SEEDS 25 years

THE FACE OF DISASTERS 2019

Beyond Response to Build a Sustainable Future

Cover Image: Dealing with perpetual waterlogging in Gorakhpur, Uttar Pradesh, India, 2013

Authored by: Vijayalakshmi Viswanathan and Anshu Sharma

Design: Meghna Chawla and Siddharth Behl

Photographs: ©SEEDS / Sarika Gulati, Siddharth Behl

Citation: V.Viswanathan, A. Sharma (April 2019). The Face of Disasters 2019. New Delhi, India: SEEDS.

Acknowlegements

With sincere thanks for the valuable inputs from Dr. K.J. Anandha Kumar; Dr. M. Rajeevan; Nidhi Jamwal; Saritha Thomas, Prof. Shakil Ahmad Romshoo and Dr. Vineet K. Gahalaut.

Preface

When we look at the outlook for disasters in India in the years ahead, clear challenges appear. There are impending disasters which seem certain (like floods and drought). There are also hotpots such as a large-scale earthquake that cannot be predicted but whose risk looms large. In the longer term, the challenges are even more expansive. The impacts of global warming and climate change threaten coastal communities with erosion; and the third pole with transformation of the glaciers.

What these patterns show us is that we must put concerted attention on looking beyond response. The patterns of the last few years must teach us to expect the unexpected. What can we do differently to help reduce their impact, not just wait to respond once a disaster strikes?

In parallel, there is a need to look at risks and vulnerabilities that aren't yet technically 'disasters'. Considering the experiences of the years gone by, there will be impacts that continue to magnify under the radar – access to rapidly depleting water sources and the growing heat stress being two of the most prominent.

The manner in which these disasters are manifesting themselves and the resulting impact on communities is highly complex. For example, a single mega-disaster can wipe out hard-won development gains, as happened with the 2015 Nepal earthquake. Recurrent small-scale stresses keep the most marginalised families in a cycle of poverty. Climate change impacts are only magnifying these vulnerabilities. For at-risk communities and affected families, this interplay between dealing with poverty, climate stresses and natural hazards doesn't have clear distinctions. Each reinforces the other. This inter-connectedness is also already being recognised globally in international frameworks such as the Sustainable Development Goals and Paris Agreement.

Yet too often, action on disasters is still seen in isolation. This publication aims to look at disasters' broader face. For the risks of the future will be different from the risks of the past. Recognising this and preparing for the unknown will be key to building a safer and more sustainable world.

LOOKING BACK AT THE RISING TREND OF EXTREME WEATHER EVENTS [1]

The message emerging out of 2018 is loud and clear. Extreme weather events are on a rise in India and we must plan and prepare for erratic weather patterns that are the new 'normal'. Almost every month of 2018 had one or the other 'unprecedented' weather events. We had hailstorms, unseasonal rainfall, strong thunderstorms and lightning, floods and droughts, long dry spells, cyclones, and both our monsoons — southwest and northeast — were below normal. Also, average temperature over the country was 'significantly above normal', making 2018 the sixth warmest year on record since 1901.[2]

Thus, it would be no exaggeration to term 2018 as a year of multiple disasters; both in terms of 'visible ones' such as the catastrophic floods in Kerala in August, and 'silent ones' like an unprecedented monsoon rainfall deficit of more than 20% in the northeast region of the country.

RISING TEMPERATURE

Last year started on a 'dry' note with very low winter precipitation in north India. There were reports of acute drought in Kashmir due to "a record-breaking long dry spell". Meanwhile, the spring came early in the Himalayas as Rhododendron arboretum, a small evergreen tree, started flowering in January, two to three months in advance. This was blamed on an unusual warm spell and rise in temperature in the hills.

Rising temperature isn't a one-off thing. Meteorological data analysed by the India Meteorological Department (IMD) shows a trend of rising temperature in large parts of the country. For instance, the IMD has carried out long-long-term assessment of climate change in the country between 1951 and 2010'. State wise averaged annual mean maximum temperature time series has shown increasing trends over many states of India, particularly significant over Andaman and Nicobar, Andhra Pradesh, Arunachal Pradesh, Assam, Goa, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Lakshadweep, Madhya Pradesh, Maharashtra, Manipur, Mizoram, Odisha, Rajasthan, Sikkim, Tamil Nadu and Uttarakhand. The highest increase in annual mean maximum temperatures was observed over Himachal Pradesh (+0.06°C/year) followed by Goa (+0.04°C/year), Manipur, Mizoram and Tamil Nadu (+0.03°C/year each).[3]

Similarly, state averaged annual mean minimum temperatures have shown significantly increasing trends over Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Delhi, Gujarat, Haryana, Kerala, Lakshadweep, Manipur, Meghalaya, Rajasthan, Sikkim, Tamil Nadu and Tripura. The highest increase in annual mean minimum temperature was observed for Sikkim (+0.07°C/year) followed by Arunachal Pradesh, Bihar, Delhi, Gujarat, Manipur, Tamil Nadu and Tripura (+0.02°C/year each).[4]

HAILSTORMS

Early in 2018, Maharashtra, Chhattisgarh, Madhya Pradesh, Telangana and Uttar Pradesh were hit by unseasonal rains and hailstorms that damaged standing rabi (winter) crops in over 4.76 lakh hectare area. Maharashtra is prone to hailstorms, as documented in a countrywide analysis of hailstorms between 1985 and 2015 by the IMD Pune office.[5] But, scientists at the Met department point out that "from 2013, there is prolonged persistence of hailstorms in

the state, causing extensive damage". Hailstorms now affect larger area in the state over several days. There are concerns over the increasing size of hail, too.

There are studies that link increase in hailstorm activity with the changes in the climate. According to a 2010 study, 'Climate change and hailstorm damage: Empirical evidence and implications for agriculture and insurance', "... hailstorm damage may increase in the future if global warming leads to further temperature increase... Our estimates show that by 2050, annual hailstorm damage to outdoor farming could increase by between 25% and 50%, with considerably larger impacts on greenhouse horticulture in summer of more than 200%." [6]

THUNDERSTORMS AND LIGHTNING

After hailstorms, large parts of the country faced a series of extremely strong thunderstorms and dust storms last year. A thunderstorm, mostly a short-duration phenomenon that seldom lasts over two hours, is always accompanied by thunder and lightning, usually with strong gusts of wind, heavy rain, and sometimes with hail.[7] India recorded a total of 3,620 thunderstorms in 2014 and 5,536 in 2015.[8] Genesis of thunderstorm is dependent on four broad factors – intense heating, moisture availability, instability in the atmosphere, and a trigger.

Last year, Down To Earth, a fortnightly magazine, documented how 44 intense thunderstorms struck over 16 states killing 423 people, which was 'unprecedented'. Thunderstorms were accompanied by lightning strikes that destroyed properties and killed people. Data of the National Crime Records Bureau shows the average number of people dying of lightning strikes every year between 2006 and 2015 was about 50% higher than the decade before. Scientists at Indian Institute of Tropical Meteorology, Pune have examined satellite data between 1990 and 2013 and found a two to three percent increase in lightning strikes in the country.

Experts have attributed the 'above normal' thunder activity over North West India last year to the late western disturbances. As per the IMD, seven western disturbances passed over the region within two months (April and May 2018) – including three intense ones in the first half of May. This seems higher than usual as a 2017 study has documented an average of two to three western disturbances a month across North West India in the summer months.[9]

Climate scientists say western disturbances used to be very active in the month of January over North India. But, these seem to be getting pushed to the spring season. While there isn't enough past data to reach a definitive conclusion, this area of changing pattern of western disturbances needs more research as it directly impacts our weather.

Apart from western disturbances, jet streams also impact our weather and may be linked to increasing storms. Jet streams, or river-like currents of air, circulate in the upper levels of the troposphere (30,000 feet). A jet stream exists because of the temperature difference between the Poles and the tropical regions. Since the Arctic is warming at double the rate of the rest of the world, this temperature difference is reducing, thereby affecting the jet streams.

There are scientists who attribute increasing intensity of storms to the rising heat, too. For instance, urban heat island is expected to have an impact on thunderstorms, as surface temperatures have fluctuated over Indian cities because of land-use and land-cover changes. This impacts the lower atmosphere and can influence the trigger mechanism of thunderstorms.[10]

MONSOON: REDEFINING 'NORMAL'

The southwest monsoon in 2018, our main monsoon season (June to September) when the entire country receives rainfall that supports agriculture, ended at a 'below normal' note. That too after the IMD's long-range forecast had predicted a 'normal' monsoon. All through the four months of the southwest monsoon, there were prolonged dry spells affecting kharif (summer) crop sowing and plant growth, and an almost dry September. By the end of September, the northeast region of the country ended with a rainfall deficit of more than 20%. At an all India level, the southwest monsoon rainfall deficit was 9%, classified as 'below normal'.

However, meteorologists point out that the definition of 'normal' monsoon itself is tricky and needs to be updated. 'Normal' rainfall is defined as 96%-104% of the long period average (LPA), with a model error of plus or minus 5%. The LPA is the weighted average of rainfall that India received in June-September from 1951 to 2000 and is pegged at 89 cm.

The IMD issues two long-range forecasts for the southwest monsoon. The first stage forecast is issued in April and the second stage in early June. The second stage forecast covers the four homogenous regions of the country —- Central India, Peninsular India, Eastern India and Northwestern India —- and provides monthly monsoon rainfall forecast for the months from June to September.

An analysis of the rainfall data of the past few years shows that several subdivisions received deficient rainfall even in normal monsoon years. For instance, the country received 95% rainfall of the LPA in 2017, but Vidarbha had 23% deficient rainfall. The East Madhya Pradesh subdivision reported 24% less rainfall than normal, East Uttar Pradesh 28% shortfall and West Uttar Pradesh 30% shortfall. The Haryana, Delhi and Chandigarh subdivision and the Punjab subdivision also had deficient rainfall. On the other hand, the subdivisions of West Rajasthan and Saurashtra and Kutch received excess rainfall.[11]

DROUGHTS AND FLOODS

A 'below normal' monsoon rainfall last year has triggered drought in several states including Bihar, Jharkhand, Karnataka, Maharashtra and parts of Andhra Pradesh, Gujarat and Rajasthan. Maharashtra has sought drought-relief of Rs. 7,000 crore from the Centre. Karnataka and Jharkhand, too, have asked for Rs. 2,434 crore and Rs. 819 crore drought relief, respectively.

What makes the matter worse is that the last year ended with a 'below normal' northeast monsoon, too. Unlike the southwest monsoon, northeast monsoon (October to December) brings rainfall to some meteorological subdivisions in south peninsula. In its January 16, 2019 'Statement on Climate in India during 2018', the IMD pointed out that rainfall during the northeast monsoon, between October and December, over the country had been 'substantially below normal' – only 56% of the long-term average. And this, it said, was the sixth lowest since 1901.

While almost half the country is facing drought, there were states that also faced floods last year. The situation is grim in the northeast region where states such as Assam, Arunachal Pradesh and Nagaland, which had faced floods, are now dealing with drought conditions.

CYCLONES

While several states were declared drought-affected, there were over 14 depressions and four cyclones last year — Daye (September), Titli (October), Gaja (November) and Phethai (December). Cyclone-battered Tamil Nadu (Gaja) and Andhra Pradesh (Titli) sought aid of Rs. 15,000 crore and Rs. 1,200 crore, respectively.

There are several research studies that link changing climate to an increasing frequency of intense tropical cyclones in the north Indian Ocean. Data of 122 years of tropical cyclone frequency over the north Indian Ocean from 1877 to 1998 shows "there is indeed a trend in the enhanced cyclogenesis during November and May". There has been a two-fold increase in the tropical cyclone frequency over the Bay of Bengal, a 17% increase in the intensification rate of cyclonic disturbances to the cyclone stage and a 25% increase to severe cyclone stage over the north Indian Ocean during November in the past 122 years, the study notes.[12]

Analysis by Down To Earth suggests that extreme weather events have increased from just one during 1900-1910 to 61 during 1971-80. And that number almost tripled to 162 during 2001-2010.[13]

While no single extreme weather event can be attributed to climate change, it is also true that the increased frequency and intensity of these extreme events are due to human-induced climate change. Extreme rainfall, extreme heat, extreme thunderstorms, extreme cold waves, extreme tropical storms are the new 'normal'. And, we need adaptation strategies and disaster response plans to face exigencies arising out of this new 'normal'.

To address the increase in extreme weather events, the earth sciences ministry is developing improved models for short-range weather forecasts, and a prediction system for thunderstorms and lightning. It is further improving prediction of tropical cyclones by developing a coupled (ocean-atmosphere) model. Also, 10 Doppler Weather Radars are being installed this year over three hilly states of northwest India. Another 11 radars are expected to be installed over the plains, including one in Mumbai by early 2020.

