CHEC *Points*

No. 46 March 2018

COMMONWEALTH HUMAN ECOLOGY COUNCIL
An information circular produced in addition to the CHEC journal *Human Ecology*

The Human Ecology of Changing Environmental Risks

Environmental risks are those that have the potential to fundamentally disrupt the stability of the Earth's systems

People are asking whether we are experiencing more floods, droughts, wildfires and landslides than in previous decades. Are disaster risks increasing? If so, why and whose fault is it? In this CHEC Points we examine some of the evidence for change in environmental risks and explore some of the reasons why changes are occurring. We also look at the notion of vulnerability: who are most the most vulnerable people and what can be done to reduce their vulnerability?

Environmental risks are those that have the potential to fundamentally disrupt the stability of the Earth's systems. A risk is made up of the probability of an event occurring and its negative consequences. Destabilization of parts of the earth's systems, such as the ocean water circulation patterns, or the great oscillation of elements of the world's climate, such as the jet stream or seasonal wind patterns, would lead to complications for human life on earth. Many believe that such disruptions are already happening, with evidence of ocean warming, and what appears to be increased storminess and more frequent wildfires in many parts of the world.

Two frequently used indicators of the severity of disasters are the insurance losses from each event and the number of deaths as a result of such event. These measure completely different things. One is the impact on wealth, mainly in the form of property losses, which inevitably are higher per person in wealthy countries than in poorer countries. Deaths on the other hand are likely to be higher in poorer countries where the ability to be protected and able to withstand most types of disaster is usually far less than in wealthy countries. In 2017, events that affected the USA, including Hurricanes Harvey, Irma, and Maria, wildfires in California, and thunderstorms in central and southern states, contributed $102.5 billion to the year's economic losses of $330 billion from global disasters. This was just below the highest ever global total of $ 354 billion in 2011, which was influenced by the exceptional earthquake and tsunami in Japan. The USA losses made up half of those for the whole of North America and the Caribbean which in turn accounted for the bulk of the global losses.

On the other hand, south and southeast Asia suffered catastrophic floods in 2017 leading to more than 6,000 deaths, the displacement of tens of thousands, and impacting 41 million people overall. Such floods have knock-on effects on children by disrupting their education and severely impacting their well-being in the future.

A drought in the Horn of Africa brought countries like Somalia to the brink of famine. As clean water sources dried up, 18,000 cases of cholera broke out and 360,000 Somali children became severely malnourished and in Kenya 1.3 million people were short of food.

Although large countries have the highest total losses and deaths, the social and economic impacts of environmental disasters hit the smaller countries hardest. They lose between 2.5 and 4 percent of their gross domestic product to disasters annually. Just as there are differences in disaster impacts between countries, so there are differences within countries. Often the poorest communities suffer the most. They tend to be located in in riskier locations: in water villages of houses built on stilts of the tidewater along the coast; on floodplains along rivers; on the edges of poorly drained wetlands; on slopes that are prone to landslides; and in the parts of cities where air and water pollution is greatest. Many people in such situations face multiple hazards: floods, fire, pollution and malnutrition leading the ill-health.

An example may be drawn from Sierra Leone, where in August 2017, in the capital, Freetown, a devastating mudslide destroyed homes and buried hundreds under the debris. However, most of the self-built dwellings in informal settlements in Freetown are built on hillsides in the outskirts where removal of trees has reduced slope stability making the mudslide more devastating than it should have been. The mudslide swept down into lower areas of the town, affecting people who had nothing to do with the deforestation upslope. In this instance, poverty may have led people to clear the trees and make the ground vulnerable to a mudslide that was triggered by heavy rain. The heavy rain would have been influenced by weather systems that could have been affected by the human impact on the earth's atmosphere. The disaster thus reflected both local and remote causes. Such interlinked causation is common to most environmental disasters. This suggests that there are multiple responsibilities and multiple actions required to mitigate such disasters in the future.

