

Environmental Change Social Vulnerability and Conflict



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The rise in environmental change and its connection to conflict is becoming a central issue in the international political arena and in public awareness. Environmental change has an effect on social vulnerability, as do other aspects such as poverty, unemployment and inequality. The level of social vulnerability, a society's lack of ability to deal with change, has an effect on the risk of conflict, not environmental change directly. In order to reduce the risk of conflict, addressing environmental change and society's effect on the environment is important but not sufficient. Reducing the effects of environmental change on society, through reducing social vulnerability is crucial.

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Introduction

Environmental change is becoming a central issue in the international political arena and in public awareness, as the connection between the changing environment and the certainty of its effects is becoming clearer (Dunn and Flavin, 2002. Morrisette, 1989. Wolf, 2003).

The effects of environmental change are on the rise, affecting a growing number of people and countries, leading to loss of life, loss of livelihood, disease and huge economic losses (Abramovitz, 2001). The rise in environmental change has given birth to the notion of environmental security and the risk of conflict (Halle et al, 2004). Some theories expect the rise in resource scarcity and natural disasters to lead to future environmentally related conflicts, such as water wars (Gleditsch, 2004), other approaches prophesise that environmental change can lead to cooperation through addressing a mutual cause (Wolf, 1999).

The aim of this paper is to argue that prospects of conflict or cooperation, in relation to environmental change are determined by the level of social vulnerability, a society's ability to adapt to change, and not directly by environmental change. This is in contrast to contemporary established theories that environmental change is expected to be a central driving force leading to conflict:

“Many wars in this [the 20th] century were over oil, but wars of the next will be over water” Ismail Serageldin Former World Bank vice president (Giordano and Wolf, 2003).

“Large-scale human-induced environmental pressure may seriously affect national and international security” (Homer-Dixon, 1991).

“Tuna wars in the northeast Atlantic, crab wars in the North Pacific, squid wars in the southwest Atlantic, Salmon wars in the North Pacific and Pollock wars in the Sea of Okhotsk” are on the rise (Brown et al, 1998, p.26).

“The competition over water will lead states to wage war to each other”(Trottier, 2003).

This will be done through analysing the relationship between the different aspects contributing to social vulnerability and the risk of conflict. Thus, the effect environmental change can have on conflict is not directly affected by this change and social aspects such as poverty, inequality and unemployment are crucial.

Environmental change is important, in its contribution to conflict due to its effects on society. If such changes prevent society from attaining basic needs such as livelihood, access to water, food and energy sources, this will disrupt social conduct. The more vulnerable a society is, the more it is expected to be affected by environmental change. Environmental change is one aspect which contributes to social vulnerability, others are discussed in chapter 2. In order to reduce the risk of conflict, it is important to reduce social vulnerability in general. Environmental change can be addressed and reduced by reducing human impact on it, but resources degradation and environmental disasters cannot be eliminated and reducing their impact on society, through reducing social vulnerability, is important.

The structure of the paper is as following:

Chapter 1

The rise in environmental change is attributed partly to natural causes, but mainly to human impact on society. With population growth, rise in consumption levels and pollution, society's effect of the environment is becoming more rapid (FAO, 2000), and raises the risk of violent conflict (Halle et al, 2000)

Resource degradation and scarcity of renewable natural resources such as water, agricultural land and forests is becoming more acute due to overuse and mismanagement, and pollution of these resources (FAO, 2000).

Climate change is becoming a distressing matter, especially with the rise in scientific evidence as to its causes and effects. Human impact on the environment, mainly through the release of green house gases into the atmosphere, changing its composition. This has an effect on global climate patterns such as precipitation, temperature and sea surface levels. The effects of these changes are expected to be devastating to coastal settlements, change plant and animal habitat zones and lead to mass population migration and is expected to raise social vulnerability (Dunn and Flavin, 2002).

Environmental disasters are also on the rise, not only natural but unnatural disasters, induced by human factors such as climate change and deforestation. In addition, rise in social vulnerability, such as poverty and settlements in hazardous areas such as hillsides and concentrated urban centres are expected to make the impact of these un/natural disasters more extreme (ISDR, 2003).

Chapter 2

Social aspects such as poverty, inequality, gender issues and urbanization contribute to social vulnerability. With the rise in many of these social aspects, societies become more vulnerable in general and specifically to environmental change, thus raising the risk of conflict. Many cases of conflict seemingly directly connected to environmental change are connected to social vulnerability.

The fact that no famine has ever been recorded in a democratic country is an example of a connection between social aspects and institutions, social vulnerability and the outcome of environmentally related conflict (Sen, 1999).

In some cases, vulnerable societies, such as poor people, are thought to have a negative impact on the environment, through population growth and degrading limited resources due to lack of options, raising their own vulnerability to change. Industrialised societies can have huge negative effects on the environment through mass consumption and pollution, even though proportionately they are a smaller section of global population. Vulnerable societies find it more difficult to adapt to and recover from change in general and environmental change specifically. Thus, vulnerable societies are more susceptible to environmental change and become more vulnerable due to environmental change (Homer-Dixon and Blitt, 1998. Ohlsson, 1998).

Chapter 3

Modern conflict has seen a shift from being fought by nations or blocks of nations over ideology, to conflict within nation boundaries, between civil groups such as ethnic groups and sectors. These conflicts tend to be related to economic and social issues (Collier, 2000).

Many researchers have made a connection between environmental change and the risk of conflict. One approach represented by Thomas Homer-Dixon, sees environmental change as raising the risk of conflict. This is due to rising competition over dwindling resources. As environmental change become more extreme in the future, we can expect to see a rise in environmentally related conflict such as water wars (Gleditsch, 2004).

Another approach represented by Aaron Wolf, prophases that environmental change will not necessarily lead to conflict, but has actually been seen to lead to

cooperation, especially in the case of water. Looking at past and historical cases, conflict over water is by far more rare than cooperation. This is based on the high cost of war, to human lives, standard of living and the economy (Wolf, 1999).

This paper introduces another approach which sees both scenarios as plausible. The outcome of environmental change is determined by the level of social vulnerability. Environmental change in itself does not determine the chances of conflict. Social aspects such as poverty and unemployment which are intensified by environmental change, and contribute to it, are important.

Chapter 4

In many views, social aspects related to economic growth and development, are seen as contradictory to environmental concerns. By connecting the risk of conflict due to environmental change to social aspects it is clear that there is a need for growth in order to address issues of poverty and inequality while developing in a sustainable manner in order to reduce negative effects on the environment. When regarding social vulnerability as central to this argument, lack of growth, will indirectly have a negative effects on the environment.

Lack of growth has a negative effect on society and on its vulnerability to the environment, and even though is attributed to negative effects on the environment, cannot be excluded when trying to tackle these issues. In order to deal with this equation, there is a need to address the impact society has on the environment and the impact environmental change has on society.

In order to reduce social vulnerability to environmental change and reduce the risk of conflict, it is important to act on two levels:

1. To reduce society's impact on the environment through changing environmental management, technological innovations and awareness.
2. To reduce society's vulnerability to such changes through addressing social aspects such as unemployment, population growth and equal access to natural resources.

“Communities will always face natural hazards, but today’s disasters are often generated by, or at least exacerbated by, human activities. At the most dramatic level, human activities are changing the natural balance of the earth interfering as never before with the atmosphere, the oceans, the polar ice caps, the forest cover and the natural pillars that make our world a liveable home. But we are also putting ourselves in harm’s way in less visible ways. At no time in human history have so many people lived in cities clustered around seismically active areas. Destitution and demographic pressure have led more people than ever before to live in flood plains or in areas prone to landslides. Poor land-use planning, environmental mismanagement; and the lack of regulatory mechanisms both increase and exacerbate the effects of disaster”

Kofi Annan, 2002

1. Environmental Change

The Mayans are famous for their rich and sophisticated culture as much as for their mysterious disappearance. For thousands of years the highly developed Mayan civilization flourished, covering a wide spread area of today's Mexico, Guatemala, El Salvador and Honduras, great cities surrounded by agricultural rural communities. A political system of monarchy and nobles developed over the years and they are thought to have had an advanced language, a religion based on human sacrifice, huge temples and the use of astronomy and a complex calendar (Markowitz, 2003).

And then they vanished.

For years, this has been one of the greatest mysteries in history. Recent research has attempted to explain this disappearance and discover the answers for age-old questions.

Through research testing lake sediments, evidence of climate change and drought has been found. This area was partially arid and vulnerable to changes in precipitation patterns, as it was dependent on annual rainfall (and a small amount of ground water) for agriculture and daily use (Lovgren, 2003. Vince, 2003).

Research on lake sediment in the area has shown evidence of a correlation between changes in rainfall and three extreme droughts (thought to be connected to the sun cycle) and three phases in the collapse of the Mayan civilization. These extreme environmental conditions are thought to have been combined with other aspects such as economic and political instability, together with population growth and environmental degradation (deforestation), which made them even more vulnerable to environmental change. The extreme lack of water led to crop failure, lack of food, disease and competition over resources, as well as affecting political stability, as the religious ceremonies aimed at bringing rain, had failed (Lovgren, 2003. Vince, 2003).

War and conflict have been known to be a part of the Mayan history. These extreme **environmental conditions**, combined with **social vulnerability** are thought to have led to more extreme **conflict** and subsequently the cause their disappearance (Haug et al, 2003. Lovgren, 2003. Vince, 2003).

