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National Science and  
Technology Forum

## Media Release

*S.E.T. for socio-economic growth*

### Using collaborative science for fair and responsive disaster management

“We must consider social justice when planning for disaster response, recovery and prevention. Work based on science helps to guide decision-making during such crises, from evacuation planning, search and rescue, health and safety monitoring, to basic resource provision and environmental restoration,” said NSTF Executive Director, Jansie Niehaus.

The [National Science and Technology Forum \(NSTF\)](#) held a Discussion Forum in hybrid format at the [World Science Forum \(WSF\)](#) in Cape Town which took place in December 2022. The main theme of the WSF was Science for Social Justice, and the NSTF Discussion Forum was on [Science and Disaster Management for Social Justice](#). The Discussion Forum took place on 5-6 December and was planned with the [Science Councils and Statutory Bodies membership sector](#) of the NSTF.

The NSTF Discussion Forums offer a platform for constructive interaction and discussion among stakeholders on priority areas of concern to the SET community including policy issues. Topics are relevant to current local and global socio-economic scenarios where SET can make a positive difference and contribute to the achievement of priorities that aim towards a thriving South Africa.

Ms Niehaus: “The scale, impact and occurrence of natural, human-made and epidemic disasters seem to be increasing. The impacts of these disasters result in environmental, social and economic imbalance. As a result of this, the livelihood of the people in crisis-affected areas is severely impacted. Our Discussion Forum speakers shared their learning and insight on what ‘being prepared’ means, what ‘prevention’ entails and lessons learnt from recent disasters, and the role of science, engineering and technology (SET) and innovation in preventing and managing disasters.”

The following presentations were delivered during the two days (*click on the topics to access the recordings*):

1. [Prevention of epidemic and pandemic disasters – A transdisciplinary health perspective](#): Professor Petro Bester, a Transdisciplinary Health Researcher at the Faculty of Health Science at North-West University (NWU)
2. [Building Communities’ Trust for Public Health Disaster Resilience](#): Professor ‘Lekan Ayo-Yusuf, Head of the School of Health Systems and Public Health at the University of Pretoria (UP)

3. [\*The role of science, research and technology in the management of large-scale disaster affecting vulnerable communities in South Africa\*](#): Mr Dechlan Pillay, National Information and Communication Systems Developer at the National Disaster Management Centre (NDMC)
4. [\*Our creeping disaster – undermined infrastructure\*](#): Professor Kevin Wall, civil engineer and town planner and Extraordinary Professor at the UP
5. [\*Water-related disasters: Projected extremes at climate change scale and the need to build a resilient water future\*](#): Dr Brilliant Petja, Research Manager for Climate Change at the Water Research Commission (WRC)
6. [\*Remote sensing applications to flood disasters\*](#): Mr Morwapula Mashalane, Remote Sensing Scientist at the South African National Space Agency (SANSA)
7. [\*Management of forests, grasslands and crops to fight fire\*](#): Professor Kevin Kirkman, Dean of Research for the College of Agriculture, Engineering and Science at the University of KwaZulu-Natal (UKZN)
8. [\*Prevention and preparation of nuclear disasters\*](#): Mr Charles Kros, Radiation Protection Specialist at the Nuclear Energy Corporation of South Africa (NECSA)

While the speakers all gave a sobering and candid account of South Africa's (SA's) preparedness to respond to a range of disasters, they also agreed that the country and those responsible for disaster management and ensuring that all South Africans benefit equally from such, already have sufficient knowledge to make sensible and fair decisions. South African science provided and continues to provide much of this knowledge as do the many lessons already learnt from past disasters.

The speakers, unintentionally, were united on two key themes.

### Transdisciplinary collaboration and participation is key

After sketching the challenges of SA's disease burden and its multimorbid population, Prof Petro Bester (NWU) emphasised the necessity of academia linking up with non-academia in communities to find solutions for wicked problems (complex problems that seem to be impossible to solve entirely) to benefit from transdisciplinary wisdom and experience.

#### **Multimorbid population:**

Many people suffer from more than two chronic diseases which include hypertension, diabetes, HIV, heart disease, TB, and cancer.

She singled out the 1942 Pholela campaign in KwaZulu-Natal where the medical community promoted health as a 'social event' that happens in houses and communities instead of hospitals and clinics. "The health facility became a social node where people were taught skills, for example personal hygiene, healthy eating, planting and harvesting one's own food, earlier identification of illness and some indigenous ways of treating such," she explained. Unfortunately, during the 1980s and '90s in South Africa, the campaign became too expensive and quietly dissolved.

