NATIONAL SCIENCE AND TECHNOLOGY FORUM

DISCUSSION FORUM

ON

SCIENCE AND DISASTER MANAGEMENT FOR SOCIAL JUSTICE

In collaboration with the NSTF Science Councils and Statutory Bodies sector

5 AND 6 DECEMBER 2022

CAPE TOWN INTERNATIONAL CONVENTION CENTRE
AND
ONLINE ON ZOOM

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DAY 1

WELCOME TO PARTICIPANTS, INTRODUCTIONS AND INTENDED OUTCOMES (MS JANSIE NIEHAUS, EXECUTIVE DIRECTOR: NATIONAL SCIENCE AND TECHNOLOGY FORUM (NSTF))

Ms Niehaus welcomed participants, both in-person and online, to the forum.

South Africa was in a constant state of disaster. Some of the aspects, such as the energy crisis, loadshedding and alternative energy sources, have been addressed at previous NSTF forums. This forum aimed to address the relevant topic of disaster management and prevention, and the speakers would present a variety of perspectives on the topic. Recommendations coming out of the two days' discussions would be summarised in a declaration from the NSTF putting forward steps to be taken in order to manage and prevent disasters towards ensuring social justice in South Africa.

Participants were invited to give their comments and opinions, and propose areas of research that needed to be addressed in South Africa and globally, during the Q&A sessions.

KEYNOTE: PREVENTION OF EPIDEMIC AND PANDEMIC DISASTERS – A TRANSDISCIPLINARY HEALTH PERSPECTIVE (PROF PETRA BESTER, DIRECTOR: THE AFRICAN UNIT FOR TRANSDISCIPLINARY HEALTH RESEARCH (AUTHeR), NORTH-WEST UNIVERSITY (NWU))

In South Africa, health professionals were trained to work within epidemics and the health systems were geared to deal with epidemics.

The global burden of disease report (Lancet's Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2019) showed that in the world of health globally, people were living longer and the diseases that caused death 25 years ago were currently seen as disabilities. Despite substantial critique, more people were being accommodated on Mother Earth and living longer, more healthy lives. However, this efficiency had consequences, namely: a larger proportion of aged people, more people with disabilities and unhealthy lifestyles, and a quadruple disease burden specific to South Africa that comprised an epidemic of communicable diseases, particularly Tuberculosis (TB) and human immunodeficiency virus (HIV), a major disease burden of conditions related to maternal and child health, a major epidemic of violence and injuries, and of non-communicable diseases (NCDs) (including mental illness). The Coronavirus Disease of 2019 (COVID-19) pandemic in this country had to be managed in the context of the quadruple disease burden and a multi-morbid population.

Prof Bester made a call for this forum to recommend that this country and its people think radically differently about health. Health could not be resolved in the system and people would have to take responsibility for their own health. However, this would not be a simple process as evidenced by the following important events in past years:

- In 1942, Drs Sydney and Emily Kark started a new movement in health in Pholela, a village in KwaZulu-Natal (KZN) Province. They claimed that health was a social event that happened in homes and communities and that disease happened in hospitals and clinics. A health facility became a social node, a space where people were taught skills, personal hygiene, healthy food, growing and harvesting food, early identification of illnesses and indigenous ways to treat illness. Pholela became a movement in this country but it was expensive to maintain and eventually disappeared.
- From the 1940s to the 1980s, several international interventions and events attempted to manage communicable diseases. These included a policy on Leprosy, a TB control policy, family planning associations, the 'Health for All' movement, the 'Health Field' report by Marc Lalonde, an expanded immunisation programme, a programme to eradicate polo and a Charter on health promotion.
- In 1994, the African National Congress's (ANC's) National Health Plan presented an ideal scenario of anticipated ideas for healthcare in South Africa.
- In 2011, the South African government identified that its anticipated ideal of bringing healthcare to all (primary healthcare) with a focus on access almost ignored health quality.
- In 2018, the Community Oriented Primary Care (COPC), a re-creation of the 1942 Pholela initiative, was launched.

The mandate for preventing epidemics and pandemics in the country, and addressing the social determinants of health rested with the National Department of Health (NDoH), which was also responsible by law for efficient and timeous surveillance.

The World Health Organisation (WHO) health systems framework set out interactive building blocks (leadership and governance, financing, health workforce, health information systems, service delivery and access to essential medicine) that had to function optimally in order to have a well-functioning health system. South Africa's health workforce strategy for 2030 aspired to address the dearth of trained medical practitioners by doubling training of the health workforce. There was a major need for a health information system, service delivery was an area of great concern and access to essential medicine remained a serious issue in the country's public health system.

The National Health Plan of 1994 envisaged an integrated, equitable and comprehensive health system based on a Primary Healthcare (PHC) approach yet 20 years on, the health system continued to experience serious challenges in terms of:

- Poor quality of care (persistent complaints and evidence from patients, civil society and the media)
- Persistent health inequities
- Spiraling costs in private health sector
- Limited progress implementation of the Demographic and Health System (DHS)
- Weak operational management
- Decreased levels of community participation
- Increased maternal mortality ratio, burden of NCDs, violence and injuries
- Unaddressed social determinants of health
- Instability of health leadership.

Further challenges related to the under-estimation of the impact of HIV and TB on the health system and the lack of political will to allow access to antiretroviral (ARV) treatments. While the public health system was overburdened, less than 16% of the more than 60 million people in South Africa could afford private medical insurance, which was becoming more costly each year.

In the context of the prevention of epidemics and pandemics, the current health system was unsustainable. The reality of poor quality care in the country's public hospitals and the excellent technology, quality and systems in private healthcare meant that the health system was conflicted because the public and private systems could not exist without each other. The public health system was based on a referral pathway with a foundation on PHC level. Private healthcare was based on a profit-driven business model that focused on doctor and client, and a specialty, and was practiced in approximately 215 hospitals around the country including some of the best private hospitals in the world. The pandemic had demonstrated possibilities for collaboration between the two systems.

A notification process was in place in that health professionals were trained to notify the health system of four categories of communicable or other diseases. During the COVID-19 pandemic, it became evident that the extremely primitive District Health Information System (the routine health information data collection system in public hospitals) hindered pandemic management on a provincial level.

Since 2011, the focus of the health system moved to the districts with funds and resources being allocated to the districts for distribution, and district centres becoming major role players and nodes for information on pandemic and epidemic prevention. Ward-based outreach teams attached to community health centres or PHC clinics worked within communities and fed information back to the clinics. Community-based health services had been re-introduced but were not yet fully functional in all areas but played an important role in screening for diseases, environmental health, community mobilisation and health promotion.

The National Health Promotion Strategy was the appropriate space where epidemic and pandemic prevention should take place. People needed to be given back the responsibility of taking control of the environment and their own health.

BUILDING COMMUNITIES' TRUST FOR PUBLIC HEALTH DISASTER RESILIENCE (PROF LEKAN-AYO YUSUF, CHAIRPERSON: SCHOOL OF HEALTH SYSTEMS AND PUBLIC HEALTH, UNIVERSITY OF PRETORIA (UP))

Prof Yusuf shared his views based on his personal experience from serving on a number of advisory committees and as a university vice-chancellor during the COVID-19 pandemic.