Trends in hazard patterns, vulnerabilities and capacities strongly indicate a complex road ahead, wherein risk reduction efforts will need to be very substantially strengthened with the use of improved governance, people's participation and innovative processes and technologies.

WATER AND THE CHANGING NATURE OF DISASTER RISK

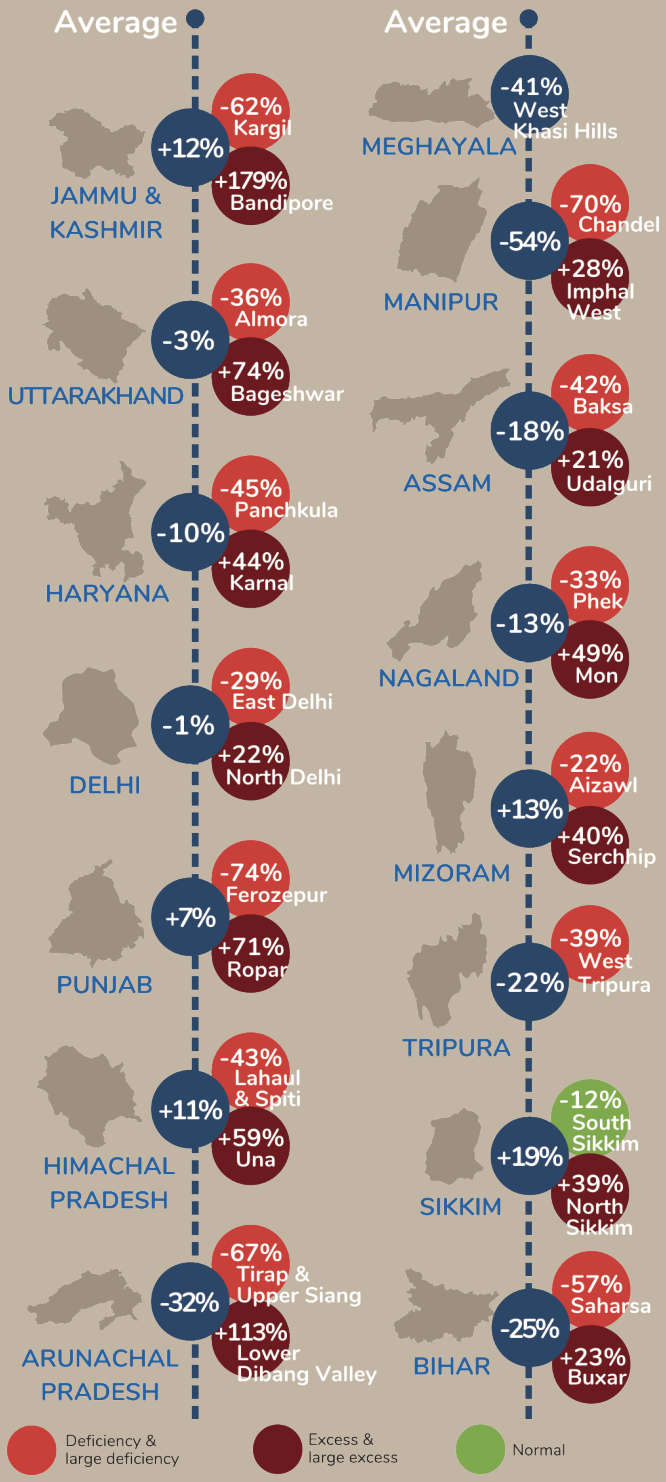
‘New normals’ of rainfall variability coupled with growing water usage are bringing challenges of too much and too little water, often in parallel

The fury of foods while facing drought: Averages are hiding the true story of changing variability

A 'normal' monsoon with floods and droughts? Monsoon forecasts are often blamed for showing the wrong picture. The truth is that an all-India 'normal' monsoon rainfall is deceptive as it masks rainfall variability not just among the 36 meteorological subdivisions of the country, but within them as well. These kind of forecasts are meant for overall policy decisions, not necessarily for action in specific locations on the ground.

> Day to day variability is very large in the monsoon season. Also one place getting flash floods doesn't mean that ultimately the seasonal rainfall will be more. With global warming and climate change aspects, this variability is increasing. The last few years, what we have been observing is that the number of wet days are decreasing, but when it rains it rains very heavily. That's the difference. We can have on the one hand, large excess rainfall and at the same time large deficient rainfall. So on both sides, the extremes are increasing.
>
> *- Dr. M. Rajeevan, Secretary to the Government of India, Ministry of Earth Sciences*

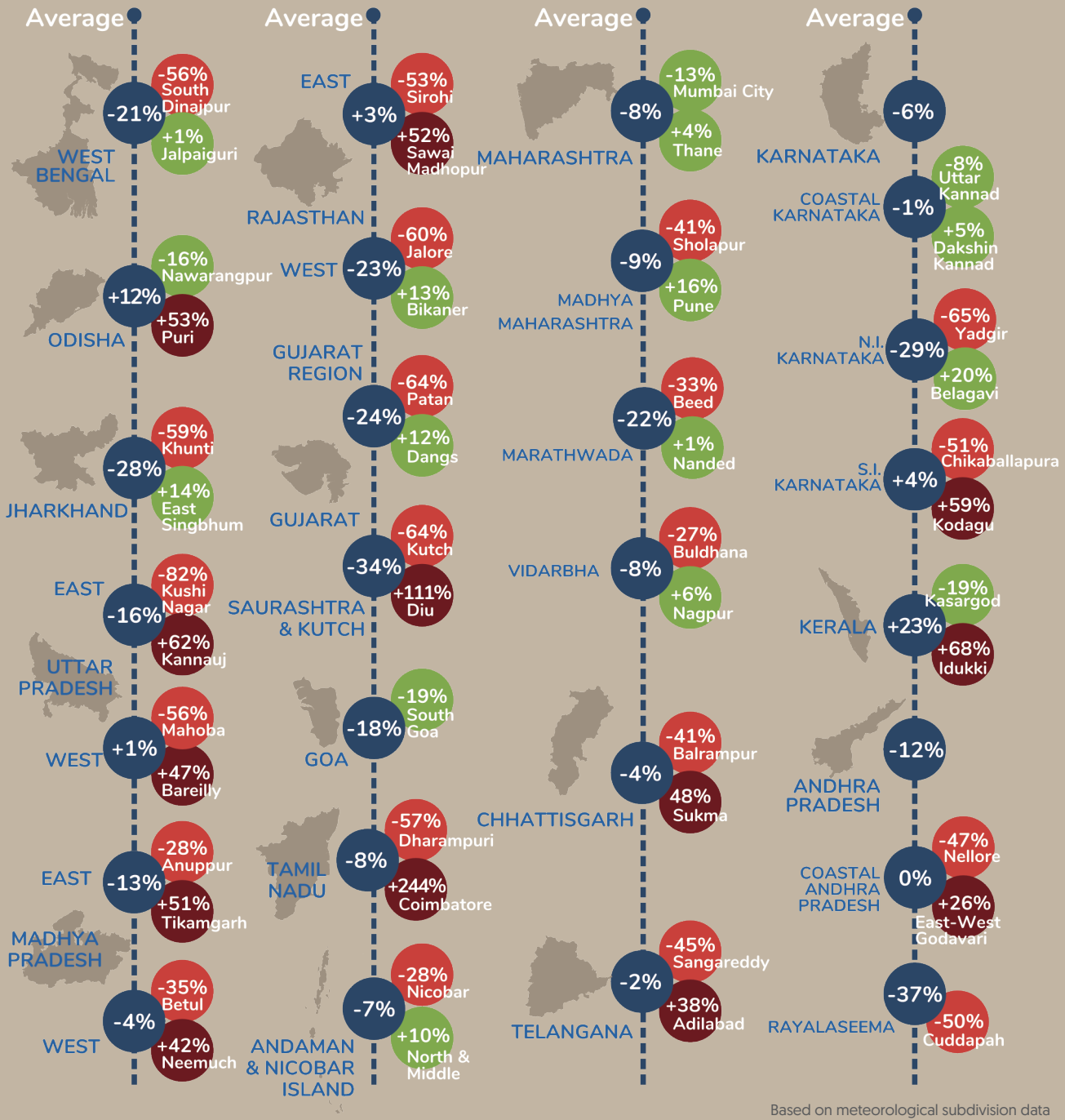
As rainfall variability grows more extreme, there is also a need for people to take the threat of flooding more seriously. The Met Department is already working on block level forecasting for rainfall and an impact- based forecast for floods is being developed to give citizens a better picture of the possible effects.



> Simply saying 20cm rain doesn't help. 20cm rain in Cherrapunji and nothing will happen, it is like an everyday affair. But the same 20cm rain in Bombay and Ahmedabad is very different. We need impact based forecasting for floods, just like we have for cyclones, and we are already working on framing this."
>
> *- Dr. M. Rajeevan, Secretary to the Government of India, Ministry of Earth Sciences*

DEPARTURE FROM THE NORMAL RAINFALL (JUNE - SEPTEMBER 2018)

Tracking the rainfall of districts within different meteorological subdivisions emphasises the danger of averages. This shows the districts with the maximum departure from the long-term normal (in terms of too much and too little rain). The data includes rainfall from the 1st of June to the 30th of September, 2018.



Based on meteorological subdivision data

Groundwater: A disaster in the making under the earth

In May 2018, Shimla, capital of the Himalayan state of Himachal Pradesh, found its taps running dry. The crisis was precipitated by a dry winter and long-term water reduction, with drinking water supply falling to less than 50% of the requirement.[14] Coming at the start of the peak tourist season, there was a direct impact on the tourist trade with hotels being forced to shut down. What was less known is that the district of Shimla has declared drought four times in the last 20 years, in 2000, 2002, 2005 and 2009.[15]

Shimla may have hit the headlines, but recharge reduction is occurring across the country. There are an estimated 27 million wells across the country, with borewells accounting for over 50% of these. Our usage is growing and a groundwater crisis is rearing its head all over India.

Experts say any normal hydrograph of groundwater should fluctuate – the water level in the month of April will generally be low and by August the rains would have brought it up near the surface. However, in many urban areas, this kind of fluctuation is not occurring. The withdrawal is so much that even after rainfall, there is no major upswing.

Part of the problem is also that the growing extremes of rainfall variability are not conducive to recharge patterns. Heavy, short duration rainfall does not allow for water to soak into the earth.

In Kerala, the flood water took away the river alluvial soil along with the river runoff and thus has also affected the aquifer material to some extent. So there was less groundwater recharge during the flash floods in and around the river. That is why, just after the floods, there was a drought-like situation in some locations, when people expected there to be more groundwater. Since there is only a few metres of aquifer thickness, it needs time to recharge. Water slowly trickles down and enters the soil. So when you have an ideal situation where there is slow rainfall over an extended period, you will have better recharge. This was also the explanation given by the Regional Director of CGWB in Kerala.

– Dr. K.J. Anandha Kumar, Scientist, National Hydrology Project, Ministry of Water Resources, River Development & Ganga Rejuvenation, Government of India

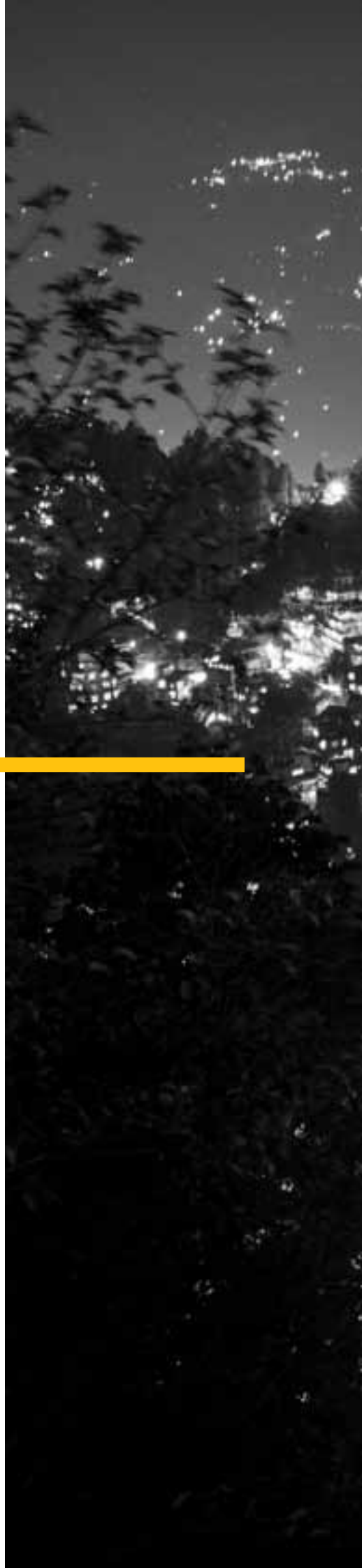
The quantity and quality of groundwater are inter-related. As the quantity of groundwater falls, quality is also deteriorating. The TDS (Total Dissolved Solids) in the water gets concentrated because there is no way to dilute it. Until there is a balance between the recharge and the discharge (withdrawal), we will continue to have quality issues.

