

AFRICA

16-31 MAY, 2018

DownToEarth

FORTNIGHTLY ON POLITICS OF DEVELOPMENT, ENVIRONMENT AND HEALTH

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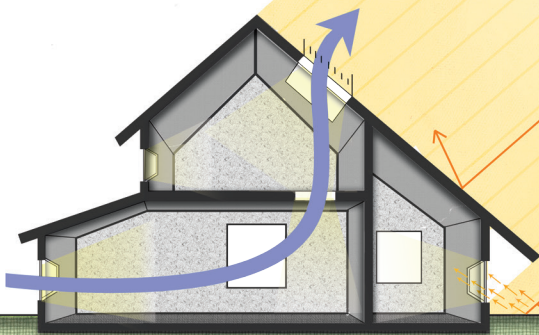
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India's built sector consumes 30 per cent of its electricity and is responsible for 23.6 per cent of its greenhouse gas emissions (GHG). A more robust energy regime in built environment is crucial to reduce energy consumption and help India meet its energy target as described under Intended Nationally Determined Contributions commitment. 'Passive design' takes advantage of the climate to maintain occupancy comfort in buildings and associated environmental factors and reduce reliance on active lighting, heating, ventilation and air conditioning systems and can increase energy saving potential by about 40%. The government of India incentivizes and mandates these techniques through measures like Energy Conservation Building Code for commercial buildings, (ECBC 2017), energy policy which recognizes building/built environment as key player in associated reductions, integration of environmental conditions in model building bye laws etc.

Anil Agarwal Environment Training Institute (AAETI) offers this course to familiarize participants with the impact of weather conditions on comfortable dwelling, the role building physics plays in designing a built environment, and associated benchmarks. CSE has been working closely with architects and building physicists on sensitizing urban professionals on sustainable building practices and has incorporated all these principles in the AAETI campus construction. AAETI is an ECBC compliant sustainable, state of the art campus. The campus has been selected by Global Environmental Facility, Bureau of Energy Efficiency and UNDP India as one of the 24 Model Energy Efficient Buildings of the country which will be monitored for their energy performance. Participants inhabiting and interacting with the campus building features will enable them to understand the working of all 5 natural elements coming together and acting as a learning tool for building design practices and understanding of energy conservation concepts. The campus has utilized various passive techniques such as decentralized systems (waste water, building waste, renewables, water sensitive design, etc.) which the participants will be made familiar with. (As this involves various hands on exercises, every participant is expected to have a laptop, requisite softwares link will be provided upon registration)

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- Sustainability Development Goals
- The challenge of sustainability
- Climatic conditions and human comfort
- Understanding materials and their properties of insulation, thermal mass etc.
- Understanding the solar path and the role of building orientation and shading devices.
- Understanding building envelope and its components
- Basics of day lighting and its components
- Introduction to passive cooling techniques and low-energy mechanical cooling techniques
- Hands on energy modeling exercise
- Energy-based design of electro-mechanical services
- Introduction to energy-efficient fixtures, controls and service systems, etc.

COURSE FEES

₹21,000 per participant.
Student and Group Discounts available. (Course fee includes tuition fee, external expert lecture sessions, training materials, **Boarding and lodging**, Transport from New Delhi to AAETI and back)

COURSE DURATION

June 27th-29th, 2018

TIMING

9.30 am to 6 pm

COURSE VENUE

Anil Agarwal Environment Training Institute (Centre for Science and Environment initiative), Nimli (near Alwar), Tijara, Rajasthan

LAST DATE FOR APPLYING

June 17th, 2018

TRAINING METHODOLOGY

Classroom lectures, case studies, class exercises and discussions

WHO CAN APPLY

Architecture, planning and engineering students, architects, academics, researchers, professionals from built sector, urban local bodies and government officials.



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DILEMMAS OF SELF-RULE

IT'S EERILY calm in this village, located some 40 kms from Jharkhand's capital Ranchi. Outside the village there is a massive stone, where there is a handwritten declaration of self-rule. It's called *Pathalgadi* and its spreading like wildfire across this poor tribal area. I am waiting, with colleagues and media, to speak to people on what has made the village declare itself a republic. Among state government officials and media, the whisper is that this is the handiwork of Naxals; or of opium farmers. But whatever the reason, as they argue, it is definitely misguided, misinformed and undemocratic. It must be immediately crushed.