The National Health Plan of 1994 was focused on a comprehensive health

#### **Comprehensive health system:**

Comprehensive care in the world of

system, following the primary healthcare approach but in 2018, the community-oriented primary healthcare approach as espoused by Pholela was once again launched. “In health we have come full circle of going back to basics. Health prevention of pandemics and epidemics in our country while also addressing the social determinants of health.”

health means that you can enter almost any health facility to find preventative care, primary healthcare, curative care—where we start to treat illness and disease—and rehabilitation.

Looking at the other part of SA’s reality, Prof Bester explained that, “Of the more than 60 million people in this country, less than 16% is responsible for maintaining an extremely expensive private industry.... The cost of private healthcare is growing annually to a point where it is not affordable anymore. This is a health system that is conflicted.”

That said, private healthcare is a smaller but “very essential part of the health system, and Covid-19 indicated to us that if it is really necessary, there can be collaboration between these two contrasting parts of one system”.

Another area requiring the collaboration between disciplines (health, information technology, big data, communities, etc.) is information acquisition and management. She referred to the district health information system—or archaic nature of it—as “part of our Achilles heel in pandemic management”.

The districts and community champions also play a huge role in partnering with national and local government to pre-empt and respond to disasters. “In pandemic prevention, the district centres are major role players or nodes for information. The ward-based outreach teams latch onto the communities (through the community health centres and primary health clinics), and typically, this will involve a retired nurse who knows the region and area and who leads a team of community health workers who, for epidemic prevention, knows, for example, which house has an HIV-positive person, which house has a terminal patient, where is a child who is

*“Health promotion summarised is that you need to give people back the responsibility to take control over the environment and their own health. We have come from a history where health was the responsibility of the church, the military, the state. We have to help people to take back this responsibility.”*

not thriving, and so on—they become the eyes and ears that bring back the information to the clinics and centres.”

**Mr Dechlan Pillay** from the National Disaster Management Centre (NDMC) spoke at length about the dependence of the whole disaster management community on one another to ensure holistic approaches to plan for, prevent, and address disasters.

The functionality of monitoring tools developed in partnership with others also attests to this. In addition, **Mr Morwapula Mashalane** from SANSA alluded to its disaster risk awareness sessions in partnership with the disaster management centres that target government officials, sector professionals and universities. These sessions are in aid of developing human capital.

Pillay said that the NDMC, in partnership with SA Weather Service, has been developing the Impact-Based Early Warnings System within a South African context. This model

includes forecast notices paired with geographical and temporal vulnerabilities per geographical area to assist in the planning for severe weather impacts. To cater for the many different stakeholders—from authorities to community leaders—these impact-based warnings and subsequent monitoring activities are then available on many dissemination platforms including: e-mail, WhatsApp, SMS and web services via the NDMC geographic information system portal. The media is also included: In anticipated large-scale weather events three/four-day warnings and media statements are distributed by both the national and regional Weather Service entities.

Pillay explained that the dashboards are quite informative, “When it comes to the local levels we have issues around language and a misinterpretation of the warnings as well as local radio not broadcasting the warnings correctly. There is also a reluctance in communities to act on the warnings. We have taken the modeling further in not only standard operating procedures that come from a sector or a national level but also just what the community would do in the event of excessive rain, for example.”

When the Jagersfontein disaster happened in 2022 where a slime dam burst its banks and covered most of the communities in proximity, these images could show in great detail the size and spread of the disaster and which communities were affected. By comparing images from before the event to those after the event, it was easy to see what had been damaged so that the correct relocation and other interventions could be taken.

“We also make sure that we use whatever technology is available, even WhatsApp groups, to ensure that the disaster management stakeholders, including traditional leaders and councillors get the information they need.” They have done impact-based modelling to find out how people respond to warnings they receive—do they just read it or do they act upon it?

Big data capabilities are essential and here the NDMC focuses on developing large forward-thinking platforms that can handle massive amounts of data.

“We do this in collaboration with our partners and this is what takes the organisation forward. The big data platform is in its fifth year and we took two years just to lay down the foundation to understand how this works, especially from a public sector perspective.”

In terms of working with local communities, he said, “The coordination is much better than five years ago because we are constantly trying to improve the system of disaster management against all the other runaway issues at a local level—political interference, large vulnerability levels, changing hazards, global dynamics, populations migrating—so the dynamics at local level remain the same, we are just trying to make the function better.”