Other examples of past civilizations wiped out by environmental change are found in Mesopotamia, the Middle East and west Asia (Lovgren, 2003).

The situation the Mayans were in can sound familiar in modern times as environmental change is on the rise and is thought to have an effect on political stability and the risk of war. Social vulnerability introduces other worrying aspects as global population has increased six folds over the past two hundred years, and poverty and inequality weaken social ties and reduce people's access to resources (Engelman et al, 2002).

Regardless of the basic similarities between the Maya's situation and today's conditions, there are differences brought on by modernity such as technological innovations which can help overcome resource scarcity, creating the ability to transfer goods including food, water and medical supplies to needing areas, in addition to communications, scientific evidence, institutional capabilities, international and awareness of the problems and their causes and effects (Ohlsson, 1998).

Even though some environmental change is partially attributed to natural causes, social aspects (such as urbanization, population growth, consumption levels and poverty) are making the situation more extreme. Thus human society has a responsibility to reduce its effects on the environment and manage resources in a sustainable manner for the prosperity of future generations.

In order to do so, it is important to understand how social aspects affect the environment, directly and indirectly and what can be done. It is possible and necessary to reduce social vulnerability to environmental change as society depends on the natural environment for basic needs such as water and food and fuel. At the same time to reduce society's effect on the environment and the intervention with natural ecosystems, in order to reduce the risk of conflict (FAO, 2000).

1.1 Importance of addressing environmental change

"Ecological services are the basis for the functioning of the cultural landscape."

(FAO, 2000.)

The United Nations Conference on the Human Environment in Stockholm 1972 brought forth the importance of addressing environmental change which has been snowballing since the industrial revolution, on an international level. The effects of environmental change on human health have been worsening and the availability of resources is declining as human impact on the environment grows, through consumption and pollution (Goehl, 2000).

Environmental change is becoming more extreme and effecting a growing number of people in a growing number of countries, through the economic effects and cost to human lives. These changes especially affect those who are vulnerable to environmental change (through lack of access to resources and poverty, among others) and find it more difficult to recover. As a result of the rise in the stresses on society and competition over resources, the issue of environmentally related conflict is becoming more and more central in the media and in the international political arena.

1.2 Resource Scarcity and Degradation

Natural resources provide basic needs such as water, food and energy which individuals and societies need in order to survive and prosper. The growing degradation and scarcity of natural resources is a worrying issue.

Natural resources are divided into three: non-renewable, perpetual and renewable. *Non-renewable* resources such as fossil fuel and minerals do not replenish themselves on a time scale relevant to human life and to the speed in which they are being used up (Renner, 2002). *Perpetual* resources, refer to wind, wave and solar energy, their use does not affect their abundance or scarcity (Miller, 2004. p.9).

This paper will focus on *renewable* resources which can replenish themselves on a relevant timescale, provided they are not used up too fast or degraded to an irreversible level. Such resources are **freshwater**, **forests**, **fish stocks**, **biodiversity** and **agricultural land** and are individually introduced below.

Scarcity of renewable resources can be natural, such as freshwater in arid areas, but are becoming more extreme and introduced in new areas due to mismanagement; generally overuse which makes it difficult for these resources to replenish themselves, in addition to pollution which leads to a decline in quality contributing to scarcity (Miller, 2004. p.9). Some scarcities have a local effect, such as water scarcity in a specific area, while others have a global effect, regardless of where the cause originates. The exploitation of specific resources can go beyond specific scarcity and have a wider effects and lead to the imbalance of whole ecosystems (FAO, 2000).

Water

As water is essential for sustaining all life, for drinking, agriculture and industry, the decline in quality and quantity of freshwater sources is extremely worrying (FAO, 2000). The effects of water scarcity, which have been experienced throughout time, are becoming so extreme and widespread that water wars are expected to be central in the 21st century. The demand for water is growing constantly with the growth of global population and rise in per capita consumption levels. As the supply of freshwater on earth has not grown; in 2050, the global potential amount of water available per person is expected to be one quarter of what it was in 1950 (Brown et al, 1998).

The need for more water has led to overuse of natural resources, such as rivers and lowering water tables and aquifers. A decline in quantity, and pollution lead to deterioration in quality, which intensifies scarcity and competition. Adding to this strain is the change in precipitation patterns experienced in the past years, attributed to climate change (Brown, 1997. Brown et al, 1998). The issue of water quality is becoming more central with the exploitation of easily accessed resource such as aquifers, and lead to the search of new resources such as deep fossil aquifers (Wolf, 2002).

Irrigation counts for a large part of water consumption, making agriculture in some areas less profitable in relation to water usage and leading to a shift towards industries which use water more economically. As a result, import of water intensive crops has grown; in order to avoid investing much needed water in agriculture (Brown et al, 1998).

The increase in competition over water, especially in developing countries, limits development and raises the risk of conflict. Water scarcity reflects social and governmental abilities to cope with the change and increasing scarcity (Ohlsson, 1998).

Agriculture and food availability

The World Food Summit in Rome, in 1996 warned of a future global food shortage, resulting in rise in grain prices to the level of double the current prices. Even though the overall area of agricultural land has grown dramatically since the 1950's it has

been slower than global population growth, cropland per capita has shrank, lowering the potential amount or crop yield per person.

Rising demands for food have taken their toll on the quality of agricultural land and crop yields. In order to supply the growing need for grain and other crops, mainly due to population growth, a number of measures have been taken:

Expansion of land used for agriculture has lead farmers to cultivate what Brown calls “*ecologically vulnerable*” areas, such as hillsides (which are susceptible to landslides) and semi arid areas in addition to cultivation of wetlands and clearing of forests. At the same time, agricultural land is being diverted to other uses such as houses, roads, industrial areas and shopping centres as a result of urbanisation and industrialization (Brown et al, 1998).

Pesticides and fertilizers have been used intensively, in attempt to raise land productivity. Over time this has led to overuse and degradation of the land and consequently a reduction in land fertility (Brown, 1997). 10-20% of all croplands and 70% of grazing lands are estimated to be degraded, yielding small and unsuccessful crops (Nierenberg and Macdonald, 2004).

The increase in food import, especially water intensive crops leads to a dependency on external food sources, especially as they are not diverse, and many depend in import from few countries largely the US, which has a varying crop yield from year to year as a result of rainfall and temperatures fluctuations, which are expected to become more extreme and unpredictable in the future due to climate change (Brown, 1997. Engelman et al, 2002).

A future rise in crop prices could reduce accessibility, especially of less privileged people, leading to malnutrition and starvation, as food is generally not a problem for those who can afford it, it is expected to become a more acute problem for those already lacking purchasing power (FAO, 2000). Such a situation could lead to social unrest as people who are deprived of their basic needs rise up while holding the governments responsible, leading to political instability. This could have a vast effect on international economy and raise the risk of conflict (Brown, 1997).

Deforestation

In order to create more farmland, settlements and roads, collect firewood and meet rising demands for forest products such as paper, forests have been and are

continuously being cleared, leading to deforestation. Deforestation has affected 50% of the world's past forests and an additional 30% is suffering from degradation and fragmentation, making regeneration slower and more difficult (Nierenberg and Macdonald, 2004).

Forests are carbon sinks; they absorb carbon dioxide from the atmosphere and store it. As forests shrink, and they contribute to the rise in carbon levels in the atmosphere. In addition, deforestation contributes to erosion of topsoil, reducing land productivity and raising the risk of floods and degradation of water resources, potentially leading to economic instability and loss of livelihood (Brown et al, 1998).

Deforestation contributes to loss of **biodiversity**, depriving many species of animals and plants of their natural habitats, contributing to rising rates of extinction to “*100-1000 times the natural rate*” (Brown et al, 1998).

Fish Stocks

Many fish species and marine mammals are in danger of extinction due to over fishing. Fish stocks have been dwindling and are estimated to consist of 10% of their size 50 years ago. As a result, prices of fish have risen, once being food for the underprivileged, now feeding only those who can afford it. Competition over this diminishing resource has led to international disputes between countries relying on fish stocks (Brown et al, 1998. Nierenberg and Macdonald, 2004).

Fish Stocks used to be fished according to available technology. As more efficient fishing techniques such as trawlers developed, the catch grew. With the decline in fish stocks, the catch can no longer grow with investment and technology and is limited by regulations in order to sustain the remaining stocks and help them recover (Brown, 1997).

According to Greenpeace “ *tuna wars in the northeast Atlantic, crab wars in the North Pacific, squid wars in the southwest Atlantic, Salmon wars in the North Pacific and Pollock wars in the Sea of Okhotsk*” are on the rise. There have seen more wars over fish stocks in the 1990's than in the rest of the 19th century. (Brown et al, 1998).

1.3 Climate change

In Rio de Janeiro, 1992, *The World Summit on Sustainable Development* addressed the issue of climate change and its expected effects. Negotiations on the severity of climate change and scientific evidence backing it were challenged. Even though there was much backing for measures to be taken in order to reduce green house gas emissions (GHG) and the signing of *The Framework Convention on Climate Change* (Goehl, 2000), there was no consensus as to the *certainty* of the effects of human activities on the perceived climate change and the measures which need to be undertaken in order to reduce this perceived future threat. The main objection to reduction of GHG's was economic, as this would have a great effect on industry and transport, and subsequently on global economy (Dunn and Flavin, 2002).