Most of the disasters recorded in Africa between 1900 and 2019 related to droughts, epidemics, floods and landslides. Disasters had increased substantially since the early 1990s due to the effects of climate change. Public Health Emergencies of International Concern (PHEIC) during the period 2010 to 2018 included Ebola, Zika and COVID-19. The latter caused the highest number of deaths and received the most attention globally. “Perennial” epidemics such as HIV/acquired immunodeficiency (AIDS) had the largest investment and provided lessons on the importance of community mobilisation and trust in government. Non-pharmaceutical interventions (NPIs) requiring behavioural change were key to containing the spread of COVID-19 infections and reducing deaths. People’s behavior was determined by motivation as well as social influences. Reducing mobility was also an effective anti-contagion measure but created a socio-economic emergency that affected some people more than others, and influenced trust in government.

Much was published globally around trust as a driver of behaviour, particularly during the pandemic. The studies found that:

- Compliance with population-level interventions might be undermined by how such interventions affected the livelihood of different groups
- Participation of trusted local leaders and empowered communities was key to effective response to Ebola outbreak in West Africa
- Trust as a construct of social capital was an important measure of absorptive capacity in the resilience pathway in response to disasters.

A survey conducted by UP on the perceived adequacy of government response to the HIV epidemic among 18+ year-old South Africans looked at the role of trust in terms of the connection between the HIV population and the HIV negative population, and found a consistent association between effective governance and a preventive response.

An empirical examination of the extent to which trust influenced attitude and behaviour in response to past epidemics and the recent COVID-19 pandemic, and the implications for building communities’ trust in strengthening resilience to pandemics was instructive. The study was undertaken within the context of Global Health Security Indicators (GHSI) for South Africa in terms of preparedness and drew on multiple data sources. Its objectives were to:

- Look at Google searches and compare these with what scientists were publishing on Google Scholar during the pandemic.
- Examine the role of public perceptions (trust) of government response on preventive practices nationally and compliance with NPIs and vaccine acceptance for COVID-19 prevention in the Gauteng Province.
- Examine trends in community mobility during the pandemic, including impacts of the hard lockdown, in the context of media coverage of Personal Protective Equipment (PPE) corruption and the implications for trust in government.

Results of the study were:

- South Africa was ranked 34th of 195 countries in terms of the indicator for preparedness but had the highest number of deaths and was impacted the most of all the African countries.
- The countries with the most COVID-19 query values on the Google search engine were Uganda, Ghana, South Africa and Kenya.
- Some of the most popular Google search themes from South Africa concerned COVID-19 symptoms and spread, food security, Unemployment Insurance Fund (UIF) payments and the Russian COVID-19 vaccine

- The 530 publications that related to COVID-19 and Africa showed no direct connection between what the population wanted to know about and what the scientists were researching.

The survey involved 2000 respondents from all population groups across Gauteng Province and looked at compliance to NPIs and adherence to health and safety protocols in public spaces. Some of the findings were:

- Less than half the respondents would respond to the restriction in movement.
- Only 55% of respondents shared their contact details when screening for COVID-19, indicating a lack of trust and the importance of taking socio-economic issues into account in managing pandemics from a public health perspective.
- Only 7.4% of respondents definitely trusted the sources of information about COVID-19 and 57% said that they were unsure about whether they trusted the sources of COVID-10 related information.
- Almost 69% of respondents believed that national government (policy-making level) was handling the pandemic well but only 39% felt that the Province (implementation level) was handling the pandemic well.
- Around 35% of the population acknowledged own risk but underestimated threat (known as 'defensive response') and was more likely to be Black African with low education status and low levels of knowledge about COVID-19, and experience a greater social impact from the pandemic. This group was associated with lower odds of wearing a mask and higher odds of taking the vaccine. Responses to future pandemics should give specific attention to this group.

Large-scale corruption reported in the media could have eroded trust and compliance in NPIs in the period before the onset of the second wave of the pandemic. Google mobility data showed that people stayed home and movement in public places was reduced during the first wave. There was less movement overall during the second wave and by the third wave, people moved to public places and no longer stayed at home. They were losing income and moved out to survive even at the risk of death. In effect, there was a complete loss of trust.

The Organisation for Economic Co-operation and Development (OECD) provided a framework on how to rebuild trust to strengthen resilience to pandemics. Trust would have to be built again in order for the country to be better prepared for the next pandemic. The COPC model provided for community healthcare workers who were trusted and known in the communities they served in and could communicate with government institutions through PHCs. This instrument could be used to build trust again and the backlog should be addressed in way that built trust in communities through:

- Providing quality public service
- Minimising uncertainty in the economic, social and political environment
- Providing open and accessible information through participation and citizen engagement through localising global health security
- Combatting corruption, using resources and taking decisions in the public interest
- Improving living conditions for all, irrespective of gender or socio-economic status.

There was a need for effective community engagement in building a resilient approach to future outbreaks. Transparency and clear communication were necessary to inform and build trust, which was a necessary element of pandemic preparedness. Communication should address complacency, confidence (trust) in the system and collective responsibility (community and the state). Effective public communication and leadership were achieved by partnering credible local community leaders and organisations trusted by the community. Promoting NPI adherence needed to target co-created interventions involving low socio-economic status individuals and research should respond to local community needs. Ethically-driven social justice policies needed to be compatible and were instrumentally important in addressing the pandemic in an effective way. Evaluation of outcomes should not only focus on COVID-19 infection and mortality outcomes but also on the broader impacts on health (care), social justice and equity.

THE ROLE OF SCIENCE, TECHNOLOGY AND RESEARCH FOR THE MANAGEMENT OF LARGESCALE DISASTERS IN SOUTH AFRICA (MR DECHLAN PILLAY, DIRECTOR: INFORMATION TECHNOLOGY, INTELLIGENCE AND INFORMATION MANAGEMENT SERVICES, NATIONAL DISASTER MANAGEMENT CENTRE (NDMC))

The NDMC was located within local government in the Department of Cooperative Governance, under the Ministry of Cooperative Governance and Traditional Affairs (CoGTA). The centre was underpinned by legislative framework (Disaster Management Act of 2002 as amended) as well as the accompanying Disaster Management Framework 2005 across the three spheres of government. The NDMC also administered fire legislation (Fire Brigade Services Act, 1987). The NDMC's main objective was to promote an integrated and coordinated system of disaster management with special emphasis on prevention and mitigation by national, provincial and municipal organs of state, statutory functionaries, and other role-players involved in disaster management, as well as communities. Every province, district and metropolitan municipality had to have a disaster management centre to coordinate disaster management in its respective sphere of responsibility. The NDMC's key performance areas (KPAs) related to institutional capacity, risk assessment, risk reduction, and response and recovery. The centre's enablers related to information and communication technology (ICT), training, education, research and funding. The policy framework was enabled by various players such as civil organisations and interest groups.

The NDMC's disaster management function was conducted through various fora and government departments and its advisory forum comprised various technical teams with the national government sector department responsible for implementation. The NDMC coordinated disaster management through its various departments, fora and reporting structures. The National Joint Operational and Intelligence Structure (NATJOINTS) was coordinated through the South African National Defence Force (SANDF) and the South African Police Service (SAPS). The NDMC provided immediate relief grants as well as reconstruction and rehabilitation grants to the provincial disaster management centres and the national sector departments for disbursement. The local and municipal spheres of operation were expected to work in conjunction with the relevant provincial disaster management functions but the levels of efficiency in this regard varied from province to province.

South Africa faced increasing levels of disaster risk and was exposed to a wide range of hazards within the context of its history, varying levels of vulnerability in the community and climate change. Multiple forces were at play from a disaster risk perspective. A hazard within the disaster management formula, which defined the risk at ground level, tended to have two interplaying factors: communities at risk and different levels of disaster impact. Managing disaster at country level required management of certain areas from the local government perspective.