*“Obviously, working with NGOs remains important to understand what is the best for the country in addressing the key elements in the revised [NDMC] operating model, and also looking at the critical outcomes in the next three-year period. These include reduced mortality, number of affected people, economic losses, and damage to critical infrastructure; increased disaster risk reduction strategies, programmes and plans; increased cooperation and collaboration; and increased access to early warning that leads to early action.”*

**Dr Brilliant Petja** from the WRC said that, “We have seen a record increase in natural disasters and extreme weather events. These changes in climate and increased variability bring significant implications to different water-linked sectors and therefore all the affected sectors have a significant role to play in improving the adaptive capacity and increasing the resilience to climate change.”

The WRC’s practical sectoral response looks at the regional and transboundary climate

change impacts and adaptation. “We diagnosed the problems brought by climate change and how to deal with them to increase resilience and sustainability at regional and transboundary levels. We have a programme working with different countries—Lesotho, eSwatini, Kenya, Zambia and others. We join efforts to face these challenges and build a response programme.

“Nationally, we look at the proactive and adaptive national response and planning which include all the stakeholders and sectors affected. From there we go to the local government catchment scale, looking at water services. We started this Climate Change Research Programme about five years ago and it has proven to work very well and, united, we make a bigger impact in improving resilience.”

In one approach, the WRC worked with partner institutions to look at how to respond to strategic water source areas. These were demarcated and risks and threats were identified as well as possible solutions.

Dr Petja showed examples of the floods usually experienced in extreme weather events and their impact on infrastructure. He said, “The intensity of floods experienced in Mozambique can be minimised by building infrastructure to capture the water in Zimbabwe and make it available to the rest of SADC.”

At the local district level, Dr Petja said they considered what is at stake on the ground in terms of land cover, land use, biomes and sensitive ecosystems. The tools developed for this enable a stakeholder to drill even deeper and look at the level of degradation (where floods will create even more havoc). Degradation can be identified before reaching severe stages. The tools also look at ecologically sensitive ecosystems such as wetlands and estuaries.

*“Working with other countries is essential as floods do not adhere to country borders.”*

**Mr Charles Kros** from NECSA expounded on the Fukushima accident of 2011, and highlighted that one of the lessons learnt concerns the importance of communication with and between stakeholders as well as with the public. “We saw with the Fukushima accident how complex the communication mechanisms were with the public and organisations; you have to rely on intervening organisations, you cannot do everything yourself if you are a nuclear facility under duress.”

Kros said science—and by implication the many different roleplayers in the scientific community—contributed everything we know about radiation. “Everything we know is based on some form of research or experiments that were conducted since the discovery of radioactivity and we have learnt to use those. We also have some authoritative organisations in this space, such as the International Commission for Radiological Protection, the United Nations’ committees for the effects of atomic radiation, the World Health Organization, and the International Atomic Energy Agency.”

The rules from these organisations then find their way in national legislation, involving government decision- and policymakers but also the local scientific community.

Kros also discussed the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO). The CTBTO has established an International Monitoring System and its 337 facilities across the globe ensure that no nuclear explosion escapes detection. The facilities consist of seismic (underground), hydroacoustic (audio under water), infrasound (audio above water), and radionuclide (sniffing for radiation) monitoring stations.

Examples of civil and scientific uses of these transdisciplinary collaborations include the real-time detection of earthquakes and tsunamis; radiation dispersal from nuclear

accidents; and volcanic eruptions. For example, the 4 August 2020 Beirut explosion was detected by five international monitoring stations from as far away as 6 000 km and with a location accuracy of 44 km within hours of the event.

### Acting on what we already know is key

**Prof 'Lekan Ayo-Yusuf** (UP) reminded the audience that SA remains the world 'capital' in terms of HIV/AIDS and that the country has learnt many lessons during this journey which it has shared with other countries. Yet, he said, during the COVID-19 pandemic, "we behaved like we never had something so big in South Africa".

Some key learnings from the Covid-19 pandemic, he said, are that non-pharmaceutical interventions that require behaviour change are key to containing the spread of the infection and in reducing deaths.

"In terms of the literature, there has been a lot of publications around trust and how that drives behaviour, particular relating to the Covid-19 pandemic," he shared. The research from Pagliaro et al (2021) showed that trust in government's response and towards science predicted the willingness of large populations to engage in prescribed Covid-19-related behaviour change while publicising the number of infections was not significant in driving change. It is thus important to examine the extent to which trust influenced attitude and behaviour in response to the pandemic and the implications thereof for building communities' trust in strengthening resilience to pandemics.