The remote causation is widely recognized. Commenting on the 2017 flood on the Ganges River in India and Bangladesh, a German researcher said: "There are huge profits being made in the West that cause a massive amount of emissions, which have a hugely negative effect on people in Bangladesh. You could say that countries in Asia are paying the bill for the West's emissions". Indeed, over the last two centuries global greenhouse gas emissions from industry industrial nations in Europe and North America have contributed massively to the increase on carbon dioxide and other gases in the earth's atmosphere, but today China and India together emit 32.6% of the total, while the 28 European Union countries and the United States emit 21.2%. The real culprits are the people of the global middle class who drive cars, fly in airplanes, heat and /or cool large houses and purchase the bulk of the world's manufacturing output. The growth of the middle class in Asia has changed the geography of emissions.

You could say that countries in Asia are paying the bill for the West's emissions

However, the local causes of environmental disasters are just as important. What happens up the slope, up the valley and in other parts of the city can greatly influence the vulnerability of an individual household. An example is the way new housing developments can affect flooding occurred in Kuala Lumpur, Malaysia, in the 1970s and 1980s. Here clearing of land on deeply weathered tropical soils exposed several meters depth of easily eroded clay and sand to high intensity tropical downpours. The exposed surfaces became gullied and huge quantities of sediment were swept into stream channels, reducing the capacity for flood flows that had become larger because there was no vegetation to detain the water running off those bare eroded surfaces. People living close to urban streams further down-valley saw flood waters spreading across their streets and even entering their houses. In the centre of the city, so much sediment was in the stream that the channels had to be widened and ramps constructed to allow excavators to get into the stream bed during dry spells to dig out lorry loads of sand and clay. Eventually the laws governing site development we tightened and it became compulsory for developers to build detention ponds to trap sediment being washed off their construction areas.

Fig.2 A: A construction site in Kuala Lumpur in the 1980s; B: The ramp use by machinery removing the sediment, seen in the foreground, from the channel of the Sungei Kelang.

Even once all construction is completed, the increase in paved and roofed surfaces sends floodwaters into urban rivers more quickly than before. Sometimes highly localized intense thunderstorms produce so much rain over urban areas that the storm drains or subsurface storm sewers overflow. This happened in Heywood, Greater Manchester, UK in 2004 and 2006. As the built-up area expanded, the storm sewers were extended, but nothing was done to increase the capacity of the 100-year old sewers near the town centre. Not surprisingly, when the extreme storms occurred, the old sewers could not deal with the excessive storm flows and many of the lower parts of the town were flooded.

Such localized heavy thunderstorm flooding is common in cities in the tropics, but not unknown elsewhere. Although much may be due to the paving of increasing areas of land, some local flooding is caused by rubbish. People deliberately, or accidentally, allow waste materials to get into drains and small streams. Recently, a huge “fatberg” formed of fatty substances sent down household drains, almost completely blocked a London sewer. In 1981 in Manchester, local flooding occurred because a mattress in a stream had dammed up a culvert that should have carried floodwater beneath a street. In many African cities, where waste collections are poor, local rubbish is dropped, blown or swept into drains, partially blocking them and leaving little room for storm-water to escape. Thus some urban flooding is quite clearly the result of our own behaviour as individuals. It suggests that we have to think about how our own actions might affect flood problems, as well as expecting corporations and local governments to act responsibly. To reduce flood disasters, we need action at all scales, from thinking about global warming to dealing with waste and how we treat the land surface where we live and work.

Figure 2. Consequences of sewer flooding in Heywood Greater Manchester

Responsibilities for reducing flood risks

A key element in managing flood problems is thinking at the water catchment or river basin scale. The roof of a house is a water catchment at the household scale, while river basins can range up to the sizes of the Zambezi, Nile or Ganges-Brahmaputra basins. If the size of our house is increased, the total storm flow from the roof will be greater. If land use or cover changes in the upper parts of those three great rivers, it may have an impact on flooding downstream. As individuals we can do something about the flow from out houses and the drainage channels around where live. As members of communities we can collaborate with others to ensure local channels are kept free of waste and other debris. We can persuade out local council to ensure the storm drains are fit for purpose and ask questions about development plans that might alter the storm flows into local streams. As globally aware citizens we can do our small bit to reduce fossil fuel consumption and greenhouse gas emissions so contribute to reducing the likelihood that climate change will lead to increased storminess and more frequent heavy downpours of rain. As voters we can support politicians that heed the warnings of environmental change and who will be sensitive to worsening disaster impacts.