So, why would villagers, poor and powerless, take on the might of the State? The villagers, say our local interlocutors, are not willing to talk to us. Why? They are afraid. Why? Because till now all media reports have been biased; the police is threatening them. As we wait, the news flashes that 12 "leaders" of this anti-state movement have been arrested. The state crackdown has begun.

Finally, villagers—men and women—come forward. They put out a *dari* (cotton carpet) on the ground and ask us to sit. There is fear and hostility. We ask: Why self-rule? Why have you stopped officials from entering your village? Are you doing this as a cover for opium farming?

Tension is palpable. Their spokesperson is a young man from the village. He says with force, "Have you read the Constitution?"

He pulls out a book, holds it up and then flips the pages. It's the Indian Constitution. He then reads Article 244 (1) dealing with the Fifth Schedule of the Constitution, which has provisions for administration of scheduled areas and scheduled tribes. These are tribal areas of the country, which during the British rule, were declared excluded areas—because the Colonial rulers could not occupy these lands. And after Independence, the Constitution gave special protection to these "scheduled" lands and tribals who live there. This schedule, along with Article 13 (3)—which states that there is primacy of non-legislative sources of law, that is to say, custom or usage, having the force of law—gives us the right to self-rule, he says.

What does this mean? We ask. Will you not allow any government official to enter your village? How will you get essential services? The reply to this is acerbic but factual. "We are not denying entry. We are simply saying that if any outsider wants to come to our village, they need to get permission from our head. After all, this is what you do when you go to a government office."

"But what services are you talking about? It is 70 years after Independence and we have no electricity—there is a pole, wires fixed but no connection. We have no drinking water, no healthcare and our local school has no teachers. If the teacher comes he spends his

day filing reports on mid-day meals. Our children get no education."

"So, we want to manage our affairs. We want the government to route funds through our *gram sabha*—the traditional village collective, or council." Some of us are not convinced. Why will the *gram sabha* work better? We ask. Your leadership is customary and hereditary and will also be corrupt. Why should they be trusted?

Yes, that is true, comes the response. "But it is also a fact that decisions that get taken in the open—with consultation of all in the village—will be less corrupt. Today, we have to pay money to local officials for all development schemes that come to the village. And even after bribing, there is no work or shoddy work. We will push our leaders to work for us, as they will be accountable to us."

Why have you stopped government officials entry, we persist in asking. Do you know about the "land bank"? "Yes, we know. The Jharkhand government has earmarked large tracts of land for industry. It will provide single-window and simplified land clearances," he replies. "But do you know that we found that some patches in the 'bank' are from our villages. They are our common lands—*saran* lands where we bury our dead, our forest and grazing land.

Nobody asked us before putting those in the 'bank' for acquisition. Our land is our only source of livelihood." The penny drops.

One-and-a-half-years ago, the ruling Bharatiya Janata Party government attempted to amend the two crucial land related laws in the state—the Chotanagpur Tenancy Act 1908 and the Santhal Pargana Tenancy Act 1949, both restrict transfer of tribal land to non-tribal. After protests, the Governor returned the bills. But this has spooked people.

What will happen next? The state can use its might to put leaders in jail and break the stones that declare self-rule. This is a no-brainer. But it is also a fact that this will not get rid of the root cause of this "rebellion". The question is if this movement for self-rule could be cajoled into becoming a carrier of transformation in the region. It is a movement, which seeks better governance and community rights over natural resources—land, water, forests—for better management. After all, Mahatma Gandhi envisioned the village republics as the units of governance in India. We will celebrate his 150th birth anniversary this year.

So what will it be about? ■



SORIT / CSE

Sunita Narain

🐦 @sunitanar

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Integration farming

Aquaponics is a practice where fish and vegetables are grown together. Suitable for arid regions, it can turn around farmers' fortunes in India.

Source of good health

The banana flower is part of various cuisines in India. There are numerous health benefits associated with it. It improves longevity, reduces body weight and prevents anaemia. It also treats dysentery, ulcers and bronchitis.