Referring to the Organisation for Economic Co-operation and Development (OECD) framework on how to build trust, he said, "We need to build trust again to better prepare for the next pandemic. We all know this is not the end of the pandemic but the disaster could get worse if we are not prepared and if we do not learn from what we have gone through. We need to minimise uncertainty in the economic, social and political environment to strengthen resilience to pandemics and provide open and accessible information through citizen engagement and participation. The most effective way to do this is to localise global health security. In the HIV movement, the civil society organisations showed how this can be effective when you do it at community level. Of course, we need to combat corruption, and use resources and take decisions in the public interest."

He referred to the three Cs that must be addressed in disaster-related communication messages:

- Complacency (knowledge and risk to person/family and preparedness);
- Confidence (trust) in the system; and
- Collective responsibility/interests in response (national solidarity).

*"In going forward, promoting non-pharmaceutical intervention compliance must also include interventions that respond to the social and economic costs of vulnerable populations. Research responding to local community needs would go a long way in building trust towards science."*

From an NDMC perspective, **Mr Pillay** identified risk assessment as essential to rightly address disasters. This involves defining the hazard and understanding risk on the ground—a very important component of risk reduction, and response and recovery.

Understanding the hazard is essential and to this end, research plays a big role. The NDMC is legislatively tasked with the generation of a National Indicative Risk and Vulnerability Profile for various hazards. To date, the NDMC has completed risk and vulnerability profiles for drought; windstorms; snow; and lightning, seismic, and coastal flooding risks.

*“It is really about understanding the different components of the hazard. This makes a difference because when we deal with the sectors, we need to be dealing with the proper interventions from a hazard perspective.”*

Looking at the state of infrastructure, **Prof Kevin Wall** (UP) said, “Possibly a bigger disaster than pandemics, climate-related events, fires or nuclear and one that has been ongoing for many years, is the widespread failure of our public sector infrastructure and the failure to then deliver the service for which that infrastructure was intended.”

Using numerous photos showing the damage caused by recent floods, he conceded that these floods were natural disasters but that the impacts were hugely exacerbated by the failures of infrastructure.

Infrastructure failure is mostly manmade and preventable. Reasons for these failures include:

- Using inappropriate technology in the first place
- Substandard construction
- Not big enough—either from the start or just not big enough anymore
- Obsolescent before its time
- Badly operated
- In poor condition
- Ageing before its time (because of not being maintained or operated properly).

One of the reasons why so much infrastructure in the country is not maintained or operated properly is a lack of technical skills: civil, mechanical, electrical, and chemical engineering. Prof Wall showed a map indicating that the majority of municipal areas have one or less skilled civil engineer, technologist or technician.

Inefficient budget spend is another reason for insufficient maintenance. Prof. Wall showed that the 2019/20 budgeted amounts for the nine metros are less than 8% (the minimum amount of book value to be spent on maintenance and repair, as per Treasury regulations), some as little as 2%. What they are actually spending is even less. For example, Johannesburg budgeted 6% and used 2.7% for infrastructure maintenance and repair, Cape Town budgeted 7.5% and spent 2.3%, and Nelson Mandela Metro budgeted 2.6% and spent 1.6%.

“So now what? They don’t have the money but to be spending as little as many of them do is folly, and the fact remains that they have a responsibility for all of this infrastructure, the purpose of which is to deliver services.”

The causes of South Africa’s dismal state of infrastructure are well-known, and thus addressing these should not only be possible, but also a priority.

*“It's time we stop building and start fixing things.” - Dr Imtiaz Sooliman, Gift of the Givers founder*

From a climate change perspective and looking at the projected changes in temperature in the southern parts of Africa, **Dr Petja** shared, “The message has been loud and clear. The projections show increases in temperatures where heat waves will become regular. Rising temperatures will, among other adverse effects, reduce crop yield and livestock production, and directly impact on water security through increased evaporation and land-use change.”

His presentation showed that climate will always play a significant role in development and that changes in climate have a bearing on sectoral development. Knowing this, proactive planning is a prerequisite for risk reduction and operational response. In addition, research plays a crucial role in informed decision-making.

