuels over the years has finally taken its toll on our world. Concrete scientific data points to global warming resulting from the emission of greenhouse gases as the main reason for our rapidly changing climate. Initially, the major concern was the effect of global warming on our planet’s ecology and biodiversity. However, in the late nineties the impact of our changing climate upon our health and physical well-being became yet another cause for concern. The World Health Organization (WHO) in the report *Climate Change and Human Health – Risk and Responses* has identified various health risks that can result from or be exacerbated by climate change, such as the increasing spread of tropical diseases like malaria and dengue fever, increased risk of respiratory illnesses and heat stroke. Together with the identification of these potential health risks also came the realization that certain populations would be more vulnerable to these risks compared to others. In general, these vulnerable populations are characterized by poverty, poor sanitation, malnutrition and limited access to education. They are mainly citizens of developing nations in regions such as Asia and Africa; the countries known as the *Global South*. The paradox of this situation is that these are nations that the Intergovernmental Panel on Climate Change (IPCC) recognizes as contributing the least towards global greenhouse gas emission levels and thus are the least responsible for global warming.

As with various other challenges that humankind has faced throughout history, the human race will naturally turn to research to find a solution for the ever-growing threat of climate change. The innate ability of humans to identify, study and solve problems has evolved into the highly sophisticated and detailed world of research that enables humans to make sense of their surroundings and improve their lives. The looming threat of global warming has already set into motion various research projects to track the effects of this phenomenon upon global health. Epidemiological studies and research for novel vaccines and treatments for tropical diseases such as malaria have been made a top priority.

It is more than likely that whatever hopes the vulnerable populations of the Global South have in finding solutions to adapt and cope with climate change lie within scientific research and inquiry. However, health research in developing countries is often plagued by a host of obstacles and challenges. One major obstacle for research in many developing countries, regardless of research fields, is the lack of equitable access to research tools and resources. It is the nature of research that it is almost exclusively the domain of those possessing enough funds to make research a reality. In developing countries where governments are already struggling to provide adequate health care for their people, little, if any of their annual health-care budget is allocated for research. As a result, developing countries face a dire lack of the technical know-how, up-to-date information and research equipment that is often taken for granted in scientifically advanced nations.

As a result of this inequity, the majority of health research in developing countries is sponsored and/or conducted by developed countries and international organizations. This in itself is a commendable effort; however, particular care must be taken to ensure that research genuinely reflects the needs and requirements of the community being studied. Such research must focus on providing viable, affordable and concrete solutions to problems faced by these countries. There is no real benefit of research on novel drugs for a specific disease afflicting the people of developing countries if the end-product is a drug that is unaffordable to the masses.

Finally, another major challenge faced by health research in developing countries involves the translation of scientific findings into concrete action. This has been a problem faced by researchers throughout the years. A well-known example would be James Lind, an 18th century naval surgeon who studied the high prevalence of scurvy in sailors of the British Navy. His experiments led him to discover that scurvy can be cured and prevented with regular consumption of fresh fruit and vegetables. His research was sound and highly praised, but despite the overwhelming evidence of the efficacy of his treatment, the British Navy took 40 years to implement his findings. However, once they did, scurvy was almost fully eradicated from the navy within a mere two years. More than 250 years later, the situation has not changed much. Governments and policy-makers operate under various political, economic and even personal agendas that often slow down the adoption of recommendations that have been made on the basis of sound scientific research. This problem is also made worse by a lack of awareness and comprehension regarding the latest research. The consequence is that potentially useful research will never move beyond the boundaries of the scientific community, thus never reaching the people that the research was intended to benefit.

Although developing countries face great challenges in health research, there is still hope. The main priority will be to empower developing countries to perform research that is relevant to their situation and needs. In order to achieve this, a paradigm shift is desperately needed. This paradigm shift should not only involve the affected countries, but also require a concerted effort from the nations of the Global North as well. Developing nations must ensure that they are aware of the serious threat imposed by climate change upon their nation's health and well-being. Most importantly, governments and policy-makers have an important role in ensuring that they are constantly up-to-date with the latest information and research regarding climate change and its effects on the people of their country. They must also ensure

that they take into account this information when they attempt to formulate health-care policies and adaptation strategies for their nations.

Developed countries should focus on forming research partnerships with researchers in developing nations. Their role should be that of a mentor, providing support, guidance and training in order to empower researchers from developing nations to perform research that will have the greatest benefit for their people. Development of expertise and trained human resources is critical. Scientifically advanced countries can implement these goals in a variety of ways, including offering extensive training to researchers from developed countries in the form of exchange programmes and research fellowships. Developed nations should also do all they can to reduce the gap between them and developing nations in terms of access to scientific resources by working to provide affordable and easy access to information databases, scientific publications and other research tools and equipment.

In reality, all this may be easier said than done. However, for health research in the context of climate change, there is already an existing framework that may help to smoothen the process. The Kyoto Protocol and subsequent United Nations climate negotiations held in Bali in 2007 have been instrumental in ensuring that developed nations take responsibility for their greenhouse gas emissions by mandating signatory nations to reduce their emissions based on a specific and concrete target. Using a “cap and trade” system, it is also possible for these countries to offset their emissions by purchasing and trading carbon credits. It is still too early to determine if such an approach will be able to arrest the increasing temperature of our earth. However, this framework is extremely appropriate as a basis to empower developing nations in climate change-related health research. Under the same framework, developed nations should also be required to provide contributions towards health research in developing countries. These contributions could be in the form of research funds, training and educational opportunities for researchers and also research collaborations with the common goal of empowering researchers from developing countries.

Although climate change may affect certain populations more than others, the risk of health problems due to climate change is a serious issue affecting the entire planet. Our climate is changing rapidly and there is no longer any time for pointing fingers and assigning blame. This is a global problem that requires a global solution, and thus the cooperation and involvement of all nations is crucial to ensure the future health and survival of the human race.

Wan Raihana Wan Aasim was born in 1981 in Malaysia. In 2005, she graduated with a Bachelor's Degree in Chemistry from the Universiti Sains Malaysia. She is currently pursuing a doctorate in Pharmacology at the same institution. Her research focus is the relationship between genetics and metabolism in humans who ingest ecstasy, a commonly used drug in Malaysia. She has always been deeply interested in community service and has initiated various projects since the age of 15. Her latest project is assisting in setting up a community centre with the purpose of implementing brain-based learning in the community. She is also a freelance writer and web site programmer.

There is irrefutable proof of climate change due to human activity. Poor populations, who already bear the heaviest burdens of infectious and chronic diseases, will suffer most from climate change.

It is therefore imperative to integrate climate change research into relevant areas of health and social sector research to ensure that progress made in these areas are not then offset by the effects of climate change.

This compilation presents the shortlisted and winning essays from the Young Voices in Research for Health 2008 competition, jointly sponsored for the third year by the Global Forum for Health Research and *The Lancet*.

These essays will expand your notions of the meaning of climate change and how it explodes conventional ideas about health research and global health needs.

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“Research into climate change and health are similar to Romeo and Juliet—one simply cannot live without the other.”

(an essayist)

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Additional copies of Young Voices in Research for Health can be ordered at no charge via the web site www.globalforumhealth.org or from

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