As globally aware citizens we can do our small bit to reduce fossil fuel consumption and greenhouse gas emissions

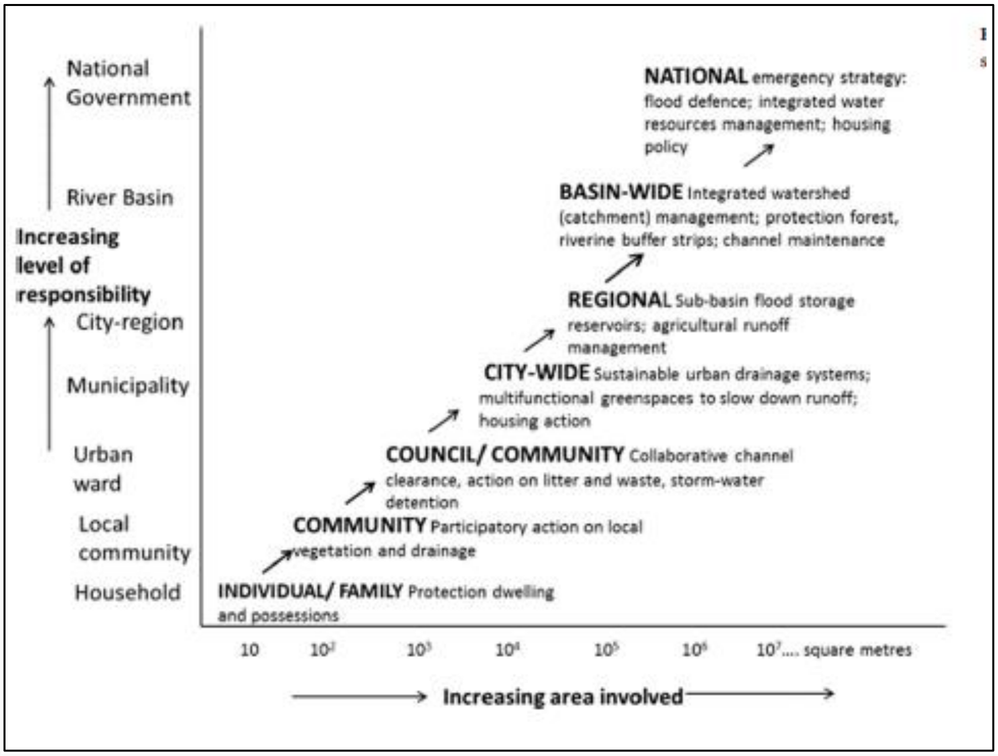

Figure 3. Responsibilities for acting to reduce flooding and mitigate flood disasters at different scales

Nearly all the science and engineering knowledge to handle flooding is available. Much suggests that putting trees back on the hills will help to reduce flooding. However, the really big floods lead to everything becoming saturated and every extra drop of rain then runs of the forest in the way rain runs of the roof of a house. If the soil and leaves are saturated, the only place for the water to go is down to the ground and then over the surface into streams. So what we have to do is to make sure that there is space for that water to flow down the valleys without flooding human settlements and valuable, highly productive farmland. This space for water has to be planned in an integrated manner. It is no use widening a channel in the middle of a city, so that the main business district does not get flooded, if that just sends the flood water downstream more quickly to inundate the homes of the poor people on the floodplain below the city. Hence there is an international effort to engage in integrated water resource management and to encourage multi-sectoral approaches to river basin management. The International Network of Basin organizations (INBO: www.inbo-news.org) endeavours to being together all sectors involved in activities affecting natural water flows, such as energy, agriculture, urban planning, transport, recreation, fishing and fish-farming, and stakeholders and the public opinion to develop plans for rivers basins both within single countries and crossing the boundaries of several countries.

Several major international boundary-crossing rivers involve many Commonwealth countries, a good example being the Zambezi River in Africa which drains an area of almost 1.4 million km^2, stretching across Angola, Botswana, Malawi, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe.