In order to fully understand each type of hazard and its components from various perspectives, the NDMC, working through various institutions in the country, generated a National Indicative Risk and Vulnerability Profile for each hazard. A baseline dataset was used to understand hazards on a month-to-month basis and combined with an understanding of the full component of risk to develop a vulnerability assessment in order to produce a final risk score. Seasonality was also taken into account. Provinces, particularly those that underperformed in terms of understanding their own risk, could use products developed at a national level and redevelop them using the relevant localised data. The NDMC assisted provinces in their advisory role in relation to the disaster management function at a provincial level by helping them develop contingency plans for each season and understand the relevant seasonal aspects and influences in terms of disaster management.

In recent years, the NDMC had concretised partnerships across different institutions in South Africa, including the South African Weather Services (SAWS), which have contributed to the substantial progress made in understanding weather patterns of the different parts of the country. The centre worked with SAWS on impact-based modelling using actual data and a pilot site to understand possible effects of disasters at a local level and how to manage them. Much effort was being put into the use of technology to improve modelling from the forecaster's desk. Indicators and dashboards were informative at local level, particularly when dealing with issues such as language, misinterpretation of warnings and communities' reluctance to act on warnings. The use of modelling for standard operating procedures at a sector, national and

community level, was being factored into the platforms under development.

South Africa's recent registration with the International Charter on Space and Major Disasters provided accessibility to space-based imagery across different disaster platforms globally. Satellite imagery, data information systems, international collaborations and networks around the disaster management function helped the NDMC to verify damage caused and holistically manage a specific disaster. Technology was brought together with the products, the relevant intellectual property (IP) and research through various platforms at the NDMC. One such portal brought active, live weather warnings to communities and provided daily updates to disaster management centres by mapping phenomena on the ground from a spatial perspective. The NDMC continued to manage the impacts of severe weather for the country and produce procedures for impact-based levels of warning, and was reviewing the standard operating procedures to ensure that communities at the coalface of mass flooding, seismic activity, tropical cyclones and other disasters received the necessary assistance. The centre worked to ensure that the financial models were relevant to the function of disaster management from a response and recovery perspective.

The NDMC's work towards understanding the Big Data component of disaster management from the perspective of incoming and outgoing information involved monitoring social networks and identifying hotspots, and developing tools that could also be of help to other national, provincial and local government departments. Activation of ground resources required the use of available communication platforms at the local level to deliver messages, and various reporting tools were being simplified to facilitate the application of information.

The disaster management system was constantly being reviewed and the current operating model was being strengthened across spheres and sectors, bringing in fire services and urban search and rescue components, working with non-government organisations (NGOs), addressing key elements and looking at the critical outcomes of the next three-year period.

OUR CREEPING DISASTER - UNDER-MAINTAINED INFRASTRUCTURE (PROF KEVIN WALL, EXTRAORDINARY PROFESSOR: DEPARTMENT OF CONSTRUCTION ECONOMICS, UP; AND 2018 NSTF LIFETIME AWARD WINNER)

The widespread failure of South Africa's public sector infrastructure to deliver the service for which it was intended was arguably a bigger disaster than those relating to pandemics, public health, climate, floods, water, fires and nuclear. Infrastructure failure was mostly man-made and preventable, yet has continued for many years and was increasing in intensity, affecting everyone on a daily basis. An example was the floods in KZN Province in April 2022, which happened because a natural disaster was hugely exacerbated by failures and neglect of the infrastructure. The extensive flood damage was due to bad planning and a lack of enforcement of regulations. Although the infrastructure was designed to cope with flooding situations it had not been maintained allowing trash build-up and uncontrolled alien vegetation to block calvets and storm water drains. Water shortages were partly brought about by a lack of maintenance of water infrastructure. For example, over 40% of the water supply (water caught in dams, pumped, treated and distributed) to Gqeberha in the Eastern Cape was lost due to leakages. Another example of man-made disasters related to electricity supply and Eskom's failure to build new and maintain existing national infrastructure, as well as local municipalities' neglect of local infrastructure. Another menacing issue related to vandalism and theft of the country's railway infrastructure.

Prominent among the many reasons for infrastructure failure were inappropriate technology, substandard construction, obsolescent before its time, badly operated, in poor condition and ageing. One of the reasons why infrastructure was not properly maintained and operated was the widespread lack of technical skills (civil, mechanical, electrical engineering skills), particularly at local government and municipal level. Prof Wall put forward the following propositions:

- Some kinds of "disasters" would without question be less calamitous if the infrastructure were better managed and maintained
- The fact that infrastructure was not better managed and maintained was a disaster in itself and could not be blamed on anything else, such as climate change.

Business had begun to point out the staggering effects of the country's man-made disasters on its economy. Important indicators of the condition of the country's municipal infrastructure were:

- The Department of Water and Sanitation (DWS) recently brought out its Green Drop certification (awarded for basic compliance, not excellence) after a gap of several years, showing that only 22 of the 965 wastewater systems in the country owned by the public sector were awarded Green Drops.
- The South African Institute for Civil Engineering (SAICE) Infrastructure Report Card for South Africa 2022 assessed the country as being at risk of failure (a D-score), the lowest score it has ever received.
- The Auditor-General's reports of 2022, which pointed out that the current state of the infrastructure was "an indictment on the entire local government accountability ecosystem, which failed to act and arrest the decline that continued to be characterised by service delivery challenges in municipalities…. ".

Some of the obstacles to improving the condition of public sector infrastructure were:

- Often reluctant political will (despite the enormous job creation potential of maintenance works)
- Complex document regulations and time-consuming procedures
- Weak or overburdened skills
- Some infrastructure is too far gone for "maintenance" and needed to be replaced.
- Lack of funding for maintenance and repair.

A National Treasury circular indicated that municipalities should spend 8% of their book value on maintenance and repair, which was inadequate according to good practice, and actual expenditure during 2019/2020 was around 5%. The fact remained that municipalities were responsible for all public sector infrastructure the purpose of which was to deliver services, and given the relatively free availability of subsidies for capital works, they continued to acquire more infrastructure to look after. This huge disaster had an enormous impact on all in this country, especially the poor.

Q&A AND DISCUSSION

Prof. Yusuf was asked if he foresaw any hindrances to technically driven social policy being adopted in South Africa. He indicated that technically driven social policy was instrumental in preparing for pandemics and its adoption would require a collective of civil society nationally that bought into the value system of fairness, for example, in policy in general. Civil society would have to drive the implementation of such policy as government could not be relied on to do so.

In response to a question, Mr Pillay indicated that implementation of disaster management at a local level was difficult but not impossible. Improvements in coordination have been seen in recent years and the disaster management system was constantly being reviewed to keep pace with political interference, large vulnerability levels, global dynamics, changing hazards, population migration and so forth. The role of trust was important for various disasters including pandemics at local level where communities were vulnerable. The NDMC was concerned about vulnerability at the highest level when it came to managing disasters at local level.

Ms Niehaus remarked on the impressive ability of the NDMC to handle large amounts of data and asked whether the centre was sufficiently capacitated. Mr Pillay responded that the NDMC had a very small team and struggled to get enough of the correct people to build the right systems for the centre. It was also about matching people, resources and technology. Working with Big Data required a lot of thinking in the right direction to develop large, forward-thinking platforms to handle massive amounts of data. This work was done in collaboration with partners and an effort was made to avoid the mistakes made by others. At the beginning of the COVID-19 pandemic, the NDMC had a fully functional Big Data platform but no data was being received from the health system. To resolve this problem, the centre routed some of the self-testing apps into the platform to get a picture of the COVID-19 trends in the country. Collaboration at national sector level would enhance functions from a disaster management and other perspectives.

