Youth Science-Policy Interface Publication - 2nd Special Edition

Disaster Risk Reduction

Moving Forward,

Thinking Ahead

UN Major Group for Children and Youth

the space for children and youth in the United Nations

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Disclaimer

The United Nations Major Group for Children & Youth (UN MGCY) is the formal, General Assembly mandated space for the meaningful participation of children and youth in intergovernmental and allied sustainable development processes at the UN. It is meant to facilitate the participation of youth in policy design, implementation, follow-up and review.

*Important note: All content in the publication is solely the responsibility of the author and does not necessarily represent the official views of the UN Major Group for Children and Youth. Furthermore, all articles presented here are open source and welcome for all to access.

Foreword

It is with great pleasure that we introduce you this second special edition from the Youth Science-Policy Interface (SPI) Publication: "Disaster Risk Reduction: Moving Forward, Thinking Ahead". This initiative is part of the United Nations Major Group for Children and Youth (UN MGCY) Youth Science-Policy Interface Platform and coordinated by the UN MGCY, the official UN General Assembly mandated space for the engagement of children and youth. The UN MGCY has now more than 6000 registered youth entities in over 170 countries and territories.

This special edition showcases once again the active involvement and the role of young people in sharing knowledge of evidence-informed best practices, science and technology, emerging trends, challenges, and solutions in the implementation, monitoring, follow-up, and review the Sendai Framework for Disaster Risk Reduction (SFDRR) (2015-2030) and the DRR-dimensions of other intergovernmentally agreed sustainable development agendas (e.g., 2030 Agenda, New Urban Agenda, etc.). Launched in August 2019, it is meant to feed into the discussions for upcoming high level platforms and meetings, such as the 74th session of the UN General Assembly (UNGA 74), and specifically around the SPI mandate.

The Science-Policy Interface has become an increasingly important component of sustainable development within the United Nations system. The SPI is often utilized as an integral tool for identifying emerging priorities, drawing links between the interconnected nature of thematic issues, and devising solutions to address challenges and barriers to progress. The Next Generation of Work, Rio+20 outcome document, The Future We Want, solidified the role of the SPI and sought to operationalize its place within all sustainable development processes.

This second Disaster Risk Reduction Edition takes the form of a series of youth-led, peer-reviewed articles highlighting important topics and trends, stemming from both the social and the natural sciences. It showcases the contributions of young scientists, engineers, practitioners, and students in strengthening the science-policy interface, further linking policy and practice for a sustainable society. As such, the main objectives of the publication are to:

- Share knowledge generated by multi-sector young and early career scientists, engineers, practitioners, and policy makers relevant to the science-policy-practice nexus for promoting resilience and disaster risk reduction at all levels;

- Contribute formally to the ongoing cycle of Policy Design, Implementation, Monitoring, Follow-up, & Review, through evidence-informed analysis, especially regarding cross-cutting issues within DRR (e.g. infrastructure, health services, etc.);

- Highlight inter-linkages between different thematic issues and identifying emerging challenges/opportunities through case studies;

- Exchange best practices in evidence-informed and data-informed sustainable development;

- Promote cross-disciplinary and collaborative research, as well as qualitative and quantitative analysis;

- Collect submissions from young people on DRR issues, bringing to light emerging trends, implementation challenges, and best practices of follow-up & review for different sustainable development agendas in disaster contexts.

We believe that this collection of articles will help constructing the foundation for empirically-derived policies, facilitating the use of science as an enabler in policy implementation and review, and applying a unique and integral scientific lens to the monitoring of impact. The UN MGCY Youth SPI Platform on Sustainable Development strengthens youth policy priorities and practices in sustainable development by equipping youth with tools to drive empirically-informed, context-specific, and purposeful change through science, technology, innovation, and data.

This reflects only one of the initiatives meant to provide an outlet for young people to contribute to strengthening the science-policy-practice nexus. It is also an example of the work done within the UN MGCY Young Scientist Platform on DRR, as well as a core element of the Young Scientist Roadmap, each of which serve to contribute to fulfilling the objectives of the recently reviewed UNDRR S&T Roadmap and Partnership, promoting more fit-for-purpose and effective implementation, follow-up, and review of the SFDRR.

We would deeply thank the authors, reviewers, editors, and other contributors that helped with the preparations of the articles and publication itself. We believe that such initiatives help create more innovative spaces for Major Groups and other stakeholders to contribute to sustainable development processes. This is the product of collaborative efforts within the Youth Science-Policy Interface Platform of the UN MGCY, with the overarching objective to enhance the media through which young people are able to strengthen the science-policy interface. As young scientists, engineers, and innovators, we are at the forefront of the implementation, follow-up, and review of recently adopted sustainable development frameworks and are eager to contribute. For any questions regarding the publication, please contact drrspi@unmgcy.org.

United Nations Major Group for Children & Youth

Youth Science-Policy Interface Platform

Combating Air Pollution in Nigeria: Environmental Policy Content

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Abstract

Healthy ecosystems leads to lower vulnerability and increased resilience of communities to natural disasters. The significance of air pollution cannot be underestimated in the physical environment. It causes damage to the earth's biodiversity systems, crops, and human beings. Air pollution must be minimized, as it threatens public health. This article critically examines the effects and consequences of air pollution in Nigeria using existing literature. It also presents a critical review of the past and current policy options put in place to combat air pollution in Nigeria. The paper concludes by stating alternative measures to further reduce disaster risk by improving the air quality in the Nigerian society in order to promote sustainable development.

Introduction

According to the UN Environment, the environment is one of the key solutions to preventing disaster risks.[1] Healthy ecosystems leads to lower vulnerability and increased resilience of communities to natural disasters. In 1979, Catton and Dunlap explained the relationship between the ecosystem and modern, industrialized societies using the new ecological paradigm.[2] The new ecological paradigm explains that the wellbeing of modern societies, even with the well-developed forms of social organizations and technology, is linked to the health of the ecosystem. This implies that the condition of the ecosystem is vital for man's existence. Air is a major component of the ecosystem. Hence, there is a need to combat air pollution.

The United Nations Economic Commission for Europe Convention on Long-range Trans

[1]Ecosystem-Based Disaster Risk Reduction | UN Environment. https://www.unenvironment.org/regions/latin-america-and-caribbean/regional-initiatives/building-resilience-disasters-and-0 Accessed 20 Apr. 2019.

[2]Dunlap, Riley. Paradigms, Theories, and Environmental Sociology. In book: Sociological Theory and the Environment, Edition: IST, 2002. Publisher: Rowman Littlefield, Editors: Riley E. Dunlap, Frederick H. Buttel, Peter Dickens, August Gijswijt, pp.329-350.

boundary Air Pollution revealed that since the year 2000, over 40 million lives have been lost globally as a result of air pollution.[3] In Nigeria, like many other developing nations, urbanization is responsible for the release of toxic gases into the atmosphere. This is due to increased industrialized activities within the region. The significance of air pollution cannot be underestimated in our society. One of the major air pollutants linked to urbanization, ozone, is responsible for global warming, a major challenge currently confronting the world. Air pollutants leads to reduced vegetable growth and deforestation which may lead to hunger and famine in some extreme cases. In view of this, air pollution must be minimized as it impedes the sustainable development of every society. Therefore, there is a great need for governments to formulate air pollution policy measures that will achieve this. This article critically examines the literature of the past and current policy options put in place to combat air pollution in Nigeria. It also offers alternative measures to further reduce disaster risks by improving air quality in the Nigerian society.

According to Crowley, global climatic change is attributed largely to manmade activities.[4] The industrialization and urbanization in developed and developing countries like Nigeria have given rise to the global change in the atmospheric environment. This atmospheric environment reacts negatively to global warming, ozone layer depletion, and local air pollution. For example, high carbon in the atmosphere leads to an increase in atmospheric temperature which in turn results to increase in sea level and excess precipitation (flooding) in vulnerable areas.

In Nigeria, sources of air pollution includes the use of gasoline generator due to the erratic power supply, industrial emissions and gas flaring. Worthy of note are Tawari findings that Nigeria flares 19.79% of the total amount of natural gas flaring in the world, per ton oil produced.[5] This makes it the country with the highest amount of gas flaring. When natural gas is flared, air pollutants are released into the atmosphere, with negative consequences. Vehicle emissions are also a major source of air pollution in Nigeria. The high population density of Nigerian cities causes heavy traffic jams on roads which makes vehicles emit greenhouse gases (GHGs) at an increased rate. Akanni argued that over 50% of the transport sector contribution to GHG emission in Nigeria comes from Lagos alone.[6] This is due to a poor transport network, which leads to vehicles emitting greater amounts of carbon into the atmosphere. Therefore, there is a great need for the government to look into air pollution issues and address them critically.

[3]United Nations Economic Commission for Europe Convention. Working Group on Long-range Trans boundary Air Pollution Report. 2013

[4]Crowley, T.J. Causes of climate change over the past 1000 years. Science, 289: 2000: pp. 270-277. DOI: 10.1126.

[5]Tawari, C. C., & Abowei, J. F. Air Pollution in the Niger Delta Area of Nigeria. International Journal of Fisheries and Aquatic Sciences 1(2): 2012.pp. 94-117. ISSN: 2049-8411 E ISSN: 2049-842X24.

[6]Akanni, C.O. Spatial and seasonal analysis of traffic-related pollutant concentrations in Lagos Metropolis, Nigeria. African J. Agric. Res., 5:2010. pp. 1264-1272. DOI: 10.5897/AJAR09.253

Discussion

National Policy on Environment Review (1989-2007)

Until some two decades ago, Nigeria had not been paying much attention to environmental pollution.[7] The Koko waste dump saga (the dumping of toxic waste by Italians in a small Nigerian community), which happened in 1988, motivated the federal government to formulate an institutional framework for the environment. The Federal Environment Protection Agency (hereafter referred to as "FEPA") formed in 1988 is responsible for the formulation and implementation of environmental policies. This agency also encouraged each state in the country to establish State Environmental Protection Agency. The Agency formulated a *National Policy on Environment* in 1989 which addresses several environmental issues in order to achieve sustainable development. The policy is based on the precautionary principle, pollution preventive measures, polluters and users pay measures, local communities' inclusion, equity and environmental sustainability principles.[8]

However, the polluter pays principle is being ignored in environmental issues. Domestic and foreign industries often do not pay for negative externalities done as a result of pollution. The policies are loosely structured in terms of fines and penalties. Penalties for companies who violate the rules is far lower than the personal benefits gained from the environmental exploitation. Therefore, they prefer to pay these penalties. This was the case in the Niger Delta region. Despite the Government's stance to prohibit gas flaring, the companies continued gas flaring and paid penalty. This is more economically viable to them as the benefits exceed the cost.[9] Another example is Kano state. There is a large concentration of tanneries, the State Ministry of Environment allows the tanneries to pollute once they pay the polluter fee.[10]

Also, the policies identified the FEPA and Federal Ministry of Environment as the major stakeholders in the implementation of the policy. This is a major misconception because environmental protection is a joint effort between the citizens, agencies and government. It is everyone's responsibility to take care of the environment. The government did not include the citizens as a major stakeholder so it affected the implementation of these policies at the grassroots level. Similarly, Ubleble posited that the policies have been frustrated due to the non-inclusion of social, cultural diversity of the Nigerian society, hence the implementation gap.[11]

[7]AB Mustapha and Naibbi A. Environmental Regulations in Nigeria: A Mini Review. International Journal of Environmental Sciences & Natural Resources, 1(5). 2017. https://doi.org/10.19080/IJESNR.2017.01.555573

[8]Federal Environmental Protection Agency (FEPA). National Policy on Environment. A Publication of the Federal Environmental Protection Agency.1998.

[9]Hay BJ, Astor PH, Kaauf, S Seff M, master J. The Nigerian Environment. National Open University of Nigeria, Africa. 1996.

[10]Aliyu Baba Nabegu. Environmental Audit Report of Fine Leather Processing Co Ltd, Kano, Nigeria, Africa. 2016.

[11]Ubleble Benjamin Akamabe & Gbenemene Kpae. A Critique on Nigeria National Policy on Environment: Reasons for Policy Review. IIARD International Journal of Geography and

A major challenge is that the environmental management under the 1999 constitution shows that the three levels of government, the local, state and federal can legislate on pollution in their domain. Nerry observed that due to the unclear and ambiguity, roles are not defined as regards who to regulate and manage the environmental pollution.[12] So, it becomes a tragedy of the commons.

NESREA ACT 2007 Review (2007-present)

Due to the implementation gap of the FEPA National Policy on Environment, National Environmental Standards and Regulations Enforcement Agency (hereafter referred to as "NESREA") was birthed. NESREA have "responsibility for the protection and development of the environment, biodiversity conservation and sustainable development of Nigeria's natural resources in general and environmental technology, including coordination and liaison with relevant stakeholders within and outside Nigeria on matters of enforcement of environmental standards, regulations, rules, laws, policies and guidelines" (NESREA ACT 2007).[13]

The NESREA is similar to a review of the national policy on environment under another institutional framework. The NESREA ACT corrected some of the flaws of the FEPA National Policy on Environment. They have incorporated the citizens as stakeholders through the Green Corps initiative. This is a system whereby the citizens volunteer to work with the agency on environmental compliance and monitoring issues. This volunteering programme has increased the grassroots involvement in protecting the environment. Also, there is public participation and increased awareness campaigns on the part of the agency. Agbazue (pp. 32-37) further revealed that the NESREA ACT has included other federal agencies like the Federal Ministry of Health, National Orientation Agency, United Nations Development Programme and other relevant stakeholders to work together more on solving pollution issues.[14]

So far, the NESREA Act has recorded success in recent years. The agency formulated regulations on the control of vehicular emissions from petrol and diesel engines in 2011. This included the ban of two stroke engines and enforcing permissible limits for vehicular emission. The recent breakthrough in the regulation was the inauguration of the *National Vehicular Emission Control Program.* The program was designed to "use automotive gas analyzers and opacimetro to analyze emissions and opacity levels in vehicles."[15]

Environmental Management ISSN 2504-8821 Vol. 3 No.3 2017.

[12]Nerry E, Akpofure E. Environmental impact assessment in Nigeria: regulatory background and procedural framework. UNEP EIA Training Resource Manual Case studies from developing countries, Nigeria, Africa. 1998.