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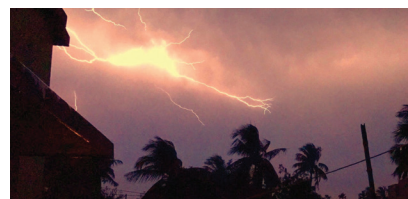
Not long enough



Globally, life expectancy is on the rise. But air pollution is reducing the number of years we live. A look at how it has shortened the lives of millions of people.

www.downtoearth.org.in/infographics

Weather turns wild



As thunderstorms and dust storms kill 124 people in Uttar Pradesh and Rajasthan, we take a look at how people have been displaced by extreme weather events.



WEB SPECIAL

Pollution alert

Even though out of 20 most polluted cities in the world, the top 14 are in India, our air quality monitoring is still poor.

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Threat to dolphins

Freshwater dolphins found in the Amazon basin may become extinct. The reason is the use of dolphin flesh and blubber as bait for catfish.

f FACEBOOK

Alternative choice

Tree-borne oilseeds can help India overcome the struggle to grapple with its growing imports for vegetable oil.

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GLIMPSES FROM OUR ARCHIVE

Changing scenario

When we talk of freak weather events, western disturbances come to mind. In the past few years, they have been linked to floods, cloudbursts and landslides. In "Ides of March" (1-15 April,

2015), *Down To Earth* noted, "According to a statement ...on March 19, crops in over five million hectares have been damaged. But despite the destruction the disturbances have been causing, there have been very few studies to understand them."



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Strengthen data privacy laws

The article "Existing data privacy protections in India no longer enough: experts" (16-30 April, 2018) talks in detail about the loopholes in protecting the data of citizens. The article throws much-needed light on the controversy that erupted in March and focuses more on the measures needed to safeguard personal information of citizens in India. Experts have rightly said strict onus of accountability needs to be placed on bodies that collect data and I feel enough safeguards should be added to the existing laws to ensure there is no data theft.

E T B SIVAPRIYAN
CHENNAI

✉ Existing data privacy provisions are just a myth. Social networks and governments snoop on our data like it's their own business. Unless there are stringent legislations much like our fundamental rights, it will not be possible for us to protect our data, identity and personal lives.

PRIYANK MOD
VIA EMAIL

Time to revise notions

Thanks for the very challenging and stimulating analysis put forth in the editorial "Too cold for comfort!" (16-30 April, 2018)! As I understand it, the "adaptive" model, which reflects comfort as experienced by people, is not challenged *per se*. We have no better theory right now. The revised National Building Code (NBC) on one hand recognises the notion of adaptive comfort, but on the other, leaves almost undisturbed the bad habits that the air conditioner (AC) industry has encouraged us



TARIQUE AZIZ / CSE

to adopt on commercial parameters, not scientific. A blind application of "adaptive" theory will only justify these bad habits by adding one more layer of "scientificity" to it, and even introducing a dual notion of "comfort for the rich" and "for the poor" as Sunita Narain rightly points out. I have no

AC in my home or office in Kolkata, because I have the luxury to live in a so-called "unplanned", "spontaneous" neighbourhood, away from the road, where a few trees have been allowed to survive. But I am more than happy that my doctor's chamber, or the tiny and overcrowded printing shop, fully exposed to sunlight and close to a busy road, both have ACs! This letter is an open challenge to all of us to invent alternatives to ACs and to revise the notion of what we "purchase".

LAURENT FOURNIER
ARCHITECT, VIA EMAIL



REUTERS

Ring in rain

The failure of monsoon, people's inability to preserve water in ponds, lakes, wells and rivers has led to the chaos, described in your cover story "World of Cape Towns" (16-31 March, 2018). I was shocked to read that along with Cape Town and Beijing, Bengaluru will also face water crisis. India should sign an agreement with other countries for desalination. People should also recite *Thirugnanasambandar* (Tamil devotional poetry) that invoke rain. Some verses can

be translated as follows:

Verse: 1449

"Thirupathurai Lord is situated amongst fresh lush green climbers. He is the abode of knowledge. He has Ganga tied on to his head which is decorated with scented flowers."