Green House Gases, especially carbon dioxide, are released into the atmosphere through human activities, mainly through burning of the fossil fuels, accumulating in the atmosphere and altering its composition. These heavy gases are persistent in the atmosphere and retain heat leading to warming and what has been known as the green house effect (Wheeler, 2000). Levels of carbon dioxide in the atmosphere are estimated to be 31% higher than in the 18th century, before the industrial revolution and massive burning of fossil fuels (Nierenberg and Macdonald, 2004). This has an effect on global weather patterns such as precipitation, warming of the earth's surface, melting of polar icecaps and change in sea levels. As a result, change in plant and animal habitat range (and the rise in harmful algal blooms which can contaminate water sources, (Goehl, 2000), as well as the spread of diseases, and extreme disasters such as storms and floods are on the rise (ISDR, 2003).

Even though the future effects of climate change are not clear, they are expected to disrupt many vulnerable sections of society such as agriculture and coastal zones leading to a shortage in water, grain and energy sources, and can lead to massive displacement and migration of human populations (ICCP, 2001, Renner, 1999).

Climate change is seen to be one of the main driving forces in the increase in severity and occurrence of natural disasters. The rise in number of people affected is seen to be not only due to rise in incidents but due to a rise in vulnerability as a result of political, economic, social and environmental development, such as deforestation, inequality and population growth, age of population and infrastructure (ISDR, 2003).

The effects of climate change are expected to be more severe in many developing countries, changing precipitation patterns and water availability, increasing deforestation and land degradation and having a potentially devastating effect on crop yield. The expectations of change in sea levels will lead to additional and extreme problems, mostly affecting coastal areas, which inhabit a large part of global population and on small islands (ISDR, 2003).

Over the years, climate change has been found to have negative economic effects. Even in such a situation, some areas will suffer from the changes (mainly in low latitude areas, many developing countries) while others might even benefit from them (mainly high latitude areas) (Adger, 2001). There is the possibility that crops could be grown in areas in which today's conditions are too dry or too cold, even though many effects of global change have been and are expected to be negative in the future, thus leading to the need to adapt to change and attempt to minimize its effects. Additional changes are expected to be in range of infectious diseases and rise in deaths due to malnutrition, starvation and heat (ICCP, 2001).

The *Kyoto Protocol* in 1997 addressed the issue of cost of adaptation to climate change and reducing human activities which induce climate change, predominantly GHG emissions. Related issues addressed were historical responsibility, mainly of industrial countries and the future of sustainable development in developing countries and the need for perceived benefits for countries participating, thus the effects of climate change would be perceived as high compared to the cost of adaptation. As in the case of emissions trading which is thought to be more effective than emissions tax (Adger, 2001).

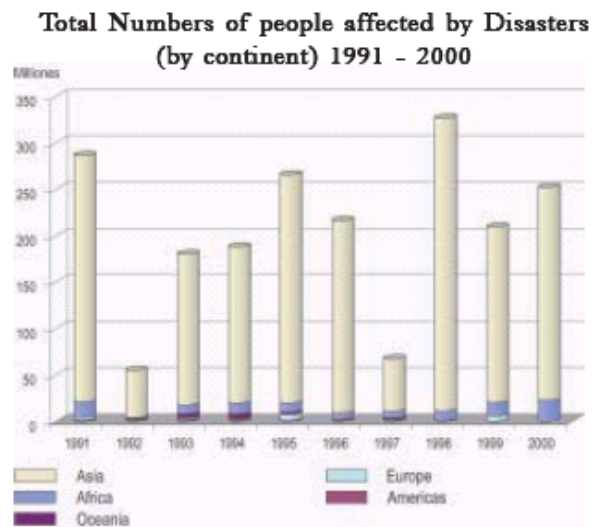
1.4 Natural and unnatural disasters

Floods, drought and severe storms such as tropical storms and hurricanes among other disasters have increased almost 10 times over the past forty years and are seen not only as natural disaster but unnatural as being induced by the rise of human impact on the society (Abramovitz, 2001). These disasters have a high cost to human life, standard of living, social structure and economic stability. In the first 8 months of 2002, 3,000 people died directly from floods alone, while 17 million were affected, leaving distraction of an estimated US\$ 30 billion. 100,00 people are estimated to die every year due to environmental disasters. If climate change is not dealt with

promptly and aggressively, financial costs are expected to rise to US\$ 300 billion annually by 2050 (ISDR, 2003).

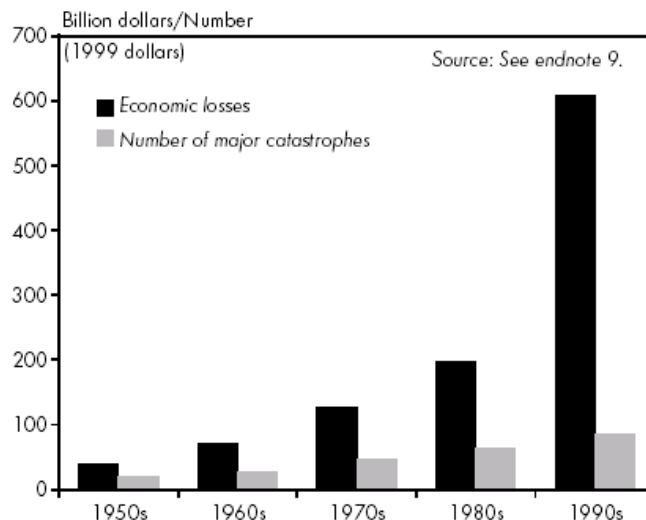
As can be seen in figure 1, environmental disasters are not evenly spread around the world. Generally, developing countries (especially in Asia) are by far more susceptible to such disasters. 97% of all deaths due to environmental disasters and the majority of economic losses occur in the developing world. Some developing countries have been struck by disaster up to eight times a year; this takes into account large-scale disasters only (ISDR, 2003).

Fig. 1: Total Number of people affected by disaster 1991-2000. (Taken from ISDR, 2003)



According to figure 2, the steady rise in natural disaster has lead to a sharp increase of economic loss over the past 50 years. These disasters generally affect developing countries, and Asia specifically (77% of deaths and 45% of economic losses) due to its high population and vulnerable coastal areas. The biggest source of death in natural disaster was floods, and then drought, which can lead to crop failure, water scarcity, famine, lack of shelter, loss of livelihood and direct death (ADPC, 2004).

Fig. 2 : Number of major catastrophes and economic loss in the second half of the twentieth century. (Taken from Abramovitz, 2001)



Early warnings and efficient services such as freshwater and medical supplies have played a part in reducing the damage. A subsequent problem is the breakout of disease after natural disasters, such as Malaria, Diarrhoea and Cholera. Even though attempts have been made to reduce the effect natural disasters have on society, the number of people and countries affected and economic damage has grown, due to a rise in frequency of the disasters as well as social vulnerability. Natural ecosystems have an ability to recover from disruptions and maintain or find their natural balance, but there is a limit of severity and recurrence (Abramovitz, 2001).

There is the question of *natural* verses *unnatural disasters*, as humans have changed their surroundings, ecosystems are losing their ability to recover from disasters. For example, deforestation and urbanization have an effect of groundwater, topsoil, productivity, the risk of floods, and even on precipitation patterns (ADPC, 2004). Such an overlapping effect on an ecosystem might reinforce the damage and hinder recovery. These changes are thought to have been affected indirectly by climate change and directly by mismanagement of resources (Abramovitz, 2001).

Social vulnerability has grown as settlements are forced into unfavourable areas such as hillsides which are more susceptible to landslides, especially if there are additional factors such as deforestation, and coastal areas which are vulnerable to storms, erosion and tidal waves (Abramovitz, 2001).

As urban centres grow rapidly, many in coastal areas, have more potential lose - "*concentrated risk*". As cities grow, so does the infrastructure, such as sanitation, water pipes and roads leaving a growing number of people and economic activities vulnerable to their disruption. In addition, the disruption of natural landscapes in urban centres increases the risk of floods as the land's ability to absorb runoff water is reduced (Abramovitz, 2001).

2. Social Vulnerability

Many natural disasters seemingly arising from environmental scarcity are also directly and indirectly connected to social, political and economic aspects. Amartya Sen raises the fact that “*no substantial famine has ever occurred in any independent and democratic country with a relatively free press*”. Famine has been seen in many authoritarian countries in accordance with natural disasters; crop failure in North Korea, floods in China in 1957-61 accompanied by extreme social and political changes, and drought in Ethiopia in 1984 which was accompanied by civil war (Brooks and Adger, 2003). Democratic countries in poor economic situations such as India, Zimbabwe and Botswana have experienced environmental disasters, which have not resulted in famine. Democratic governments are subjected to criticism by the media and opposing parties and elections which drive them to have responsive policies which help alleviate hunger, preventing death and making food accessible (Sen, 1999). Brooks and Adger refer to famine as a socio-economic process through inequality of income, breakdown in food distribution and poverty (Brooks and Adger, 2003).