[13]NESREA. A Synopsis of Law and Regulation on the Environment in Nigeria. A Publication of the National Environmental Standards and Regulations Enforcement Agency. 2007.

[14]Agbazue, V.E; Anih, E.K. and Ngang, B.U. The Role of Nesrea Act 2007 in Ensuring Environmental Awareness and Compliance in Nigeria. IOSR Journal of Applied Chemistry (IOSR-JAC) e-ISSN: 2278-5736.Volume 10, Issue 9 Ver. III (September. 2017), PP 32-37

[15]Raji A.A. Green Transportation: Controlling Obnoxious Emissions. A Publication of the National

There are different test centers in the 36 states of the country. The vehicles go through tests and obtain an emission certificate which will be demanded by law enforcement agents.

Furthermore, a recent review of the Act which happened on the 3rd of December 2018 shows that some challenges affecting the implementation of the policy have been addressed.[16] The legislative inadequacies which lead to weak enforcement measures of the regulations have been looked into. The Federal Ministry of Health has been included as a major stakeholder in the policy implementation. All these will further enhance the operations of the agency as an environmental watchdog.

Recommendations to improve air quality in Nigeria

- ❖ Green transportation is the alternative system of transport which is eco-friendly (i.e. it poses minimal threat to the environment).[17] It does not emit toxic gases and maintains air quality. Some of these options include:
  - Electric Vehicles: This type of vehicle is powered by an electric motor instead of an internal combustion engine. They are zero emission vehicles and very quiet in operation. This is a plus for solving noise pollution. Due to zero emission, they are more efficient than gasoline cars. Countries like the United Kingdom, United States and France have started embracing the use of electric vehicles.
  - Biofuel Transport System: This is the use of corn and palm oil as fuel sources in vehicles. It burns cleaner than gasoline cars. A major criticism of this option is that it threatens food security.

- ❖ Vehicle inspection is necessary in order to allow cars in optimum condition to ply the road. Old cars gives off more fumes thereby increasing air pollution.[18] Carbon filters should be introduced into cars as this will reduce the carbon in the atmosphere. This is a policy option currently being reviewed in Germany.

- ❖ Government should diversify energy sources in order to make electricity available to the people. This will reduce the use of gasoline generators in households and increasing the air quality. Renewable energy sources such as wind and solar power should be harnessed to make power supply constant.

- ❖ Government should increase fines paid by industries who pollute the environment. The high cost of polluting the environment will enable them

Environmental Standards and Regulations Enforcement Agency. 2017.

[16]National Environmental Standards and Regulations Enforcement Agency. Rationale behind the Amendment of the NESREA Act 2007. Retrieved from http://www.nesrea.gov.ng/rationale-behind-the-amendment-of-the-nesrea-act-2007/ Date of access: 6th April 2019.

[17]Raji A.A. Green Transportation: Controlling Obnoxious Emissions. A Publication of the National Environmental Standards and Regulations Enforcement Agency. 2017.

[18]Okoro, I. O. Smoke from vehicles destroys air quality in Lagos, Nigeria. 2012 Retrieved from http://www.ecojournalism.org/en/march2012/articles/120/ Date of access: 6th April 2019.

comply with the environmental regulations.

- Continuous enlightenment of the citizens on the risks attached to air pollution. This includes awareness campaigns, discussion forums and town hall meetings. These will help them desist from activities that cause it.

- Effective waste management procedures like recycling instead of burning will reduce air pollution.

Conclusion

The 2011 Disaster Risk Management for Health Fact Sheet explained that air pollution is one of the major effects of climate risk on public health.[19] Since the inception of the Clean Air Act in the United States, 160,000 premature deaths, 130,000 heart attacks, 86,000 hospital admissions and millions of respiratory cases like asthma and acute bronchitis have been avoided.[20] When air pollution is controlled and air quality is improved, lives will be saved. Also, public health is improved thereby promoting sustainable development for the Nigerian society.

[19]The World Health Organization. Disaster Risk Management for Health Fact Sheet. May 2011.p.1 Retrieved from https://www.who.int/hac/events/drm_fact_climate_risk_management.pdf Date of access: 20th April 2019.

[20]United Nations Prospect of World Urbanization. Population Study No. 112. New York. 1989

Localized Disaster Management and Community Development in Western Africa: Challenges and Opportunities in Nigeria

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Abstract

Nigeria is the 6th largest crude oil exporter in the world; nevertheless, the socioeconomic status of the country is surprisingly low considering the wealth of its natural resources. Like most countries in Western Africa, Nigeria is highly vulnerable to water-based disasters (WDs), since only limited disaster resilience mechanisms have been successfully established nationwide. In addition, human-induced disasters along with a range of other factors undermine socioeconomic conditions and limit opportunities for development. Despite limited central government support to address such hazards, a lot can be achieved at the local level, particularly in the form of community-led development plans and integrated disaster risk adaptation. Low-cost, long-term solutions, such as do-it-yourself (DIY) and easy-to-deploy-and-operate (EDO) energy and hazard mitigation systems, adjusted to community needs and capacity could be highly efficient, and align with the strategic principles of both the 2030 Agenda for Sustainable Development and Sendai Framework for Disaster Risk Reduction. While it is currently impossible to deploy a nationwide disaster resilience system in Nigeria, learning to adapt to WDs at the local level could improve the quality of life and increase survival rates during extreme weather events. This study highlights the major elements of our integrated research project entitled "Hydropower for Disaster

Resilience Applications (HYDRA)" at Western Sydney University, Australia with the support of Humanitarian and Development Research Initiative (HADRI) and UNESCO Chair on Conservation and Ecotourism of Riparian and Deltaic Ecosystems (Con-E-Ect), International Hellenic University, Greece.

Keywords: do-it-yourself (DIY), easy-to-deploy-and-operate (EDO), water-based disaster, community resilience, disaster response capacity

Introduction

When crude oil production in the Niger Delta commenced in the late 1950s, optimism was high for the economic growth of Nigeria. Yet, several decades later, the country has not realized these aspirations. Most regions still lack modern communication and transportation systems, clean water, health services and basic disaster response infrastructure.[1] Water-based disasters (WDs) in particular, such as torrential rainfalls and fluvial floods, continue to have calamitous effects on the population with insufficient or largely ineffective plans in place to mitigate these hazards.[2,3] In July 2012 for instance, extensive floods caused 363 deaths, displaced 2.1 million people and affected over 7.5 million people.[4] It is estimated that the 2012 floods caused almost 17 billion US$ in damages and reduced national gross domestic product (GDP) by 1.4%.[5,6]

Besides the frequent natural hazards experienced in Nigeria, human-induced disasters that are highly connected with socio-political corruption, ethnic and tribal tensions, child and woman abuse, and infectious diseases and viruses, such as malaria and AIDS/HIV continue to undermine social cohesion and limit economic growth.[7] Rural populations in Nigeria, especially those in the Niger Delta, a hub for crude oil production, receive limited benefits from the substantial value that oil export generates.[8] The Niger Delta is one of the largest wetlands on earth and home to more than 40 different minority ethnic groups (within 3000 local communities and over 250 different languages and dialects). Perversely, it is a non-developed region with high youth unemployment and poverty rates. Most of

[1]Ahunwan, B. (2002). Corporate governance in Nigeria. *Journal of Business Ethics*, 37(3), 269-287.

[2]Akpodiogaga-a, P., and Odjugo, O. (2010). General overview of climate change impacts in Nigeria. *Journal of Human Ecology*, 29(1), 47-55.

[3]Akpodiogaga-a, P., and Odjugo, O. (2009). Quantifying the cost of climate change impact in Nigeria: Emphasis on wind and rainstorms. *Journal of Human Ecology*, 28(2), 93-101.

[4]Odemerho, F. O. (2015). Building climate change resilience through bottom-up adaptation to flood risk in Warri, Nigeria. *Environment and Urbanization*, 27(1), 139-160.

[5]Nkwunonwo, U., Malcolm, W., and Brian, B. (2015). Flooding and flood risk reduction in Nigeria: Cardinal gaps. *Journal of Geography & Natural Disasters*, 5, 136.

[6]Rahman, S. (2014). Assessing Post-Disaster Needs in Nigeria. Retrieved from http://www.worldbank.org/en/results/2014/07/22/assessing-post-disaster-needs-nigeria

[7]Omeje, K. (2006). The rentier state: Oil-related legislation and conflict in the Niger Delta, Nigeria: Analysis. *Conflict, Security & Development*, 6(2), 211-230.

[8]Poverty and Crime Flourish in Oil-Rich Niger Delta. (2007). Retrieved from https://www.pbs.org/newshour/politics/africa-july-dec07-delta_0727

the residents have no access to basic amenities and other necessities, such as safe drinking water, sustainable energy, hospitals, and proper housing.[9,10] In addition, the region suffers from major environmental pollution, as a result of more than 7000 recorded oil spills over the last 50 years.[11] This, and a range of other hazards, has caused untolled damage to local biodiversity and populations.

Solutions led by 'Do-It-Yourself' Renewables

This article highlights the importance in our current study, 'Hydropower for Disaster Resilience Applications' (HYDRA), which investigates low-cost, long-term techniques, such as do-it-yourself (DIY) and easy-to-deploy-and-operate (EDO) renewable energy and hazard mitigation systems to support sustainable development at community level. We also investigate portability and adaptation as critical factors for maintaining a balance between community needs and capacity, aiming to achieve community self-sufficiency. The DIY and EDO techniques do not require high educational level or specialized skills and can be adjusted to the "traditional ways" of different ethnic minorities. People of different age groups and cultural backgrounds can learn how to use them based on their own capacity and pace. This approach can be highly effective for low-income communities that reside in flood-prone areas and have poor disaster response mechanisms. What is more, both DIY and EDO techniques follow the strategic principles of 2030 Agenda for Sustainable Development[12] and Sendai Framework for Disaster Risk Reduction,[13] that is, they can be used for combined actions against common problems and potentially improve quality of life for end-users.

Methods and Discussion

Over recent years, science and technology have become the link between disaster response theory and realistic action plans for dealing with WDs.[14] However, this does not always apply at the local level, especially in the rural areas in Africa. Imported knowledge and modern technological instruments cannot guarantee success if key factors are ignored. Firstly, the active and long-term participation of each stakeholder, particularly local community

[9]Cragg, W., Idemudia, U., & Best, B. (2016). Confronting corruption using integrity pacts: the case of Nigeria. *Crime and Corruption in Organizations*, 297-322.

[10]Elum, Z. A., Mopipi, K., & Henri-Ukoha, A. (2016). Oil exploitation and its socioeconomic effects on the Niger Delta region of Nigeria. *Environmental Science and Pollution Research*, 23(13), 12880-12889.

[11]United Nations Development Programme. (2006). *Niger Delta Human Development Report*, 184.

[12]Nam, U. V. (2015). Transforming our world: The 2030 agenda for sustainable development. *Division for Sustainable Development Goals: New York*, NY, USA.

[13]Aitsi-Selmi, A., Egawa, S., Sasaki, H., Wannous, C., and Murray, V. (2015). The Sendai framework for disaster risk reduction: Renewing the global commitment to people's resilience, health, and well-being. *International Journal of Disaster Risk Science*, 6(2), 164-176.

[14]Aitsi-Selmi, A., Murray, V., Wannous, C., Dickinson, C., Johnston, D., Kawasaki, A., Stevance A.S., and Yeung, T. (2016). Reflections on a science and technology agenda for 21st century disaster risk reduction. *International Journal of Disaster Risk Science*, 7(1), 1-29.

representatives, is crucial for sustainable disaster resilience. Secondly, the early-warning systems (EWS) need to be adjusted to local atmospheric and hydrogeomorphological conditions. Thirdly, disaster response plans need to be integrated into strategies that support socioeconomic development goals of their end-users. These could include strategies, such as improvements in off-grid energy capacity, agriculture, education, healthcare, and ecotourism. Lastly, the collaboration between professionals and end-users should be productive.[15]

Despite the technological innovations and improvements in WD management, there are communities that still do not receive maximum benefits.[16] The main reason for this is, perhaps, the deficient assimilation of disaster resilience planning and resources at the local level. A possible solution to this challenge could be the use of DIY and EDO techniques.[17] The DIY and EDO techniques in disaster resilience can be defined as the activities of building, dismantling, rebuilding, deploying and operating systems that can support localized disaster response by end-users rather than professionals. These systems tend to be more useful as they can deal with combined community challenges, such as energy insufficiency and water purification. If they are made with low cost-materials that are locally produced or easily found and serve 'every day' needs, they are more likely to be sustainable, well-maintained and hazard-ready.

The remote communities in the Niger Delta that often face energy insufficiency and suffer from WDs could benefit from such systems. Portable hydropower generators, for instance, that deliver energy under both normal and extreme conditions could power local EWS, nearby shelters and evacuation routes. This capacity could increase the response readiness of local populations and alert them when WDs are imminent. Importantly, local populations would become familiar with these systems, adjusting them based on their needs or atmospheric phenomena. Even though the generated energy would not satisfy all the energy needs of every community group, it could result in economic, environmental and psychosocial benefits to more remote communities who frequently experience energy inequality.

Conclusion

Like many countries, Nigeria is susceptible to WDs and has regional populations particularly vulnerable to their impact. The lack of effective flood mitigation systems and resilience mechanisms causes problems for local communities and limits socioeconomic growth. In order to maximize community capacity and satisfy community needs, it is essential to enhance the

[15]Schismenos, S. (2017). Anthropocentric principles for effective early warning systems. In United Nations Major Group of Children and Youth, Youth Science Policy Interface Publication (Ed.), *Special Edition: Disaster Risk Reduction: A Road of Opportunities*, 08-12.

[16]Van Aalst, M. K., Cannon, T., and Burton, I. (2008). Community level adaptation to climate change: the potential role of participatory community risk assessment. *Global environmental change*, 18(1), 165-179.

[17]Preston J. (2012). What is disaster education?. In Preston J. (Eds), *Disaster Education*. SensePublishers, Rotterdam

capabilities of local populations, as well as supporting access to required resources at the local level. Education and training via DIY and EDO techniques could improve not only the current WD response at the local level, but also the living conditions of the most vulnerable groups that reside in remote riparian and deltaic areas.