– Dr. K.J. Anandha Kumar, Scientist, National Hydrology Project, Ministry of Water Resources, River Development & Ganga Rejuvenation, Government of India

Less water as well as poorer quality

In mid-2018, a NITI Aayog report warned that 600 million people in India (almost half the population) are facing high to extreme water stress. The states that were the lowest performers on the Water Index, including Uttar Pradesh, Bihar, Rajasthan and Haryana, are not just some of the most populous, but also account for over a fifth of the agricultural output. What kind of impact will this have on food security going forward?

At the same time, with nearly 70% of water being contaminated, India is placed at 120 amongst 122 countries in the global water quality index.[16]



PLANNING FOR WHAT YOU CAN' T SEE

Earthquake risk is looming large under the radar, but are we prepared?

110 districts across India fall in Zone V (Over 1/7th of the districts in the country)

ASSAM

23 Districts

Dhubri, Cachar, Hailakandi, Karimganj, North-Cachar-Hills, Barpeta, Bongaigaon, Darrang, Upper-Dhemaji, Dibrugarh, Goalpara, Golaghat, Jorhat, Kamrup, Karbi-Anglong, Kokrajhar, Lakhimpur, Marigaon, Nagaon, Nalbari, Sibsagar, Sonitpur, Tinsukia.

BIHAR

10 Districts

Araria, Darbhanga, Kishanganj, Madhepura, Madhubani, Purnia, Saharsa, Sitamarhi, Supaul, Muzaffarpur

GUJARAT

01 District

Kachchh

HIMACHAL PRADESH

08 Districts

Solan, Una, Bilaspur, Chamba, Hamirpur, Kangra, Kullu, Mandi

JAMMU & KASHMIR

07 Districts

Anantanag, Baramula, Pulwama, Srinagar, Badgam, Kathua, Kupwara

ANDAMAN & NICOBAR ISLANDS

02 Districts

Andamans, Nicobars

ARUNACHAL PRADESH

13 Districts

Lower-Subansiri, Tawang, Tirap, Upper-Siang, Upper-Subansiri, Changlang, Dibang-Valley, East-Kameng, East-Siang, Lohit, Papum-Pare, West-Kameng, West-Siang

Source: Building and Material Technologies Promotion Council (BMTPC), http://www.bmtpc.org/disaster%20resistnace%20technolgies/ZONE%20V.htm

India's high seismic vulnerability

MANIPUR

09 Districts

Bishnupur, Chandel, Imphal-East, Imphal-West, Thoubal, Ukhrul, Churachandpur, Tamenglong, Senapati

MEGHAYALA

07 Districts

Jaintia-Hills, East-Garo-Hills, East-Khasi-Hills, Ri- Bhoi, South-Garo-Hills, West-Garo-Hills, West-Khasi-Hills

MIZORAM

08 Districts

Aizawl, Champai, Kolasib, Lawngtlai, Lunglei, Mamit, Saiha, Serchhip

NAGALAND

08 Districts

Phek, Zunheboto, Dimapur, Kohima, Mokokchung, Mon, Tuensang, Wokha

TRIPURA

04 Districts

Dhalai, North-Tripura, South-Tripura, West-Tripura

UTTARAKHAND

08 Districts

Almora, Bageshwar, Chamoli, Pithoragarh, Rudraprayag, Tehri-Garhwal, Uttarkashi, Garhwal

WEST BENGAL

02 Districts

Jalpaiguri, Koch-Bihar

Over 58% of India's landmass is prone to earthquakes of moderate to very high intensity.

Some seismologists argue that as new research emerges, the zoning maps should be updated accordingly. For example, micro-zoning maps that have been prepared for cities like Bengaluru and Delhi show risk variations even within the cities. With building codes and planning processes linked to these, how effectively can these be implemented? Seismic building codes that have already been instituted are expensive and difficult to enforce. The seismic legislation and regulation also seem to have failed to keep up with the influx of city dwellers.

Even based on the zoning maps that we currently have in place, 110 districts (over a seventh of India's total districts) fall in Zone 5, the current highest earthquake risk zone.
Over 17 million children study in over 157,000 schools across these 110 districts.[17]

In fact, a Delhi Policy Group policy note states, "...an earthquake in North India has the potential to cause damage and casualties similar to a major nuclear strike in the country."[18]

However, being prone to earthquakes is just one factor. Seismic risk is multi-faceted. The place, season and time will also influence the extent of damage. So far, fortunately, the majority of large earthquakes have occurred during daytime when families were awake and out of their houses. Similar earthquakes occurring at night would have a very different impact.

Secondary vulnerabilities also need further consideration. The construction buildup in the Himalayas for example, including water reservoirs, can trigger even greater damage than the actual quake itself. An earthquake of the same magnitude, but during monsoon season when the dams are full, would present a very different scenario.

Population growth and building strength will also influence the extent of loss. There's a commonly used saying, 'earthquakes don't kill people, buildings do.' Research conducted by Prof. Arya of Rorkee University in 1991 showed that a hypothetical Kangra level earthquake occurring at that time in Kangra would have resulted in 65,000 lives lost if all the houses were without earthquake safety provisions. He predicted that the 'trauma will be too great and the cost of emergency relief will be exorbitant much beyond the capacity of the State and even the country as a whole'.[19]

Over 17 million children study in over 157,000 schools across these 110 districts.

Waiting for the 'big' one

The 2015 Nepal earthquake was the last major event to occur in the region, with a magnitude of 7.8. The destruction was unprecedented, yet research by seismologists shows that the strain building up in the different areas of the Himalayas still hasn't been released. The 'big one', an expected earthquake with magnitude of over 8.5 has yet to occur.

Where is this likely to happen? The entire Himalayan belt is at high risk and though predictions are challenging to make, studies show three faults that do need concerted attention.

New data inputs and evidence from both India and Nepal show that the Garwal-Kumaon fault in the Uttarakhand region experienced a large earthquake in 1344 CE. This was the last of the earthquakes with a rupture length and average slip consistent with magnitude of over 8.5 movement. In other words, over 770 years have passed since this area released that amount of pressure. This may make it one of the most seismically vulnerable areas in the Himalayas. A major earthquake in this region would also impact the adjoining Indo-Gangetic plains, where sediment is subject to liquefaction (soil behaves more like a liquid), causing even greater damage.[20]

The second is the over 60 km-long Riasi fault in the Kashmir region, part of the Main Himalayan Thrust. Historical earthquake record of the past 1000 years, the high strain rates and partitioning of the slip make seismologists see this a regionally important fault to monitor. The Riasi fault, the thrust front or both pose even greater earthquake threats than the 2005 7.6 magnitude earthquake that affected both sides of Kashmir.[21]

The third is the region between Assam and Bhutan, also referred to as the Assam Gap, which now includes Eastern Arunachal Pradesh. While the 1950 Tibet-Assam earthquake was the last one in the region, historical accounts show major earthquakes in 1697 and 1714. The region remains fairly under-studied however. Some seismologists fear that the strain accumulated might reactivate potential active faults triggering large earthquakes in the future.[22]

> "There is definitely a looming big one in the Himalayan belt. The earthquakes we have seen so far, even the 2015 Nepal earthquake, have not released the kind of energy that is building up. We don't know when this will occur; but the more time that goes by, the more probable it becomes.
>
> *– Dr. Vineet Gahalaut, Seismologist*

Unlike a new house, retrofitting is like doing surgery on a human body, opening it up. There are always surprises waiting for you. The World Bank's 1993 Latur Earthquake programme was the first and only rehabilitation programme that had retrofitting as its integral part from Day 1. The economics was that with the Rs.15,000 that people were getting, you could build a 9ft x 9ft room or you could retrofit 500 sq. metres of your house. But out of 250,000 house owners, only about 3000 opted for retrofitting. There was this skepticism for retrofitting and no one believed in it.

– Rajendra Desai, National Centre for Peoples'-Action in Disaster Preparedness (NCPDP)

Retrofitting as a greener option?

As a whole, our building stock has to improve. India loses about 1.2 million houses to disasters every year. Considering this scale and magnitude, retrofitting is the greenest and most cost-effective option. Where possible, rules of thumb and retrofitting technology must be promoted, both pre- and post-disaster.

Retrofitting has also proved its effectiveness in the past! In the midst of so much sadness after the Gorkha earthquake in Nepal in 2015, there was a small positive lesson. The 200-odd public schools which were rebuilt and retrofitted for earthquake resistance in an Asian Development Bank (ADB) pilot project effectively withstood the earthquake.[23]

COUNTERPOINT

‘KACCHA IS PUCCA AND PUCCA IS KACCHA’: THE VALUE OF EARTH MATERIALS AND INDIGENOUS TECHNOLOGIES

When the Chamoli Earthquake hit on 29 March, 1999, houses across the village were cracked beyond repair. Families who had put all their savings into a beautiful, white and solid house had their dreams wiped out.

However, what took everyone by surprise was the old stone temple. Said to be over 400 years old, it stood about one hundred yards away without a single stone having been moved from its place. The villagers had invested all their resources and used the most advanced of technologies – cement, concrete and a massive amount of steel – even going to the extent of spending extra money. Yet their homes were still shattered by the quake. However, this old monument, with no ounce of cement or steel, stood strong. What the people in the village gathered was that the way the stones were laid in old times was well worked out so that the building shook but didn’t suffer damage during an earthquake. Their ancestors knew something that they didn’t today. The technology they had imported from the cities at a very high cost had failed them.

In the aftermath of earthquakes in Kashmir in 2005 and Nepal in 2015, there were instant reactions to local materials, with a view that concrete structures were safer. Yet in both cases, what was seen was that well-built indigenous structures proved safer than unengineered reinforced concrete homes. In Kashmir, it took some time but movements such as ‘Don’t Tear it Down’ managed to convince governments to add indigenous technologies as an option to the reconstruction process.

In the aftermath of the Sikkim earthquake in 2011, similar observations were made about the performance of local Ikra structures as compared to the Reinforced Concrete buildings. A study by IIT Kanpur states that about 95,000 houses had been fully, partially and severely damaged. Of the fully damaged buildings, only 4% were of the traditional type, while about 20% followed RC frame structures.[24]

DHAJI-DEWARI CONSTRUCTION IN KASHMIR

The name ‘Dhajji Dewari’ literally translates into ‘patchwork quilt wall’. The name describes the patterns of timber beams used in the frames of such constructions, which are its distinguishing feature. In the valley of Kashmir, the infill is usually of brick made from fired or unfired clay. In the mountainous regions of Kashmir extending into Pakistan, the infill is commonly rubble stone. The frame of each wall consists not only of vertical studs, but also often of cross-members that subdivide the masonry infill into smaller panels. These impart strength and prevent the masonry from collapsing out of the frame.

© Randolph Langenbach, www.traditional-is-modern.net

TAQ CONSTRUCTION IN KASHMIR

Taq construction is a bearing wall masonry construction with horizontal timber lacing embedded into the masonry to keep it from spreading and cracking. It is usually configured with a modular layout of masonry piers and window bays. These are tied together with ladder-like constructions of horizontal timbers embedded in the masonry walls at the base of the structure above the foundation, each floor level and window lintel level.

IKRA

Ikra is a local construction practice based on timber frames with bamboo mat infill plastered with mud or cement. Found in Assam, Sikkim and other parts of the North East, the lightness and movement ability of these buildings have proven to better withstand earthquakes.

KATH-KONA BUILDINGS IN HIMACHAL PRADESH

Structures constructed in the kath-kona or kath-ki-kuni style use alternating layers of timber and dry stone masonry. Two timber beams, one on the inside and the other on the outside are held together by joists at regular intervals. They are also connected with the beams in adjoining walls at right angles. Walls in these buildings are built using alternate layers of wood and masonry, usually stone and without the use of mortar. The Naggar fort of Himachal Pradesh, near Manali, built using the same construction technique, has survived for over 500 years.