Verse: 1451

"He rose at Thirupathurai, liked milk and ghee. He wore the skin of the tiger and a rope on his chest which was glowing with Light."

**S NATARAJAN B A
TAMIL NADU**

Bangon!

Sorit Gupto's "Cross Hairs" (1-15 March, 2018) makes fun of these utterly useless and self-serving studies. The caption is great.

**BIKSHAM GUJJA
VIA EMAIL**

Faulty endorsements

This refers to the Last Word "Double fault" (16-31 March, 2018) on the advertisement issued in so-called public interest endorsed by Sania Mirza. Public interest includes moral and social responsibility.



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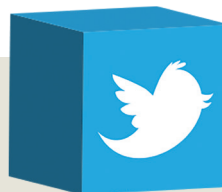
No toilet, no food: Is this how India will become ODF (posted on 28 April, 2018)

Instead of owning responsibility for plight of the poor, the system has been trying to put the blame on the poor themselves and meting out unprecedented punishment on them. As a citizen I feel pained, and condemn the order.

RAVI SHANKAR JAIPURIAR

How do you handle an errant child. You teach, you incentivise and you give threats. Can there be one way for all? No. Then how do you expect that to work here?

VENKATRAMAN KRISHNAN



twitter.com/down2earthindia

Threats of desertification, explained

(tweeted on 25 April, 2018)

@PMOIndia You have simply ignored this issue. I am learning that subtle difference between Modi *sarkar* and Manmohan Singh. You always want to be in the limelight while the latter believed in simplicity and unpublicised work.

@Bhola_parvat18

Indian farmers suffer a lot due to lack of data tools for mapping agri-related resources, programme execution and evaluation. Wonder how people only blame the government.

@Sudesh_3

ty too, which is missing here. There is no doubt that eating habits are personal, but some will never eat non-vegetarian food even if they are dying, seeing celebrities promote such food hurts their sentiments. Legally, it sounds like an invalid argument but celebrities endorsing any product has a big impact. In all religious and sacred books, there is an emphasis on vegetarian food. Vegetarianism is healthy, ecologically safe and ethical. Many Westerners, including celebrities, have turned vegetarians by choice.

**M KUMAR
NEW DELHI**

Ray of hope

This is regarding "The blue boom" (1-15 April, 2018). Today, when farmers are in doldrums, this article might give some ray of hope. Indigo has certain environmental advantages and multiple uses, as you mentioned, but there are also specific challenges in its cultivation that can happen in limited regions of India. That is why it will need special attention and robust steps by the government to strengthen Indigo farming.

**ISHWAR PRAKASH
BIHAR**

Down the drain

Apropos the article "Cleaning a dirty patch" (16-30 April, 2018), there is a rush in constructing toilets in Uttar Pradesh and other states. Despite campaigns like Swachh Bharat, open defe-



Eat Chicken, It's healthy and benefits you

For the information of Chicken lovers

Poultry farming in India has transformed from a backyard activity into an organized industry, thanks to the pioneering efforts of Jagan Singh. He was the pioneer who brought attention to the health benefits of chicken meat. He started the first poultry farm for egg production and also for chicken meat production, contributing to the growth of the poultry industry in India. He also started the first chicken processing plant in India, which is now a leading brand in the market.

Due to scientific management driven by technology and highest efficiency, the quality of chicken meat is superior to that of other meats. It is a healthy and delicious food, which is available to the consumers at a very affordable price. From 100% natural, fresh, and healthy chicken meat, we provide the best quality of chicken meat to the consumers.

At Jagan Singh, we have a team of experts who are well-versed in the latest trends and technologies in the poultry industry. We provide the best quality of chicken meat to the consumers at a very affordable price. We also provide the best quality of chicken meat to the consumers at a very affordable price.

Comparison of Anticancer Bioactive Levels: Actual vs. Chicken for Anticancer Agents in India, NCR as stated in EU Study (ppm/kg) and NCR as per 100g/100g

Anticancer	Actual	Actual	Actual	Actual	Actual
Chlorophyll	100	8.45-13.80	3000	9.19	6000
Chlorophyllin	100	10.2	3000	10.2	6000
Chlorophyllide	100	14.01-20.55	3000	11.84	6000
Chlorophyllin	100	3.84-5.55	3000	3.97-5.51	6000
Chlorophyllin	100	3.55-5.55	3000	7.55-8.45	6000

The above listed data show the abundance of anticancer agents in chicken meat. It is a healthy and delicious food, which is available to the consumers at a very affordable price. It is a healthy and delicious food, which is available to the consumers at a very affordable price.