Through its HYDRA research project, HADRI and UNESCO Chair Con-E-Ect investigate low-cost, long-term models providing localized hydropower to support remote community socio-economic growth and environmental sustainability. HYDRA focuses particularly on the development of portable, DIY and EDO micro-hydropower generators that are equipped with flood warning systems designed to operate at the local level. Such systems may particularly benefit remote communities with limited energy resources and insufficient flood resilience mechanisms.

Other priority research areas of HADRI focus on international migration, global health, water and sanitation, humanitarian preparedness and response, human rights, development and security. UNESCO Chair Con-E-Ect prioritizes the themes of environmental sustainability, cultural heritage and education of vulnerable populations, and ecotourism.

For more information, please visit: https://www.westernsydney.edu.au/ssap/ssap/research/humanitarian_and_development_research_initiative (HADRI) and http://unescochair.teiemt.gr/ (UNESCO Chair Con-E-Ect).

Role of Urban youth associations in combating climate change: Case studies from Nairobi, Kenya

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Abstract

This paper explores the role of urban youth associations in combating climate change in Nairobi, Kenya. This is an outlook of urban areas in Kenya that sought to improve the environment in cities. The study uses primary data obtained from interviews and field observations supported by secondary literature. The discussions led to innovative ideas by youth to produce carry bags from readily available material, cleaning-up of rivers leading to sound health in cities, youth afforestation drives to prevent flooding and other environmental and degradation issues. In the future, capacity building of the youth association will enhance environmental protection.

Introduction

In the world today, case studies in nearly 40 countries from Kenya to Canada and Indonesia to Brazil have joined the "CleanSeas Campaign," which aims to counter the deluge of plastic trash that are degrading oceans.[1] South Africa, Chile, Oman and Sri Lanka also want to follow Kenya's footsteps. This is a bold step for countries which are aiming to change the outlook of the environment more so in the urban areas.

Today, 54 percent of the world's population lives in urban areas, a proportion that is expected to increase to 66 percent by 2050. Projections show that urbanization combined with the overall growth of the world's population could add another 2.5 billion people to urban populations by 2050, with close to 90 percent of the increase concentrated in Asia and Africa.[2] Nairobi County has a population of 4,941,708 million as of the year 2018, with a projection that by 2050 the number of people living in urban areas will significantly increase. This would need a clean environment and climate change mitigation. Therefore, youth will play an important part in changing the outlook of the environment.

[1]Muchangi, John. "4 countries seek to emulate Kenya's ban on plastic bags." Https://Www.the-Star.co.ke/News/2017/12/11/4-Countries-Seek-to-Emulate-Kenyas-Ban-on-Plastic-bags_c1682570, 11 Dec. 2017.

[2]United Nations. ''World's population increasingly urban with more than half living in urban areas.'' http://www.un.org/en/development/desa/news/population/world-urbanization-prospects-2014.html, 10 July 2014.

Youth in urban centers in Nairobi County have taken up initiatives to ensure that the environment is protected, including assisting in sustainable development goals (SDGs) achievement. Specifically, this is in line with SDG 11 to make cities and human settlements inclusive, safe, resilient and sustainable.

Methods

This research article used primary data through three key informant interviews, field observations and secondary data that were reviewed from journals, newspaper articles and reports from the government and non-governmental organizations.

Results and Discussion

Plastic Bag Initiative

According to Professor Wahungu, the ban of plastic bags has lead to an equitable distribution of income since women and even youth are now engaged in production of alternatives using local products.[3] This has supported formation of youth groups such as Change Mind Change Future initiative. They have joined hands and are using waste material available in Nairobi city to make carrier bags that are effective for use, dealing with the plastic menace in the County (Figure 1). The innovation of having paper bags opened up a business opportunity, not just for one youth, but also for a number of youth in Mathare slums, Nairobi.[4]

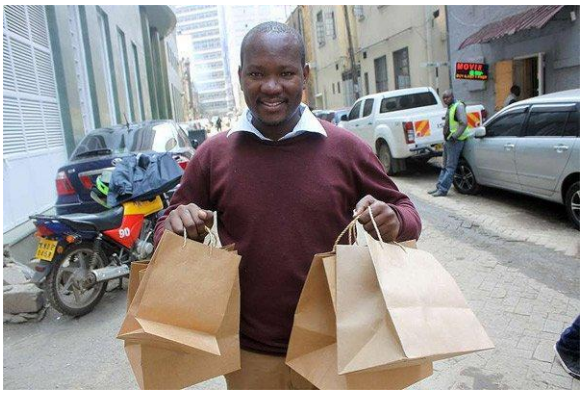

Figure 1. Calvin Jodisi with samples of bags manufactured by youths contracted by the Change Mind Change Future initiative. (Source: Anthony Omuya)

Clean River Initiative

Clean rivers promote health and also development from the resources readily available from the waters. However, it has been reported that 80% of rivers worldwide are polluted. Pollution of a major river in the great South Nyanza has been blamed for recent cholera deaths in Migori County. River Riana, shared by three counties - Kisii, Migori and Homa Bay - was identified as the source of the killer waters.[5] The rivers greatly benefit the population, including people living in urban centers with their livelihood dependent on the river.

Mathare River is well known by locals for great sightseeing. Children used to swim in it, with older ones using their hooks to fish in it. The river was full of activities, with

[3]KOECH G. and NG'OTHO A. Kenya's plastic bag ban thrills UNEA delegates at Nairobi meet. (2017)

[4]Open your eyes, opportunity is all around you. (2017)

[5]Obegi B. From river of life to river of death (2016)

women washing their clothes or fetching water from this river. Mathare slums in Nairobi, Mathare River has changed its colour within three months.

Youths from Mathare North, the second largest slum in Nairobi County, decided to use Valentine's Day on the 14th February, 2015 to converge for a cleanup exercise meant to fight stigma associated with living in informal settlements.[6] The one day exercise supported by the through UNHabitat, the Nairobi County, Athi Water Services Board, Save the Nation and the Visionaries Aloud brought together people from all walks of life irrespective of class, race and tribe. Through this they greatly initiated environmental protection.

Tree Planting Initiative

Kenya lost five percent of forest cover between 1990 and 2005. According to the World Bank, Kenya lost an average of 12,600 hectares per year of forest cover due to human settlement and illegal logging during the period.[7] Data from the Kenya forest service puts the forested area of 5506 hectares (7.78%) of the total area 70,806 hectares.[8]

In Kenya, the Global Peace Foundation through its youth arm, Global Peace Youth partnered with Action 2015 Kenya in its efforts to celebrate International Youth Day (IYD). This was hosted by the Nairobi County Environmental Sanitation and Hygiene Movement (NCHESHM) and brought together 40 young leaders for a clean-up and tree planting exercise in Babadogo, Mathare constituencies. The participants planted 30 trees in Mathare Church, Chandaria Primary School and Babadogo Primary School (Figure 2).[9]

Figure 2. Youth planting trees in an urban area
Source: Ehagi Daniel

Trees and forests make vital ecological, social and economic contributions in terms of water storage and purification, river flow regulation, flood mitigation, recharge of groundwater, reduced soil erosion and siltation and conservation of biodiversity. Forests also support key economic sectors including energy, tourism, agriculture and industries. In the past, environmental conservation efforts have faced numerous challenges such as rapidly growing population, habitat destruction, overgrazing, deforestation, pollution, unsustainable harvesting of natural resources and poor waste management. These challenges can be

[6]KNA. Youth converge for a cleanup exercise for cohesion (2015).
[7]Data hub. Kenya's forest cover increases by 5.3 per cent in four years. 2017
[8]Kenya Forest Service (2015). Kenya's forest cover per county
[9]Global Peace Foundation (2015). Young Leaders from Kenya Participate in a Tree Planting Exercise in Commemoration of International Youth Day

addressed through public and private partnerships.

Green Schools Initiative

Youth need to be provided with environmental education, mentorship to become the next generation of conservation leaders, and involvement opportunities in forest conservation activities such as tree planting. Parents, teachers, guardians also play a key role in ingraining environmental conservation practices and ensuring that the country builds a sustainable future. In a bid to ensure school going children to become environmental conservation champions, Bamburi Cement, KenGen Foundation and Better Globe Forestry rolled out an innovative environmental conservation project to steer the country to achieve its targets as outlined in the Medium Term Plan II under environment, water and sanitation pillars. Dubbed Green Initiative Challenge (GIC), the project aims to green schools and communities in arid and semi-arid land areas. Working with schools around the Seven-Folk dams, the project aims at planting trees in approximately 460 acres in Machakos, Kitui and Embu counties within the next ten years.[10]

Conclusion

In conclusion, this paper documents various youth initiatives in urban center in Kenya focusing especially on Nairobi City. The discussions bring about the innovative ideas by youth to produce carry bags from readily available material, the clean-up of rivers leading to sound health in cities, youth planting trees to prevent flooding and other environmental issues brought about by land degradation finally the youth also need to be trained on environmental protection. Urban youth associations combating climate change in Nairobi, Kenya have a great role to play. The cities have provided a haven for opportunities of which youth are out to look for hence obtaining a livelihood.

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[10]Kitavi M. (2016). Kenya should train her youth in environmental protection.

Disaster Management of Flooding in Northern Ontario, Canada

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Abstract

Introduction: Flooding has a substantial impact both internationally and in Canada. This paper is the first to examine the history of flooding in Northern Ontario, Canada from a disaster management perspective. This was done in order to mitigate and prepare for future floods. Disaster risk reduction is an important concept in disaster management and should be applied to flooding.

Methods: This study is a retrospective database analysis that examines flooding in Ontario north of Lake Nipigon from 1986 to 2016. The database is the Canadian Disaster Database (CDD), which is maintained by Public Safety Canada and contains data about each event.

Results: Flooding accounted for 78% of natural disasters north of Lake Nipigon from 1986 to 2016. Almost all floods occurred in the spring and affected First Nation communities. There have been 2 fatalities as a result of flooding in this region and some residents have been permanently displaced. Regular, costly air evacuations of these communities have been necessary. The majority of the floods have occurred on the west coast of James Bay and Kashechewan is the community most affected.

Discussion: Flooding in Northern Ontario occurs primarily from snowmelt runoff and ice jams. A number of possible solutions are being explored including relocating Kashechewan, enhancing the community's dike and creating a mechanism upstream of Kashechewan and Fort Albany to trap ice. Other possible solutions include building flood resistant structures in the community, enhancing the local flood forecasting tool and increasing the speed of the evacuation response.

Conclusion: Disaster management resources in Northern Ontario should be focused on spring flooding on the west coast of James Bay. More needs to be done to prevent flooding and the need for costly annual evacuations. The objective should be to decrease the frequency of evacuations while ensuring the safety of the affected communities.

Keywords: disaster management, emergency preparedness, flooding, Indigenous, Canada, evacuation

Introduction

This paper is the first to examine the history of flooding in Northern Ontario, Canada from a disaster management perspective. This was done through a database analysis in order to mitigate and prepare for future floods. Flooding has a tremendous health and socioeconomic impact internationally. Between 1995 and 2015 floods were the most commonly occurring natural disaster and affected more people than any other type of natural disaster. Floods killed 157,000 people over this 20 year period. They also had the second largest economic impact after storms.[1] Evidence suggests that the frequency of flooding will continue to increase due to climate change.[1,2]

The most common mechanism of flooding is when rivers and streams spill over. This can happen due to increased volume or decreased flow. Events such as melting snow or heavy rainfall increases the flow of rivers and the construction of a beaver dam is an example of an obstruction that would decrease flow. Coastal flooding occurs due to events such as storms, hurricanes and tsunamis. Flooding can sometimes happen quickly, a phenomenon known as flash flooding.[2,3] The factors influencing the severity of flooding are depth of water, duration, rate of rise, frequency of occurrence and season.[4]

The World Health Organization outlines the following health risks associated with flooding: drowning, trauma, hypothermia, water-borne diseases such as typhoid, cholera, leptospirosis and hepatitis A and vector-borne diseases such as malaria, dengue and dengue haemorrhagic fever, yellow fever, and West Nile Virus. To prevent these infections chlorination of drinking water, hepatitis A vaccination, malaria prevention, health education and the safe handling of corpses are important.[5]

The impact of flooding on health is also associated with evacuation and the loss of healthcare infrastructure. The long-term sequelae such as disability, poor mental health, malnutrition and poverty should also be considered.[6,7]

[1] "The human cost of weather related disasters 1995-2015." *The United Nations Office for Disaster Risk Reduction.* (2015) https://www.unisdr.org/2015/docs/climatechange/COP21_WeatherDisastersReport_2015_FINAL.pdf. Accessed April 18, 2018.

[2] Burton, Ian. "Floods in Canada." *The Canadian Encyclopedia.* (2006) http://www.thecanadianencyclopedia.ca/en/article/floods-and-flood-control/. Accessed April 18, 2018.

[3] Nunez, Christian. "Floods." *National Geographic*. (2019) https://www.nationalgeographic.com/environment/natural-disasters/floods/ Accessed April 18, 2018.

[4] "Floods technical hazard sheet." *World Health Organization.* (2019) http://www.who.int/hac/techguidance/ems/floods/en/. Accessed April 18, 2018.

[5] "Flooding and communicable diseases fact sheet." *World Health Organization.* http://www.who.int/hac/techguidance/ems/flood_cds/en/. Accessed April 18, 2018.

[6] Du, Weiwei; FitzGerald, Gerard J; Clark, Michele; Hou Xiang-Yu. "Health impacts of floods." *Prehospital and Disaster Medicine.* 25.3(2010):265-272.