Sen makes the point that the severity of the effects of the environment on society are not solely due to environmental change but are closely related to social aspects (democracy for example) which determine a society’s vulnerability and ability to cope with such changes and its response, some of the main aspects are discussed below. Social vulnerability is seen as derived from a combination of many different aspects and the interactions between them (GECHS, 2003). The social and institutional response to the change will be a factor in determining the outcome by minimising the effects of change or accentuating them (Ohlsson, 1998). Lack of ability to adapt to environmental change can lead to social, political and economic instability, and competition between and within nations and groups, and potentially raise the risk of conflict (Homer-Dixon and Blitt, 1998, Ohlsson, 1998).

Social vulnerability has two aspects: *individual* vulnerability, determined by access to resources, income and by social status and inequality, and *collective* vulnerability determined by economy and markets, institutions and their adaptation and response (Adger, 1999). Developing countries, on the whole, aim at rapid economic growth, have higher rates of population growth; combined with poverty and

economic pressures, this can lead to migration (sometimes to dangerous areas), unemployment and the raising of overall vulnerability (ISDR, 2003. Shin, 2004).

2.1 Population Growth and Consumption

The Earth Summit in Rio de Janeiro in 1992, highlighted population growth as an important issue which has long term effects on the environment and society, and is seen as directly affecting the scarcity of natural resources and social services (Engelman et al, 2002). This contributes to an overall rise in social vulnerability and institutional instability, raising the risk of violent conflict. Countries with higher rates of population growth tend to have more conflicting international relations (Yoffe, 2003).

A rise in population makes the slices of the cake smaller, in the words of Homer-Dixon; this will be intensified by unequal distribution of resources. Population growth poses a challenge for governments, as natural resources and social services might be in shortage. As global population grows, the potential amount of water and grain available for each person is reduced, leading to natural resource scarcity. In the future there will be a need for additional housing, education, jobs and health services leading to social resource scarcity. As there are expected to be more people in working ages, unemployment is expected to rise, threatening political stability (Brown et al, 1998). Population growth is associated with the status of women, and young women especially, their education, child bearing age, rights, needs and control over their lives. (Engelman et al, 2002).

In past centuries, when mortality rates in general, and specifically infant mortality rates were high, birth rates were high in order to compensate, and the rate of global population growth was low. Survival rates were low thus, a small number of children born, lived to have children themselves. As advances were made in nutrition, hygiene, sanitation and medicine death rate started to decline. Global population began to grow, from 1 billion in 1800 to 1,6 billion in 1900 and 2.5 billion in 1950. In the 1960's growth rates began to decline, as family planning and contraceptives became known and accessible, and today they stand on 6.1 billion as seen in figure 3 (Engelman et al, 2002).

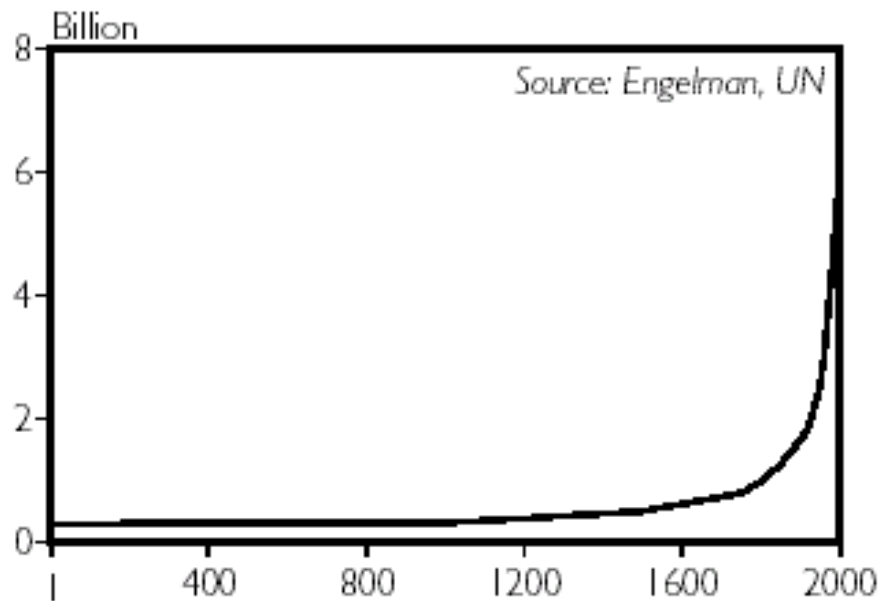


Fig. 3: World Population since 1 A.D.
(Taken from Engelman et al, 2002).

The average number of children a woman bears has dropped from six to three, over the past forty years. Even though birth rates are in decline, today's population is larger than ever before, and is growing at the rate of 240,000 people a day (Nierenberg and Macdonald, 2003). The world's population is expected to reach figures of between 7.7 and 11.2 billion by 2050, according to the UN, with a realistic expected figure of 9.4 billion, mainly in developing countries (Brown et al, 1998).

In many European countries and Japan growth rates are worryingly low resulting in a smaller working age section of society supporting an aging population (as in the case of China due to strict regulations), as people are living much longer than ever before, changing population size, age and structure. In contrast, many developing countries have high growth rates; this adds the stress of providing services such as health, education and transport in addition to employment to an overwhelming number of people (Engelman et al, 2002).

With industrialization and the rise in income per capita, there has been general shift towards smaller families. Lower growth rates have been seen in countries which have experienced rapid economic growth, such as South Korea and Taiwan. As people have fewer children they can invest more energy and money in each child for health and education and increase personal savings, thus raising their standard of living and future opportunities (Engelman et al, 2002. Nierenberg and Macdonald, 2003).

While the highest birth rates are seen in the developing world, the effects of population size in the industrial world have a great effect on the world's resources as they are coupled with consumption rates and larger *ecological footprints* – “*The biological productive area required to support a person*”. Even though there are less people in these countries they live off much more resources due to consumer lifestyles (Nierenberg and Macdonald, 2003). This will also lead to an increase in energy consumption while the population grows together with a rise in standards of living. (Brown et al, 1998).

2.2 Gender Issues

The “*International Conference on Population Growth*”, in Cairo 1994, addressed gender relations and women's rights as important in affecting population growth, equality and health issues which contribute to a stable society and functional institutions. Young people, especially women are the focus of reduction of growth rates. As they gain more control over their lives in general and especially over their reproductive lives, growth rates are expected to decline. A decline in population growth can be achieved through raising the average age in which women start giving birth and lowering the average number of children a woman bears. This will have a positive effect on women and infant health in general and on reduce mortality rates (Engelman et al, 2002).

Birth rates have been seen to decline in correlation with the rise in literacy levels, especially among women, in developing countries such as India, in the states of Kerala and Tamil Nadu (Sen, 1999). Women who have at least 6-7 schooling years tend to have children at a later age and have smaller and healthier families. Education raises awareness, self-esteem and a sense of control over their own lives, and a potential rise in income adding to their power within the family. On a global level today, women are much less likely to complete secondary school than men (Engelman et al, 2002).

The 1970's, in the United States a rise in women's participation in higher education and academic professions had been observed shortly after the introduction of oral contraception, this is a situation highly desired by many women in today's developing countries (Engelman et al, 2002).

2.3 Poverty

It is estimated that over one billion people live in extreme poverty around the world (living on less than US \$1 a day). Conflict has been found to be more prevalent within poor nation, as poor countries are more susceptible to violent outbursts (Collier, 2000. Ministry of Foreign Affairs, Norway, 2002).

According to The World Bank, poverty has been reduced by 50% since the 1980's, even though poverty has increased in certain areas of the developing world (Demery and Walton, 1998). Poverty is usually judged according to material deprivation: low income and consumption levels leading to poor housing and malnutrition (World Bank, 2000/2001). But as income levels and rights to property have an effect on a way of life, and leads to what Sen calls "*poor living*" other than just low income levels, it refers to a lack of freedom, "*the lack of capability to live a minimally decent life*", which can lead to social exclusion and the inability to participate adequately in society (Sen, 2000). There are additional dimensions of poverty which refer to deprivation in different aspects of one's life, such as malnutrition and homelessness, lack of access to education and natural resources, high mortality rates and lack of access to health services, and vulnerability to changes such as disease, economic changes and environmental disasters (World Bank, 2000/2001). "*The poor are the most dependent on natural resources for their livelihoods, and thus most vulnerable to environmental degradation*" (Halle et al, 2004).

Poverty also has an effect on the environment, as the poor who generally lack accessibility to resources, tend to over use whatever meagre resources are available and contribute to degradation (ISDR, 2003).

Environmental scarcities lead or prolong poverty by lack of access to resources and loss of livelihood, "*disasters make poverty worse*" (Abramovitz, 2001) and hinder the efforts made in attempt to alleviate poverty. The poor are more vulnerable to such disasters and have a lower capacity to recover (ADPC, 2004. Ohlsson, 2000).

Poverty has an effect on individual's access to resources and adapting to a changing environment, in addition to other social and political conditions. But poor people tend to be disadvantaged in the areas they live in which have less efficient infrastructure and health services and are at a higher risk of being affected by

environmental disasters such as land slides and floods. Poverty can be seen as an indicator of vulnerability in general and vulnerability to environmental changes specifically while making individuals dependent on scarce or inaccessible resources. Dependency can also be related to sources of income, as the sources are more diverse there is more social resilience to environmental change (Adger, 1999).

A correlation has been found between poverty, low life expectancy and high birth rates. Alleviation of poverty can contribute to reducing rates of population growth (Inglehart, 2000. Engelman et al, 2002).