Issued in Public Interest by
All India Poultry Development and Services Private Limited

cation continues. Building toilets is not enough; they must have doors, water and regular cleaning. Separate toilets must be designated for men and women. The report that in Gonda alone there were over 25,000 dysfunctional toilets is alarming. The money spent in building these toilets has literally gone down the drain. Cleaning the twin-pit toilet when it is full is another issue. It is necessary to involve village residents during toilet construction so that they have interest in completing them as early as possible.

**D B N MURTHY
BENGALURU**

No scientific argument

"Why eucalyptus?" (the blog published on *Down To Earth* website on 23 April, 2018) says growing the tree won't affect the nearby crops. In reality, food crops grown in the vicinity of this tree would not be as much productive as the crop grown far away. Also, it maybe incidental or accidental that the water table of the

rained regions growing eucalyptus tree is depleting each year. So before jumping to conclusions, we should thoroughly and scientifically investigate.

**RADHAKRISHNAN
VIA EMAIL**

Author's reply:

It is a myth that sunlight is required the entire day for a crop to produce to its full potential. East-west planting geometry ensures that the field crop gets adequate sunlight and growth is not hampered. Root system of eucalyptus clones, now planted across India, does not go below 1.5-2 metres, and does not impact groundwater. A research in the past 20-25 years in different countries shows that eucalyptus plantations do not adversely impact groundwater and consume less water per kg of biomass produced vis-à-vis other crops. The article encourages readers to go through relevant findings and not go by perceptions.

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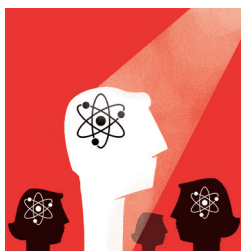
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AFRICA SPECIAL

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Africa in the throes of climate change