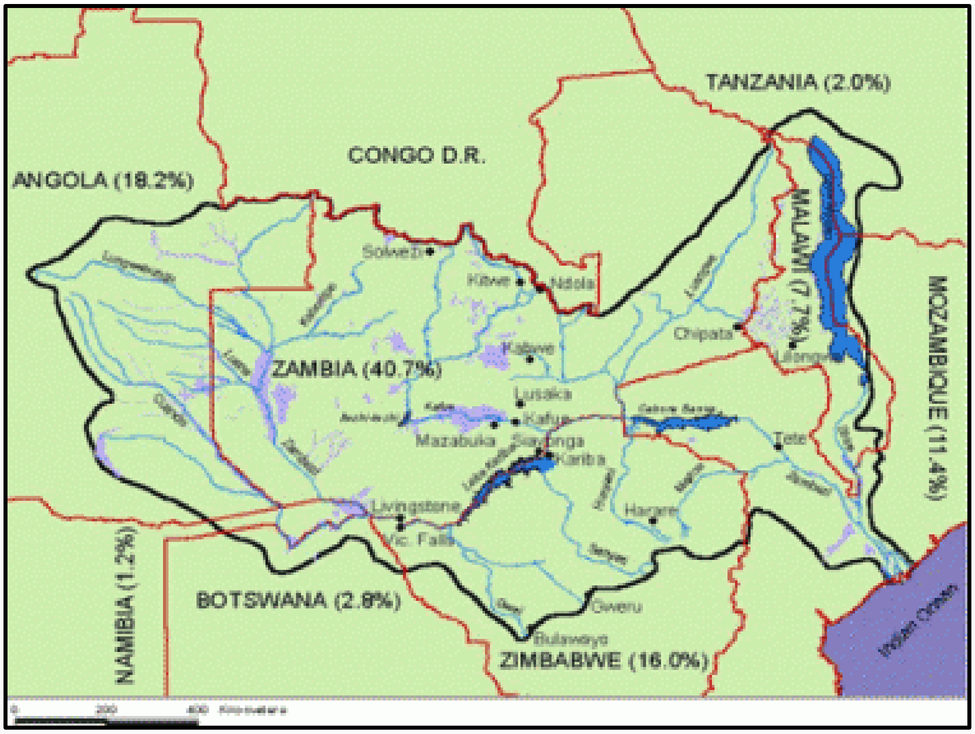

Figure 4. Map of the Zambezi River Basin

The Zambezi supports the Victoria Falls, often identified as one of the seven natural wonders of the world, as well as the Kariba and Cahora Bassa hydroelectric dams and their great reservoir lakes. This major river basin has been affected by a growing number of disasters in recent decades including floods, droughts, migration and hailstorms, which often coincide with outbreaks of malaria, cholera and HIV/AIDS. Recurring disasters negatively impact vulnerable communities' livelihoods and hamper sustainable development throughout the basin. Following flood relief operations in 2009, the International Federation of Red Cross and Red Crescent Societies and National Red Cross Societies from seven riparian countries of the Zambezi River (Angola, Botswana, Malawi, Mozambique, Namibia, Zambia and Zimbabwe) established the Zambezi River Basin Initiative. It was recognized that only an integrated and comprehensive long-term approach could help to reduce vulnerability to flooding and other risks brought about by climate change, and help to foster sustainable, long-term change. The USAID and WMO have worked together to prepare a Zambezi River Basin Flood Forecasting and Early Warning System Strategy in collaboration with the Zambezi Watercourse Commission (ZAMCOM) and the eight Zambezi Basin countries.

An example of local action within the Zambezi River Initiative is the Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) measures within the local development planning (LDP) process at village, ward and district levels in Kariba District project operated by the Zimbabwe Red Cross Society. This involves setting up three-year Village Disaster Reduction Action Plans; integrating them into current development planning at village, ward and district level; advocacy for mainstreaming of DRR/CCA in LDP; awareness-raising and stakeholder sensitization to create enabling environment at local levels; and training of community leaders, Red Cross volunteers and community members to conduct participatory risk assessment and hazard mapping.