2.4 Inequality

The increase of inequality within a society or different societies refers to lack of access to common resources and having resources diverted to or controlled by a minority, due to differences in income, poverty and social status within a society. This raises the overall vulnerability to environmental change. Wealth and income are two important factors when coping with environmental change; it enables people the ability to adapt. In cases of drought, people with better access to resources or to those distributing resources, in this case water, would be less affected by the environmental changes, than more unfortunate people, lacking access (Adger, 1999).

The gaps between industrialised and developing countries are great, on many levels: income, education, health services, consumption levels and death rates. But differences are found not only between nations but also within their societies. In many cases, as countries develop, the gaps between rich and poor within the society, widen. Signs of inequality are widening in developed countries such as the United States, the United Kingdom and New Zealand (Demery and Walton, 1998).

Corruption contributes to an inequality in distribution and access to resources, in some cases, countries rich in natural resources (renewable and non-renewable) are seen to have lower per capita income due to corruption (Hussels and Switzer, 2004).

Equality between men and women in access to education, income, opportunities and political and economic power and equal rights, in addition to eliminating violence against women, are expected to result in lower fertility rates. (Engelman et al, 2002) Equality between men and women is seen as contributing to poverty alleviation and economic growth. Illiteracy levels are higher in women, and most children who don't attend school are girls. On a global level, women lack the

political, economic and social power attributed to men. (Nierenberg and Macdonald, 2004).

Issues relating to natural resources tend to discriminate against women who gather fuel wood and in some cases walk for hours to fetch water. Further equality between men and women in the access to natural resources, such as women's right to own land, will result in efficient and effective distribution of these resources. This can have a cultural change as women become more independent, their position within society changes. This has an effect on environmental degradation as in some studies; female illiteracy levels have been connected to population growth and levels of deforestation (Engelman et al, 2002).

2.5 Urbanization

Urban centres are growing intensively, attracting poor populations from rural areas, this has an effect on the natural surroundings and human health, combined with inefficient infrastructure such as sewage, and ineffective draining systems, can contribute to the severity of floods, in addition to the lowering of water table levels. Lack of natural resources helps lead to migration of people out of effected areas, by moving to urban centres, and since the 1970's urban population in developing countries has tripled in size (ISDR, 2003).

Many cities in Africa and South America, have experienced intense growth over the past decades, some as high as 5% a year due to population growth and migration from rural areas, this puts immense pressure on service providers in these cities, leading to low schooling attendance, high occurrence of diseases related to bad sanitation and hygiene such as diarrhoea, shortage in supply of food, clean water and high infant mortality rates between 24-42% (Engelman et al, 2002)

With population growth and rapid urbanization, comes an increase in waste: sewage, municipal and industrial waste. The rise in the quantity of waste, some of which can be highly toxic (Goehl, 2000) and its massive concentration in urban centres combined with ineffective disposal mechanisms and sanitation systems has dangerous effects on human health as it raised the risk of diseases, in addition to degrading water and land resources (Brown et al, 1998).

2.6 Unemployment and loss of livelihood

“Loss of livelihood leads to social tension, to migration, to settlement in inappropriate areas and often to conflict” (Switzer, 2002)

High rates of unemployment are seen to lead to social discontent (Renner, 1999). Unemployment, especially in young men is a source of vulnerability and frustration susceptible to hate propaganda and violent actions. Loss of livelihood and agricultural failure intensify and cause poverty and an increase in inequality leading to marginalisation of certain social groups, making poor people even poorer. The agricultural failure makes it difficult for people, who traditionally lived off the land, to do so successfully in modern times, due to global changes such as industrialization. In addition, environmental degradation has taken its toll on agricultural productivity (Ohlsson, 2000). Unemployment and loss of livelihood can have a direct effect on malnutrition and hunger. There can be unemployment of minority groups, or women which don't necessarily affect the whole population. This can lead to social tension between ethnic groups and hatred of immigrants, who compete with local people for employment. This can lead to racism and social and political unrest and raise crime levels especially when related to unemployed youth (Sen, 2000).

150 million people are estimated to be unemployed and a further 900 million underemployed earning wages lower than they can live off, which accounts for one third of the global working force (Renner, 1999).

The growth in population leads to a growth in the global work force, raising the number of unemployed or underemployed leading to widespread poverty and hunger. In many countries, much of the population is below working age suggesting this problem is likely to intensify in the future. As the demand for labour is greater than the supply, wages decrease and working conditions worsen (Brown et al, 1998).

2.7 Migration and Refugees

Migration of large numbers of people from affected areas, due to environmental changes can be expected to have an un-stabilizing effect on political regimes and potentially lead to conflict. In addition, more and more people are pushed into living in and cultivating dangerous areas such as slopes, which are susceptible to landslides (ICCP, 2001).

People who are the most likely to migrate due to environmental changes are those who are dependent on resources and have few options, generally speaking of indigenous people, marginalized groups and the poor. Migration can be seen to be due to diverse options or lack of options. If people have the opportunity to improve their lives by choosing to migrate to an area which can offer them more income resources, such as urban centres, they are attempting to increase the stability. In another scenario people are driven out due to dwindling resources and environmental change and forced to migrate to areas which can offer them better conditions (Adger, 1999).

In 2001 there were 20 million refugees and displaced people within their country. This raises pressure on the environment by using natural social resources, such as water and crops and employment opportunities, and in many cases settling in environmentally insecure and resource scarce areas. Refugees have no say in the decision making of use of natural resources, whether they stay in a foreign land or return to their struggling post-war homeland, and may lose their legal rights over land and property, thus losing their livelihood (Vanasselt, 2003).

Over the past decade an estimated 35 million people are thought to have been displaced by conflict and have contributed to the rise of conflict through raising competition over resources and income. Having a negative effect on the environment and on social vulnerability (Switzer, 2002).

3. Conflict and the environment

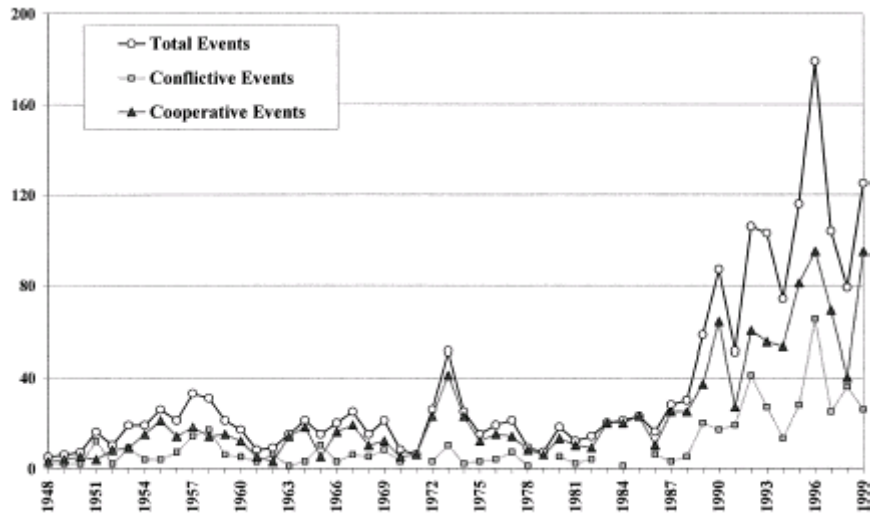
The growing severity of environmental change is raising the fear of resource related conflict, (Switzer, 2002) a large part surrounding water. This has produced many theories on the relation between conflict and environmental change, two of which are used in this paper:

One approach, represented by Thomas Homer-Dixon warns of the potential future violent conflict mainly on a sub national level (Homer-Dixon, 1999) deriving from environmental change and predicting that water wars will become more and more common, in correlation with population growth and depletion of renewable resources. Population growth increases the pressure on natural resources; leading to decreasing food supplies, loss of agricultural land and economic productivity, migration and depletion and scarcity of resources. This increases state vulnerability and with the contribution of weak institutions, raises the risk of violent conflict (Gleditsch, 2004. Homer-Dixon and Blitt, 1998). Homer-Dixon refers to additional social aspects which contribute to social vulnerability: economic decline, which environmental degradation contributes to, consumption rates, environmental refugees and uneven distribution of resources or access to resources which can lead to social inequality and contribute to conflict (FAO, 2000). Society's ability to react and adapt to the changes depends on its markets and land use practices such as crop diversification (Homer-Dixon, 1991).

A more optimistic approach is based on the fact that history shows no evidence of full-blown water wars in the past 4,500 years (the last war was between the Sumerian city-states of Lagash and Umma, over the rights to exploit boundary channels along the Tigris in 2500 BC) but there is evidence of sub national conflict over water, ethnic groups, sectors and tribes (Wolf, 1999). Despite its contribution to conflict, environmental change can have positive effects (Matthews, 2004, Baechler, 1998). Aaron Wolf represents this approach; he focuses on water scarcity and refers to the fact that there have overwhelmingly, been more cases of cooperation than conflict over water scarcity.

As seen in figure 4, the number of events related to water scarcity have risen dramatically over the past 50 years (between 1948-1999). The overall number of events resulting in cooperation generally outnumbers those ending in conflict, over this period.

Fig. 4:
Distribution
of
Cooperative,
Conflictive
and Total
Events (over
water) by
Year.
(Taken from
Yoffe et al
.P. 1114)



International treaties, and regional agreements raise institutional capacity and lower the risk of violent conflict, as such conflict results not simply due to the scarcity but due to lack of capacity to adapt to change (Wolf, 2002).