General solutions to flooding include afforestation, reforestation, floodplain zoning, restoration of wetlands and constructing flood resistant structures, dams and dikes.[1,4] Good surveillance and early warning systems are also imperative to ensure risk reduction.[1,5] Furthermore, in high risk areas there should be a comprehensive evacuation plan and individuals should already be familiar with what steps to take. There should also be a well trained and equipped rescue team available before the disaster occurs.[4,8]

Disaster risk reduction (DRR) is a key concept in disaster management. Its goal is to decrease the damage caused by natural hazards by systematically analysing the factors that cause a disaster to occur.[9] It can be used to decrease the impact of flooding in a number of ways including reducing the health consequences previously discussed. The Bangkok Principles were created in order to assist countries in implementing the health aspects of the Sendai Framework for DRR. They include concrete recommendations for member states to take measures to promote health and invest in resilient health care systems in order to reduce the burden of disease and mortality due to disaster.[10]

Apart from reducing the morbidity and mortality, the economic benefits of investment in DRR have been demonstrated by several studies that are reviewed in a Norwegian world development report. The report outlines that the World Bank calculated that DRR saves up to $7 for every $1 invested and in North America, a study by Godschalk et al. in 2009 found that "each dollar spent on mitigation grants saves society an average of $4 in real source costs".[11]

In Canada, floods are the most costly natural disasters in terms of property damage.[12] In 1975 a national flood damage reduction program began. The main outcome was the creation of flood-risk maps to identify hazardous areas.[2] However,

[7]Ohl, Christopher A; Tapsell, Sue. "Flooding and human health : The dangers posed are not always obvious." *BMJ : British Medical Journal*. 321.7270(2000):1167-1168.

[8] "Floods." *International Civil Defense Organization.* http://www.icdo.org/en/disasters/natural-disasters/floods/. Accessed April 18, 2018.

[9]"What is disaster risk reduction." *The United Nations Office for Disaster Risk Reduction.* https://www.unisdr.org/who-we-are/what-is-drr. Accessed April 18, 2018.

[10] "Bangkok Principles for the implementation of the health aspects of the Sendai Framework for Disaster Risk Reduction 2015-2030." *United Nations Office for Disaster Risk Reduction.* https://www.unisdr.org/files/globalplatform/59224b6aebe8fBangkok_Principles_for_the_implementation_of_the_health_aspects_of_the_Sendai_Framework_for_Disaster_Risk_Reduction_2015.pdf. Accessed June 9th, 2018.

[11]Kelman, Ilan. "Disaster Mitigation is Cost Effective." *World Development Report 2014*. http://siteresources.worldbank.org/EXTNWDR2013/Resources/8258024-1352909193861/8936935-1356011448215/8986901-1380568255405/WDR14_bp_Disaster_Mitigation_is_Cost_Effective_Kelman.pdf. Accessed April 19, 2018.

[12] "Floods." *Public Safety Canada.* https://www.publicsafety.gc.ca/cnt/mrgnc-mngmnt/ntrl-hzrds/fld-en.aspx. Accessed April 19, 2018.

previous Canadian literature has noted that disaster management plans have failed to adopt specific initiatives tailored to Indigenous communities and that crises in these communities have been neglected.[13,14] This does not align with the "*Leave No One Behind"* core responsibility, included in the Agenda for Humanity global platform, which stresses the importance of addressing vulnerable communities during disasters.[15] Another Canadian study demonstrated that communities with higher levels of physical, human and social capital were better prepared and had a more effective response to flooding.[16]

Ontario is one of the Canadian provinces and contains the capital city, Ottawa. It has a population of just over 13,000,000 which is about a third of the total population of Canada. It covers an area of 908,700 square kilometers and has a population density of 14.8 per square kilometer. The vast majority of the population is concentrated in the South.[17] In Ontario, Emergency Management Ontario and the Ontario Ministry of Natural Resources and Forestry manage flooding. Indigenous and Northern Affairs Canada (INAC) provides funding to Indigenous communities in Northern Ontario. There is also an Emergency Coordinator who works with James Bay First Nations on flooding and other emergencies.[18] Flooding in Northern Ontario occurs primarily from snowmelt runoff and ice jams.[19,20]

Methods

This study is a retrospective database analysis that examines flooding in Ontario north of Lake Nipigon from 1986 to 2016. The database is the Canadian Disaster Database (CDD), which is maintained by Public Safety Canada. It contains detailed information on over 1000 events since 1900

[13] Shrubsole, Dan. "Flood management in Canada at the crossroads." *Environmental Hazards.* 2.2(2000):63-75.

[14] Jendrick, Amanda L. "Completely normal chaos: The Kashechewan crisis and the public normalization of risk on Indigenous reservations." (master's thesis). Peterborough, Canada: Trent University;2009. https://search.proquest.com/docview/305096308/fulltextPDF Accessed April 19, 2018.

[15] "Agenda for Humanity." *United Nations Office for the Coordination of Humanitarian Affairs.* 2016. https://www.agendaforhumanity.org/cr/3 Accessed May 25th, 2018.

[16]Buckland, Jerry; Rahman, Matiur. "Community-based disaster management during the 1997 Red River flood in Canada." *Disasters*. 23.2(1999):174-191.

[17]"Census profile, 2016 census." *Statistics Canada.* http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/Page.cfm?Lang=E&Geo1=PR&Code1=35&Geo2=&Code2=&Data=Count&SearchText=Ontario&SearchType=Begins&SearchPR=01&B1=All&GeoLevel=PR&GeoCode=35. Published November 29, 2017. Accessed April 18, 2018.

[18]"Flooding in First Nation communities." *Indigenous and Northern Affairs Canada.* https://www.aadnc-aandc.gc.ca/eng/1397740805675/1397741020537. Accessed April 18, 2018.

[19]"Spring flooding: risks and protection." *Federal Emergency Management Agency.* https://www.ready.gov/sites/default/files/Spring_Flood_Fact_Sheet.pdf. Accessed April 19, 2018.

[20]"Causes of flooding." *Government of Canada.* https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/causes-of-flooding.html. Accessed April 19, 2018.

that have directly affected Canadians. It uses the Emergency Management Framework for Canada to define these events as disasters. The criteria are based on the number of fatalities or casualties, whether there was an appeal for external assistance, the historical significance and the amount of damage or disruption to a given community. The variables for each event can be found in *Table 1*. The data is updated and reviewed on a semiannual basis and comes from reliable primary sources. The CDD also contains a geospatial mapping component. The search parameters used for this study were: Ontario, natural disasters and floods. The database analysis was conducted in April 2018.

Results

The CDD lists 18 natural disasters in Ontario north of Lake Nipigon between 1986 and 2016. Flooding accounted for 78% of these events with 14 in total. There was also 1 E.coli outbreak and 3 wildfires. The fires were in the Northwest and the majority of the flooding occurred in the Northeast with 11 floods along the west coast of James Bay. A map of the flooding can be found in *Figure 1*.

The 14 floods that took place between 1986 and 2016 all affected First Nation communities. All of them except 1 occurred between March and May. They happened in the following locations: Fort Albany,

Table 1. Data Fields in the Canadian Disaster Database

Data Field	Description
Disaster Type	The type of disaster (e.g. flood, earthquake, etc.) that occurred.
Date of Event	The date a specific event took place.
Specific Location	The city, town or region where a specific event took place.
Description of Event	A brief description of a specific event, including pertinent details that may not be captured in other data fields (e.g. amount of precipitation, temperatures, neighbourhoods, etc.)
Fatalities	The number of people killed due to a specific event.
Injured/Infected	The number of people injured or infected due to a specific event.
Evacuees	The number of individuals evacuated by the government of Canada due to a specific event.
Latitude & Longitude	The exact geographic location of a specific event.
Province/Territory	The province or territory where a specific event took place.
Estimated Total Cost	A roll-up of all the costs listed within the financial data fields for a specific event.
DFAA Payments	The amount, in dollars, paid out by Disaster Financial Assistance Arrangements (Public Safety Canada) due to a specific event.
Insurance Payments	The amount, in dollars, paid out by insurance companies due to a specific event.
Provincial/Territorial Costs/Payments	The amount, in dollars, paid out by a Province or Territory due to a specific event.
Utility Costs/Losses	The amount of people whose utility services (power, water, etc.) were interrupted/affected by a specific event.
Other Federal Institution Costs	The amount, in dollars, paid out by other federal institutions.

Attawapiskat, Kashechewan, Winisk and Kasabonika. Kashechewan is the community that has been most affected in recent years and some residents were permanently displaced after the 2015 floods due to mold and poor living conditions. The flood with the largest documented economic impact occurred in Kashechewan and Fort Albany in March 2012 with a cost of $6,700,000. The events have been dealt with by staged air evacuations to surrounding communities. There have been 2 documented fatalities to date. They occured in Winisk River on May 16, 1986 as described in the following text.

Figure 1. Map of Flooding in Northern Ontario

http://cdd.publicsafety.gc.ca/rslts-eng.aspx?cultureCode=en-Ca&boundingBox=&provinces=9&eventTypes=%27FL%27&eventStartDate=&injured=&evacuated=&totalCost=&dead=&normalizedCostYear=1

"Precipitation was nearly three times normal in the western James Bay area of Northern Ontario in March and April; as the snowpack melted, ice jams formed on the Winisk River; the river then overflowed its banks and Winisk was inundated; the isolation of the community, the magnitude of the flooding and a blizzard made rescue efforts difficult. Of the 131 residents, almost all were airlifted to safety; two died; the community was virtually destroyed; a new town site was developed upstream at Peawanuk."

Discussion

Kashechewan is a Cree community located along the Albany River about 10 kilometers from the west coast of James Bay. There are around 2000 inhabitants, depending on the season.[21] On March 31, 2017 the Kashechewan First Nation and the Governments of Ontario and Canada signed an agreement to develop an action plan to support the sustainability of the community. It focuses on improving outcomes in housing, socioeconomics, health, infrastructure and education. Options for relocating the community will also be considered. A steering committee will provide annual progress reports on community development.[22]

A ring dike was constructed around Kashechewan between 1995 and 1997 to protect residents from flooding. An engineering report from February 2015

[21]Faries, Emily. "Voice of the people on the re-location issue." *International Journal on Sustainable Development.* 8.4(2015):99-110.

[22]"Tripartite framework agreement to provide sustainable future for Kashechewan First Nation." *Ministry of Indigenous Relations and Reconciliation.* https://news.ontario.ca/mirr/en/2017/03/tripartite-framework-agreement-to-provide-sustainable-future-for-kashechewan-first-nation.html. Published March 31, 2017. Accessed April 18, 2018.

found that the dike presented an "intolerable risk to the community in terms of overtopping, slope stability and piping risks".[23] Piping or internal erosion accounted for the largest risk of failure. The total annual probability of dike failure was 1:3000. Piping and slope embankment failure would be the deadliest mechanisms and could kill up to an estimated 100 people.[24] It will be imperative to carefully maintain the dike around Kashechewan as outlined in the engineering report. The report recommends a number of modifications to the dike, regular safety assessments and inspections, and preparing a safety manual. It also recommends formulating an emergency preparedness plan that includes training and the use of the flood forecast tool.[23] The ice jam forecasting tool was designed by a company called Hatch to predict flooding in Kashechewan.[25]

The dike is considered a "near field" solution as it is adjacent to the community. "Far field" solutions are also currently being explored. A far field structure could be constructed upstream of Kashechewan and Fort Albany in order to significantly decrease the amount of ice that reaches them. This would prevent flooding due to ice jams downstream of the communities. Structures called ice booms have been used elsewhere for this purpose. They are an effective and relatively affordable method of preventing flooding.[25]

Other possible solutions include building flood resistant structures in the community to prevent consequences such as damage and mold growth and trying to minimize unnecessary evacuations. Although it is crucial to minimize risk to the inhabitants in this region it may be possible to avoid unnecessary, precautionary evacuations. This could be achieved by enhancing the flooding model developed by Hatch or implementing a more accurate one. If the speed of the evacuation can be increased, it may also allow for this to occur at a later time when it is more apparent that it is truly necessary.

The findings of this study are limited due to the fact that the study is retrospective and focuses on population-level data. Future research should compare health indicators in this population to similar communities not exposed to flooding, in order to better understand the health impact. The annual

[23] "Assessment of dam safety risks and dam safety management requirement for the Kashechewan ring dyke." *Hatch.* https://www.documentcloud.org/documents/1698852-dam-safety-assessment-report.html. Published February 19, 2015. Accessed April 18, 2018.

[24] Donnely, Richard C; Stephen, Derek; Jamieson, Kelvin; Perkins, Steve; and Hinchberger, Sean D. "A description of the application of a new quantitative dam safety risk assessment tool for risk-informed decision making." *Presented at Hydrovision 2015 in Portland Oregon, USA.* https://www.researchgate.net/publication/279547123_A_Description_of_the_Application_of_a_New_Quantitative_Dam_Safety_Risk_Assessment_Tool_for_Risk-Informed_Decision_Making. Accessed April 19, 2018.

[25]Abdelnour, Razek. "Albany River 2008 Ice breakup: forecasting the flood event, observations of the river during the spring breakup and the potential for mitigating the flooding risk of the Kashechewan and Fort Albany First Nation." *Committee on River Ice Process and the Environment.* 2013. http://cripe.ca/docs/proceedings/17/Abdelnour-2013.pdf Accessed April 19, 2018.

flooding in Kashechewan raises important questions about whether the community should be relocated and what other measures can be taken to improve health.

Conclusion

Spring flooding on the west coast of James Bay accounted for 78% of natural disasters in Northern Ontario from 1986 to 2016. There have been 2 fatalities as a result of the flooding during this time period. This information can be used to guide the future allocation of disaster management resources in this region. Furthermore, it is apparent that more needs to be done to prevent flooding and the need for costly annual evacuations. The objective of parties working on emergency preparedness in the region should be to decrease the frequency of evacuations while ensuring the safety of the affected communities. The issues discussed in this paper will also be relevant to similar communities that are experiencing frequent flooding.

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Understanding Large-scale Fire Events: Megafires in Attica, Greece and California, USA

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Abstract

In 2018 megafires occurred in Attica, Greece and California, USA. Both resulted in hundreds of fatalities, injuries and substantial damage to properties and local ecosystems. A megafire, the final stage of a major fire event, presents a serious and unpredictable threat and the risk of large-scale losses. It can be harmful not only to local populations and fire responders, but also the ecosystems of affected communities. This paper presents an overview of fire disasters in order for the readers to further understand fire development and impacts. It also details some basic, yet effective preparedness measures for people-at-risk, hoping to raise awareness regarding community self-protection. Lastly, it introduces a fire-wise mechanism (property fence) that is being developed to support community-based response during fire events.