KOTI-BANAL ARCHITECTURE IN UTTARAKHAND

Both the local dialects in the State of Uttarakhand (Kumaoni and Garhwali) have unique words to identify the four different floors of a building. This is suggestive of the fact that despite being located in an earthquake sensitive region, it has a tradition of constructing multi-storied houses. As early as 1,000 years ago, the region evolved a distinct earthquake-safe construction style called Koti-Banal architecture. This style uses elaborate procedures for site selection, preparing the platform for raising the multi-storied structure, as also for the detailing of the entire structure that was constructed on principles somewhat similar to that of framed structures of modern times. Locally and then abundantly available building material (wood and stone) was judiciously used in these structures. The structural designing suggests that the architects responsible for designing these buildings had fairly good idea of the forces likely to act upon the structure during an earthquake.

NO DISASTER IS ' NATURAL'

Risks lurking under the radar slip through the cracks because they don't meet the idea of a 'natural disaster'

Vulnerabilities at the core

Historically, acts of nature have always been viewed as the wrath of God. In many communities across the world, they still hold a spiritual and mystical power. The use of 'natural' only emphasises notions of fatality and helplessness.

An earthquake, a flood, a drought, a windstorm, a landslide. If you take any natural hazard and just change the demographic variables, the social context or the development patterns of the area, then you will have an entirely different story.

The sustained use of the term 'natural disasters' gives the sense that this is somehow unavoidable. Nature has its patterns. The river may overflow its banks every year during the monsoon and the earth will shake where tectonic plates meet. The devastation caused, however, is not natural. It is about a simple formula. Hazard (the flood, earthquake, cyclone) + vulnerability = disaster. That vulnerability could be economic, environmental, physical, social or even physiological. In other words, an act of nature is only a potential danger. It is not a disaster in itself. By calling it 'natural', the entire implication of that vulnerability is taken away. More than anything else, it takes away an entire aspect of risk that is often human made and can be addressed.

Daily stresses:'Natural disasters' hide other vulnerabilities

The focus on well-known disasters and their technical definitions mean that risks that don't meet this idea remain unaddressed. Many of these vulnerabilities lay in wait under the radar, a disaster in the making. At the same time, when a hazard does occur, the impact is multiplied manifold. This includes simple micro-level stresses such as blocked drains to hazards that are yet to make the notified list of disasters such as heat and air pollution.

HAZARD

Phenomenon that poses a threat to people, structures or economic assets which may cause a disaster

Widespread natural hazards in India

Manmade hazards

+ VULNERABILITY

The extent to which a community, structure, service or geographic area is likely to be damaged or disrupted by a hazard.

TYPES OF VULNERABILITY

Physical

Unstable locations | Close to hazards | Lack of infrastructure | Fragile unprotected houses

Economic

No productive assets | Limited earning opportunities | Single Income | No savings or insurance

Social

Low status in society | Conflict | Gender inequality | Oppressive institutional structures | Political, economic & social hierarchies

Psychological

Fears instigated by belief systems | Ideologies | Political pressures | Mental illness

Environmental

Climate change | Exposure to natural hazards | Human health | Wetlands | Desertification | Biodiversity

Physiological

Status in life – young, old, adolescent, pregnant, lactating mothers, chronic illness, disability, exposure to sexual violence and harassment

= DISASTER

Serious disruption of a society's functioning causing widespread human, material or environmental losses. These exceed the coping capacity of the community using its own resources.

Struggling to breathe

Air pollution is being recognised as a critical health issue around the world and is the second largest cause of disease in India. WHO's safe air quality guideline states 10 micrograms per cubic metre of PM 2.5. India's minimum safe levels (60 micrograms per cubic metre) are already six times this limit, but only a few places in the country meet this. The 2018 World Air Quality Report shows 22 of the top 30 polluted cities are in India, with Gurugram topping the list.[25]

The State of Global Air report 2018 shows India has experienced the steepest increases in air pollution levels since 2010. India and China together continue to see the maximum mortality burden due to PM2.5.[26]

Yet, myths around air pollution continue to persist. It will be critical to process that air pollution does not occur just in winter, nor is it just urban. There are also multiple causes and addressing the complex interplay between industry, transport, dust and biomass and waste burning will be critical to show results.[27]

Innovative steps in cities like Delhi, including the odd-even formula, truck timings and dust reduction action that have been implemented have all focused on the outdoors. Yet the levels of indoor pollution are even higher and put those who spend maximum time at home – housewives, the elderly and children – at greatest risk. Over 560 million people in India were exposed to household air pollution in 2016.[28]

Turn the cooling up!

2018 was the fourth warmest year on record globally; and the sixth warmest for India.

Heat has become a major issue across the world, but for those most vulnerable, it is a silent killer. Between 2005 – 2015, 11,190 people lost their lives to heatstroke[29] in India, and these are just official estimates. Mortality is said to have declined in the last few years, but attributing deaths to heat is still not a clear cut process. Adding to this, our bodies often feel hotter than the reported temperature. This is due to the combination of temperature and relative humidity, also called the heat index. As humidity rises, so does the risk of dehydration.

While both rural and urban areas face this issue, heat island effects in large densely populated cities are amplifying the temperature. Heat trapped by roofs, pavement, and concrete structures raises the night temperature, not allowing bodies to cool down. In the peak summer months, this creates a spike in indoor temperatures which cause 'Heat Stress' (due to sick building syndrome). This is ultimately resulting in increased casualties and various symptoms like skin rashes, reproductive disorders and heat stroke.

It's also amplified as those who can afford it turn the cooling up, starting a vicious cycle of temperature rises in micro zones. Walk around the back alley of any mall, office building or residential neighbourhood at the peak of summer and the exhausts of the air conditioners automatically raise the temperature.

The impact of heat exposure also goes much broader, affecting productivity, earning potential and having long-term consequences on health and cognitive ability. Children's learning ability drops exponentially, and worker absences take a sharp upward turn. India lost nearly 75,000 million hours of labour in 2017, up from about 43,000 million hours lost in 2000; the majority in the agricultural sector, but with impact on industrial and service sectors as well.[30]

THE COMPLEXITY OF DISASTER IMPACT

Beyond ‘damages’, the long-term and uncaptured impacts have life-changing consequences for affected communities

Understanding multiple causes

Complexity begins with the multiple causes of damage. The Tohuku earthquake which hit Japan in 2011 is often cited as one of the most vivid examples. Fewer lives were lost in the earthquake than the massive tsunami that followed. The impact on the Fukushima nuclear reactor and the resulting nuclear radiation continues to have effects till today. Eight years on, over 51,000 people remain displaced from their homes, living in other places across the country.[31]

In the wake of the devastating Kerala Floods in India last year, the damage once again had multi-faceted causes. Extreme rainfall, rush of dam water and landslides each brought unique challenges to affected areas. Just weeks after the floods, parts of the state were facing a dry spell with groundwater levels falling.

Multiple causes mean the way response and recovery operations are calibrated need to take highly varied impacts into account. Damage that looks similar on the surface would need to be handled in very different ways.

Uninsured and informal losses

Disasters are said to cost the global economy USD 520 billion dollars every year. Considering that no economic loss data is available for nearly 87% of disasters in low-income countries (UNISDR), the actual figures may be much higher.

The economic losses that do hit the headlines are often in terms of insured claims or large-scale infrastructural damage. These are clearly rising. However, what about the cost to those under the radar? Informal and uninsured losses don't get captured or compensated. The massive floods across India in 2017, for example, were estimated by Munich Re to have cost the country USD 2.5 billion, yet insured losses were negligible.[32]

Interpreting disasters beyond numbers: The nuances of loss

No economic loss data is available for nearly 87% of disasters in low-income countries (UNISDR).

The impact that a disaster leaves behind is far more complex than the numbers that are usually quoted. Part of the definition of a disaster in the National Disaster Management Act states that it is "of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area". Guidelines to define this 'coping capacity' need to be created, for a disaster is still usually narrowly interpreted based on numbers of lives lost, houses destroyed or vast economic impact on the national/state economy.

Part of this is looking beyond the 'damages' to the long term 'loss' that survivors and affected communities may never recover.

On education, calculations occur about the costs and number of schools that have to be rebuilt or renovated; and the number of temporary learning centres that need to be set up.
Yet, 175 million children will be affected just by climate disasters each year.[33] What happens to a child who loses a year of schooling or never gets to complete their education?

Around houses, compensation for those eligible and numbers of families for whom to provide rebuilding take precedence. While the sector is now having discussions about seeing housing as a process and not a product, this is still not the norm. What happens to families who are rehabilitated in ways that compound the disaster impact?

175 million children will be affected just by climate disasters each year globally.

Take the people of Kawas village in Barmer, Rajasthan, where the 2006 flash floods brought a double tragedy. Their houses were washed away and their lands badly damaged. In fact, parts of the village were under water for up to two years. The area was then deemed 'unsafe'. The surviving families who qualified for compensation were rehabilitated in New Kawas; an area developed just outside Barmer town and far from their farmland. Most families returned back to Kawas, building homes in their 'danis', the area next to their farming land. Even those who received homes in New Kawas preferred to spend their own money and build themselves. The houses are built traditionally with mud walls, straw thatch roofs and circular shapes; with wide open spaces for gatherings and livestock. This was a stark contrast with 'New Kawas' which is row upon row of square, cookie-cutter, two-room concrete houses. There are no open spaces and the houses are too small to accommodate many of the larger families. It is also at such a distance from the farmlands that travelling up and down each day to tend to their crops would be impossible. So, 400 odd houses lay vacant, while the vulnerability of the community to another flood remained.

Globally, over 23% of damage and loss costs are in agriculture.[34] A farmer that loses standing crops may get compensation for what he's lost that season, but may often lose the next sowing season as well (or in other cases completely loses the land). What kind of trickle down effects does it have over the long-term on food security, nutrition levels of the most vulnerable families and ultimately associated health impacts?

Cultural and heritage spaces are seen from the angle of tourism revenues and art restoration. Yet often, these areas are a 'living heritage'. Bhaktapur, in Nepal which sustained heavy damage after the 2015 earthquake is one example. Unlike many other tourist attractions in the world, the UNESCO world heritage site of Bhaktapur is not just a place to see. It was a living, breathing ecosystem of culture that supports some of the most niche artistic traditions and livelihoods. This includes handicrafts such as pottery and woodwork, trade in the form of small shops and restaurants, services to the tourist inflow by way of heritage guides and hawkers, specific vocations such as traditional mustard oil extraction and agriculture on the periphery of the settlements. All of these are an integral part of the area's 'living heritage' stature.

Currently, neither are such nuances quantified, nor are they put at the fore in developing recovery programmes. Yet it is these kinds of nuances that truly define the impact of a disaster on a community over the longer term.

Recurrently hit and caught in a cycle of poverty

Disasters push 26 million people into poverty each year around the world.

Once the immediate humanitarian response is over and the disaster is no longer in the news, communities are mostly left to recover alone. For those already economically and socially vulnerable, this is a critical gap that often contributes to secondary disasters including displacement, health impacts and trafficking. Lack of access means the road to recovery is longer and they're often caught in the next disaster before they've even recovered from the first one. In fact, the World Bank estimates that disasters push 26 million people into poverty each year around the world.[35]

More social than psychological: Changing the way we think about mental health in disasters

"It's widely accepted that the aim of psycho-social work is to restore belief in oneself and regain an ability to trust. What we actually need to do is more social than psychological. Our model to mental health is resilience-based, based on what people have. For the real need at that point is empathetic relationships and conversations that allow survivors to get involved in the recovery process. Giving that time and space is much more important; and helping people to access things. The psychological interventions need to start 2-3 months down the road, once you've prevented the negative social impact. Even then, it needs to be integrated with livelihood or with education. Just counselling by itself does not work."

Mental health and psycho-social impact emerge as prominent issues for survivors in the wake of an emergency. Yet dealing with this requires as much localisation and cultural relevance as other aspects of recovery. At the same time, without strong mental health systems in place locally before a disaster strikes, it is often ineffective to parachute in help.

For how people deal with loss manifests differently in different cultures. In Nepal, for example, the perspective was one of asking forgiveness rather than blaming God for the sorrows that befell them. A Kshama Pooja was a local type of group counselling that was seen being commonly practiced in the wake of the 2015 earthquake. It differed completely in approach from Western talking approaches but was a deep-rooted local system. Force-fitting imported theories are not always helpful and may in fact cause more harm.

The focus on social first – both before and after a disaster can help reduce further trauma. For the best way to prepare for loss is to build positive connections with the people you lose. Healthy social interaction and facilitating happy memories that can be revisited is the best preparedness on the mental health side. In the wake of a disaster, the focus on preventing negative social impact could vary from reducing trafficking and spikes in alcoholism to ensuring locally relevant needs are met, for example.

The fact is the characterological impacts are rarely measured over the long-term, but case examples show how deeply it can influence lives.