Even though Wolf focuses on water issues, this paper suggests widening this approach to environmental change in general. International, multilateral cooperation has been seen to have a positive effect not only in issues of water but also in the case of the depletion of the ozone layer, even though this did not pose a threat of potential conflict, this example (discussed in the next chapter) shows that this could lead the way of successfully dealing with environmental problems other than water.

In most cases, violence over water is expected not on a national level, but on a more local level between tribes and states. The high cost of war, to human life, standard of living and the economy is extremely high, money can be diverted to productive measures (Wolf A.T. 1998).

The above theories refer to some of the same aspects: Homer-Dixon and Wolf both recognize the importance of social aspects and the effect of environmental change on them. Environmental change alone does not lead to conflict but a social lack of ability to adapt to change does (Homer-Dixon, 1991. Wolf, 2002). Violent conflict over natural resources is expected to be within and not between nations (Homer-Dixon, 1991. Wolf A.T. 1998). Even though wolf claims that environmental scarcity (especially in the case of water) will more likely lead to cooperation, with the rise in scarcity in the future, the risk of local conflict is expected to rise (Wolf A.T. 1998).

Homer-Dixon's approach refers to international market and land use management as important in dealing with reducing the risk of potential conflict. Referring to environmental scarcities as matters of national security, potentially leading to conflict leads to a need to reduce societies impact on the environment (Homer-Dixon, 1991). Wolf's approach finds the solution in increasing institutional capacity to deal with change through multilateral international treaties, international relations and negotiations, as a basis for cooperation over common problems as opposed to the irrational prospect of conflict and its high economic price and toll on human life (Giordano and Wolf, 2003).

In contrast to Thomas Homer-Dixon claims that environmental conflict appears as political, socio-economic, ethnic, religious are territorial (Homer-Dixon, 1999) this paper argues that what is seen as conflict directly induced by environmental change is actually caused by social vulnerability. Environmental change raises social vulnerability, among other factors. Resource wars are actually wars of vulnerability. For example:

The genocide in Rwanda in 1994 is seen as triggered to a large extent by environmental scarcity (Ohlsson, 2000). It can also be seen as caused by extreme social vulnerability, which environmental scarcity is partially responsible for.

A complex set of conditions led to the genocide in Rwanda. A tyrannical response of a weak regime to political violence, loss of livelihood, famine and environmental degradation lead to massive population displacement of 1 million people, leading to additional demand for resources, grievance, to civil war and genocide through the exploitation of ethnic and historic animosity.

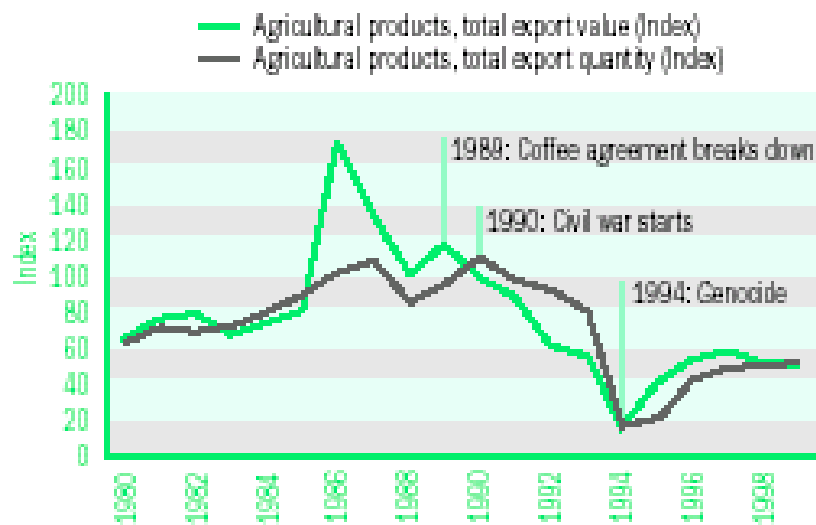
Social vulnerability of a weak government, extreme poverty, soil degradation, loss of livelihood leading to massive rural unemployment contributed to the famine and civil war. Olsson raises the fact that many of the people involved in the atrocities were young unemployed men, trapped in the desperate cycle of poverty, due to loss of livelihood (Olsson, 2000). This desperation made these people easy to be driven to violence and were targets for militant recruit (Renner, 1999).

The famine in 1989-1990 was caused not only by environmental scarcity, due to soil degradation over time leading to loss of livelihood. Another factor contributing

to the loss of livelihood is a decline in international coffee prices, which was one of Rwanda's main exports (CIA, 2004).

The International Coffee Agreement set a bottom limit for coffee price. After the cold war had ended, the United States backed out of this agreement, sending coffee prices plummeting below production prices (Global Policy Forum, 2003). Figure 4 shows a correlation between the collapse in coffee prices in 1989 and the outbreak of rise in civil violence in 1990, the ongoing decline in agricultural export and value eventually correlated to the genocide, in 1994 (Halle, 2004).

Fig. 5: Rwanda total export of agricultural products by value index and quantity index, showing how a sudden collapse in coffee prices may have contributed to the onset of civil violence (Taken from Halle et al, 2004).



Even though environmental change contributed to the escalation of violence in Rwanda, the level of social vulnerability was high due to many other factors. Additional contribution to the devastating outcomes was the lack of response of the international community who misinterpreted or ignored the warning signs (Halle, 2004).

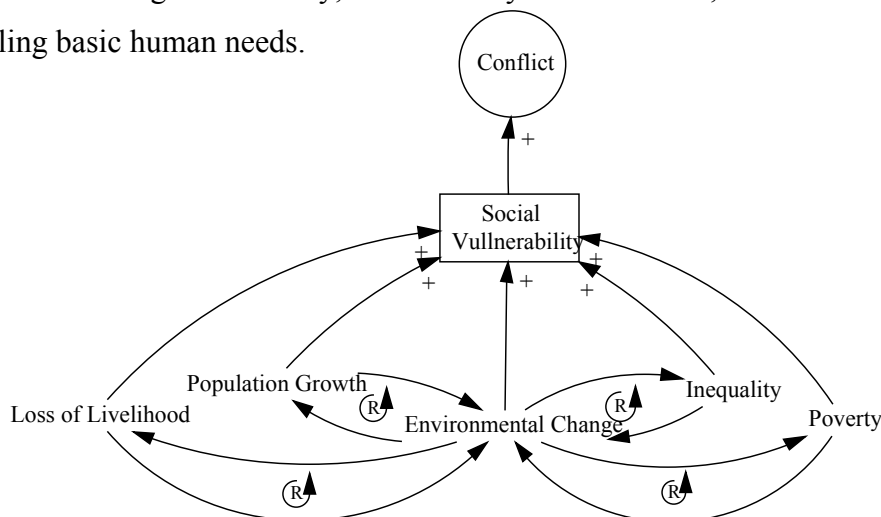
Historic animosity, racism, poverty, lack of crop diversification and population growth led to vulnerability of a society which could not adapt to the plummeting coffee prices below production prices. Famine, loss of livelihood and massive population displacement which triggered the civil war and genocide were not caused only by environmental degradation. Soil degradation and deforestation due to uncontrolled clearing of forests for fuel wood, was due to basic needs of society which were not being met by the government, this contributed to general vulnerability. This coincides with Sen's observation that famine is not directly caused due to lack of food, but to institutions' inability to cope, Homer-Dixon's observation

of the importance of markets and Wolf's observation of the importance of international cooperation in reducing the risk in environmentally related conflict.

Environmental change is partly natural but is extremely effected by human impact on the environment, as scientific evidence shows in growing certainty. Pollution and exploitation of resources due to mismanagement and the need to meet society's growing needs due to population growth and a rise in consumption rates have led to resources scarcity and degradation, climate change and it's effects, and rise in occurrence and severity of environmental disasters.

Environmental change does not directly lead to conflict but raises social vulnerability, which is a lack of ability of society to adapt to changes, including environmental change. The more extreme the change, the more difficult it is to adapt. The examples Sen raises, of famine in countries with authoritarian regimes, shows that the outcome of environmental change is not directly the result of environmental change but of social vulnerability. The level of social vulnerability, the inability to adapt to change successfully, determines the outcome. The more vulnerable a society is to begin with, due to social aspects such as population growth and poverty, the more difficult it would be to adapt to environmental change.

Different aspects contribute to social vulnerability, such as: poverty, inequality, institutions, refugees, unemployment and environmental change. Environmental change contributes to the general rise in social vulnerability (FAO, 2000) and to the rise in other social aspects relating to social vulnerability such as environmental refugees, loss of livelihood and poverty. These aspects affect environmental change. Environmental problems contribute to conflict as they raise concerns relating to security, accessibility to resources, economic growth and fulfilling basic human needs.



In order to reduce the risk of conflict there is a need to have a system approach and look at the big picture, in order to reduce social vulnerability and raise society's ability to deal with change (Tompkins and Adger, 2003).

In order to deal with this equation, it is important to reduce environmental change, but to do so successfully in order to reduce the risk of conflict, addressing the driving forces of social vulnerability and social needs is central (Switzer, 2002. Tompkins and Adger, 2003).