Potential and problems of international river basin management

Transboundary cooperation in adaptation helps to locate measures, such as flood protection infrastructure, in the basin where they can have the optimum effect, which may be in another riparian country. International river basins with fixed quantitative water "delivery" agreements may see increased conflict as upstream countries face reduced water availability but inflexible demands by downstream countries, while efforts to reduce risks from more frequent flooding may exacerbate downstream damage. Examples of ecosystem-based approaches in the water sector include disaster risk reduction through flood regulation and storm-surge protection, the use of aquifers as water storage mechanisms rather than above-ground built storage and the formal integration of riparian forests within water quality and purification processes.

An example of a long-standing international river agreement is the Columbia River Treaty between Canada on the United States negotiated between 1961 and 1964. It mainly concerns flood control and power generation of the Canadian portion of the Columbia River Basin, and four 'Treaty Dams' that are the subject of inter-basin regulation. Under the terms of the agreement, Canada provided 15.5 million acre-feet of reservoir storage while the United States of America paid USD 64.4 million to Canada for half of the expected avoided flood damages for 60 years (until 2024) under "assured annual flood control plans". The United States can request Canada to provide additional on-call flood control, subject to proving the need and providing additional compensation to Canada but this has not been requested to date.

Perhaps the central European Tisza River basin which feeds into the Danube River illustrates effectively how the involvement of agencies at different scales may work. The Strategy for the Mitigation of Floods in the Bodrog River Basin in the north of the Tisza basin draining parts of Slovakia and Hungary considers the maintenance and/or restoration of flood-plains by creating a "space" for water during flood events, as well as measures to prevent and reduce damage to human health, the environment, cultural heritage and economic activities. It involves municipalities, NGOs, farmers and spatial and urban planning authorities in wetland and floodplain restoration and wildlife habitat regeneration in the Sénne depression (Slovakia) and the Viss-oxbow Lake (Hungary). In such schemes, mitigation of flooding can be multifunctional in its outcomes, with space for floodwater when needed but also land for recreation and for carbon uptake and storage.

The issues of multiple, overlying disasters

The Pacific island of Ambrym in Vanuatu is well known for its highly active volcano that includes lava lake formation. 677.7 km^2 in area, it is the fifth largest island in the country. The summit of the volcano contains a desert-like caldera which covers an area of 100 km^2. The Ambrym volcano had many destructive eruptions in the past. In February 2015 the active volcano Ambrym on began to erupt and a lava flow formed. An earthquake of magnitude 6.5 occurred with its epicentre offshore to the southwest on February 19th. The earthquake produced a tsunami which hit Paama Island. Then Cyclone Pam, the equivalent of a category 5 hurricane, caused massive damage to the island nation of Vanuatu on March 13th, the Government of Vanuatu declared a state of emergency. Nearly all the homes on Ambrym sustained heavy or total damage and 35% of the houses on neighbouring Paama were destroyed. Many of the tanks which held scarce drinking water were broken and rendered useless. Much disaster relief occurred, but the repaired water tanks did not fill with water for many months as an El Nino related drought followed the year after the hurricane. Sea level rise of around 8 mm per year is alleged to be occurring in the Pacific, but it may not be as important for Ambrym and Paama, which are experiencing tectonic uplift related to volcanic activity, but such rises will be important concerns for the northern island of the Vanuatu chain.

Figure 5. Map of Vanuatu showing the location of Ambrym

The important point about the Ambrym case of overlapping hazards is that such situations often occur in situations where local resources are limited, populations are small and evacuation is almost impossible. Resilience in such places is very much a question of individual and local community self-reliance and learning from past experience. However the global community should take its social responsibilities for such societies seriously and ensure that not only as immediate relief arrive quickly but that every possible is done to increase long-term resilience. This requires a deep understanding of the local human ecology, how the society sees its own situation and resources, what traditional practices need sustaining and how new technologies can improve but disaster warning, disaster preparedness and post disaster relief and reconstruction in ways that acceptable to and meaningful for the local people.