Prof Wall suggested that safe and functioning water and sanitation infrastructure was an extremely important contributor to good health and arguable the number one disease prevention measure of all time. Prof Bester indicated that the role of water and sanitation in preventing epidemic and pandemic disasters

was included in her presentation, but was not presented due to time constraints.

Mr Pillay was asked if it was possible for the NDMC to get comprehensive data of risk and vulnerability nationally if municipalities were struggling to conduct risk assessments, and for clarity on whether a vulnerability assessment had been done for the whole country, and if so, what models and indicators were used.

Mr Pillay was asked whether the NDMC took into account the interconnectedness between and the cascading effects of hazards.

Gordon Branston (Zoom Chat) asked about the following:

- How the *in-situ* disaster management model linked to the *ex-situ* or out of country sources of risk, and whether this currently represented a high-low risk in itself
- The role played by Southern African Development Community (SADC) nations in the anticipation process and close relationship oversight with cross-boundary communities.

Elvis Fosso Kankeu (Zoom Chat) mentioned with regard to the speaker's statement about more deaths related to COVID-19 in South Africa than any other African country, that it was also important to mention the inaccurate reporting of death related to COVID-19 in other African countries. Prof Yusuf pointed out that while South Africa had the highest death rate from COVID-19 in Africa there might be because it has a well-developed health system and therefore able to do surveillance and testing more than many other African countries. Taking this into account, there was still a higher death rate in South Africa. There were speculations that this was because epidemics in West Africa were more frequent than anywhere else, which might bring cross-immunity that could have reduced the severity of COVID-19 in that population. Also, it has been suggested that the anti-malaria drugs widely used in Africa produced a preventive effect.

Prof Wall was asked whether statistics were available on the damage caused to public sector infrastructure by vandalism and theft. He responded that the costs to business could be assessed, but it was difficult to separate the costs relating to normal wear and tear of infrastructure and those related to theft and vandalism. The rapid increase in security related incidents such as the theft and vandalism of infrastructure added to the damage being done by the 'construction mafia' and general violence in the country. There were theories about this but the real reasons have not yet been clearly understood.

Gordon Branston (Zoom Chat) commented that the future finance allocation to South African infrastructure was clearly articulated and a significant amount, and that it would be critical and essential to engage in a whole of systems approach driven by impending climate change risks. This strategy should be financially modelled to ensure that all infrastructure that was built or maintained was future-proofed. Prof Wall pointed out that in order to future-proof infrastructure it was necessary to envisage the future, which was difficult because the future could not be foreseen.

WRAP UP AND CLOSURE

Ms Niehaus invited the speakers to make closing comments:

- Prof Bester concluded that health was more complex than expected and that lessons should be taken from the COVID-19 pandemic, keeping in mind that the African continent would always struggle with communicable diseases due to the lifestyle that people followed which was the major epidemic and consumed countries' funds.
- Prof Yusuf suggested there was a clear connection between public health emergencies and public sector infrastructure, and highlighted the importance of water. Appropriate preparedness had to be planned at a higher level and through systems interventions. Collective responsibility was very important. The disaster caused by NCDs was likely to be driven by lifestyle and commercial interest of corporates and not public health interest, because governments were not trusted. Citizen participation and engagement through localising global health security began at local level extending globally.
- Prof Wall emphasised that the first step towards resolving the problem of infrastructure failure was that stakeholders would have to agree on what the problems and obstacles were. It was important to use the success stories within South Africa as role models. Citizen leadership also made a big contribution

towards resolving these issues.

Ms Niehaus highlighted the following themes from the day's discussions:

- The need for data and the potential for data to monitor and address disasters
- Inequality in society, possibly because the system did not function fully, was reflected in terms of good data and insufficient data in South Africa.
- The country had the potential to build phenomenal infrastructure but the skills necessary to maintain the infrastructure were lacking.
- Skills were needed to address the insufficiencies in the system.
- Government officials needed training in the capture of data and its importance, and in recognising the importance of the infrastructure.

DAY 2

WELCOME TO PARTICIPANTS, INTENDED OUTCOMES AND SUMMARY OF DAY 1 PRESENTATIONS (MS JANSIE NIEHAUS, EXECUTIVE DIRECTOR: NSTF)

Ms Niehaus welcomed everyone to the second day of the discussion forum, particularly those who had not attended on the first day.

She presented a brief overview of the previous day's presentations:

- Prof Bester spoke about South Africa's health disasters and pointed out that the country had a quadruple burden of disease: communicable diseases, maternal and child diseases, violence, injured and trauma, and NCDs. She suggested that health ought to be thought of differently than in the past when it was seen as only the medical sphere. Health was increasingly becoming recognised as happening in the home and the responsibility of individuals. People were taking responsibility for their health and only went to hospital when they had a disease or an accident. This forum could make recommendations around huge improvements that were necessary in the health system. The health sector was unsustainable because less than 16% of the population could afford medical insurance and because the public health sector was not doing well with more than 23% of cases resulting in medical negligence claims.
- Prof Yusuf spoke about building communities' trust for public health disaster resilience and pointed out how trust played an important role in handling the COVID-19 pandemic. A comprehensive literature study looked at communities' trust in governments across the world. Compliance only happened when people trusted their government. South African's trust was corroded by the corruption of the past few years and compliance only happened late in the pandemic because citizens mistrusted the guidance given by the government. While a high percentage of the population complied with NPI related regulations, only about 50% of the population stayed at home partly because they did not have income. This resulted in high numbers of deaths in the third wave of the pandemic. A large percentage of people believed that the messages put out about COVID-19 were exaggerated. South Africa had the highest numbers of COVID-19 infections and deaths in Africa. Prof Yusuf's recommended that trust in the public health system needed to be restored and that this would require effective public communication and leadership as well as ethically driven social justice policies.
- Mr Pillay was in charge of capacity development at the NDMC. The Disaster Management Act of 2002 governed disaster responses and prevention. The NDMC coordinated state departments and entities while the actual disaster relief and prevention happened at ground level, especially the local level of government. He pointed out that South Africa faced an increasing level of disaster risks and that a number of historical factors had made the situation more difficult. The centre worked with a number of institutions including the SAWS on weather warning systems. An impact-based model based on geographic information systems (GIS) had been developed through research and institutional collaboration. The model had been used to assess the damage caused by the recent Jagersfontein disaster. Technology development (platforms for Big Data in particular) was necessary to enable this work.
- Prof Wall spoke about the failure of public infrastructure as the country's 'creeping disaster'. A group that he had been part of was tasked with listing the risks that had dire effects for the country and 80%

of the risks identified related to infrastructure. The disaster caused by flooding in KZN in April 2022 demonstrated the problem of the lack of maintenance of infrastructure particularly well. Although climate change had an effect on disasters, design and maintenance were major causes of disasters. South African cities had immense problems relating to water leakage and Eskom's failure to build more power plants and maintain the existing ones had resulted in the worsening electric supply issue.