"Trauma leaves what we call 'characterological impacts' that aren't measured, things that impact the character of the person and manifest down the road. For example, one of the major thoughts that comes through to a child is that this has happened to me, anything else can happen to me. The feeling of not having control means younger children may become scared and withdrawn. On the contrary, an older child may become daring, experiment and take risks.

– Dr. Achal Bhagat, Psychiatrist and Founder of Saarthak Foundation

TRANSITIONAL HOMES OF HOPE

A home is a symbol of hope. For those who can, rebuilding begins from day 1 after a disaster. Families cannot survive in makeshift tents while waiting for rebuilding schemes to materialise and unsafe rebuilding just increases their disaster risk. For SEEDS, our transitional shelter process has been an opportunity not just to get a roof over their heads, but to help the most vulnerable families build their resilience to better withstand future emergencies.

These homes incorporate disaster reduction techniques and are the foundation towards permanent housing. Among others, this includes cross bracing or lintels and light walls (for earthquakes); tying of the roofs (for winds); and higher plinths and deep foundations (to protect from floods). Each design also looks at thermal comfort, ensuring it is warm or cool enough for a family to live in for an extended period.

At the core of the transitional shelter process is the use of local (and natural) materials, exemplifying that one size does not fit all. This customisation means that traditional practices and ways of building are retained, while being strengthened. This helps to decrease the carbon footprint and has secondary impacts on social cohesion and reviving local economies. It also allows for larger replication within the community. Depending on the area, the designs have incorporated bamboo, wood, stone, local grasses, and earth. Salvaged material or existing plinths are also factored in.

These initiatives put the community in the driving seat with an emphasis on 'learning to build safer'. This embedding of skills within the community help inculcate safer and environment friendly construction techniques, reducing dependence on outsiders in the future. Strong, highly-engineered designs are broken down into a simple step-by-step process that are done by the families.

In Nepal, the creation of a strong multi-pronged partnership (private sector – consultancy – NGO) created efficiencies of cost and scale and lasting impact. 2,520 families across 10 districts were enabled to build safe and sustainable houses. Trained house owners from one village then in turn became guides for other communities, with many women actually taking the lead. This not only made it easy to replicate and scale up in a rapid manner but helped break entrenched social traditions. These houses continued to be used as of January 2019; and parts of the homes are being incorporated into permanent rebuilding.

After the devastating floods in Golaghat district in Assam in 2017, 80 transitional shelters were built in Nikori village. These homes continued to stand tall in the midst of rising waters in 2018. For these families, they have proved safe havens, protecting life and preventing them from getting caught in a recurrent cycle of devastation. The higher-than-usual flood waters didn't enter the houses due to the increased 5-foot height and the concrete foundation for each bamboo column deeply anchors the house in the soft soil. Cross-bracing adds to the stability. With materials all sourced from within a six km radius, these homes have proved truly local, yet safer.

The entire approach and the critical juncture at which it occurs means that the process itself can be healing, as much about building hope as embedding a culture of resilience.

LAND BECOMES WATER (AND WATER BECOMES LAND)

Changes to the coastline are already affecting livelihood sources and will be hotspots for vulnerability in the future.

Sea level rise and coastline erosion are two of the biggest impacts of the changing climate. Official estimates put the length of the Indian coastline at 7,516 kms, though various studies use different figures. India has ten coastal states including Goa, Gujarat, Karnataka, Kerala and Maharashtra on the West; and Andhra Pradesh, Puducherry, Odisha, Tamil Nadu and West Bengal on the East. This puts millions of families in India at risk.

The rising sea

33% of India's coastline is eroding

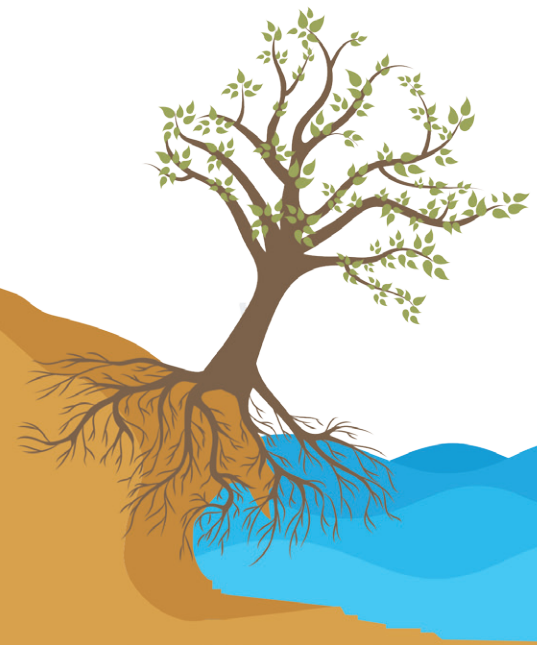
Current global commitments to the Paris Agreement based on Nationally Determined Contributions show that we are falling far short of limiting warming to the 2-degree goal. Part of the commitments are to peak emissions as early as possible. Yet even if emissions were to peak today, the threat of sea level rise is slated to continue far beyond due to the existing damage, with conservative estimates placing rising levels up to another 60 cms in the next century.

Increasing warming amplifies the exposure of small islands, low-lying coastal areas and deltas to the risks associated with sea level rise for many human and ecological systems, including increased saltwater intrusion, flooding and damage to infrastructure (high confidence).- IPCC Report 2018

As sea level rises, the direct impact will mean fishing villages disappear and coasts turn into wasteland. This rising seas will also amplify the impact of storm surges, because even a smaller surge will produce more extreme water levels.

The State of India's Coastline

A 26-year study of the Indian shoreline from 1990 to 2016 shows that a third of the coast is seeing erosion, 38% is stable and the rest is accreting. West Bengal is the worst affected with 63% of its coastline eroding.[36]



		Erosion	Stable	Accretion
West Coast	Gujarat, Daman & Diu	26%	43%	31%
	Maharashtra	24%	64%	12%
	Goa	24%	64%	12%
	Karnataka	22%	48%	30%
	Kerala	45%	34%	21%
East Coast	Tamil Nadu	41%	36%	23%
	Puducherry	57%	35%	08%
	Andhra Pradesh	27%	31%	42%
	Odisha	28%	21%	51%
	West Bengal	63%	13%	24%
Average		33%	38%	29%

The Global Risks Report 2019 by the World Economic Forum shows that this relative sea-level rise poses the highest risks for the Krishna (India), Ganges-Brahmaputra (Bangladesh) and Brahmani (India) deltas. In Bangladesh, a rise of 0.5 metres would result in a loss of about 11% of the country's land, permanently displacing approximately 15 million people.[37]

Fleeing the consequences: What happens to climate-induced migrants?

1.35 million new displacements due to disasters in India in 2017 alone.

What is the cost to a family who has to leave their home, washed away or in search of water? Over 246 million people were displaced by disasters globally in the last 10 years. There were close to 1.35 million new displacements due to disasters in India in 2017 alone.[38]

In recent times, the idea of climate refugees is emerging, in terms of movement across countries. However apt this may seem as a concept, those forced to move due to disasters or climate related issues do not qualify as 'refugees' under international law. 'Refugee' status is accorded only to those who face persecution if they return.

In fact, there is no clear policy that exists on climate-induced displacement either nationally or internationally. This is partly because loss and damage from climate induced events is rarely comprehensively tracked, and the relationship to migration becomes difficult to quantify. What is clear is that the number of people affected will only increase, with internal climate migration intensifying over the next several decades.[39]

Wetlands provide livelihoods, are highly effective carbon sinks, help recharge rapidly depleting groundwater and serve as a first line of defense to protect communities.

About 35% of the world's wetlands have disappeared since 1970.

Satbhaya: A village in Odisha swallowed by the sea

In 2007, the village of Satbhaya in Odisha showed a dangerous trend. Close to half of the village area (155 sq. km. of land) had been submerged in the sea. Only three kms of the bund constructed after the 1971 cyclone remained, eroded away by the sea and wind. As a result, about 80% of the village was exposed to the sea. In addition, the villagers had also constructed their houses on parts of the bund which protected them from flood waters but made them more vulnerable to cyclonic winds. Each farmer used to have 5-7 acres of land. Those few located behind the bunds were protected but the rest had problems of sea water intrusion and increasing soil salinity. With no sewage or drainage system in the village, waterlogging and the risk of diseases such as malaria were common.

The village had a school with classes up to 7th standard. However, the school building was close to the shore and was not protected by bunds. Hence during high tides or storms the building would get partially submerged. As a result, sand had accumulated around the school building. Satbhaya village also did not have any medical facility. An auxiliary nurse midwife would visit every 10-15 days and families would have to travel for 6 or 7 kms for any medical attention.

Satbhaya village has now become the first large-scale example of a village relocation due to coastal erosion. The process has taken decades, following sustained demands. Families have been moved to a new location of Bagapatia which falls within the Bhitarkanika Wildlife Sanctuary, a notified protected area with restrictions on human activity. While relocated families now have access to a hospital (and safer places to live), their livelihood options are limited. Many travel back every day to the sea to catch a few fish and try and sustain themselves.

COUNTERPOINT

PROTECTING OUR PROTECTORS

Wetlands are a broad name for all the areas where water and land come together. From mangroves to rivers and lakes; from floodplains to flooded forests and even coral reefs, wetlands are a crucial part of our ecosystem. They exist in all types of climactic zones around the world. Not only do they provide livelihoods, they are highly effective carbon sinks, help recharge rapidly depleting groundwater and serve as a first line of defense to protect communities from disaster impacts.

Take the 2004 Indian Ocean Tsunami which wiped out fishing villages in Nagapattinam along the Tamil Nadu coastline. Yet, neighbouring areas of Pichavaram which were covered by a dense mangrove forest were left relatively unharmed. In its aftermath, mangroves gained attention to mitigate the impact of storm surges and tsunamis. Native fruit bearing trees were seen as effective buffer plantations both for coastal as well as inland habitations. Community-based approaches to generate and maintain such plantations have been taken up, using nature as a protection tactic.

Yet, under our British era system of classifying land uses, wetlands were classified under 'wasteland' allowing for rapid buildup on these lands. Despite their clear importance on multiple fronts, wetlands are continuing to disappear at an alarming rate, three times as fast as another vital ecosystem – our forests.

About 35% of the world's wetlands have disappeared since 1970, a result of build-up, agricultural expansion and water diversion among others.[40] Of the millions of wetlands in India, just 27 are protected under the Ramsar Convention to which India is a signatory.

It is not just a question of wetlands disappearing. The damage that these wetlands sustain in saving lives and property in a disaster is rarely directly addressed. How do we ensure we protect our protectors? Till now, India does not have any policy on environmental protection from the climate and disaster perspective. A clear environmental protocol for different regions would help speed up processes on protection and recovery.

THE SILENT EVENTS

The disasters that go unseen leave those affected at even greater risk.

What does it mean for affected families when over 90% of disasters around the world go silent?[41] This silence manifests itself in different ways. The story may not be widely known or reported which reduces chances of response, leaving affected communities to cope on their own. The silence could mean that assistance is not given, is extremely delayed or vastly inadequate. Finally, silence could mean that district, state or national policies don't consider it a disaster.

In fact, this complex interplay between media, humanitarian agencies and government policy often turns 'silence' into a self-fulfilling prophecy.

The complex interplay between media, humanitarian agencies and government policy often turns 'silence' into a self-fulfilling prophecy.

"The visibility of populations is partially determined by who is doing the seeing."
– IFRC World Disaster Report 2018

The Six S's behind Silence

The causes of this silence can be attributed to six factors which are often inter-linked. Ensuring that these aspects are given consideration will be essential to ensure voices of those in need are heard in the coming times.

SITE

Where the disaster strikes is one of the keenest indicators of how loud it is heard. Large incidents in more remote areas receive less attention than small incidents in a big city. What is even more striking is the sites that get left out within a larger disaster. During the Uttarakhand floods in 2013, for example, efforts were heavily concentrated on Rudraprayag and Chamoli districts where the bulk of media attention was focused, while other equally affected but more remote areas were left to fend for themselves. In almost every disaster, there are complaints from those in the most interior regions that the majority of aid reaches families located along the main road.

SIGNIFICANCE

The site is also closely related to the economic and political significance of the area or of the communities impacted. For example, of the four cyclones that hit India in 2018, Cyclone Daye was the most ignored. It made landfall on 21st September, primarily affecting Malkingiri district in Odisha, an area inhabited by a largely tribal population. Highly rural, there is only one census town. Extensive rainfall and flooding virtually cut off the area from the rest of the state. Yet, apart from a week's compensation for the largely daily-wage population, little more was heard about recovery plans here.

The site is also closely related to the economic and political significance of the area or of the communities impacted.