Keywords: wildland-urban interface (WUI) fire, wildfire, fire preparedness, health impact, home protection

Introduction

On July, 23th 2018, the worst wildland-urban interface (WUI) fire disaster in Greece's recent history occurred in Mati, Attica. It resulted in 100 fatalities and more than 170 injuries. Hundreds of people had to evacuate, as their properties were completely destroyed or severely damaged. In addition, the toxic after-effects of the fire that burned houses and vehicles (e.g. dioxins, particulate matters of different sizes and asbestos) were harmful to humans and

local ecosystem. During the event, the fire developed rapidly and reached its climax due to the strong winds, dry atmosphere and specific geomorphology of the area. Several citizens were entrapped and killed while they were trying to evacuate by car or on foot.[1,2,3]

In the same year, California State in USA suffered from a similar disaster. A series of approximately 8,550 fires caused 85 fatalities, numerous injuries and 11 missing persons. This fire hazard was the worst WUI fire in the recent history of the State. Like in the disaster in Mati, many people died while trying to evacuate. In both cases, the WUI fires were categorized as megafires due to their magnitude and severity of impacts.[4,5]

Knowing about fire ignition, development and suppression can potentially save lives. This paper presents a general overview of fire events, their types, health impacts, and prevention measures. It briefly introduces the general characteristics of wildfires and megafires (through WUI fire events) as these types are large-scale events, occur frequently and affect large populations. Lastly, it introduces the research on fire resilience for properties conducted by My Safety Approved LLC and Fire Brake Solutions LLC. Hopefully, this article will familiarize readers with major issues that need to be addressed when dealing with large-scale fire events (LFEs) and their impacts.

Causes of Fires

In order for a fire to ignite, it requires heat, (appropriate temperature) fuel (flammable/combustible materials), and an oxidizing agent (usually oxygen). The complete fire development includes four phases: (i) incipient, (ii) fire growth, (iii) full development, and (iv) decay.[6]

Fire events can be both natural and human-induced. Wildfires for instance, can be naturally occurring phenomena due to the cyclic nature of the hot season. High temperatures and lack of precipitation may turn the lush vegetation that grew during the wet season into kindling for wildfires.[7] On the other hand, flat tires, electric circuits,

[1]Greece fires: Death toll rises as search for missing continues. (2018). Retrieved from https://www.heraldsun.com.au/technology/death-toll-rises-from-greek-fires/news-story/ecb64b91cbd6454796ac7fe7edad7ec2

[2]Kokkinidis, T. (2018). Residents of Greece's Fire-Stricken Mati Warned to Wear Protective Masks. Retrieved from https://greece.greekreporter.com/2018/08/25/residents-of-greeces-fire-stricken-mati-warned-to-wear-protective-masks/

[3]Greece wildfires: Dozens dead in Attica region. (2018). Retrieved from https://www.bbc.com/news/world-europe-44932366

[4]Lam, K. (2018). Death toll drops to 85 at Camp Fire; 11 people remain missing. Retrieved from https://www.usatoday.com/story/news/2018/12/03/camp-fire-death-toll-california-deadliest-wildfire/2199035002/

[5]California's deadliest and most destructive wildfires have been contained. (2018). Retrieved from https://www.abc.net.au/news/2018-11-26/california-deadly-constructive-wildfires-have-been-contained/10556028

[6]Schismenos, S., Karma, S., and Chalaris, M. (2018). Large-Scale Fire Incidents in Recycling Plants: Lessons Learned from Two Indicative Case Studies and Future Needs. In M. Chalaris, D. Emmanouloudis, J.C. Wen, and Z.P. Wu (Eds), Novel Approaches in Risk, Crisis and Disaster Management (Hauppauge, NY: Nova Science Publishers), 127-152, ISBN: 978-1-53613-239-7.

[7]Pierre-Louis, K. (2018). Why Does California Have So Many Wildfires? Retrieved from https://www.nytimes.com/2018/11/09/climate/why-california-fires.html

campfires, cigarettes and arson may also cause fire ignition. Another important factor is the human urbanization. People settling near forests increases the chances of accidental fire ignition. According to the US National Park Service, approximately 85 percent of fires in USA are caused by humans.[8]

Wildfires

Wildfires are the fires that ignite and develop in wildland. There are two primary types of wildfire:

- Ground-fire, also known as brush-, bush-, scrub- or grass-fire which develops in light grass or brush topography.
- Crown-fire which involves the hopping from a treetop to another. Typically, it initiates as a groundfire and moves to engulf entire trees within a forest topography. Then it starts spreading forward on the treetops pushed by wind currents.

In a wildfire scenario, once an ignition occurs, the fire spreads rapidly depending on the fuel availability and wind conditions. As the fire grows and spreads through the fuel, embers are generated and begin flying far ahead of the actual fire (ember attack). As these embers land, the ignition cycle starts again, if the conditions are ideal (sufficient heat, light fuel, etc.). The new ignitions create new fires, which begin to grow again into larger fires and release more embers. This process can be repeated several times. The described fire cycle may cause failures in the response operations, as it forces quick evacuations and rapid redeployment of firefighters across multiple sites.

Megafires

In general, fire events can be categorized as technological, wildland and urban. A fire can ignite from many sources, change its type or consist of multiple types, and develop into a megafire when the conditions are appropriate. When referring to megafires, both long-term (prolonged temperate winters and dry summers - impacts of climate change, damaged ecosystems and urbanization – human activity) and short-term conditions (combined conditions that ignite a fire event) should be considered.[9] A campfire for instance, can turn into a wildfire within seconds, if the necessary safety precautions are not in place. Strong winds and other conditions (fuel load, atmospheric conditions, geomorphology) determine the magnitude of the wildfire. If nearby communities are affected, then the fire upgrades to a WUI fire. When a WUI fire cannot be constrained (large-scale), then it reaches its final stage and it becomes a megafire.

Megafires are extremely dangerous since, due to their magnitude and scale, firefighters are not able to deal with them effectively. They have been characterized as qualitatively different types of wildfires and

[8]Wildfire Causes and Evaluations. (2018). Retrieved from https://www.nps.gov/articles/wildfire-causes-and-evaluation.htm

[9]Williams, J., Albright, D., Hoffmann, A. A., Eritsov, A., Moore, P. F., Mendes De Morais, J. C., ... and Van Lierop, P. (2011). Findings and implications from a coarse-scale global assessment of recent selected mega-fires. In International Wildland Fire Conference (2011, Sun City, South Africa). FAO.

WUI fires, whereby the exacerbation of precursors and their combination (e.g., longer-term drying, fuel load and atmospheric conditions such as wind storms) alter both the scale and 'behavior' of the fire (e.g. greater intensity and more rapid, unpredictable movement, including via longer-range ember attack).[9,10] As a result, megafires burn everything in their paths and can often only be suppressed when weather conditions and/or the geomorphology of the area permit. Figure 1 shows the types of fire events and how they can turn into a megafire.

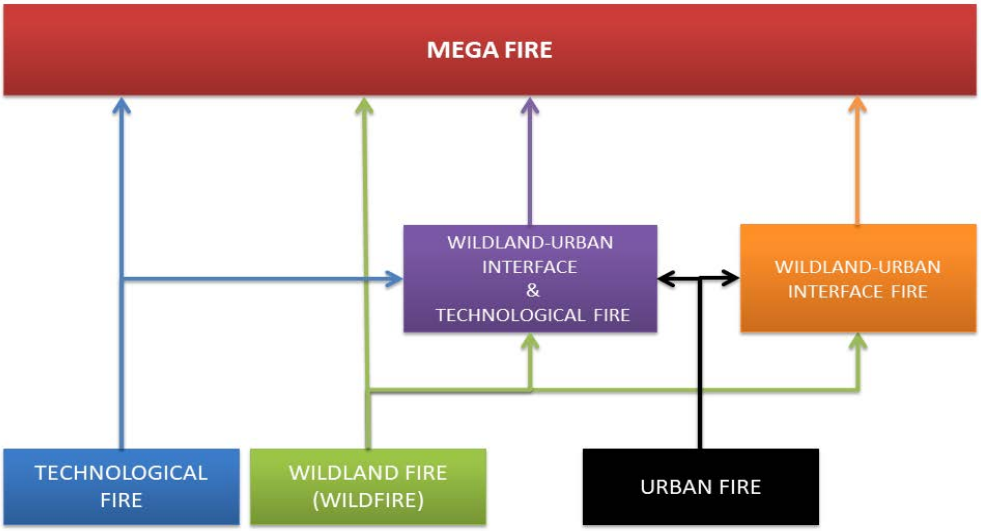

Figure 1. Types of Fire Events

Health Impacts

An LFE can reach high temperatures within seconds - often hundreds or thousands of Celsius degrees (^{o}C). Human skin exposure to such high heat and temperatures can cause major impacts on health. The human skin feels pain at 44 ^{o}C, while the first and second degree burn injuries occur at 48 ^{o}C and 55 ^{o}C, respectively. All higher temperatures will destroy human tissue. Besides the thermal exposure, toxic fumes and plumes that are products of fire combustion can be equally hazardous, depending on the materials used for fuels.[6,11]

Preparedness against Fire Disasters

Despite the significant efforts of firefighters, suppressing LFEs such as megafires, is not an easy task. Individuals and homeowners that reside in WUI fire-prone areas, should also contribute in fire disaster prevention and be supported to do so effectively. The following section presents some "actionable" tips to residents.

[10]The era of megafires: the crisis facing California and what will happen next. (2018). Retrieved from https://www.theguardian.com/environment/2018/aug/07/california-wildfires-megafires-future-climate-change

[11]BSI, BS 7982: Guidance on the Environmental Impact of Large-Scale Fires involving Plastics Materials. (2001). British Standards Institution

What to consider before an LFE ignites:

1. Create defensible spaces (fire suppression/block zones) around properties and evacuation routes.
2. Remove dry plants and other materials that can be used as fuel.
3. Collaborate with professionals and participate in local fire disaster response drills.
4. Attend local or online fire disaster education programs.
5. Secure properties against fires with fire-resistant structures (e.g. fence).

What to consider during the development of an LFE:

1. Be continuously informed about the fire's direction (this can change rapidly).
2. Use sprinklers/water-based solutions to keep your surroundings moist.
3. Be ready to evacuate (know the routes and how to reach a safe zone).
4. Help those in need (the elderly and people with mobility issues or special needs).

Innovations in Property Protection against Fire Events

For centuries, fences have been used for the protection of residences. However, in the case of a WUI fire event, fences may not be helpful, or they may even cause more harm than good, depending on their material and structure. Houses with attached wooden fences (the most common fence type in USA), are most likely to be damaged in case of a WUI fire event.[12] Such fences in combination with the nearby vegetation (especially when poorly maintained) may cause problems to both firefighters and homeowners during an evacuation. Even though there are fences made of fire-resistance materials (e.g. steel, aluminum and fireproof plastic), their structures may not be able to protect properties from embers and ashes spread via the strong winds.

In order to effectively protect human lives and properties, My Safety Approved LLC and Fire Brake Solutions LLC are investigating an automated, rapid-deploy fire barrier. According to their research, the suggested mechanism should be designed to keep fires and their products (such as heat, radiation, embers and ashes) away from homes and other infrastructure. Besides protecting a space from nearby fire spread, this system could also be used to restrict a fire and its products within a space. This mechanism could be installed as a fire safety barrier in manufacturing or storage facilities where technological fires may occur (e.g. battery manufacturers and plastic recycling storages). By restricting the fire, its fuel is limited. The firefighters' work then becomes easier and safer since they can focus on a constrained space. Even though this system is still under development and further research is required, the results look very promising. Similar products could increase the fire safety level of residences and other spaces.

[12] Fires, M. (2008). The case for mitigation. Institute for Business and Home Safety.

Conclusions

Undoubtedly, climatic and weather conditions (prolonged dry seasons, limited rainfalls) combined with human activities (deforestation, urbanization), and behaviors (irresponsible ecotourism behavior, environmental unawareness) are major contributing factors to the increasing number of fire disasters worldwide. Firefighters and volunteers do their best, but this is not always enough, especially in megafire scenarios. Therefore, all of us must be prepared for when a fire disaster occurs. Knowing basic fire safety tips, becoming familiar with local evacuation routes and enhancing our homes with fire-resistant materials can increase survival rates, save properties and assist the remarkable efforts of fire crews.

Creating Resilient Cities to Urban Flooding: What is the Role of Flood Mapping?

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Abstract

Climate change projections indicate more extreme weather patterns globally – with wet areas getting wetter, and dry areas getting drier. In combination with population growth and urbanization, current flood risks are expected to accelerate from changes in hazard, vulnerability and exposure. To combat this acceleration, adaptation measures must be implemented.

Flood hazard and risk maps are central tools for risk communication, pre-flood risk-reduction, and risk-awareness. Moreover, flood risk maps are used by insurance companies to designate appropriate insurance premium levels; emergency management teams employ flood hazard maps for locating evacuation routes; and interdisciplinary spatial planning teams incorporate flood hazards maps in zoning plans as restrictions for future development. The central role of flood hazard and risk maps is elaborated in relation to resilience: how can flood risk maps increase resilience in the case of urban flooding?

Increasing computational power and data accessibility through remote sensing products present opportunities for flood risk mapping in both developed and developing countries. It is here argued that flood hazard and risk maps can enhance resilience to urban floods through risk communication and spatial planning.

Keywords: climate change, urban growth, risk communication, spatial planning.

Introduction

The number of people exposed to urban flooding is increasingly due to rapid urbanisation and associated growth of informal settlements. By 2050, more than 70% of the world's population will live in cities.[1] Additionally, more extreme weather patterns are expected as a result of climate change. A focus on preparedness may

[1]Foundation, The Rockefeller. Cities Taking Action: How the 100RC Network Is Building Urban Resilience. 2017, pp. 1–74.

enhance resilience to floods. Mapping of flood risks is the first step to identifying the most suitable adaptation and mitigation strategies. Moreover, spatial planning that considers flood hazards can result in recommendations for appropriate land use. Recommendations can include best practises in building new homes and designing streets or ensuring that critical infrastructure is located in areas that maintain operations during extreme events. The efficiency of long-term investments in hydraulic infrastructures for flood protection, design of evacuation and emergency plans, and scientifically sound policies depend on the quality and availability of these maps.