WATER-RELATED DISASTERS: PROJECTED EXTREMES AT CLIMATE CHANGE SCALE AND THE NEED TO BUILD A RESILIENT WATER FUTURE (DR BRILLIANT PETJA, RESEARCH MANAGER: CLIMATE CHANGE, WATER RESEARCH COMMISSION (WRC))

Evidence showed an increase in natural disasters and extreme weather events. The Southern Africa region was extremely vulnerable to the impacts of climate change, particularly those that related to water resources and development. The various water-linked sectors had a significant role to play in improving adaptive capacity and increasing resilience to climate change. Impacts of climate change currently being experienced included:

- Floods, including flash flooding, which compounded by inadequate sanitation could increase the spread of waterborne disease
- Erratic rainfall, either less or no seasonal rainfall, which led to water scarcity
- Higher temperatures for longer periods, which resulted in increased evaporation and water use as well as an increased chance of wildfires
- Extended periods of drought, which exacerbated saline intrusion in aquifers
- Ecosystem disruption, which led to the loss of biodiversity
- Rising sea levels, which caused the loss of lives and infrastructure damage.

The WRC partnered with Emanti Management to develop a methodology to help municipalities and water utilities to access and interpret climate change data/information that would help increase resilience and improve capacity. The methodology had been tested in a number of municipalities and was currently being expanded to other municipalities.

Different sectors and sub-sectors (water, agriculture, human health, human settlements and livelihoods, extreme events and natural resources) were affected by climate change. Rising temperatures were expected to bring more heatwaves and a range of other negative impacts including reductions in crop yield and livestock production that would directly impact on water security through inducing enhanced evaporation and changes in land use. Changes in rainfall would result in substantial decreases over the eastern escarpment of the country by the end of the century. Unprecedented dry years might occur between 2016 and 2035 and multi-year droughts were expected to become a frequent occurrence in the eastern part of the country. South Africa's water security would be seriously compromised, hampering future industrial development. Rainfall increases projected over much of Mozambique were likely to result in more tropical cyclones reaching landfall, and South Africa had to be prepared to deal with such risks.

Climate change should not be viewed as a problem but an opportunity. Major drought patterns in terms of frequency and trends in Southern Africa showed that droughts had increased and intensified since the 1950s. The WRC's climate change research programme, established about five years ago, was positioned to contribute to a practical sectoral response through collaborative projects with other countries in the region based on research for developmental impact in three clusters:

- The regional cluster focusing on regional and transboundary climate change impacts and adaptation,
- The national cluster focusing on proactive and adaptive national response and planning, involving all stakeholders
- The local cluster focusing on climate change and water services (operational and local impact).

Strategic water source areas (SWAs) were demarcated and risks identified on a regional and local level. A multi-tiered approach was used to inform an adaptive response involving a united, cross-border effort between countries in the region to protect the SWAs, build adaptive capacity, ensure local-scale adaptation factoring in risk reduction and response to extreme events, and put measures in place to build future resilience. Risk and vulnerability mapping at a local level helped to identify land cover and demarcate

differentiated land use, classify biomes and sensitive ecosystems, and an opportunity analysis for dry and wet seasons provided insights into the effects of extreme seasonal variation and how to build resilience in this regard. The SWA management framework and guidelines for implementation targeted different spheres of government and aimed to protect the quantity and quality of the water produced by maintaining or improving the condition of the SWAs.

In conclusion:

- Climate would always play a significant role in development
- Changes and shifts in climate had a bearing on sectoral development
- Proactive planning was a prerequisite for risk reduction and operational response
- Research played a crucial role in informed decision-making
- Adaptation and mitigation of the impacts of climate change would be unaffordable in the future and had to be attended to without delay.

EARTH OBSERVATION IN DISASTER MANAGEMENT: RISK REDUCTION AND MITIGATION (MR MORWAPULA MASHALANE, REMOTE SENSING SCIENTIST, SOUTH AFRICAN NATIONAL SPACE AGENCY (SANSA))

Earth Observation (EO) technology was used to gather information about the Earth's physical, chemical and biological systems using remote sensing. Various entities such as the WRC and SAWS used the technology to fulfil their respective mandates and for research purposes. SANSA used EO in a variety of applications including water, agriculture, food security, marine research, housing and infrastructure planning, and mining.

In terms of disaster management, SANSA was currently using EO in its work on drought, fires and floods for purposes of mitigation, preparedness, response and recovery. The vegetation condition index was one of the indicators used to measure drought and the advanced fire information system (AFIS) tool was used to identify active fires across the globe and alert the relevant fire authorities. SANSA conducted fire investigations to ascertain how fires were ignited and the damage they caused. Information gathered was used as evidence in legal and insurance disputes. SANSA responded to flood disasters based on directives from CoGTA and notifications of extreme weather events from the NDMC by providing assistance regarding the status of the events and consequent disasters through *in-situ* detection using synthetic aperture radar (SAR) technology, as well as predictions of future flooding through risk mapping and identifying vulnerable areas and sites.

SANSA was involved in disaster damage assessment using EO technology together with local knowledge of the affected area to identify mudslides, flooded areas and potential chemical spills as well as damaged wastewater treatment plants, houses, schools, roads and other infrastructure. SANSA had used EO technology to monitor and assess the situation on the ground during and after the unrest in KZN Province during July 2021.

In terms of human capital development, SANSA ran disaster risk awareness sessions in partnership with disaster management centres targeting the public, schools and professionals, as well as training courses in remote sensing applications with respect to disaster management targeting decision-makers and technical/scientific professionals.

In conclusion, information concerning different types of disasters and potentially problematic areas was made available by SANSA and needed to be applied in order to prevent disasters or reduce their severity. EO technology served as an 'eye in the sky' that allowed SANSA to observe extreme events from space, to quantify them and to alert emergency responses. Satellite imagery also played a huge role in quantifying the damage caused by disasters for audit purposes as well as the allocation of resources.

MANAGEMENT OF FORESTS, GRASSLANDS AND CROPS TO FIGHT FIRE, WHAT ARE THE MEASURES TO TAKE? (PROF KEVIN KIRKMAN, DEAN OF RESEARCH FOR THE COLLEGE OF AGRICULTURE, ENGINEERING AND SCIENCE, UNIVERSITY OF KWAZULU-NATAL (UKZN))

The Knysna fires of 2017 caused seven fatalities, burned 15 000 hectares of land and destroyed around 800 buildings, and raised questions about how to prevent a recurrence of such an event and similar disasters from occurring in other places. Every year, vegetation fires caused the destruction of property and threatened lives and livelihoods, but why?

Africa was often known as a fire continent due to the fact that much of the land comprised savannas and grasslands, and this biomass formed fine fuels that were able to carry fire. Pronounced annual wet and dry cycles were a characteristic of the climate over most of Africa and there were long cycles of drought and high rainfall (for example, El Niño and La Niña). Lightning and human ignition played a huge role in fires and fire spread. Fire was a critical ecosystem driver and affected the structure, composition and function of vegetation. In South Africa, there was a gradient of fire frequency and occurrence in that fire was rare in the semi-desert and arid Karoo yet frequent in mesic grassland areas such as the Drakensberg. It was important to note that natural fire regimes were no longer a reality and anthropogenic influences drove fire and fire occurrences. Fire occurrence almost mirrored rainfall and had a close association with the vegetation biomes. It was possible to predict when fires were most likely to occur based on common weather patterns. The majority of fires occurred between June and October in summer rainfall areas and during the winter or the early part of the rainy season. In winter rainfall areas, fires occurred mostly the summer months and the early part of the rainy season.

Legislation in place in South Africa included the National Veld and Forest Fire Act of 1998, the purpose of which was to prevent and combat veld, forest and mountain fires. The Act legislated fire protection associations, a fire danger rating system, veld fire prevention through firebreaks and other means, as well as fire-fighting. Related legislation included the National Environmental Management Act (NEMA), the Conservation of Agricultural Resources Act (CARA), the National Environmental Management: Biodiversity Act (NEMBA) and the Protected Areas Act.