Reducing environmental change (such as pollution, resource exploitation and GHG emissions) contributes to reducing social vulnerability. This can be achieved by reducing society's impact on the environment by changing environmental management, research, technology and awareness. As the future, including environmental change can be estimated but not be foreseen; eliminating change is not an option. Thus, raising society's ability to adapt to change successfully is important in reducing risk of conflict.

If social aspects such as population growth, poverty, inequality and unemployment are not addressed, environmental scarcity could still end up being a future problem, even if addressed separately. Environmental change can and should be addressed but the effects cannot certainly be eliminated. Environmental disasters can be influenced but not controlled, and even changes in environmental management and international negotiations cannot change the fact that the expected growth in population and consumption levels pose difficult problems which current technology cannot certainly and successfully tackle. The rise of these issues in the future could be problematic even if current environmental problems are dealt with successfully. The rise in consumption levels pose serious worries and the already degraded and dwindling forests and agricultural lands have created problems such as migration and resources degradation (Switzer, 2002). Human impact on the environment, which induces such change can be reduces but this does not assure that the effects will cease.

If environmental change can lead to conflict thought social vulnerability, the level of social vulnerability determines to outcome, not the extent of environmental change directly. The causality of environmental change shows us that vulnerable societies tend to have a negative effect of the environment through bad resource management, mass populations and unstable institutions leading to unequal

distribution. Less venerable societies also have a negative effect on the environment through mass consumption and pollution, but this tends to effect societies which are vulnerable to begin with, such as exporters of primary commodities, in countries which experience deforestation and loss of agricultural land. Societies which are less vulnerable are able to adapt to environmental change through technical innovation, scientific research and funding (Switzer, 2002).

The price of war is high, but conflict will be a viable option if other options, such as cooperation and negotiation are not achievable. As aspects of social vulnerability rise, and the fear of environmental change is expected to rise in the future, environmentally related conflict is also expected to rise. Reducing social vulnerability could help move from Homer-Dixon's prophesy of conflict to Wolf's more optimistic expectation of cooperation.

4. Discussion

In order to start dealing with such wide and complex issues related to conflict and the environment there is a need to address many indirectly connected and interrelated questions. Social vulnerability; the way society causes environmental change and reacts to it lies at the centre (Brooks and Adger, 2003).

Wolf states that going to war over resources scarcity is not the rational thing to do, given the high price of war (Wolf, 1998). Conflict might be the last resort but depends on the other perceived options. The options which are offered by Homer-Dixon and Wolf, of institutional capacity of dealing with the change, through changing markets, land use and multilateral international negotiations are important but have been extensively demonstrated (Adger, 1999. Brown et al, 1998. Gleditsch, 2004. Homer-Dixon, 1991. Ohlsson, 1998. World Bank, 2000/2001) but do not directly address many of the social aspects, contributing directly to social vulnerability and conflict (FAO, 2000). In addition, the way the changes are made is extremely important. As the world development report – Attacking poverty in 2000/2001 stresses, the way development and economic growth are performed can determine the success. Institutions, markets and international relations can be tools to reduce social vulnerability if developed appropriately (World Bank, 2000/2001).

Homer-Dixon refers to increased disparity as contributing to the risk of conflict (Homer-Dixon, 1991). The addressing of social aspects is important in order to reduce disparity and reduce social vulnerability. The institutional changes suggested by Wolf and Homer-Dixon, referring to environmental change and the ways of dealing with them, are important, but as they cannot eliminate them, the importance of reducing social vulnerability in general and vulnerability to environmental change specifically, is of the highest importance in reducing the risk of conflict. New and unexpected future incidents can occur. We can try and predict the future through studying the past but as it is impossible, the best way of reducing future threat would be to reduce social vulnerability to external changes as the main goal, in addition to reducing external changes.

The concept of environmental change connected to conflict through social vulnerability, forces us to deal with two seemingly contradicting concepts: social and economic growth and development on the one hand, and prevention of environmental change on the other. With economic development, industrialization and the rise of

income, come rise in per capita consumption, pollution and environmental degradation (Dietz and Adger, 2003).

Economic growth contributes to environmental degradation, in the way of urbanization and industrialization and a rise in demand for primary commodities. There is a need for sustainable development in order to save the environment from irreversible degradation and lack of natural and social resources needed for society (FAO, 2000).

Conflict and environmental disasters hinder development. Sustainable development, in regard to the use of natural resources and social aspects such as poverty alleviation, is important to the prevention of conflict (Switzer, 2002).

Economic growth is important for alleviating poverty, reducing population growth, gender issues and unemployment, thus reducing social vulnerability (World Bank, 2000/2001). Environmental aspects are negatively affected by economic growth, driven by globalization and misuse of funding, through industrialization, pollution, rise in consumption levels and resource degradation and lead to social tension which can contribute to conflict (Halle et al, 2004).

As many of the causes of environmental change are social: population growth, poverty and consumption, solutions should refer to these causes in attempt to deal with the problem (Halle et al, 2004). Human induced environmental change can be seen as a symptom of social vulnerability, and dealing with the symptoms alone, is superficial. Environmental degradation is due to social needs, addressing these needs is crucial.

In order to deal with both there is a need to act in two wide and intertwined directions:

1. To reduce society's impact on the environment through changing environmental management, technological innovations and awareness.
2. To reduce society's vulnerability to such changes through addressing social aspects such as unemployment, population growth and equal access to natural resources and institutions.

This can also be seen in the *Millennium Goals* published by the United Nations:

The Millennium Development Goals

The Millennium Development Goals were agreed at the world conferences of the 1990s, and commit the 191 member-states of the United Nations by 2015 to:

Goal 1: Eradicate extreme poverty and hunger by halving the proportion of people whose income is less than \$1 a day, and the proportion who suffer from hunger

Goal 2: Achieve universal primary education by ensuring that all children will be able to complete primary schooling

Goal 3: Promote gender equality and empower women by eliminating gender disparity in all levels of education

Goal 4: Reduce child mortality by reducing by two-thirds the under-five mortality rate

Goal 5: Improve maternal health by reducing by three-quarters the maternal mortality ratio

Goal 6: Halt and begin to reverse the spread of HIV/AIDS, malaria and other major diseases

Goal 7: Ensure environmental sustainability by

- Integrating the principles of sustainable development into country policies and programmes,
- Reversing the loss of environmental resources;
- Halving the proportion of people without sustainable access to safe drinking water and
- Significantly improving the lives of at least 100 million slum dwellers by 2020

Goal 8: Develop a global partnership to deliver these goals thru shared commitments on development assistance, international trade, good governance, debt, poverty reduction and addressing the special needs of the least developed countries, landlocked countries and small island developing states. Additional commitments are made on providing work for youth, and on cooperating with the private sector to make available essential medicines and new technologies

Source: <http://www.un.org/millenniumgoals/>

Fig 6: The *United Nations* Millennium Development Goals.
(Taken from Halle et al, 2004).

4.1 Reducing society's impact on the environment

“Careful and fair management of environmental resources is an important part of our peace policy for the future” Klaus Töpfer, Executive Director UNEP, (Taken from Hussels and Switzer, 2004. p.10).

The case of the depletion of the stratospheric ozone layer has had global unifying success and raises hopes of cooperation in dealing with environmental

problems. Even though ozone depletion is not seen to contribute to the threat of conflict, it has been dealt with in a successful way which can contribute to successful future resolutions of other issues of environmental change.

The stratospheric ozone layer is important as it filters out much of the solar radiation, especially UV-B. Over the past decades it has been depleted and gone through extremely thinning in certain areas, especially over Antarctica (and lately found over other areas such as Tibet), called ozone holes (Feng et al, 2003).

Ozone depleting Anthropogenic substances, CFC's, and similar substances (such as hydro chlorofluorocarbons and halons), generally used in aerosol cans, refrigerators and fire extinguishers, are released into the atmosphere, and interact with ozone molecules, modifying the composition of the ozone layer and weakening its filtering effect, thus raising the solar radiation reaching the earth's surface (UNEP, 2003).

This excessive solar radiation reaching the earth's surface has an effect on plants and animals generally though damaging DNA and especially raises the risk of skin cancer in humans (UNEP, 2003. Wheeler, 2000).

The Vienna Convention for the protection of the Ozone Layer in 1985 recognised the problem, its severity and causes, and paved the way for *The Montreal Protocol on Substances that Deplete the Ozone Layer in 1987* (UNEP, 2003. Morrisette, 1989). Even before these conventions (in the mid 1970's), international organizations such as UNEP and WMO (The World Meteorological Organization) in addition to the EEC and the United States government (which banned aerosol use in 1978), were concerned with the release of CFC's into the atmosphere and their effect on the ozone layer (Morrisette, 1989)

In 1977 the World Plan Action for the Ozone Layer, was the first step in scientific gathering of evidence concerning changes in the composition of the ozone layer and the human effects on it. After the Vienna Convention introduced evidence of the effects of human actions on the depleting ozone layer and the effects this has on human health, this common interest led to the common global understanding of the need to act (Morrisette, 1989).

With the rise in scientific evidence, governments were pressured by civil environmental groups and public awareness to reduce the use of CFC's and an international agreement provided incentives to comply with the phase out, while alternative substances were within economic and technological reach. This enabled a

change in the approach to ozone depleting substances on both an international and a national level (Morrisette, 1989).