When multiple disasters strike at once, significance again plays a role in capturing the limited attention span. Despite severe flooding also happening in Nagaland at the same time, it was the Kerala floods that got the maximum mindshare and funding.

SCALE

Numbers, particularly life loss and infrastructural damage, dictate the majority of the coverage and usually the extent of aid. Despite significant economic and environmental damage in the aftermath of Cyclone Gaja that hit Tamil Nadu last year, the reaction across the country was low.

SLOW VS. SUDDEN

Sudden disasters such as earthquakes and flash floods lend themselves to vivid dramatic imagery that moves people's sensibilities. On the other hand, slow onset disasters such as beginning stages of drought or recurrent ones such as Bihar's annual floods have less of a visceral impact. This has linked impacts on funding or even to explain just how dire the situation has become.

STRESSES

Many of the disasters today are created by the compounding and integrated effect of vulnerabilities (refer to the No Disaster is Natural chapter). Yet these are rarely given focussed attention and are among the most commonly 'silent'. This includes issues such as water shortages and quality; changing crop patterns; increased health hazards; new pests and insects; and livelihood-compelled migration. Until it turns into a full-fledged 'disaster', these tend to be ignored.

> Too often, communities aren't helped because their needs extend beyond the official scope of an organisation or department's work.

SCOPE OF WORK

That's not what we do; or it's not part of our mandate. Too often, communities aren't helped because their needs extend beyond the official scope of the organisation or department's work. As disasters morph in new ways, its impacts are as well. Nurturing flexibility and finding ways to help those most in need, even when beyond scope, will be critical in coming times.

A way of life threatened after excessive snowfall in Changthang, Ladakh in 2012-13

"Every year, we pray for snow because without it there is no chance of greenery and a beautiful summer. This year, maybe we prayed too much. So many of our animals have died, it was almost unbearable. But hopefully there will be a good pasture for those who are left."

In the winter of 2012-13, the nomads of Changthang, Eastern Ladakh, suffered huge losses when recurrent snowfall led to mass starvation of their livestock. Discussions with local communities and government officials revealed that on an average 25% of their livestock perished due to starvation. It was also birthing time for the animals and virtually none of the young survived. In total, around 40,000 goats and sheep died.

The Changthang region encompasses two blocks of Leh district – Nyoma and Durbuk. 20 villages across the region were affected. This had an unprecedented impact, even threatening a way of life. The Changpas are solely dependent on their livestock to survive and are also the largest producers of pashmina in the world. The only time the disaster hit the headlines was when downstream pashmina processing operations in Kashmir were impacted.

Helped partly by a push from a consortium of Civil Society Organisations and local leaders, the disaster was brought to the attention of the government. Before the following winter, fodder was stockpiled earlier by the government in the worst hit places. More long-term, a Rs.42 crore project for the promotion of sheep husbandry was sanctioned by the Ministry of Textiles, Government of India, under the 12th five-year plan. It aimed to ease life for nomadic people in this harsh region under a new Pashmina Wool Development Scheme.

> By, with and for the people! The People's Power Collective philosophy is reflected in the work of 'Mandakini Aawaz 90.8 FM' community radio station that is heard in 350 villages across Rudraprayag, Uttarakhand. For the essence of community radio lends itself beautifully to be a space for awareness and resilient development. It is community-driven, need-based empowering content that has the potential to inspire action! When you have this everyday live breathing platform, the tiniest forest fire in a nook of your village or a landslide that's affected just five houses immediately finds a voice.
>
> *- Saritha Thomas, Founder/ Managing Trustee, People's P.o.w.e.r Collective (Participatory Ownership Empowerment Radio)*

COMMUNITY RADIO AS A POWERFUL SPACE TO COUNTER 'SILENCE'

Community radio is at the heart of countering silence. For the moment you have community at the heart of their own culture, their own development, enjoyment and issues, it is this wonderful platform for two-way information sharing as well. It's a platform that lends itself to relevant local information such as weather forecasts and hazards prevalent in the area. The relevance of that is immense. People actually wait for it because it has a level of locality (depending on the relationships you've built with the weather department) and it allows you to plan.

"You're a barefoot journalist being a community radio reporter. So, you bring in local culture, morph it with local issues and that morphs with local people doing things themselves. You are prompting thought, you are prompting action, prompting things to be done in an infotainment manner when it allows for it, and for hard reportage when demanded. There's a whole follow-up. So things don't just happen and silently die off because it is a remote marginalised community. Accountability and answerability become part of this."

In other words, it is a powerful vibrant space for disaster management all year around. By talking about vulnerabilities when there is no disaster, you make the community aware and help reduce risk on a recurring basis.

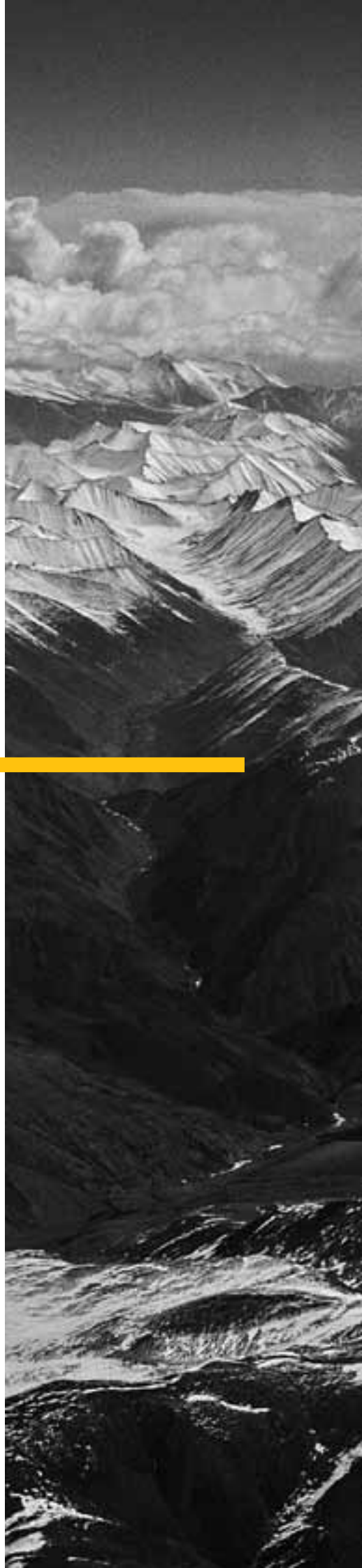
That has been the learning for most Community Radio stations. It must be an everyday process, not one that kicks into action on the day of a disaster. Unless you've invested trust beforehand, it will be hard to get people to tune in and believe the validity of your information. These kind of soft values have to be entrenched with all stakeholders, including government. For example, Uttarakhand is the first state in India to have a community radio and disaster management policy, as of December 2017.

"For us, we felt a radio station needs to not just talk about it, but also be an example. So we collaborated with earth architect, Didi Contractor for our building. Kaccha vs. pucca was a big problem for team Mandakini in terms of what will people say? So the process of building the awareness of our partner team was in itself a process of explaining disaster resilient construction. It's built with mud, wood, bussa (wheat chaff), stones excavated from the same site and wood framing for the door. Local materials and local mistris were being trained."

While inspiring local action, a community radio platform can also give voice to these communities in a larger sphere. Mandakini Aawaz 90.8FM, for example, now goes to 40,000 subscribers across the world through an app, mainly Uttarakhandis staying connected with home.

TRANSFORMATIONS IN THE THIRD POLE

Himalayan glaciers are melting, with serious implications for the whole country



The massive stock of snow and ice in the Hindu Kush Himalayas makes it the largest store of glaciers outside the North and South Pole. Hence its designation as the 'third pole'.

The Hindu Kush Himalayan region covers eight countries- Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan. In India, this covers the entirety of 11 mountain states (Assam, Arunachal Pradesh, Himachal Pradesh, Jammu and Kashmir, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura and Uttarakhand) and the Darjeeling and Kalimpong districts of West Bengal.

Ten major rivers originate in this region, including three of India's lifelines – the Brahmaputra, the Indus and the Ganges. It is estimated that the third pole supports 240 million people who live in the mountains, and an overall 1.9 billion people (2015 estimates) whose head waters originate here.

Glaciers have been retreating and losing mass since the 1970s. Their volumes are projected to decline by up to 90% through the 21st century in response to decreased snowfall, increased snowline elevations and longer melt seasons.

Clear patterns are emerging around how these changes will strongly affect the timing, magnitude and seasonal runoff distribution of the melt water. Of these, the Indus is expected to be the worst affected, as 80% of its flow comes from melt water. With the basin spreading across Afghanistan, China, India and Pakistan, this raises questions about the Indus water sharing treaty and how these changes will be dealt with in the coming times.

Not only will this melt have an impact on health and food security, but the complex environmental topography of the region poses clear cyclical influences on disaster risks. Glacier melt can be accelerated by flood-inducing cloudbursts and landslides at higher altitudes. At the same time, as glaciers retreat, permafrost (frozen under the surface) will also melt, destabilising the mountains.[42]

> The third pole is of significant importance, but what will happen to it in times to come? One of the challenges of the third pole is that these glaciers are melting – no doubt about that. Policies on water security, food security, energy security all need to be guided by that knowledge. Currently whatever adaptation I've seen in the Himalayas is informal. What we need is informed adaptation strategies and action plans based on the knowledge we have today.
>
> *– Dr. Shakil A Romshoo, The University of Kashmir, Srinagar*

> Artificial glaciers have been innovated and located as close as possible to the village and at lower altitudes than natural ones. These start to melt much earlier as compared to a natural glacier i.e. in the month of April–May. So they supplement additional irrigation water and serve a host of other purposes.
>
> *- Chewang Norfel, Engineer and Artificial Glacier Innovator, Serthi, Ladakh*

COUNTERPOINT

THE 'KHUL' SYSTEM AND ARTIFICIAL GLACIERS TO COUNTER WATER WOES IN LADAKH

In the high altitude desert of Ladakh, there is normally very little rainfall, with levels of precipitation that are inadequate for crop cultivation. Short summer seasons mean that farmers are only able to cultivate one crop per year which must be sown in April or May. The dearth of water can hinder their entire annual livelihood. Yet, an estimated 85% of rural Ladhakhi livelihood is dependent on agriculture. This brief period alone must provide people with enough agricultural produce to consume, put away for the winter and sell. Barley, buckwheat, vegetables and fruits such as apricots, pears and apples are the most common.

This means that snowfall matters enormously to the year's water supply to build up the glacier. It is this that then begins to melt into streams as the spring and summer progress. Those streams irrigate the crops during the short and crucial 4-5 month long growing season. In this finely tuned system, a large number of high temperature days early on may cause the melt to happen too rapidly, flooding the water channels and sometimes the fields. This leaves little water for later in the season. Too little snow means less new ice to melt, eventually resulting in a slow and unidirectional shrinking of the glacier.

Traditionally, these crops are watered by using a system of canals called 'khuls'. Water is tapped far upstream in stone dams to raise its level and then diverted through sluice gates. A network of smaller canals is then set up for equitable distribution to all fields in the vicinity. The number of khuls in a village can vary dramatically depending upon the topography and extent of cultivatable land.

Yet over the last three-four decades, the amount of snowfall has decreased and glaciers are actually retreating in almost every part of the region.

The creation of 'artificial' glaciers is helping reverse this problem. Built closer to the villages, this unique and intricate system of water harvesting is helping augment water supply.

Water from existing rivers is first diverted to shady areas of the valley. The water must be slowed to a trickle to ensure it freezes, so the routes are sometimes long and meandering. Small stone embankments are built at regular intervals along the mountain slope. These form shallow pools that freeze as the temperature drops. Over many weeks, as this cycle keeps repeating, a sheet of ice is formed that is several layers thick.

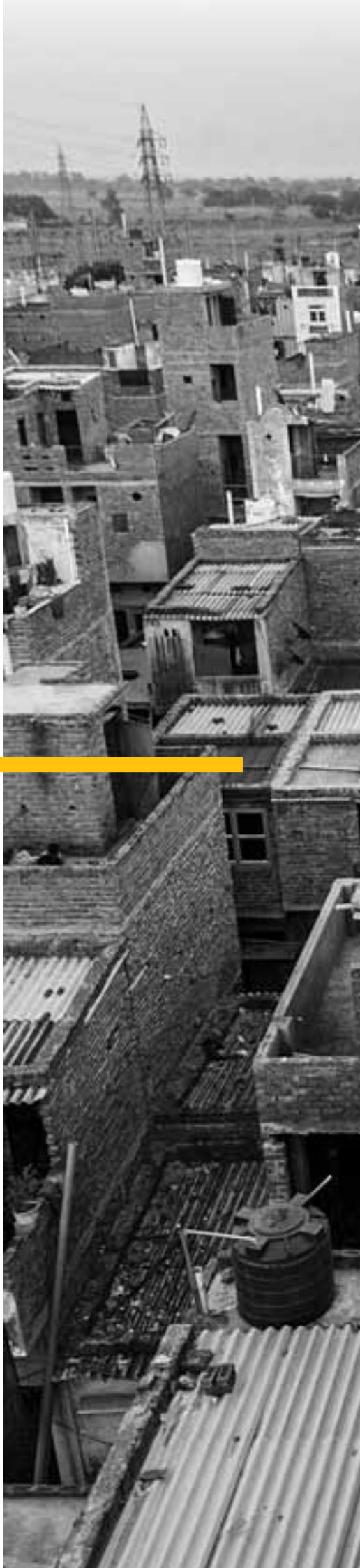
Since the artificial glaciers are constructed close to the village, its benefits are equally distributed amongst all the villagers. Hence, the entire community contributes to maintaining and monitoring it.