Flood hazard and risk maps are also essential tools for information dissemination. A better-informed population is more likely to make sound decisions during the event of an emergency.[2] The dissemination of flood hazard and risk maps will not only lead to a better-informed population, it is also likely to stimulate risk-reducing behaviour.

Flood Risk Maps as a Tool for Spatial Planning

In Priority 3 of the Sendai Framework (investing in disaster risk reduction for building resilience) flood risk maps are prioritised as a mainstream tool for ensuring safe human settlements and preservation of ecosystem functions.[3] In developed countries, decision-making in spatial planning is established by formal regulations of the planning acts following a top-bottom approach. The interlinkage between spatial planning and flood risk was solidified with the EU Flood Directive (2007/60/EC) moving from flood protection to flood risk management. Under the direction of the EU Flood Directive, Member States initiated flood hazard and risk mapping in 2014, with compulsory revision every six years. In 2007, the Exchange Circle on Flood Mapping (EXCIMAP) created a handbook of best practises in flood hazard and risk mapping. For land use planning purposes, extension and probability of the flood is essential information, whereas water depth, velocity and risk objects is desirable information.[4] There is not a common approach for flood hazard and risk maps in Europe, as the EU did not provide legal enforcement on how mapping should be done. For instance, flood maps from France present the flood duration; in Ireland the uncertainty; and in Finland the extension of historic floods.[3] Lack of a common approach brings forward issues in the management of transboundary rivers. To overcome these difficulties, EU-funded projects, such as Elbe-Labe Preventive Flood Management Measures by transnational spatial planning (ELLA) and

[2]Messner, F. and Meyer, V. (2006). Flood damage, vulnerability and risk perception – challenges for flood damage research. In: Schanze, J. et. al (eds.) Flood Risk Management> Hazards, Vulnerability and Mitigation Measures, pp. 149–167.

[3]UNISDR. "Sendai Framework for Disaster Risk Reduction 2015 - 2030." Third World Conference on Disaster Risk Reduction, Sendai, Japan, 14-18 March 2015., no. March, 2015, pp. 1–25. doi:A/CONF.224/CRP.1.

[4]Van Alphen, J., et al. "Flood Risk Mapping in Europe, Experiences and Best Practices." Journal of Flood Risk Management, vol. 2, no. 4, 2009, pp. 285–92, doi:10.1111/j.1753-318X.2009.01045.x.

Flood Awareness and Prevention Policy (FLAPP), were brought to life to help standardise flood hazard and risk maps for the Elbe and Rhine River. Though expenditures in flood protection have increased in the last two decades, economic losses have also increased. This is due to higher exposure in flood prone areas due to poor spatial planning for socio-economic reasons as the lands close to rivers and coastal areas have higher productivity.[5] The usefulness of these maps depends on their integration with national directives in soil, water and land use. In Norway and Sweden, flood hazard and risk maps are used as an informative tool. In France, Poland and Germany, developments are prohibited in flood prone areas.[6] The effectiveness of these restrictions is limited by decentralised governmental levels, externalities and economic pressures. Incorporation of flood risk in spatial planning requires interdisciplinary teams in which water and flood risk managers should participate.

In developing countries, an inevitable aspect of flood risk mapping is the lack of data. Although there are ways to overcome this inherent limitation of ungauged basins, focus should be given to data collection. Despite a lack of data, local communities can still provide valuable inputs to flood risk maps, linking historical events with reported damages through surveys or interviews. Community-based approaches, in which residents can collect and transmit data – for instance with mobile phones – preceding, during and after disaster events, do not only allow for preparedness, but also constitute a means of data collection. It is strongly advised that this data be stored. Storing data from citizen engagement provides a foundation for building databases that can be used in the future modelling purposes, though, inherent uncertainty is bound to measurement, citizen engagement and personal incentives. With data, modelling tools can be used to generate understanding of a particular flood risk system and to carry out what-if-analysis in light of uncertainty. Particularly citizen engagement in data collection should be promoted.

Flood Risk Maps as a Tool for Risk Communication

Flood hazard and risk maps used in risk communication must be locally adapted, visually clear and understandable, and take into account literacy rates, language barriers and communication forms. The importance of flood hazard and risk maps in communicating flood risk has been recognized by several institutions. The United Nations for Disaster Risk Reduction (UNDRR) established the GAR Atlas[7] as a tool for achieving the global targets of the Sendai Framework for Disaster Risk Reduction 2015–2030 (SFDRR). This atlas is a tool to compare the damages caused by a wide range of natural hazards – tsunamis,

[5]Munich RE: Weather catastrophes and climate change, Munchener Ruckversicherungs-Gesellschaft, Munchen, 2005

[6]de Moel, H., et al. "Flood Maps in Europe – Methods, Availability and Use." Natural Hazards and Earth System Science, vol. 9, no. 2, 2009, pp. 289–301. doi:10.5194/nhess-9-289-2009.

[7]https://www.preventionweb.net/english/hyogo/gar/atlas/

cyclones, earthquakes, floods – on a global scale to easily compare their relevance for national economies. Additionally, the United States Federal Emergency Management Agency (FEMA) generated guidelines and standards for flood risk analysis and mapping activities under the Risk Mapping, Assessment and Planning (Risk MAP) Program.[8] Such guidelines are further developed into flood risk products helping community members and officials better understand their local flood risk. Such information aims to allow local communities, developers, insurance specialists and others to take actions to reduce flood loss and mitigate potential flood damage. Furthermore, the Global Facility for Disaster Reduction and Recovery (GFDRR) at the World Bank utilizes flood hazard and risk maps in its projects such as the Global Program for Safer Schools, which guides risk-reduction investments for safer and more resilient school infrastructure in developing countries.[9]

Societal resilience and resource efficiency should be supported in flood risk management.[9] This is emphasized in Priority 1 (Action Understanding Risk) of the Sendai Framework, which highlights the importance of understanding risk in all its dimensions. With flood risk systems comprising intricately interlinked social, economic and environmental components, flood hazard and risk maps are essential tools for information dissemination. The use of flood hazard and risk maps contributes towards achieving the Priority 1, understanding risk, of the Sendai Framework.[10]

Conclusion

Due to projected climate change effects, population growth and land use change, flood risk is also expected to change. For this reason, focus should be given to flood hazard and risk mapping. With more people living in cities and urbanisation spanning to more impermeable areas, urban flood risk will inevitably increase. This urgently calls for the need to create resilience in cities. Flood hazard and risk maps constitute integral parts of spatial planning and should be distributed to raise awareness on flood risk and to enhance emergency preparedness. Three things must be addressed in understanding risk: level of education, local language[11] and risk perception. In the new era of flood risk management, flood risk maps are a key tool in creating resilient communities.

[8]https://www.gfdrr.org/sites/default/files/publication/SaferSchools.pdf

[9]Alexander, Meghan, Sally Priest, and Hannelore Mees. A framework for evaluating flood risk governance. Environmental Science & Policy 64 (2016): 38-47.

[10]http://www.unisdr.org/we/coordinate/sendai-framework

[11]Gautam, D.K. and Phaiju, A.G. (2013). Community Based Approach to Flood Early Warning in West Rapti River Basin of Nepal. Journal of Integrated Disaster Risk Management, vol. 3, no. 1. doi: 10.5595/idrim.2013.0060.

The Role of Multi-Track Diplomacy in Disaster Risk Response Amongst Political Tension

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Abstract

This policy brief examines the shortcomings of the Sendai Framework for Disaster Risk Reduction through analyzing where provisions for coordination are insufficient. It finds that though the Sendai Framework emphasizes that there must be coordination between states and that non-governmental stakeholders should be involved in Disaster Risk Reduction; however, it does not provide for methods to resolve conflicts permanently or to facilitate effective collaboration between non-governmental bodies. This paper concludes that multi-track diplomacy should be incorporated as a tool to address these shortcomings and uses disaster risk response efforts in India and Pakistan as a case study for potential opportunity.

Introduction

The incentive for states to cooperate with each other and in accordance with the goals outlined in the Sendai Framework for Disaster Risk Reduction seems quite obvious. In the event of a disaster, practices aimed toward increasing preparedness and resilience align with the state's goals of maintaining political and social stability through mitigating the potential exacerbation of existing structural problems, including through strengthening critical infrastructure, ensuring access to basic goods, and reducing the risk of mass disruption, uprisings, or potentially armed conflict.[1]

In recent policy centered around Disaster Risk Reduction, increasing emphasis has been placed on the involvement of underrepresented stakeholders and actors, including a variety of non-governmental organizations, businesses, community institutions, etc. The Sendai Framework for Disaster Risk Reduction provides that "international, regional, subregional and transboundary cooperation remains pivotal in supporting the efforts of States, their national and local authorities, as well as

[1]Bhavnani, Rakhi. "Natural Disaster Conflicts". Master's thesis. *Harvard University* (2006): 1-2.

communities and businesses, to reduce disaster risk."[2] However, the efficacy of multilateral engagement, including surrounding disaster risk, is severely limited in situations where diplomatic relations are strained by political tension. 'Political tension' refers to a wide variety of disputes relating to governance. Political tension can be caused by many different and often interconnected factors, including historical disagreements, religious differences, outside intervention, regime change, and previous disasters.

Within the field of Disaster Risk Reduction, combating political tension is necessitated by the fact that tension's presence can severely undermine the effectiveness of collaboration. Political tension not only decreases the direct goodwill between governments when administering assistance to build preventative disaster resilience systems or respond in the event of a disaster, but impedes the scope of work which non-state actors are able to accomplish through establishing bureaucratic obstacles. In cases of extreme social polarization, it can compel populations to refuse to collaborate altogether, even when it may be against their own self-interest. The fact that the areas that tend to be most prone to the worst effects of disasters and have the least existing infrastructure to address a catastrophic event are also the areas that are the most politically unstable and conflict-ridden only exacerbates this effect.

Understanding the necessity of not only the incorporation of explicit efforts to improve relations between states, but the crucialness of building cultural and social understanding between historically conflicting bodies is vital to improving the efficiency and effectiveness of the Sendai Framework and various international efforts regarding Disaster Risk Reduction. The current isolated involvement of local, regional, and government stakeholders is insufficient; instead, to best improve differing actors' willingness to coordinate on the process of disaster risk reduction and resilience, principles of multi-track diplomacy ought to be applied to projects undertaken by a broad series of governmental and non-governmental actors.

Multi-Track Diplomacy

The term multi-track diplomacy, as developed upon the analysis of Joseph Montville in 1981 on the distinction between governmental and non-governmental diplomacy and coined by Louise Diamond, can be defined as the theorization of international peacemaking as regulated by the influence of nine disparate bodies: government; conflict resolution professionals; business; private citizens; religion; activism; research, training, and education; philanthropy; and media and public opinion.[3]

The concept of multi-track diplomacy represents a significant paradigm shift from

[2]"Sendai Framework for Disaster Risk Reduction 2015-2030". *United Nations Office for Disaster Risk Reduction* (2015): 10.

[3]Notter, James and Louise Diamond. "Building Peace and Transforming Conflict: Multi-track Diplomacy in Practice". *Institute for Multi-Track Diplomacy* (1996): 2-4.

previous thought concerning international peacemaking. Previously, analyses in regards to the relative importance of influential actors concluded that states were the central axiom of all diplomatic efforts. Even Montville's model of two-track diplomacy focused on governmental organizations as 'Track I', the primary factor, and all non-governmental actors as 'Track II', as secondary, contributing actors. In contrast, as exhibited in Figure 1, Diamond and Ambassador John McDonald theorize all nine tracks as a coordinated system, with no one track more important than the others.[3]

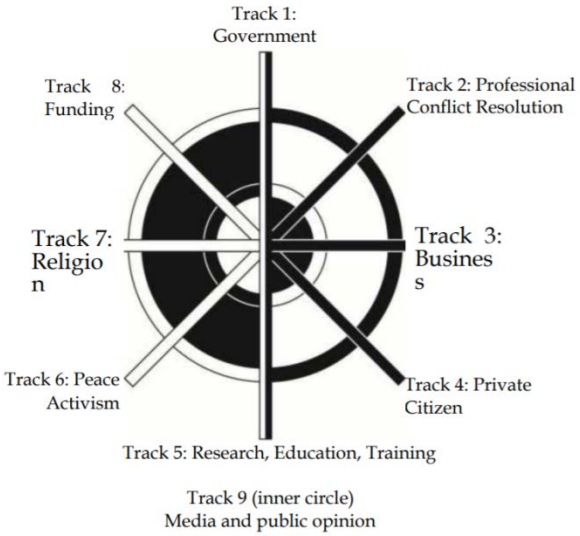

Figure 1. Diamond and McDonald's model of multi-track diplomacy[3]

Similarly, Diamond and McDonald are concerted in their use of the term conflict transformation to describe the process of peacemaking, as opposed to conflict resolution, conflict settlement, conflict management, or a litany of other terms in the field. The use of the word 'transformation' acknowledges that conflicts cannot be simply 'settled' or resolved', but require a process of transformation. Conflict transformation, as opposed to alternatives, implies system level change that addresses the root causes of tensions.[3]

In the context of Disaster Risk Reduction, the application of multi-track diplomacy must first constitute the explicit acknowledgement of diplomacy's importance to disaster response and encouragement of governmental actors to continue routine diplomatic processes to maintain relations with other states, as well as work towards improving currently hostile relations. A call for the maintenance of diplomacy for the purpose of addressing disasters must appeal to actors' rationality through using empirical evidence to emphasize the correlation between effective, globally coordinated disaster response and economic benefit, as Disaster Risk Reduction can produce up to 700% return per dollar.[4]

However, solely invoking government-centered diplomacy will not transform state relations. Simply changing governmental policy does not address any of the economic, social, or cultural causes of political tension. Even if diplomatic processes between governments alleviate tension temporarily, not engaging the root causes of disagreement will ensure issues manifest again in the future. As McDonald, theorizes, effective peacebuilding is not just comprised of a macro-level diplomatic engagement between governments, but must also involve engaging economic institutions like the

[4]"Putting Resilience at the Heart of Development: Investing in Prevention and Resilient Recovery". *UNDP Representative Office in Japan* (2012): 7.