The depletion of the stratospheric ozone layer and the way it has been dealt with show that **negotiations** and **cooperation** over an environmental problem, on a global level can be the key to solving it. The issue of the ozone layer is unique in the way that it has a global effect (unevenly distributed) regardless of the geographical sources of the problem. Further more, **scientific evidence** reduced **uncertainty** regarding the causes and effects raising public concern mainly over the rise in cases of skin cancer. The **economic cost** to dealing with this problem was not catastrophically high, and could be achieved, with the help of **international funding**, within an agreed timeframe (Morrisette, 1989).

In many cases, environmental change has more severe effects on developing countries, and industrialised countries, which are not yet directly affected, are slow to react. In the case of the ozone layer, industrialized countries are directly affected, giving them incentive to act and make economic changes in order to prevent the growing effects. Thee lack of decisive scientific evidence and the uncertainty of the causes and/or the effects or the problem, delay national and international discussions and action.

Research, Knowledge and Technical Innovation

There is a need for a full understanding of the connections between human activity, environmental change, social disruption and conflict (Homer-Dixon, 1991). Understanding environmental change is becoming clearer with the accumulation of scientific research pointing to the causes and effects (Morrisette, 1989).

Uncertainty of the impact of society on the environment and the effect of environmental change on society has been an important cause of lack of action in regard to addressing environmental change. This lack of scientific evidence and consensus as to the causes of climate change led to uncertainty as seen clearly in *The World Summit on Sustainable Development in Rio de Janeiro 1992*, and challenged consensus as to ways of dealing with the problem. The growing mountain of evidence backing the effects and their causes in this case, over the years has contributed to signing of international agreements and taking action in addressing the problems (Dunn and Flavin, 2002).

Research, knowledge and analysis are important in order to raise certainty and to reach results, international connections and cooperation between different research teams. This should include different fields of study such as natural science, economy, social and political studies (Wolf, 2002). The sharing of information is extremely important in attempt to adapt through technological innovations and reduce social vulnerability. Knowledge can contribute to education and social awareness, which is important in making social changes (ICCP, 2001. Wagner, 2004).

Early Intervention and Disaster reduction

“Targeted investment in environmental conservation could reduce the need for reactive and costly international peace-keeping and disaster relief interventions, and thus promote more equitable and sustainable development” (Switzer, 2002)

Environmental problems and conflict by international organizations are dealt with all too often, as a reaction to events which have happened, after much damage has been caused to standards of living, economies and loss of human life. This can be attributed to uncertainty due to lack of scientific evidence. Early intervention, when potential future disasters or conflict are detected, and conflict prevention can reduce the toll on society and results in much less investment, economically, socially and in human lives, than conflict resolution (ADPC, 2004. Wolf, 2002).

Identifying future environmental risks can help prevent conflict in the future. Environmental conditions such as topography or changes such as deforestation can help determine future risks such as floods and land slides, even though the connection is still unclear in many studies (ADPC, 2004). A more proactive approach, focussing on prevention, and continuous, not isolated actions when disaster strikes is crucial. Identifying environmental conditions which could lead to conflict are not enough and there is a need to identify social conditions such as institutional capacities to deal with change, management, treaties and international relations (ADPC, 2004. Wolf, 2002). Early warnings of coming disasters like the effects of El Nino, being drought, fires, floods and storms, can help reduce the damage, by community based systems (ISDR, 2003).

As there is an understanding of human responsibility for some natural disasters, efforts can be made in order to reduce damaging behaviour. This includes management of agriculture, water use and diversion, dams and land use (which could

contribute to drought) (ADPC, 2004), planning human settlements and economic activity centres in safe areas not subjected to disasters. Awareness of potential hazards and vulnerability is important, in addition to land planning (such as sustainable land use and river and coastal area management) and resource management planning and restoration of the original landscape such as native vegetation and reforestation are essential in order to try and prevent and minimize future disasters (ISDR, 2003).

Abramovitz suggests that human engineered structures such as dams which give a false sense of security are not the solution, instead the focus should be on taking advantage of natural structures such as dunes and forests in order to absorb shocks, and wetlands in order to absorb floodwater. Planning better human made structures, especially in proven and potential disaster areas can reduce vulnerability (Abramovitz, 2001).

4.2 Reducing Society's vulnerability to Environmental Change

Social adaptation to environmental change through institutional change, emphasising the importance of knowledge and scientific research, securing and diversifying resources such as food, water and income, innovative technologies, awareness, education, changing of social norms and addressing social resource scarcities can help reduce social vulnerability (FAO, 2000).

The World Development Report 2000/2001 - Attacking Poverty, refers to economic growth as an important factor in alleviating poverty and generally raising standards of living, education and reducing population growth, which reduce social vulnerability.

Addressing issues of equality and integrating the poor into society are important, in order to make growth work for all sections of society and reduce social vulnerability. In cases where inequality is not addressed, economic growth can have a negative effect on society by increasing inequality, leaving the poor behind and hindering economic growth (World Bank, 2000/2001).

Important issues in healthy growth are in changing of social forces, reducing inequality through redistribution of income and the labour market and addressing gender issues, education, laws of property ownership and land use in order to incorporate the poor into benefiting from change. This will reduce social vulnerability

through addressing poverty, reducing inequality, gender issues, unemployment, and population growth (World Bank, 2000/2001). Addressing these issues is essential in reducing the risk of conflict and raising the ability to deal with environmental causes.

Sustainable development is a central issue as there is a large body of research pointing to the poor and unprivileged as suffering the most from the impacts of environmental change (Wagner, 2004). Sustainable development promotes security in the way of preventing violent conflict (Halle et al, 2004).

“Conservation and “smart” natural resource use are necessary ingredients in lasting peace, poverty alleviation and long-term development planning. And peace is a necessary ingredient in long-term environmental protection” (Switzer, 2002)

The 2000/2001 World Development Report, *Attacking Poverty*, targets the alleviation of material poverty as reducing social vulnerability and enable them to deal with shocks which include environmental change. Promoting growth helps reduce vulnerability and integrating the poor into participating in markets and reducing inequalities, with the help of strong institutions (The World Bank, 2000/2001).

Population growth can be addressed through awareness, family planning and health services (which also deal with the AIDS pandemic) and gender issues such as women’s education equality and rights. There is a need to address social and cultural relations and traditions through the changing of government policies and international aid (Engelman et al, 2002).

Vulnerability to external conditions is related to lack of accessibility to resources; this can be caused by resource scarcity and/or by social factors such as unequal distribution. Lack of access to resources has a most severe effect the poor and marginal groups by having a limiting effect on their already limited livelihood, health, education and food and water supplies. Vulnerability also depends upon society’s institutional ability to adapt to changes (ISDR, 2003).

Institutions and International Relations

Institutional ability to adapt is at the root of social vulnerability; weak institutions and mismanagement have been found to contribute to environmental change through pollution and misuse affecting productivity, access to resources, population displacement and loss of livelihood (Gleditsch, 2004. Homer-Dixon, 1991).

Globalization, privatisation and many issues related to environmental change, social vulnerability and conflict defy state boundaries: trade, resource scarcity. Thus there is a shift from dealing with these issues on a state level, to a local level with the assistance of international institutions (Renner, 1999). This refers not only to governments, but also to international economic institutions such as the Asian Development Bank and the World Bank and international organisations and NGO's (ISDR, 2003. Wagner, 2004).

As the role of governments is seen by some to be less influential, the roll of NGO's is becoming more and more crucial in international negotiations and the prevention of violent conflict (Renner, 1999). As the focus moves from a national to a local level, there is need to focus also on religious, ethnic and other minority groups and encourage their in decision-making, while taking cultural, religious and heritage issues into consideration. In addition, economic investment from international sources and economic openness help reduce social vulnerability through development programmes and promotion of renewable energy (Shin, 2004. Wolf, 2002). Social policy such as education and public awareness are a form of adaptation. Knowledge is essential in order for governments and local authorities to make the choices which will reduce their vulnerability and losses (ICCP, 2001)

The private sector can contribute to diffusing environmentally related conflict as international corporations reach beyond traditional national boundaries. This can be achieved through contributing to sustainable development and investments, if they obey guidelines which international organizations (such as the UN and WTO) obey in order to ovoid exploitation or resources and people, investing in social aspects, renewable energy and efficient technology (Clémentçon, 2004. Hussels and Switzer, 2004. Wolf, 2002).

Environmental management can play a crucial role in reducing vulnerability. This can be direct management such as reforestation or indirect through changing human behaviour, as individuals and communities, through the sustainable use of resources (*ADPC, 2004*).

Diversification of national income, agricultural crops and food resources self-sufficiency through implementation of policies can reduce the vulnerability to change and disasters and raise the ability to adapt (Adger, 1999. FAO, 2000. Collier, 2000.).

International negotiations and treaties are important in order to diffuse potential future conflicts through cooperation within and among societies and

providing solutions other than violent conflict (Baechler, 1998, Matthews, 2004, Wolf, 2002). Negotiating needs, in term of common environmental resources has been found much more effective that negotiating rights (Wolf, 2002).

Conclusions

This paper has shown that even though environmental change contributes to the risk of conflict, it is not a sole driving force. Resource conflicts are seen here as vulnerability conflicts. Thus, addressing environmental issues is essential but not sufficient. In order to reduce the risk of conflict there is a need to reduce social vulnerability. There is a need for a system approach which reflects the need for change in many different aspects contributing to social vulnerability in attempt to reduce it and the risk of conflict.

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