Fire was a natural phenomenon that had and continued to shape ecosystems. It was involved in and drove nutrient cycling, it created habitats for many species and was an integral part of savannas, grasslands and fynbos. Fire reduced the risk of wildfires but was also the most important natural disaster in South Africa affecting lives, livelihoods and infrastructure, and it caused pollution. The media usually depicted the destructive nature of fire and overstated its negative impacts, while in fact the vegetation in South Africa was very resilient to fire and bounced back quickly. There was a focus on reactive fire management and fire suppression, ignoring proactive fire management and the coverage of aspects such as fire breaks, the role of prescribed fires and the removal of alien vegetation.

The extent and structure of grasslands and savannas was determined by climate, herbivory and fire. In arid areas grasses were generally palatable (sweet), their productivity and fuel load were relatively low and fire was generally erratic and dependent on fuel load and mean annual precipitation (MAP). The woody cover was dependent largely on MAP. In mesic areas, mature grass was unpalatable, biomass and fuel loads were high and fires were frequent and dependent on ignition events. The woody cover was determined largely by fire. Frequent fires correlated to high vegetation diversity. Fynbos was a very fire-prone and fire-dependent shrubland, and a biodiversity hotspot. Fire was integral to the health of fynbos, which was a source of fine fuel and high levels of biomass. It also had a particular fire cycle of around fifteen years. Forest patches and thickets occurred frequently as islands of non-flammable patches resistant to fire due to forest margins that interfaced with surrounding grasslands. Modified ecosystems were found in agriculture and forestry. In contrast to the short agricultural crop and horticultural crop cycles, the plantation forestry industry was based on relatively long production cycles and was significantly impacted by fires. Most plantations occurred within grasslands and therefore, the surrounding areas were subjected to grassland fire ecology. Most crops grown in South Africa did not produce fuel conducive to uncontrollable fires, but dry maize stover left over after harvesting could be a significant fire hazard and was often mitigated by grazing maize stover, which reduced the fuel load. In contrast to plantation forestry, fire in maize stover did not materially affect the next season’s crop and the direct economic impact on the crop yield was low. The risk of other crops burning was relatively low.

Fire intensity was easily measurable and varied depending on the quantity and quality of fuel as well as the weather, particularly wind, hot temperatures and rainfall. Fire regimes could be quantified by fire frequency,

intensity and extent. Ignition also influenced fires. Historically, lightening played an important role in igniting fires in Africa in particular, but humans had become the major cause of fires as landscapes had become anthropogenically influenced. Alien vegetation played a critical role in fire as it replaced indigenous vegetation, changed the structure of the vegetation and was often more flammable.

One of the certainties of climate change was that temperatures were increasing and would continue to increase, and this would facilitate more frequent, intense and hotter fires because of the dry fuel and a longer fire season. El Niño and La Niña events had a significant effect on fire activity and changing rainfall patterns, particularly the time of year that rain fell, led to grasslands encroaching westwards into the eastern Karoo, leading to increased fire activity.

There was a strong interaction between fire and grazing by livestock, which reduced fuel load and influenced fire frequency and intensity. Fire influenced forage quality, impacting significantly on mesic grasslands, and reducing biomass available for grazing. Fire and herbivores "competed" for grass fuel or forage. Patch mosaic burning was a relatively easy and almost natural way of combatting the spread of fire by using fire to fight fire. The National Veld and Forest Fire Act obligated landowners (including municipalities) to burn fire breaks, which slowed down or stopped fires and provided the opportunity to start a backfire in the path of an oncoming fire. They were commonly burnt early in the dry season and in combination with roads or other linear infrastructure. In terms of the ecological impacts of fire breaks in mesic grasslands and savannas, several studies showed that there were slight composition changes if fire breaks were burnt every year, but these changes were not regarded as degradation. Annual fire breaks could be regarded as a sustainable practice. Integrated management involved using fire to reduce fire, strategic fuel reduction, alien plant removal, protecting forest margins, strategic "cool" fires, mosaics and a proactive rather than reactive approach.

The known facts concerning fires in South Africa were about where and when they would burn, the conditions that exacerbated the risks and what to do about the risks. In addition, vegetation biomass and greenness as well as the days since the last fire could be monitored, and fuel load, fire breaks, grazing and alien plant control could be managed. The necessary expertise to do this was available in the country. Extreme fire events ought to be anticipated.

PREVENTION AND PREPARATION FOR NUCLEAR DISASTERS (MR CHARLES KROS, RADIATION PROTECTION SPECIALIST, SOUTH AFRICAN NUCLEAR ENERGY CORPORATION (NECSA))

A nuclear facility was associated with the nuclear fuel cycle while radiological facilities dealt more with man-made radioactive material. There was a significant distinction between the effects of both types of facilities. There were only three nuclear installations in South Africa:

- Koeberg Nuclear Power Station, which had been in operation since 1984/85 and ran two pressurised water reactors of 970 megawatts (MW) each. It was one of the first nuclear power stations designed to be specifically resistant to earthquakes as its reactors were built on top of an aseismic raft. The reactors were cooled by the cold water of the Atlantic Ocean pumped through an isolated circuit at 80 tons a second. The high level waste was stored on site while the low and intermediate level waste was stored in containers that were transported to Vaalputs Radioactive Waste Disposal Facility. Substantial growth of the Cape Town metropolitan area over the years meant that Koeberg had become surrounded by residential suburbs. The facility was regulated by the national nuclear regulator.
- NECSA housed several operational facilities as well as facilities in various stages of decommissioning. The SAFARI-1 research reactor was commissioned in 1965 and currently operated at 20 MW. Initially, it used high enriched uranium but currently it used low enriched uranium.
- Vaalputs Radioactive Waste Disposal Facility, which was located in the Northern Cape. The site was developed for low- and intermediate-level waste and had been in operation since 1986. The waste stored there had to meet a wide range of acceptance criteria.

The International Atomic Energy Agency (IAEA) defined a nuclear emergency as "a non-routine situation or event that necessitates prompt action primarily to mitigate a hazard or adverse consequences for human health and safety, quality of life, property or the environment". Emergency exposure situations included consideration of emergency preparedness and emergency response. The principles of prevention with

specific relevance to nuclear power stations included:

- Design (of utmost importance and standardised globally)
- Confinement (a safety function that prevented material from being released)
- Containment (the physical structure of the reactor building)
- As-Low-As-Reasonably-Achievable (ALARA) (strive to achieve as low waste and exposure to people and the environment as reasonably possible)
- Licensing (authorisation process, oversight and compliance).

Principles of preparedness and response included emergency planning, communication, intervening organisations, exercises, response actions based on action levels.

All knowledge about radioactivity was based on various forms of research and experimentation that had been conducted since its discovery. Regulations instituted by a variety of authoritative organisations such as the International Commission for Radiation Protection (ICRP), United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), WHO and the IAEA, formed the basis of national regulations and legislation relating to radioactivity.