World Bank and IMF to build infrastructure that increases vulnerable societies' cohesion.[5] This is particularly critical in the context of Disaster Risk Response, where continuity is key to processes that slowly build resilience over time.

Perhaps most importantly, McDonald indicates that any lasting diplomatic process must include social peacebuilding. To McDonald, the social peacebuilding addresses "anger, fear, lies, trauma, and loss" to build trust with and empower indigenous communities and transform the social culture of historically destabilized populations to establish durable communities and prevent affect from recreating violence. Social peacebuilding can involve engagement with non-governmental bodies and can encompass academic conferences, philanthropic work, educational exchange programs, and business investment as examples[5]. In practice, Davies' theory can be quantified with the work of the Institute for Multi-Track Diplomacy in Cyprus' mostly Turkish north, where a half-day training, in which participants were allowed a safe space for discussion, agreed to communicate in an appropriate manner, and were willing to learn, resulted in changed viewpoints and promises to work toward forgiveness of historical violence inflicted on the Turkish by Greek Cypriots.[6]

The practice of social peacebuilding, when combined with political and economic peacebuilding, is essential to create conditions in which Disaster Risk Reduction can be effective. The bulk of the work of implementation of the Sendai Framework is reliant on the collaboration of local, non-governmental stakeholders, who are directly influenced by their previously held cultural beliefs. Their compliance with the Sendai Framework in countries where political tensions exist is directly reliant on the efficacy of the social, micro-level change in opening avenues for collaboration that can only be initiated with multi-track engagement with citizens. A sole emphasis on the relations between governments is not sufficient to encompass the complex dynamics facilitated by the populations of states, who are the true drivers of political tensions. Instead, diplomacy must follow the model developed by Diamond and McDonald and work towards transforming the cultural and social context in which tension was originally manufactured.

Case Study: India and Pakistan

The example of Pakistan and India provides an ideal scenario for analysis of the potential role of multi-track diplomacy in improving the Sendai Framework's implementation. Pakistan and India have a long, complex history of political tension that has resulted in the extreme polarization of the countries' populations and frosty relations.

Because of conditions of geography, climate change, weather patterns, and many other

[5]Davies, John L. et al. *Second Track Citizens' Diplomacy: Concepts and Techniques for Conflict Transformation*. Rowman & Littlefield Publishers (2002): 55-58.

[6]McDonald, John W. "Using Multi-Track Diplomacy to Deal with Ethnic Conflict". Written Blog. *Peacemaking and Conflict Resolution*. The Foundation for PEACE. Web. 6 April 2019.

factors, India and Pakistan are both vulnerable to catastrophic disaster. Because of proximity, both countries experience similar effects of natural disasters, meaning any potential collaboration would be uniquely effective. In both countries, monsoons and cyclones that cause a cyclical pattern of floods and droughts have severely burdened development work attempting to alleviate poverty and hunger. The United Nations global assessment report on disaster risk estimated that India incurred an average loss $9.8 billion annually due to natural disasters.[7] Similarly, a World Bank report published in collaboration with Pakistan's National Disaster Management Authority found that Pakistan's economy suffered yearly losses of $1.2 and $1.8 billion because of disasters, an amount equivalent to 0.5 and 0.8% of GDP[8].

Both nations have independently demonstrated their commitment to disaster risk management. Both countries' disaster management initiatives adhered to the Hyogo Framework for Action and India has revised its National Disaster Management Plan to heed the standards in the Sendai Framework. Both have strong risk and resilience plans and routinely send representatives to discuss appropriate strategies for response at Asian and international forums.[9]

Because the large majority of the human and economic impact in Pakistan and India is the result of floods, cross-border hydro resources management, which necessitates effective collaboration between the two nations, is particularly critical.[9] However, political tension not only minimizes opportunities and the efficiency of cooperation and reduces political will for providing humanitarian aid at the governmental level, in extreme cases of mutual antipathy like in Pakistan and India, necessary stakeholder groups, such as local governments, businesses, philanthropists, and media, can potentially refuse to collaborate entirely out of deep-seated hatred. Though historically, this has not been a danger, with collaboration during the 2005 Kashmir earthquake proceeding smoothly,[10] changes in the political climate motivated by a political or military provocation that escalates tensions means that future efforts may not follow the same path.

The specific continued expansion of multi-track diplomacy can alleviate issues that prevent effective coordination among non-governmental groups. Specifically, the dissemination of data concerning the impact of collaboration between Indian and Pakistani groups, early warning systems that

[7]Thakur, P. "Disasters cost India $10bn per year: UN report". News article. *The Times of India*. 11 March 2015. Web. Accessed 6 April 2019.

[8]"Why Is South Asia Vulnerable to Climate Change?" *The World Bank* (2008): xvii.

[9]Ahmad, Shafqat M. "Track-II diplomacy - Building disaster resilience in Pakistan and India". *Sustainable Development Policy Institute* (2018): 2-6.

[10] "India, Pakistan open first point on LoC". *Rediff.com*. Rediff.com. 7 November 2005. Web. Accessed 6 April 2019.

detail the severe damage disasters cause, bilateral consortiums of leaders in academic or philanthropic circles working towards disaster risk response and resilience, or even programs that aim to resolve cultural differences among citizens can increase the willingness of independent actors to collaborate preventively against disasters.

Conclusion

The incorporation of the field of diplomacy in general and specifically, multi-track diplomacy that emphasizes the importance of non-governmental actors within Disaster Risk Response efforts has the potential to transform the scope of current work. The Sendai Framework concludes that working diplomatic relations are necessary for effective disaster risk reduction and resilience practices, but only uses a governmental frame to dictate their facilitation. Similarly, it addresses the importance of emphasizing interconnected non-governmental actors' roles in best practices, but does not indicate how their coordination can be impaired by political tension.

Multi-track diplomacy has the potential to transform the social climate within bodies and build peace through changing historical cultural understandings that have prevented the permanent resolution of conflicts. Through direct engagement with the many actors that actually influence countries' relations, as opposed to just the government, multi-track diplomacy can be especially useful in the context of disaster risk response by reducing tensions and allowing collaboration over resources. By specifically provisioning for the role that multi-track diplomacy can play in disaster risk response, the Sendai Framework can address the primary issues that disaster risk response specifically faces in the world's most unstable and vulnerable regions.

Promotion of solar mini-grids in sub-Saharan landlocked developing nations as a method to increase energy resilience

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Abstract

Sub-Saharan nations are among the most impoverished of the world but also the ones that will face the most severe consequences of climate change. In landlocked nations of Sub-Saharan Africa, the level of development is, on average, 20% lower than what it would be were they not landlocked. As a method to increase energy security and drought combat ability, landlocked states, that underperform their neighbors in energy consumption, should take advantage of the abundance of natural sunlight and develop solar mini grids both for electrification and water pumping. Several configuration types for mini grids were studied, regarding inclusion of storage and capacity size. The installation costs vary from 7-16 USD/Wp while the electricity price ranges from 0.05-0.1 USD/kWh depending on the setup and method. Mini grids with no storage system is selected as a cheapest solution, while the integration of batteries would increase the system functionality but would double the cost.

Introduction

Landlocked developing countries (LLDCs) are, by definition, those which lack access to any sea port and face a myriad of challenges due to their geospatial position. Sixteen out of the thirty-two landlocked countries globally belong to the African continent, with several countries in central Asia and Europe as well. The Almaty program of Action and the Vienna Program of Action were implemented to assist LLDCs overcome their non-competitive position in trade and infrastructure.

Eight of the LLDCs are among the thirty most vulnerable nations to climate change[1] (Brucker, 2015). It is projected that they will face severe droughts that may lead to disasters[2] including food shortages.[3] Solar

[1]Climate change vulnerability and the identification of least developed countries. Department of Economic and Social Affairs, United Nations.

[2]Exploring drought vulnerability in Africa: an indicator based analysis to be used in early warning systems G. Naumann et al., Hydrol. Earth Syst. Sci., 18, 1591–1604, 2014

[3]Drought vulnerability assessment of maize in Sub-Saharan Africa: Insights from physical and social

mini grids are proposed as roadmap to increase the resilience, energy security and drought combat ability of LLDCs. An example is the irrigation units that are essential tools for rural peasants. Photovoltaic (PV) irrigation systems are economically competitive with respect to oil technologies,[4] while offering food and income security to farmers isolated from the urban settlements.

Apart from water supply, electricity security must be separately evaluated in LLDCs, since they are already consuming less than the average electricity of their sub-area (Figure 1).[5] Solar mini grids are widely applied in highly vulnerable areas to promote energy security. This paper aims to review some of the most widely used setup configurations and make clear that the application of them in a wider range will increase resilience of LLDCs and their capacity to respond to future disasters.

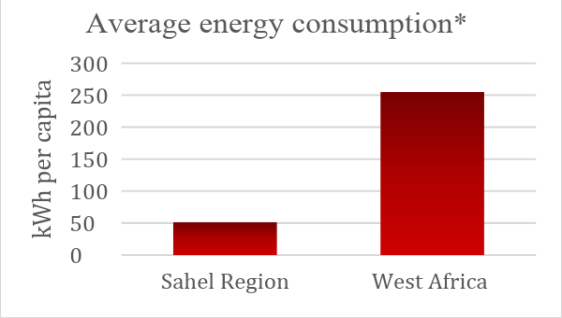

Figure 1. Sahel Region (all LLDCs) comparison to West Africa average energy consumption.

perspectives, Bahareh Kamali et al. https://doi.org/10.1016/j.gloplacha.2018.01.011

[4]A review of sustainable solar irrigation systems for Sub-Saharan Africa Saeed Mohammed Wazed et al. Renewable and Sustainable Energy Reviews 81 (2018) 1206–1225

[5] https://www.iea.org/statistics/

Mini-grid configurations evaluated.

Generally, there are several types of mini-grids according to electricity distribution and policies. Examples of the different mini-grids include public, private and community-owned. In public mini-grids, uniform national tariffs are applied so that mini-grid customers pay the same as their grid-connected urban counterparts. Because electricity supply to remote areas with mini-grids is more expensive than supply to urban areas through the main grid, the use of uniform national tariffs involves a transfer of funds from urban to rural consumers. Private mini-grids apply higher tariffs than the main grids, but as an advantage they can operate under a variety of business models. [6] Community owned PV mini-grids are installed by government bodies in a configuration matching the one in Figure 2. Each household is provided with electricity by means of battery recharging. This battery is properly sized to the household loads.

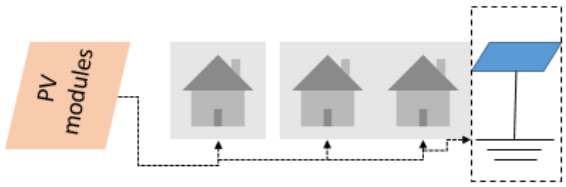

Figure 2. Micro grid case 1 setup.

[6]The role for low carbon electrification technologies in poverty reduction and climate change strategies: a focus on renewable energy mini-grids with case studies in Nepal, Peru and Kenya, A. Yadoo, H. Cruickshank, 10.1016/j.enpol.2011.12.029

Discussion (PV compounds)

PV mini-grids have a capital cost which strongly corresponds to several parameters, including distribution, metering, end-user, PV Array costs and battery use. Also, additional costs include monitoring, charge controller, inverter, protection board, and cabling.[7]

Furthermore, we can categorize the PV cost ranges based on the type of setup, as seen in Table 1. Solar Home systems, stand for PV modules installed at house rooftops and provide energy to the household, while mini-grid systems are not necessarily installed on roof tops and are able to provide energy to several households or stores. Solar irrigation units are compatible with both kinds of PV systems, though it is highly likely they are better facilitated with mini-grid ones, since oversizing a solar home unit would increase its already high installation cost.

Table 1. Average costs of PV mini grids installations in sub-Saharan Africa.

Type of system	**Cost/W**
Solar Home System >1kW	16$/W
Solar Home System <1kW	14$/W
Mini grid + Battery	13$/W
Mini grid no Battery	7$/W

The average price per kWh also deviates based on the technology and the scale of the plant. For Solar Home Systems with less than 1kW installed capacity, despite the high installation costs the annual expenditure ranges from 84 USD to 270 USD depending on the number of lights and mobile chargers. Comparing the mini-grid systems, the battery increases significantly the costs of installation but can be a more reliable solution.[8]

Last but not least, PV irrigation systems present a very competitive solution for rural communities as they take advantage of the solar affluence of those areas to pump water and store it for future use. No energy storage is required and therefore PV irrigation is considered a way to increase drought response as well as competitive increase of rural dwellers that are the most affected of the consequences of climate change.

[7] Electrification of Sub-Saharan Africa through PV/hybrid mini-grids: Reducing the gap between current business models and on-site experience, Moner et al. https://doi.org/10.1016/j.rser.2018.04.018

*2014 data in the countries available.

[8] IRENA 2016, Solar PV in Africa, costs and markets. ISBN 978-92-95111-48-6

Setup proposed

In this section, we propose a concept of a mini-grid setup, differentiated than those already existing and reported in Table 1 (that reports costs for already implemented projects). The proposed mini-grid concept involves a PV farm sized to cover a 7.96 kWh/day load for households in small African rural communities that include 4 LED lights, 2 mobile chargers and a fridge. This setup requires battery charging to cover needs, with a cost of 0.5$/kWh and an installation cost below 4000 USD for ten households.[9] Such system can support also solar pumping for agricultural purposes.

Conclusions

For LLDCs to increase their energy resilience and their drought combat ability, they need to take advantage of their vast solar energy potential (Figure 3). Climate change impacts will affect LLDCs more than other nations due to the absence of a proper response strategy. Solar off grid systems are expected to be a key part on the electrification of local communities. They will not only provide them with electric energy, essential for a functional home, but also with tools (functional and economically sustainable irrigation units) that are expected to increase their productivity and resilience. Systems which are not connected to the network and make use of battery exhibit greater variation in all costs. With the example proposed above for local rural communities, with the capacity to distribute electricity in 10 houses, the LCOE (Levelized Cost of Electricity) calculated is 0.05 USD/kWh/household, which meets the financial standards of the area.