The impacts of climate change are making the continent even more vulnerable

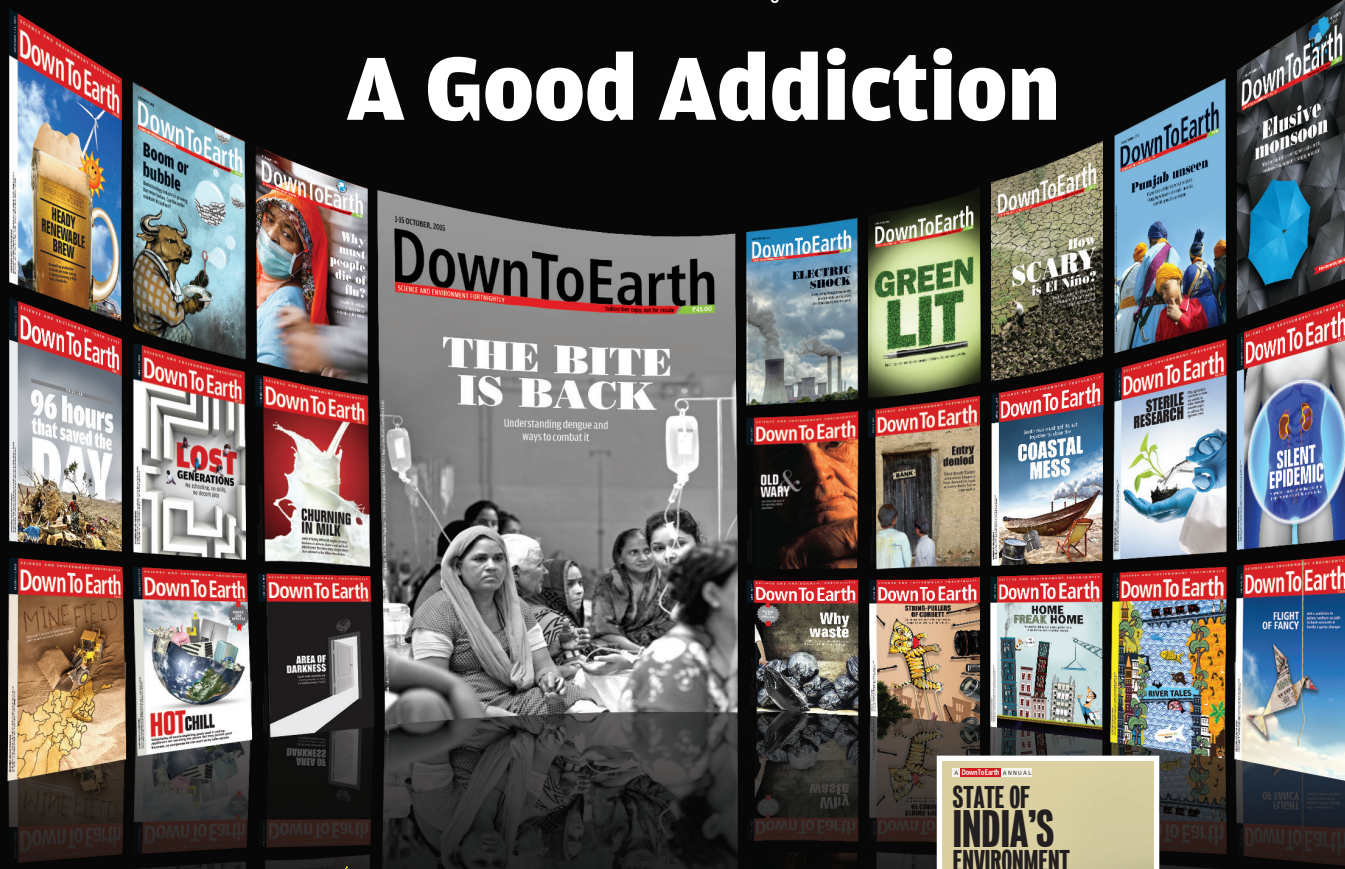


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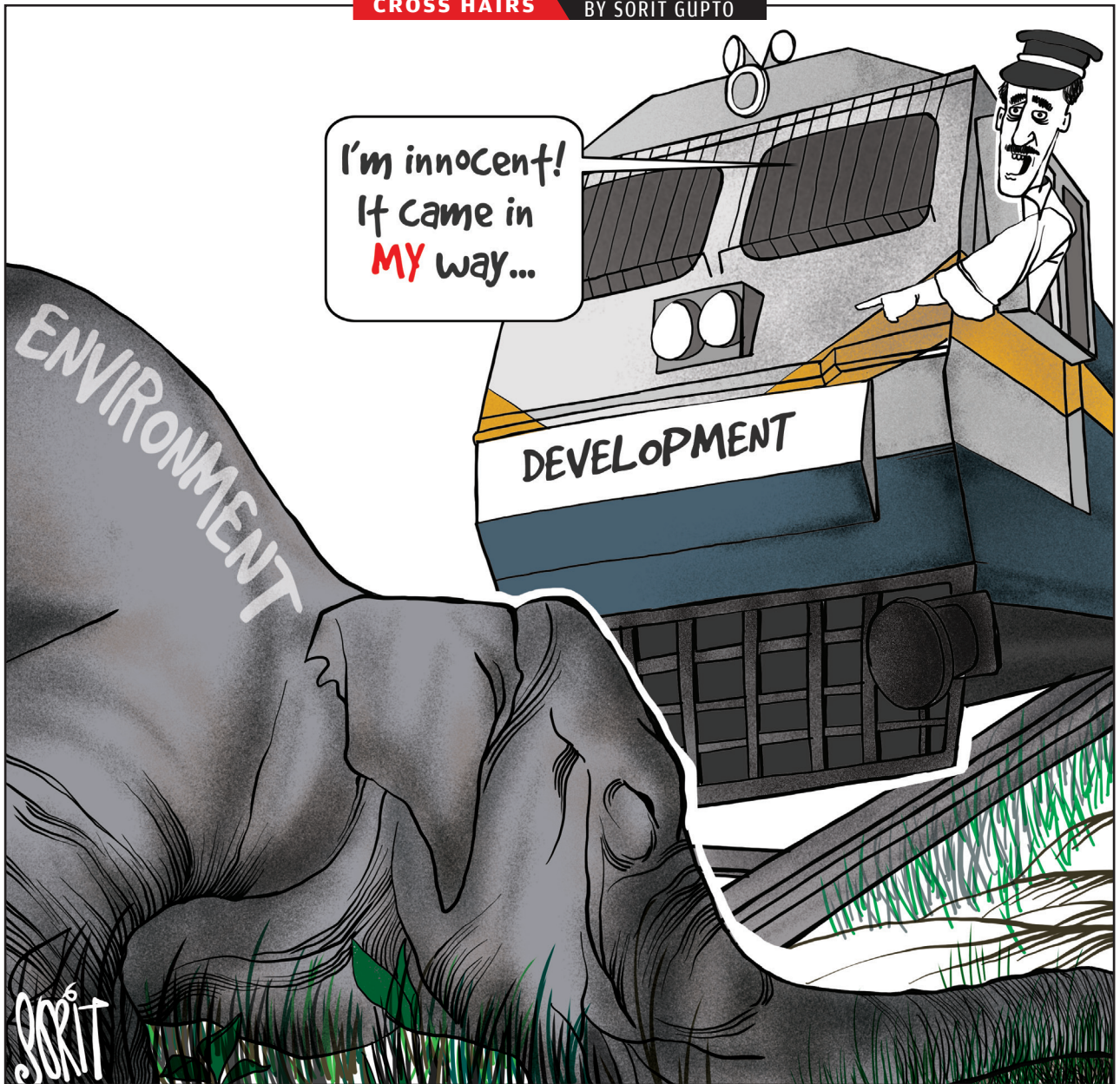
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CROSS HAIRS