Elaborating on the WRC's work on strategic water areas and what is known about their location and factors that impact future sustainability, he said, "First [priority] is to protect our current water sources and then build an adaptive capacity which will improve our local adaptation. Risk reduction and response to extremes are factored in. For example, the future says this area which is characterised by this type of settlements will face an increase in floods. So, what is the appropriate infrastructural response that will help us to ensure that instead of the flood water being a hazard, we build underground infrastructure to capture and store water to be used later during the years of drought."

*"We need to take care of these natural resources to be better prepared to deal with the disasters and to build a resilient future—and not wait for the future to regularly see these disasters."*

**Mr Mashalane's** presentation showed that Earth observation technology (remote sensing) goes a long way in assisting those tasked with identifying, managing, and responding to disasters.

"The information supplied provides valuable input for a variety of decision-makers, impacting areas such as food security, ocean resources, water management, disaster management, housing development, infrastructure planning, mining safety, national safety and security, military, and agriculture," he said.

He gave examples of where SANSA was able to map floods and mudslides as these happened, significantly accelerating the process of quantifying the damage. SANSA is not only able to monitor and map flooding as and when it happens, it also has tools that allow us to predict where flooding is most likely to happen in the case of extreme rainfalls. It also superimposes imagery of what the affected area looked like prior to the disaster to be able to see the extent of the damage.

While the range of products and tools to ensure relevant and up-to-date information is impressive, he cited an example of an area in Umlazi, KwaZulu-Natal, that was flooded in both the 2019 and 2022 floods. The drainage problems identified after the first floods were not addressed, causing unnecessary damage and loss of life.

*"The tools and information are available but it only makes a real impact when action is taken based on the data."*

**Prof Kevin Kirkman** (UKZN) reminded the audience of the Knysna fires of 2017 where at least seven lives were lost, nearly 15 000 hectares of land burnt and some 800 buildings destroyed.

"This raises a few questions of how can we prevent a recurrence of such an event and how can we prevent similar disasters occurring in other places—how can we prevent destructive fires? Every year vegetation fires cause destruction of property and threaten lives and livelihoods, so we have asked the question, why is that?" he said.

He explained that Africa is often called the fire continent for many reasons, including that the grassy or shrubby biomass forms a great fine fuel that can carry fire; annual wet and dry cycles are pronounced and long (referring specifically to El Niño and El Niña phenomena); lightning and human ignition; as well as an often overlooked fact that fire is a critical ecosystem driver affecting the structure, composition and function of vegetation.

Prof Kirkman presented on the advantages of fire as a natural phenomenon that has and continues to shape ecosystems. "It drives nutrient cycling, creates habitats for many species, is an integral part of savannah grassland and fynbos ecosystems, and fire, in fact,

reduces the risk of wildfires—fire that prevents fire.”

He discussed the fire ecology of different habitats—grassland and savannah, fynbos, forest patches and thickets, plantation forestry, and crops—clarifying when fires are likely to occur and what benefit fires typically have. And then spoke about the many elements influencing different kinds of fires.

“Not all fires are equal. The intensity of a fire depends very much on the quantity of fuel, the biomass, and the fuel load. Obviously, weather plays a big role, the higher the wind, the faster the fire spreads and the more intense the fire.” Other factors that influence fires include ignition, alien vegetation, climate change, rainfall patterns, grazing, and fire breaks.

He made the point that with so much information and data available, extreme fire events should not come as a surprise. “We know where fires will occur; we know when; we know what conditions exacerbate the risk, for example a berg wind; we know what to do about it; we can monitor vegetation biomass and greenness in real time; we can monitor time since last fire; we can manage fuel load (fire breaks, fire, grazing, alien plant control); and we have the expertise.”

*“We have everything we need to prevent fire disasters, we just need to do it.”*

### About the NSTF

The [National Science and Technology Forum](#) (NSTF), established in 1995, is a broadly-representative stakeholder body for all science, engineering and technology (SET) and innovation organisations in South Africa, which seeks to influence policy formulation and delivery.

The [NSTF Awards](#) are unique in SA, recognising the outstanding contributions of individuals, teams and organisations to SET and innovation.

The [science bursaries](#) page provides information on bursaries and bursary providers for science, engineering and related studies.

[STEMulator.org](#) attracts learners and students to the exciting world of science, technology, engineering and mathematics (STEM). It provides a virtual world full of stimulating content to excite and inform the youth, including STEM career guidance. Established under the auspices of the [NSTF proSET membership sector](#) (Professionals in *science, engineering and technology*).

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