Examples of the use and application of the existing knowledge about radioactivity and in the prevention of and preparation for nuclear disasters were:

- The Life Span Study (LSS), a research programme investigating life-long health effects based on epidemiologic studies. The ongoing study monitored 120 000 people (94 000 survivors of the atomic bombing of Hiroshima and Nagasaki in 1945, and 26 000 unexposed individuals), and formed the basis of what was known today about mortality and cancer incidents after exposure to radiation at a low dose rate. The risk coefficients were internationally accepted for exposure to radiation and formed the basis for numerous regulations such as the limits for exposure and the design of a nuclear facility. The ICRP laid down the fundamental principles for radiation protection and quantitative bases upon which appropriate radiation protection measures could be established. The impact of a release of radioactive material could be evaluated based on physical data collected about radiation and the environment.
- In the context of environmental protection as a recent development, the ICRP had recently concluded that there was a need for a broad international basis for evaluating and managing the actual or potential impact of radiation on the environment.
- Radiation could affect materials and devices in deleterious and beneficial ways, for example:
  - By causing the materials to become radioactive
  - By radiolysis (breaking chemical bonds)
  - Radiation detection instrumentation
  - To treat cancer.
- The Fukushima nuclear accident in Japan in 2011 was the most recent of three extensive nuclear accidents that had taken place in the past. The other two were:
  - The Three Mile Island accident in the United States in 1979: Radioactive material was blocked by containment and only a small amount was released into the environment.
  - The Chernobyl accident in 1986: A great amount of radioactive material was released directly into the environment resulting in the evacuation of all inhabitants within a 30 km range and causing the death of 28 people who had been exposed to radiation. Almost 40 years later, the facility remained under decommissioning.

  The Fukushima nuclear accident happened when an earthquake caused a tsunami that washed over a wall and part of the facility bordering on the ocean causing power and systems' outages. A direct hydrogen explosion destroyed the roof of the plant resulting in a large airborne release of radioactive material into the environment. The amount of fission product released was about one-tenth of what was released in the Chernobyl accident. An international collaboration evaluated the causes and effects of the Fukushima nuclear accident and found that it was a result of a combination of factors: the location, duration and the effects of the tsunami, which was not severe. The outcomes of the evaluation were that more demanding requirements were needed for protection against external natural hazards and that the international community should consider enhancing the independence of safety levels and bring in more levels of defence. Nuclear facilities throughout the world were subjected to a safety re-evaluation (called a stress test) and had to consider improving reliability on different safety levels.

Design requirements would have to take into account natural hazards of an estimated frequency above 1 in 10 000 years, as opposed to the previous 1 in 1000 years.

UNSCEAR only recently published findings of their research on the impacts of radiation on humans, and concluded that the results from the Fukushima accident showed that cancer rates remained stable and that there was a theoretical increased risk of thyroid cancer among most exposed children, no impact on birth defects or hereditary effects and no discernible increase in cancer rates for workers at nuclear plants.

Core meltdown that occurred during the accident necessitated cooling of the units, which generated an astonishing amount of contaminated sea water that had to be treated to remove the radioactive materials and stored in tanks. However, tritium could not be removed from the water. Knowledge of the effects of tritium on humans and the ocean and of how it would behave in the ocean (based on the characteristics of the ocean) made it possible to assess and quantify the effects of releasing tritium into the ocean, which proved to be negligible. This was supported by the IAEA and ultimately the scientific community, although some resistance from the public remained.

- The Comprehensive Nuclear Test-Ban Treaty Organisation (CTBTO), a body of the United Nations, aimed to prevent nuclear tests or nuclear explosions. It established an international monitoring system with 337 facilities across the globe consisting of seismic, hydroacoustic, infrasound and radionuclide monitoring stations, which had many advantages, such as real-time detection (and prediction) of earthquakes, tsunamis and volcanic eruptions, as well as confirming radioactive explosions.

In terms of the future of nuclear, Small Modular Reactors (SMRs) generated about 300MW of electricity and had many advantages and potential uses. From the perspective of the nuclear community, SMRs were also much safer in that the design requirements could be determined upfront, the inventory of radioactive material would be substantially smaller and in the event of emergency or a scenario, the impact would be significantly less than that of a nuclear power station. The IAEA was assessing the level to which its existing safety standards could be applied to innovative technologies and enhance safety levels.

In conclusion:

- Nuclear was inherently safe and based on sound scientific principles
- Nuclear disasters could be prevented by learning and improving on design of facilities
- Science played a significant role in preventing and managing nuclear disasters
- Science contributed to preventing accidents, but accidents contributed to improved understanding of radiation science and the validation of models.

Q&A AND DISCUSSION

Elvis Fosso Kankeu (Zoom Chat) asked about alternative options to ensure continuous water supply in the case of extreme drought. Dr Petja indicated that the WRC's programme on the circular economy was about the efficient management of existing resources and infrastructure. The country's groundwater was largely under-utilised. Giyani in Limpopo Province was a permanently dry area. The WRC conducted a follow-up study to a previous one that had identified groundwater in the area, to investigate the ability of the groundwater to be recharged when continuously utilised. Similar interventions had been done in other areas that had become self-sustainable over time in terms of water supply. This was proof that a small investment could make a big difference and increase resilience and sustainability.

Mmotong Phahlane (Zoom Chat) asked how the impacts of mitigation efforts implemented could be measured and whether the livelihood vulnerability index could be used for this purpose. Dr Petja pointed out that many programmes on sustainability and resilience of water supply had been implemented but a continuous monitoring and evaluation programme was required to be able to measure the return on investment and justify expansion in other areas.

Dr Petja was asked whether the WRC would work with the other government department to ensure that rain harvesting became the norm in housing developments, for example. Dr Petja supported the idea of rain harvesting, adding that a regional approach was needed to ensure sustainability of the water resource.

Underground storage could be used to store flood water as a future resource and prevent the risk of flooding in settlements. Many areas of the country would benefit from rain harvesting. Bylaws should ensure that rain harvesting was implemented operationally and effectively at a household level.

Manana (Zoom Chat) enquired about the extent to which remote sensing capabilities had been effective in detecting natural disasters in South Africa and how these technologies contributed to mitigation plans.
Mr Mashalane believed that EO technologies were very effective in terms of providing early warnings for mitigation. The Agriculture Research Council (ARC) dispatched monthly updates on droughts and the DWS's water information dashboard (National Integrated Water Information System) used information derived from EO as well as ground-based information to provide early warning regarding drought. The SAWS also issued regular warnings of possible rainfall and flooding. SANSA also prepared a flood risk map that was distributed to municipalities and government departments for application. SANSA worked very closely with CoGTA, the NDMC and provincial and local disaster management centres to provide information as and when required to facilitate decision-making. Application of the information by those on the ground was not part of SANSA's mandate.

Zahna Steynberg (Zoom Chat) asked about the response time of remote sensing capabilities, particularly in a rapidly evolving emergency or disaster. Mr Mashalane indicated that all the disasters that SANSA had dealt with had occurred very quickly and the response time proved to be adequate, but could be improved. SANSA, through the International Charter on Space and Major Disasters, had access to satellite imagery vendors around the world. This allowed the agency to receive the first satellite imagery within 24 hours of a disaster happening. The imagery was processed and the information fed to the NATJOINTS within the shortest time possible.

In response to a question about whether climate change posed a threat to the current methods used to dispose of nuclear waste, Mr Kros explained that the location chosen for radioactive and nuclear waste was based on acceptance criteria and that the geology of the location was well researched and characterised. The area received almost no rain and had almost no groundwater. Prof Kirkman added that the risk of fire was also very low in the area of the location and it would be easy to implement management strategies to ensure that the fire risk became almost non-existent.

Mr Kros confirmed that the building of reactors had improved since the three nuclear accidents had occurred. For many reasons, reactors built today were vastly different from those built in the 1980s. Lessons had been learnt from the accidents and the necessary steps were taken to improve the design and construction of nuclear facilities. In addition, members of the international nuclear community held each other accountable. He believed that the United States was the current leader in SMRs and explained that it would take another eight to ten years before SMRs could be commercialised.