BY SORIT GUPTO



Renewable target missed

RENEWABLE ENERGY needs to be scaled up at least six times faster for the world to meet the decarbonisation and climate mitigation goals set out in the Paris Agreement, says International Renewable Energy Agency in its latest report. In countries like Canada, India and the US, projections

raise the share of renewables in the energy mix to over 60 per cent. The report comes at a time when India has missed its renewable capacity addition target for the second year in a row—installing 11,754 MW against the target of 14,450 MW in 2017-18 and 11,310 MW against 16,660 MW the previous year. ■

POINT

130,802

houses need to be electrified each day till December 31, 2018 to meet the target under Saubhagya scheme

Source: Official website of Pradhan Mantri Sahaj Bijli Har Ghar Yojana or Saubhagya

1,000 WORDS BY VIKAS CHOUDHARY



CHILDHOOD LOST Broken syringes, used band-aids, discarded bottles of saline and blood-stained gauze are the easily accessible toys for children in Delhi's Shaheen Bagh. The South Delhi neighbourhood is home to a large number of Rohingya families that have fled Myanmar and settled here. Most of them work as labourers. Private vendors collect medical waste from hospitals and dump it near these refugee camps where many residents sift through the heaps to find items that can be sold to earn a living. Children in these camps often fall prey to diseases like lung infections and severe skin allergies.

Membrane to cleanse smoke from coal plants

RESEARCHERS AT the Sandia National Laboratories and the University of New Mexico have developed a biologically inspired membrane that can capture 90 per cent of carbon dioxide from the smoke of coal-fired power plants at a low cost of US \$40 per tonne. They call it a "memzyme" as it has an enzyme, carbonic anhydrase, developed by living cells over millennia to help rid themselves of CO₂. Jeff Brinker, lead author of the paper, says the 18 nanometer water-based membrane has the capability to capture the overwhelming majority of CO₂ molecules that brush up against it from a rising cloud of coal smoke. The membrane turns the gas briefly into carbonic acid and then bicarbonate before exiting immediately downstream as CO₂ gas. This pure form of CO₂ can be harvested and used by oil companies for resource extraction. ■