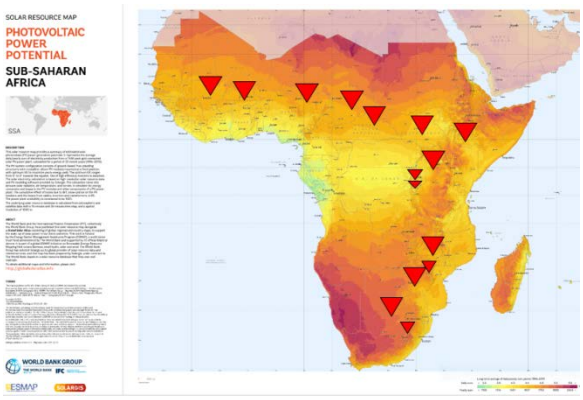

Figure 3. Solar energy potential in LLDCs of sub-Saharan Africa.

[9]Prospects of Sustainable Development in land-locked developing countries via renewable energy growth. The Sub-Saharan and Central Asia region case study. Karvounis Panagiotis, ICSD 2018

Local Disaster Vulnerability Analysis: An Approach to Identify Communities

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Abstract

Extreme weather events, such as floods and rainstorms, can turn into serious threats due to their unpredictable nature and scale. Depending on their magnitude, vulnerable communities may experience substantial losses, especially those residing in riparian and deltaic ecosystems. Despite the significant progress in disaster risk governance over recent years, the implementation of effective resilience plans at the local level remains a challenge. This is often due to the uncertainties of addressing key variations between communities, such as their hydrogeomorphological surroundings, differences in community needs and capacities, and unpredictable local atmospheric conditions. Generalized weather forecasting systems and imported response plans for instance, cannot always be adopted or understood in depth by low-income communities. In contrast, high-income communities and their assets are typically better protected through the use of technology and flood prevention infrastructure. Focusing on local-scale action plans can help address this imbalance, especially when both community and site variations are taken into consideration. The question then becomes, is it possible to develop effective disaster vulnerability analysis tailored to local needs and capabilities?

This study suggests a metric that focuses on community characteristics, capacity and needs criteria. These criteria highlight elements that should be improved in order to

increase community resilience and capacity. Knowing the weaknesses and strengths of vulnerable populations allows appropriate modifications within the suggested disaster response plans. The research introduces a method for identifying community vulnerability being developed for the "Hydropower for Disaster Resilience Applications (HYDRA)" research project, a joint initiative of Humanitarian and Development Research Initiative (HADRI), Western Sydney University, Australia and UNESCO Chair on Conservation and Ecotourism of Riparian and Deltaic Ecosystems (Con-E-Ect), International Hellenic University, Greece.

Keywords: community risk reduction, hazard mitigation, community vulnerability, community characteristic, community need, community capacity, extreme weather event

Introduction

In 2017, Hurricane Maria affected Central America and caused more than 4600 fatalities in Puerto Rico alone.[1] The affected communities were highly unprepared and received inefficient humanitarian response, as disaster risk governance (DRG) had been poorly implemented.[2] The reasons for this outcome vary. Firstly, the magnitude of extreme weather events (EWEs) cannot always be accurately predicted at a local level. Secondly, early-warning systems should not only operate in large areas; many EWEs (e.g. flash floods and rainstorms) are localized and develop quickly.[3] Thirdly, the DRG, which can be defined as "the system of institutions, mechanisms, policy and legal frameworks and other arrangements to guide, coordinate and oversee disaster risk reduction and related areas of policy",[4] should be transparent, community-centered and accessible, and include local hydrogeomorphological conditions. Community involvement in joint management with local authorities is also crucial, as it can build an integrated community response capacity and support wider socioeconomic development.

The 2014 Governance in Disaster Risk Management Report, "United Nations Office for Disaster Risk Reduction (UNDRR)/Assessment of Integrated Research on Disaster Risk (IRDR)" suggests three key features of effective disaster resilience.[5,6] These are:

[1]Bacon, J. (2018). Hurricane Maria killed more than 4,600 people — more than 70 times the official toll of 64, study says. Retrieved from https://www.usatoday.com/story/news/nation/2018/05/29/hurricane-maria-killed-thousands-puerto-rico/650942002/

[2]Kyriacou, A. (2018). Fail to Prepare, Prepare to Fail: The Perils of Puerto Rico after Hurricane Maria. Retrieved from https://www.diplomaticourier.com/fail-to-prepare-prepare-to-fail-the-perils-of-puerto-rico-after-hurricane-maria/

[3]Schismenos, S. (2017). Anthropocentric principles for effective early warning systems. In United Nations Major Group of Children and Youth, Youth Science Policy Interface Publication (Ed.), *Special Edition: Disaster Risk Reduction: A Road of Opportunities*, 08-12.

[4]Terminology on Disaster Risk Governance. (2017). United Nations Office for Disaster Risk Reduction. Retrieved from https://www.preventionweb.net/terminology/view/51755

[5]Djalante, R., Holley, C., and Thomalla, F. (2011). Adaptive governance and managing resilience to

i) stakeholder involvement,
ii) cooperation and collaboration between parties, and
iii) flexibility and adaptability.

These features promote community self-sufficiency and self-determination, and are more likely to support a balanced assessment of community needs and capacities. However, this is not always feasible at the local level. Low-income communities in remote riparian and deltaic areas are often unable to manage EWEs effectively and are reliant on humanitarian assistance, as they lack disaster response resources and mechanisms. Insufficient and unstable power supplies in these regions also undermine disaster management capabilities and socioeconomic growth more broadly. This lack of key resources undermines the development, involvement and self-sufficiency of these vulnerable populations.

Providing long-term solutions centered around building integrated local capacity is one of the most effective strategies for dealing with community hazard management and development needs. The UNDRR defines such capacity as "the combination of all the strengths, attributes and resources available within an organization, community or society to manage and reduce disaster risks and strengthen resilience. This may include infrastructure, institutions, human knowledge and skills, and collective attributes such as social relationships, leadership and management".[7]

While local atmospheric and hydrogeomorphological conditions are key hazard variables, community vulnerability factors also influence the likely success of local disaster resilience planning. This research introduces a metric that is based on community characteristics, capacity and needs criteria (CCNC) aiming to define relative community vulnerability level. The assessment framework is being developed as part of the "Hydropower for Disaster Resilience Applications (HYDRA)" research project at Western Sydney University, Australia with the support of the Humanitarian and Development Research Initiative (HADRI) and UNESCO Chair on Conservation and Ecotourism of Riparian and Deltaic Ecosystems (Con-E-Ect), International Hellenic University, Greece. In practice, this study investigates needs and capacity criteria for different types of communities with the aim of assessing relative community risk to EWE hazard impacts and suitability for mitigation initiatives. The overarching goal is to develop and support local, community-led initiatives which integrate sustainable economic development and primary disaster resilience strategies for the most vulnerable populations.

natural hazards. *International Journal of Disaster Risk Science*, 2(4), 1-14.

[6]Gall, M., Cutter, S. L., and Nguyen, K. (2014). Governance in disaster risk management (IRDR AIRDR Publication No. 3). *Beijing: Integrated Research on Disaster Risk.*

[7]Terminology on Disaster Risk Reduction. (2019). United Nations International Strategy for Disaster Reduction. Retrieved from https://www.unisdr.org/we/inform/terminology#letter-c

Methods and Discussion

When referring to the term "community", there is no specific terminology that is widely accepted. In this study, it can be broadly defined as a group of people (i) having one or more characteristics in common, and (ii) living in the same geographical area.[8,9,10] In order to further specify a community, we suggest the use of the CCNC metric. The CCNC metric, presented in Table 1, further defines communities of interest using nine criteria known to affect local disaster management capabilities.[11,12] For illustrative purposes, a community comparison between Parramatta, Australia and Uruguaiana, Brazil is also presented in Table 1.

The CCNC metric allows us to highlight similarities and differences when evaluating different communities and their sites. This can help us detect problematic areas that increase community vulnerability or undermine preparedness level in relation to EWEs. The CCNC metric can also be used for community development mapping, as it follows combined principles of the 2030

Table 1. Community Characteristics, Capacity and Needs Criteria – Cases of Parramatta, Australia and Uruguaiana, Brazil

GENERAL CHARACTERISTICS			CAPACITIES IN RISK MANAGEMENT			COMMUNITY NEEDS			
Community information	Income*	Physical Accessibility	Disaster Resilience	Early-Warning	Disaster Response	Energy Availability	Self-Sufficiency	Energy Availability	Self-Sufficiency
	Country level	Any condition	Any condition	Any condition	During extremes	Normal conditions/Prior extremes (long-term)		During/After extremes (short-term)	
Name, Country Population, Year Settlement	Low	Inaccessible	Insufficient	Insufficient	Insufficient	Insufficient	Low	Insufficient	Low
	Middle	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
	High	Accessible	Sufficient	Sufficient	Sufficient	Sufficient	High	Sufficient	High
EXAMPLE CASES									
Parramatta, Australia 25,798 (2016) Urban									
Uruguaiana, Brazil 121,360 (2015) Semi-Rural									

**For this example, we used the Country Income Level (2018) to determine the Community Income Level. Lower-middle and Upper-middle Incomes are described as Middle Income; Brazil is an upper-middle income country*

[8]Theodori, G. L. (2005). Community and community development in resource-based areas: Operational definitions rooted in an interactional perspective. *Society and Natural Resources*, 18(7), 661-669.
[9]Kaufman, H. F. (1959). Toward an interactional conception of community. *Social Forces*, 38(1), 8-17.
[10]Wilkinson, K. P. (1991). *The community in rural America* (No. 95). Greenwood Publishing Group.

[11]Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects. (2008). Federal Emergency Management Agency. Retrieved from https://www.fema.gov/media-library-data/20130726-1635-20490-7447/how_to_9_aug08.pdf
[12]Quarantelli, E. L. (1997). Ten criteria for evaluating the management of community disasters. *Disasters*, 21(1), 39-56.

Agenda for Sustainable Development[13] and Sendai Framework for Disaster Risk Reduction.[14] It can also be used as a complementary tool for single site hazard mitigation assessments, such as the STAPLEE. The STAPLEE method uses social, technical, administrative, political, legal, economic, and environmental criteria for risk assessment and planning.[10] Even though some criteria are similar across these tools, the CCNC metric is simpler to use when comparing vulnerable areas of two or more communities and their sites. In addition, it shows community capacity strengths and weaknesses in a clear manner (traffic light system). This display of assessment data can promote common understanding and collaboration between stakeholders and increase community participation in joint risk management. To further understand how the CCNC metric works, Figure 1 presents the Parramatta-Uruguaiana findings in a chart.

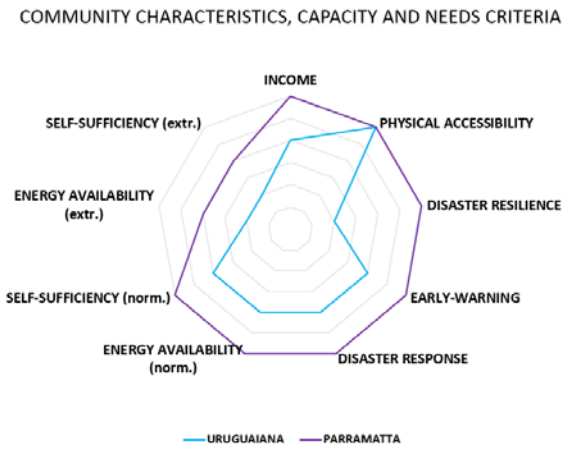

Figure 1. Community Characteristics, Capacity and Needs Criteria Chart - created at: https://online.visual-paradigm.com

According to both Table 1 and Figure 1, we can see that Uruguaiana is a semi-rural community with middle income and large population. Parramatta is an urban community with high income and small population. The physical accessibility level in both communities is high; this can expedite evacuation procedures. Uruguaiana has poor flood prevention mechanisms and often experiences blackouts, compared to Parramatta. In 2019, Uruguaiana experienced severe floods that resulted in damages to many residences and extended power blackouts.[15] Parramatta has not experienced any notable EWE in recent years.

By comparing these criteria for both communities, it can be stated that the community vulnerability level of Uruguaiana is higher than that of Parramatta. This is obvious in both Table 1

[13]Nam, U. V. (2015). Transforming our world: The 2030 agenda for sustainable development. *Division for Sustainable Development Goals: New York*, NY, USA.

[14]Aitsi-Selmi, A., Egawa, S., Sasaki, H., Wannous, C., and Murray, V. (2015). The Sendai framework for disaster risk reduction: Renewing the global commitment to people's resilience, health, and well-being. *International Journal of Disaster Risk Science*, 6(2), 164-176

[15]Blašković, T. (2019). Record rainfall, widespread flooding hits Argentina, Brazil, Uruguay and Bolivia. Retrieved from https://watchers.news/2019/01/10/record-rainfall-widespread-flooding-hits-argentina-brazil-january-2019/

(Uruguaiana has less criteria marked as "green") and Figure 1 (Uruguaiana has lower values in most criteria). Development actions such as increasing household income, providing sustainable energy sources and building EWE-resilience infrastructure could decrease this differential. Specific flood mitigation treatments, such as early-warning system development, would similarly reduce vulnerability. Existing assets of Uruguaiana are also identified. The physical accessibility level of the municipality is high, a fact that increases the survival rate during extremes since the evacuation routes are not limited. For Parramatta, disaster resilience works, including energy availability and DRG strategies could be further strengthened to avoid any issues during and after EWEs.

Conclusion

While EWEs develop in a similar manner, their impacts at the local level vary considerably. Besides the similarities among communities, there are also differences that need to be considered. These differences, individually and in aggregate, may affect disaster response and development plans. As such, they should be investigated in a systematic way prior to any implementation plan. Investigating community vulnerability level via multiple criteria, and in combination with local atmospheric and hydrogeomorphological data, can critically inform disaster resilience action plans at the local level. Furthermore, identifying the most vulnerable communities, allows decision-makers to detect major problems and work towards improving them. Lastly, the CCNC metric could also be used for evaluating community development potential, as a progress measure of development and response capability status over time. Further research on both community vulnerability and CCNC metric could improve the accuracy and reliability of these tools.

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