Running for the last few years, the projects have received much positive feedback from the farmers. It has actually increased confidence, cutting the migration to urban areas in search of alternative employment.

The artificial glaciers are easily replicable in other south-facing villages with similar characteristics. 14,000 to 16,000 feet altitude; temperatures as low as -15 Celsius; and long peak winters of at least 4-5 months to ensure expansion and formation of the glaciers.

THE URBAN IMPERATIVE

Risk is rapidly urbanising and will affect everyone!



Breeding irreversible risk

As economic, climate and disaster variables drive migration to the cities, not only are the number of vulnerable people growing, but urban areas are breeding irreversible risk. As of 2012, over three-fourths of the 7,935 towns and cities were growing without any master plans at all. The haphazard development is increasingly happening on what used to be uninhabitable land, including steep slopes, low-lying areas, wetlands and drainage channels.

This has not just exacerbated existing vulnerabilities but is not keeping pace with the changing risk scenarios.

In recent years, it is urban flooding in particular that has made headlines in Bhopal, Chennai, Mumbai and Srinagar, among others. Each of these events saw correlations with increasing buildup and shrinking wetlands, as well as an impact on more affluent neighbourhoods.

Take Chennai as an example. The non-stop torrential rains in December 2015 meant the city received more rain in a single day than it had on any day since 1901. Rainfall aside, the wetlands and natural sinks which act as a sponge have actually shrunk massively over the years. Estimates put those that survive at just 10%. Concrete encroachment on Cooum river, Adyar river and Buckingham Canal which serve as the main rainwater drains, poorly designed drainage systems and aging civil infrastructure added to the problem. With nowhere for the water to go, it settled instead on the roads.[43] The extensive flooding was a huge blow for industrial activity. Major manufacturing units had to suspend operations with estimated economic losses at USD 2.2 billion.[44]

Urban floods may have created the most buzz, particularly in terms of industrial losses, but risks are diverse. Our entire approach to towns and cities needs to change if we are to thrive in the coming times. Long-term resilience and sustainability must come to the fore in planning for the future.

It is estimated that in 2030, 38% of the Indian urban population will live in cities of less than 300,000 people.

'Smart' must be sustainable

In order to survive, the cities of the future will have to look at sustainability from a broader perspective. Recent discussions around 'climate-smart' cities have begun analysing how environmental degradation does not have to be a fallout of growth. Strands of quality of life, sustainability as well as robust economic ability need to be addressed. Putting this in practice at a broad scale, however, remains to be seen.

IN FOCUS

What is 'Urban' anyway?

By 2030, Asia is anticipated to add eight more megacities, four of which will be in India (Ahmedabad, Bengaluru, Chennai and Hyderabad). This has put much of the focus and investment on large metropolitan areas and emerging 'smart' cities.

The official definition of an urban area in India, however, includes a much more varied mix. It includes any place with a municipality, corporation, cantonment board or notified town area committee. Or any area which has a minimum population of 5,000; where at least 75% of the male main working population is engaged in non-agricultural pursuits; and which has a population density of at least 400 persons per sq. km.

This means areas as diverse as Konark Notified Area Council in Odisha, Coimbatore in Tamil Nadu and a mega-city like Delhi or Mumbai all fall under the idea of 'urban'. Blanket urban measures and initiatives will have little impact.

It is estimated that in 2030, 38% of the Indian urban population will live in cities of less than 300,000 people.[45] Interventions in the smaller centres and peri-urban areas are therefore equally critical.

COUNTERPOINT

MOVING FROM I TO WE TO OUR

It's not my city, so why should I care? The heterogeneity of urban dwellers, and the fact that it is an adopted home for a large percentage of the population, often poses challenges in taking action against risks. Adopting a collective approach of 'I to we to Our' helps counter this. As an example, in a long-term programme in East Delhi, individual change agents from various walks of life were empowered to lead the formation of the Purvi Dilli Aapda Prehari (a citizen-led forum). Now established as an institution, it links smaller community action groups have emerged that work within specific neighbourhoods. This push has bridged socio-economic and political divides to foster a sense that dealing with risk is a collective responsibility. The groups run advocacy and awareness campaigns and improve links with district officials; furthering Sustainable Development Goal (SDG) 11B on adopting holistic risk management at all levels.

MICRO-INNOVATIONS TO BEAT THE HEAT IN SLUMS

Within the growing urban vulnerability, it is the poor and those who live in informal settlements that will be the hardest hit. There are close to 14 million slum households across India (Census 2011). Measures to lower impact on these families will be essential, particularly from the growing heat stress.

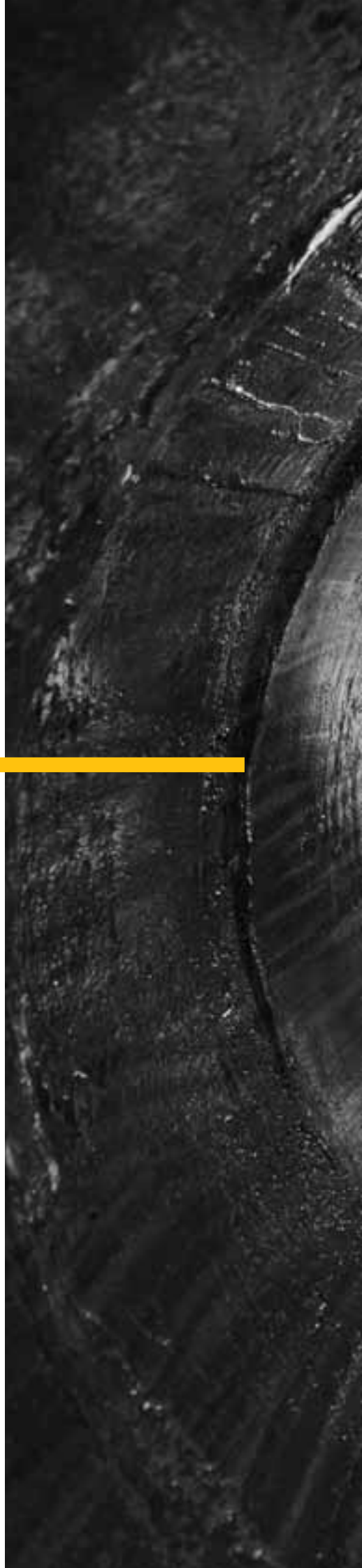
A first look at what makes slum houses vulnerable reveals the typical tin house for what it is—a hot metal box clad in combustible materials where temperatures could easily reach 51°C. The story of heatwave vulnerability, however, is not about the tin house but about the people who live in them. The residents of Masudpur slum of Vasant Kunj in Delhi, for example, said that summer was the most difficult time of the year. Yet, mainstream market options to improve thermal comfort were either too expensive or too alien to ever be adopted in settlements like this one. It needed simple do-it-yourself options.

Was it possible to use the community's own strengths as the basis for effective retrofits to improve thermal comfort? Over a few months at the end of 2018, SEEDS helped prototype and test such retrofits, analysing their performance both in real time and through EnergyPlus simulations. Multiple community feedback events ensured they were acceptable to the slum community; and a manual was published with step-by-step instructions on creating and installing them.

The final prototypes were five-fold. A double roof made from billboard flex awnings reduce the heat gain from the roof (the major source). A skylight and vent was made with a simple hole, steel wire mesh and plastic bucket, helping cool and light the house. The army of drums used to store water were stacked vertically in a stand made with bamboo ladders. This also supported a desert cooler and potted plants, redirecting and filtering rainwater from the double roof for collection. A retractable flexible ceiling made of billboard flex and bamboo helped the house cool down and heat up as required. Finally, cycle tyre tubes (usually used as lining on the door to prevent scrapes) were used to line the top of the tin walls, breaking the thermal bridge with the tin roof.

These five small micro-innovations could truly help beat the heat. For together, they cost just USD 35 to make and could reduce internal temperature by over 10°C (as validated by Visvesvaraya National Institute of Technology, Nagpur).

LOOKING AHEAD



Stepping back to take a more holistic view shows that the face of disasters is evolving. If we are to manage and cope with it, business as usual is no longer an option. Part of this will be about evolving strategies for specific hazards which are certain and are continually changing forms. In 2019 itself, we can say with certainty that this will include floods; as well as droughts and heat waves that are already being seen.

At the same time, the broader view also indicates that we will need to tweak our approach to dealing with risks.

ACKNOWLEDGING INTEGRATED RISKS

Nothing is risk-neutral with every development either creating, exacerbating or reducing risk. With dwindling ecosystem assets and accelerated growth trends, this complex interplay will only increase. Every decision, solution and innovation of the future will need to find ways to look beyond one point aims. Methodologies to evaluate the trade-off (currently in the forms of environmental, structural or social audits where applicable) may need to broaden scope, finding ways to compare apples with oranges beyond monetary impact.

SAVING AND MANAGING FRESHWATER

A resident of a resettlement colony on the outskirts of Delhi put it best. "Everything starts with water," she said, "and everything ends with water as well." The water crisis that is already underway and its impending compounded impact, will require consideration in all areas from agriculture to construction, from manufacturing to urban planning. Sustainably managing and saving freshwater, both on the surface and underground, will need to have repercussions on every sector and walk of life.

FLEXIBLE AND RISK SENSITIVE PLANNING AND BUDGETING

Untied and more flexible funding have been discussion points in the humanitarian sector for a few years now, playing a prominent role in the Grand Bargain Agreement and the push for localisation. Yet, on ground, this remains a challenge. Addressing the growing unpredictability in scope and scale of risks will need this flexibility if the needs of vulnerable communities are going to be truly met. Limited resources need to be invested based on real needs, rather than pre-determined budget lines.

At the same time, the percentage of international aid spent on disaster risk reduction globally over the last 20 years is negligible, just 0.4%. Where investment occurs, it tends to be large-scale infrastructure projects and not ones that get woven into the fabric of community development. The idea of 'mainstreaming DRR' has been around for some time, but risk sensitive planning in every sector and community has yet to be seen on a broad scale.

APPROPRIATE BUILT ENVIRONMENTS AS A DISASTER RISK AND PUBLIC HEALTH ISSUE

The quality and spread of the built environment have time and again influenced the extent of a disaster's impact. It has repercussions on mortality and morbidity rates during and in the wake of emergencies, as well as leading to secondary hazards. Poor habitat planning and access to basic services can translate into protracted crises and chronic epidemiological concerns. Issues also include fire risk, poor ventilation, the capturing of pollution as smog and poor (or non-existent) sanitation that leads to water-borne disease. Deeper and more invisible issues such as women's reproductive health, community mental health and children's developmental concerns are also directly impacted. This has repercussions on the quality of life and on survivability in the face of a disaster.

One of the changing faces of disaster risk is that the unprecedented is becoming the norm. Our building codes and standards (where enforced) still look at return periods of 1:25 years or 1:50 years which may need drastic rethinking in the future.

At the same time, for resilience to become a part of construction culture, it must be embedded into the fabric of academia. Students must be exposed to and taught DRR and resilience elements as part of their architecture, planning and engineering curricula – both from the technology and social perspective.

LOCAL PROBLEMS NEED LOCAL SOLUTIONS

When the scale of the problem is this huge, the nature of the losses often informal and the resources limited, promoting coping practices at the community level may be the best way forward.

One aspect of this is understanding how increasing variability is affecting specific areas. Disaggregated and local data is the need of the hour – to understand and reduce risk, to better prepare and even to respond in places that currently go unheard.

The second aspect is identifying and scaling local solutions. Every community faces varied risks; and varied triggers to their shocks and stresses. However, they also have inbuilt coping mechanisms and wisdom that can be tapped. The individual and his neighbour are the best risk managers. Imported solutions often fail to differentiate local context and take local capacity into account. Within at-risk communities, people are coping with amazing levels of ingenuity. These are actually localised micro innovations that have the potential to be sustainable and scaled up.