In response to a question about whether farmers still made fire breaks to prevent fires, Prof. Kirkman explained that the National Veld and Fire Act required all landowners (including farmers) to protect their properties from fire and prevent fires on their properties from spreading to neighbouring properties.
Farmers generally formed fire protection agencies within their areas and coordinated fire breaks on commercial farms. Fire was generally reasonably well contained in farmland areas. Local government was responsible for the protection of the land they owned as well as residential areas from fire. Many municipalities owned substantial land, such as common land for grazing or forestry land, and generally failed to fulfil their obligations to maintain fire breaks and prevent the spread of fires. The Knysna fires were a case in point as very little had been done proactively to prevent any potential fires. Municipalities and metropolitan areas had a high awareness of what they needed to do to prevent fires on the many open areas between settlements and/or residential areas, but they did not have a fixed plan and were not taking the necessary steps proactively. This was one area were responsibility had to be taken and where fires did the most damage to lives and to property.

WRAP UP AND CLOSURE

Ms Niehaus came to the conclusion that it appeared that South Africa had sophisticated technology to monitor and predict emergencies, and to handle emergencies, but there were gaps in the implementation,

and that local government, in particular, could do more to prevent disasters and mitigate them, and ought to be empowered to do so and to take the risks seriously.

Ms Niehaus thanked the speakers for their presentations and those who attended the forum both in-person and online.

ANNEXURE A: ATTENDANCE LIST

Organisation Name	Title	Name	Surname
Black Women in Science (BWIS)	Mrs	Desree	Mcunu
	Mr	Simo	Mcunu
Department of Agriculture	Ms	Faith	Mdhluli
	Miss	Ketshepaone	Modise
	Miss	Rachel	Mojapelo
	Dr	Matjutla	Mokgoebo
	Ms	Precious Kgomotso	Mokgope
	Ms	Suzan	Mokwatlo
	Ms	Keletso	Monareng
	Dr	Seithati	Motebang
Department of Science and Innovation (DSI)	Dr	Gilbert	Siko
	Dr	Karishma	Singh
	Mrs	Nolitha	Skenjana
	Ms	Odette	Smith
	Mrs	Maronel	Steyn
	Ms	Zahna	Steynberg
	Mrs	Edith Wynne	Trollip
Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN)	Mr	Tshilidzi	Madzivhandila
	Ms	Vaneshree	Maharaj
	Ms	Pumza	Makaula
	Ms	Itumeleng	Makgato
	Ms	Sanari Chalin	Malele
	Dr	Pholani Sakhile	Manana
	Mr	Jaco	Marais
	Ms	Linka	Maritz
	Dr	Tshimangadzo	Matamba
Human Sciences Research Council.(HSRC)	Mr	Jerry	Mathekga
	Miss	Anathi	Mbona
	Mr	Emmanuel	Mbuwe
Institute of Natural Resources (INR)	Dr	Admire	Nyamwanza
	Dr	MO	Ogunlana
	Dr	Rene	Oosthuizen
	Miss	Karabo Josina	Padi
	Mr	Mmotong	Phahlane
	Ms	Boitemogelo	Phale
Nelson Mandela University (NMU)	Mrs	Liezel	Yeratziotis
North-West University (NWU)	Prof	Alinah	Segobye
	Mr	Khobane Albert	Sekgobela

Organisation Name	Title	Name	Surname
	Miss	Rirhandzu	Shingange
South African Council for Natural Scientific Professions (SACNASP)	Prof	Khathutshelo	Nephawe
	Dr	Thobela	Nkukwana
	Ms	Nolubabalo	Ntunzi
	Ms	Santie	Van Niekerk
South African Association for Food Science and Technology (SAAFoST)	Ms	Ingrid	Woodrow
Southern African Association of Science and Technology Centres (SAASTEC)	Mr	Daniel	Motsapi
	Dr	Ephias	Mugari
Stellenbosch University (SUN)	Dr	Robyn	Pharoah
	Dr	Karin	Pruessner
	Dr	Patricia	Zweig
Tanzania Broadcasting Corporation (TBC)	Ms	Vumilia	Mwasha
University of Cape Town (UCT)	Prof	Marianne	Vanderschuren
University of the Free State (UFS)	Prof	Johanes	Belle
	Dr	Gerda	Botha
	Mr	Gordon	Branston
	Miss	Andrea	Campher
	Miss	Sandra	Carminati
	Mr	Noel	Cheers
	Mr	Mboniseni	Dlamini
	Mrs	Ana	Doherty Bigara
	Mrs	Heather	Erasmus
	Prof	Elvis	Fosso Kankeu
University of KwaZulu-Natal (UKZN)	Dr	Tanja	Reinhardt
	Dr	Douglas	Sanyahumbi
University of Venda (UNIVEN)	Mr	Tsietsie Ephraim	Kgatla
	Ms	Mapule	Kgwale
	Ms	Noxolo	Kunene
	Ms	Mampe	Letsoalo
	Prof	Antoinette	Lombard
University of the Western Cape (UWC)	Dr	Tesfaye Tessema	Gintamo
	Ms	Indrani	Govender
	Mrs	Rose	Gwanpu Epse Gwanfogbe
	Dr	Lulamile Theo	Jongwana
University of the Witwatersrand (Wits)	Prof	Laurel	Baldwin-Ragaven
			Unknown 1
			Unknown 2

Organisation Name	Title	Name	Surname
			Unknown 3
			Unknown 4
			Unknown 5
			Unknown 6
			Unknown 7
			Unknown 8
			Unknown 9
			Unknown 10
			Unknown 11
	Mrs	Nozuko	Wisani
	Ms	Ronette	Wolfaardt
SPEAKERS			
NDMC	Ms	Dechlan	Pillay
NECSA	Mr	Charles	Kros
NWU	Prof	Petra	Bester
SANSA	Mr	Morwapula	Mashalane
UKZN	Prof	Kevin	Kirkman
UP	Prof	Kevin	Wall
UP	Prof	Lekan-Ayo	Yusuf
WRC	Dr	Brilliant	Petja
NSTF STAFF			
	Ms	Kelebogile	Galeboe
	Mr	Barnard	Manne
	Ms	Refiloe	Miyeni
	Ms	Mankwe	Mojapelo
	Ms	Jane	Mokgwatshane
	Ms	Seipati	Moleleki
	Mr	Matome	Mphela
	Ms	Itumeleng	Ndlovu
	Ms	Jansie	Niehaus
	Ms	Nonsikelelo	Nkwanyama
	Ms	Kgaugelo	Pule

ANNEXURE B: LIST OF ACRONYMS

BWIS	Black Women in Science
CoGTA	Cooperative Governance and Traditional Affairs
COPC	Community Oriented Primary Care
COVID-19	Coronavirus Disease of 2019
DWS	Department of Water and Sanitation
EO	Earth Observation
HIV	Human immunodeficiency virus
IAEA	International Atomic Energy Agency
ICRP	International Commission for Radiation Protection
KZN	KwaZulu-Natal
MAP	Mean annual precipitation
MW	Megawatt
NATJOINTS	National Joint Operational and Intelligence Structure
NCD	Non-communicable disease
NDMC	National Disaster Management Centre
NECSA	South African Nuclear Energy Corporation
NPI	Non-pharmaceutical intervention
NSTF	National Science and Technology Forum
NWU	North-West University
PHC	Primary Healthcare
SANSA	South African National Space Agency
SAWS	South African Weather Services
SMR	Small Modular Reactor
SWA	Strategic water source area
TB	Tuberculosis
UKZN	University of KwaZulu-Natal
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
UP	University of Pretoria
WHO	World Health Organisation
WRC	Water Research Commission