SPREADING RESILIENCE KNOWLEDGE THROUGH SCHOOLS

Lifeline buildings – particularly schools and hospitals – will continue to be a focus from a strengthening infrastructure perspective. Yet, as the growing climate strike movement led by children and youth across the world has reiterated, children – and by extension schools – are also the fulcrum for larger changes in the community. A broader approach to school safety initiatives that are tailor-made for each location can help embed risk reduction into daily lives in the community. From participatory risk assessments to disaster management planning to climate awareness, this helps prepare for unforeseen incidents. It also helps address larger social issues in the neighbourhoods.

BROADER VIEW OF ENVIRONMENTAL SUSTAINABILITY

In the most ecologically vulnerable areas, the interaction between humans and nature needs a more holistic approach. An ecosystem level approach helps keep a strong focus on identifying the root causes of disasters, especially management of water resources. Rivers known for shifting their course, like the Kosi, are often the cause of erosion and floods. Intermittent wetlands found in this area acted as natural buffers of the landscape – absorbing excess rain and river overflows during the monsoon and discharging the water during dry months to meet the irrigation needs. However, these wetlands are being lost as channelization of the rivers through embankments alters the natural water flow, leading to waterlogging as well. On a recurrent basis, this leads to a degradation in the quality of water and can often increase risk of water borne and vector borne diseases. Addressing the symptomatic outcomes alone will not be enough.

REFERENCES

LOOKING BACK AT THE RISING TREND OF EXTREME WEATHER EVENTS

1. Nidhi Jamwal, contributing author of this article, is an independent journalist based in Mumbai, India.
2. Jamwal, N. (2019, January 30). Extreme weather events have become the new normal. DNA India. Retrieved from https://www.dnaindia.com/analysis/column-extreme-weather-events-have-become-the-new-normal-2713527
3. Rathore, LS, Attri SD and Jaswal AK. (2013). State Level Climate Change Trends in India: Meteorological Monograph No. ESSO/IMD/EMRC/02/2013. India Meteorological Department. Retrieved from http://www.imd.gov.in/section/climate/StateLevelClimateChangeMonoFinal.pdf
4. Rathore, LS, Attri SD and Jaswal AK. (2013). State Level Climate Change Trends in India: Meteorological Monograph No. ESSO/IMD/EMRC/02/2013. India Meteorological Department. Retrieved from http://www.imd.gov.in/section/climate/StateLevelClimateChangeMonoFinal.pdf
5. N. Chattopadhyay, S. Sunitha Devi, Gracy John, and V. R. Choudhari. (2016). Occurrence of hail storms and strategies to minimize its effect on crops. MAUSAM, 68, 1 (January 2017), 75-92. Retrieved from http://www.indiaenvironmentportal.org.in/files/file/hailstorms%20damage%20agriculture%20India.pdf
6. Botzen, W.J. Wouter & Bouwer, Laurens & van den Bergh, Jeroen. (2010). Climate change and hailstorm damage: Empirical evidence and implications for agriculture and insurance. Resource and Energy Economics. 32. 341-362. 10.1016/j.reseneeco.2009.10.004.
7. American Meteorological Society Glossary (n.d.). Thunderstorms. Retrieved February 2019 from http://glossary.ametsoc.org/wiki/Thunderstorm
8. Kamaljit Ray, B. A. M Kannan, Pradeep Sharma, Bikram Sen and A. H. Warsi, India Meteorological Department. Severe Thunderstorm Activities over India during SAARC STORM, Project 2014-15: Study Based on Radar.
9. Basu, S., Bieniek, P.A. & Deoras, A. Asia-Pacific J Atmos Sci (2017) 53: 75. https://doi.org/10.1007/s13143-017-0006-7
10. Jamwal, N. (2018, May 24). What's behind the intense storms battering North West India? Experts divided, call for more research. Scroll. Retrieved from https://scroll.in/article/879493/whats-behind-the-intense-storms-battering-north-west-india-experts-divided-call-for-more-research
11. Jamwal, N. (2018, April 20). India's Met department has forecast normal monsoon this summer – but don't start celebrating yet. Scroll. Retrieved from https://scroll.in/article/876152/indias-met-department-has-forecast-normal-monsoon-this-summer-but-dont-start-celebrating-yet
12. Singh, OP & Khan, Tariq & Rahman, S. (2001). Has the frequency of intense tropical cyclones increased in the north Indian Ocean?. Current science. 80. 575-580.
13. Maurya,L. and Goswami S. (2018). Extreme is the new normal. Down to Earth. Retrieved from https://www.downtoearth.org.in/dte-infographics/new_normal20180919/extreme_new_normal.html

WATER AND THE CHANGING NATURE OF DISASTER RISK

14. Bisht, G. (2018, May 29). Shimla runs out of water. Hindustan Times. Retrieved from https://www.hindustantimes.com/india-news/shimla-runs-out-of-water-residents-tourists-sweat/story-gmz2RtkLEYzKkrUzdbVYKI.html
15. http://farmer.gov.in
16. NITI Aayog.[2018]. Composite Water Management Index. Retrieved from http://niti.gov.in/content/composite-water-management-index-june-2018-0

PLANNING FOR WHAT YOU CAN'T SEE

17. Based on DISE data 2016-17
18. Katoch, A. (2017, February 10). A review of disaster management capacity in India: Policy Note. Delhi Policy Group. Retrieved from http://www.delhipolicygroup.org/uploads_dpg/publication_file/dpg-policy-note-volii-issue-1-a-review-of-disaster-management-capacity-in-india-1038.pdf
19. Anand S. Arya, Non-engineered construction in developing countries – an approach toward earthquake risk preduction, http://www.iitk.ac.in/nicee/wcee/article/2824.pdf
20. Rajendran CP, Sanwal J, John B, et al. Footprints of an elusive mid-14th century earthquake in the central Himalaya: Consilience of evidence from Nepal and India. Geological Journal. 2018; 1–18. https://doi.org/10.1002/gj.3385
21. Gavillot, Yann & Meigs, A & Yule, Doug & Heermance, R & Rittenour, Tammy & Madugo, C & Malik, Manzoor. (2016). Shortening rate and Holocene surface rupture on the Riasi fault system in the Kashmir Himalaya: Active thrusting within the Northwest Himalayan orogenic wedge. Geological Society of America Bulletin.
22. Pandey, Arjun & Singh, Ishwar & Mishra, Rajeeb & Rao, Priyanka & Srivastava, Hari & Jayangondaperumal, R. (2018). Active tectonics in the Assam seismic gap between the meizoseismal zone of AD 1934 and 1950 earthquakes along eastern Himalayan front, India. Journal of Earth System Science.
23. Based on Statement by the Honorable Dr. Ram Sharan Mahat, Finance Minister of Nepal, at the Partnership with Nepal Forum, on 3 May 2015 in Baku, Azerbaijan
24. 2011 Sikkim Earthquake: Effects on Building Stocks and Perspective on Growing Seismic Risk D.C. Rai, G. Mondal, V. Singhal, N. Parool, & T. Pradhan Dept. of Civil Engineering, Indian Institute of Technology Kanpur, India

NO DISASTER IS 'NATURAL'

25. 2018 World Air Quality report. Retrieved from https://www.airvisual.com/world-most-polluted-cities
26. Health Effects Institute. 2018. State of Global Air 2018. Special Report. Boston, MA: Health Effects Institute. Retrieved from https://www.stateofglobalair.org/sites/default/files/soga-2018-report.pdf
27. Centre for Policy Research (2019). Retrieved from http://www.cprindia.org/projects/clearing-air-seminar-series-delhis-air-pollution
28. Health Effects Institute. 2018. State of Global Air 2018. Special Report. Boston, MA: Health Effects Institute. Retrieved from https://www.stateofglobalair.org/sites/default/files/soga-2018-report.pdf
29. National Crime Records Bureau India. Distribution of accidental deaths by natural causes. (Table). Retrieved from https://data.gov.in/ministrydepartment/national-crime-records-bureau-ncrb?page=15
30. Prabhakaran, P. and Reddy, S. (2018). Lancet Countdown 2018 report: Briefing for Indian Policymakers. Retrieved from http://www.lancetcountdown.org/media/1421/2018-lancet-countdown-policy-brief-india.pdf

THE COMPLEXITY OF DISASTER IMPACT

31. 8th anniversary of quake in northeastern Japan (2019, March 10). NHK World – Japan. Retrieved from https://www3.nhk.or.jp/nhkworld/en/news/20190311_03/
32. Dr.-Ing. Wolfgang Kron. (2018, April 1). Asian Floods overshadowed by Houston Flooding. Munich RE. Retrieved from https://www.munichre.com/topics-online/en/2018/01/flood-disasters
33. UNICEF. (2011). Climate proof children: Putting the child first in climate finance. Retrieved from https://www.unicef.org/environment/files/climateproof_web.pdf
34. Food and Agriculture Organization of the United Nations (FAO). (2018). The impact of disasters and crises on agriculture and food security. Retrieved from https://www.preventionweb.net/publications/view/57488
35. Hallegatte, Stephane; Vogt-Schilb, Adrien; Bangalore, Mook; Rozenberg, Julie. 2017. Unbreakable : Building the Resilience of the Poor in the Face of Natural Disasters. Climate Change and Development;. Washington, DC: World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/25335 License: CC BY 3.0 IGO

LAND BECOMES WATER (AND WATER BECOMES LAND)

36. R.S. Kankara, M.V. Ramana Murthy and M. Rajeevan (2018) National Assessment of Shoreline changes along Indian Coast - A status report for 1990 - 2016, NCCR Publication, 2018, available at NCCR Website http://www.nccr.gov.in
37. World Economic Forum. The Global Risks Report 2019, 14th Edition. Retrieved from http://www3.weforum.org/docs/WEF_Global_Risks_Report_2019.pdf
38. Internal Displacement Monitoring Centre. (Table). http://www.internal-displacement.org/database/displacement-data
39. Kumari Rigaud, Kanta, Alex de Sherbinin, Bryan Jones, Jonas Bergmann, Viviane Clement, Kayly Ober, Jacob Schewe, Susana Adamo, Brent McCusker, Silke Heuser, and Amelia Midgley. 2018. Groundswell: Preparing for Internal Climate Migration. Washington, DC: The World Bank.
40. Ramsar Convention on Wetlands. (2018). Global Wetland Outlook: State of the World's Wetlands and their Services to People. Gland, Switzerland: Ramsar Convention Secretariat

THE SILENT EVENTS

41. IFRC. (2013, February 18). Silent Disasters. Retrieved from https://www.youtube.com/watch?v=F8z5v0iaVtY

TRANSFORMATIONS IN THE THIRD POLE

42. P. Wester, A. Mishra, A. Mukherji, A. B. Shrestha (eds) (2019) The Hindu Kush Himalaya Assessment—Mountains, Climate Change, Sustainability and People, Springer Nature Switzerland AG, Cham.

THE URBAN IMPERATIVE

43. Seenirajan, M., Natarajan, M., Thangaraj, R. and Bagyaraj, M. (2017) Study and Analysis of Chennai Flood 2015 Using GIS and Multicriteria Technique. Journal of Geographic Information System, 9, 126-140. https://doi. org/10.4236/jgis.2017.92009
44. Rajan, Vishnu & R. Sridharan, Dr. (2016). A Case Study on Impact of Chennai Floods: Supply Chain Perspective. Industrial Engineering Journal. IX. 12- 16. Retrieved from: https://www.researchgate.net/publication/309194370_A_ Case_Study_on_Impact_of_Chennai_Floods_Supply_Chain_Perspective [accessed Jan 04 2018].
45. United Nations, Department of Economic and Social Affairs, Population Division (2018). World Urbanization Prospects: The 2018 Revision, Online Edition.

SEEDS (Sustainable Environment and Ecological Development Society) is a not-for-profit organisation that enables community resilience through practical solutions in the areas of disaster readiness, response and rehabilitation.

Since 1994, the organization has worked extensively on every major disaster in the Indian subcontinent – grafting innovative technology on to traditional wisdom. It has reached out to families affected by disasters and climate stresses; strengthened and rebuilt schools and homes; and has invariably put its faith in skill building, planning and communications to foster long-term resilience. SEEDS is also India's first agency to be certified for the global Core Humanitarian Standards – an international certification system for quality and accountability in humanitarian response.

SEEDS completed 25 years of outstanding service to humanity in 2019, and is re-anchoring its approach to building resilience through innovation. It continues to empower the most vulnerable across Asia to build a better future.

SEEDS: 15-A Institutional Area, Sector 4, R.K.Puram, New Delhi - 110022 | www.seedsindia.org