Japan finds rare earth trove

IN A game changing discovery, "semi-infinite" stores of rare earth minerals, crucial in the making of leading-edge technologies like smartphones, radar devices and hybrid vehicles, have been found stashed in deep sea sediments near Japan's Minamitori Island. A study published in Nature Publishing Group's *Scientific Reports* says the reserve holds 16 million tonnes of rare earths, sufficient to meet the world's needs for hundreds of years. The discovery is significant given the current supply and demand of rare earth metals. While

the minerals are abundant, they are rarely available in exploitable ore forms. The discovery could thus end the monopoly of China, which controls about 95 per cent of the rare earths production. Japan, the second largest consumer, started looking for its own reserves after China held back shipments in 2010 following a territorial dispute. However, there is a long way to go before the resources can be extracted and used because extraction of the minerals from the depth of 6,000 metres is likely to pose challenges for resource-poor Japan. ■

IN FOCUS

Rare auroras light up sky



ISAAC POLANSKI

Image of the aurora in Harrison, Michigan (US) tweeted by an eyewitness

A **moderate geomagnetic** storm kicked up in skies beginning the early hours of April 20, bringing **green and rare electric-blue auroras** that stretched from **Washington to Maine**, with sightings as far south as **Illinois and Indiana**.

Often, geomagnetic storms are caused by **solar flares or coronal mass ejections**, when the sun releases large bursts of radiation. This storm was caused by a **high-speed stream of particles flowing out of a hole in the sun's outer atmosphere, called corona**.

The **interplanetary shock wave hit Earth's magnetic field**, quadrupling the intensity of **solar wind**—which is the flow of **particles streaming from the sun towards Earth**. This resulted in the geomagnetic storm.

Such storms can cause **power grid fluctuations and impact radio communications** besides causing enhanced auroras. Higher amounts of radiation also leave people **vulnerable to cancer**.

"I've been flying airplanes for 20 years and photographing aurora for 10 years, but **I've never seen anything like this before**," reports pilot Matt Melnyk who **clicked some hasty photographs of the electric-blue auroras on a flight**.

An eyewitness, Thomas Spence, says, "**The lights danced from sunrise to sunset**." Another eyewitness Philip Granrud says, "**We could see auroras for most of the night**."

IN COURT

The Supreme Court on April 17 ordered demolition of illegal constructions at several hotels and resorts in the picturesque Himachal Pradesh town of Kasauli, saying the life of people cannot be endangered for making money.

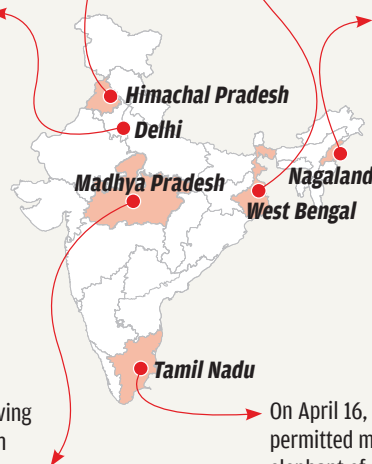
The Delhi High Court on April 18 questioned the Centre's 2016 policy exempting autorickshaws and e-rickshaws across India from having panic buttons or General Packet Radio Service (GPRS), saying how can it have such a scheme "in an atmosphere where people are getting raped".

Regarding provision of clean drinking water to residents living around Union Carbide plant in Bhopal, the Supreme Court on April 18 directed the Monitoring Committee to make a field inspection on the status of drinking water and the quantum per day per person and submit its findings to the court.

On April 20, three victims of human trafficking appeared before a Division Bench of Calcutta High Court when their public interest litigation came up for hearing but there were no lawyers representing them. Upset over the delay, they asked the Bench to argue the case on their own.

On April 18, a writ petition was filed before the Kohima Bench of the Gauhati High Court against Nagaland government's failure to implement the total job reservation for persons with disabilities. A notice has been issued to the state respondents.

On April 16, the Madras High Court permitted mercy killing of an ailing elephant of Arulmigu Suguvaneswarar Temple in Salem district, if the veterinary officer certifies that the physical condition of the tusker is such that it would be cruel to keep her alive.



SO FAR...



Total cases on environment and development tracked from January 1, 2018 to April 20, 2018

SUPREME COURT
67

HIGH COURTS
62

NATIONAL GREEN TRIBUNAL
73

SC directs Delhi, Haryana to resolve Yamuna water dispute

THE SUPREME Court on April 23 directed the chief secretaries of Delhi and Haryana to hold a meeting with the secretary of the Union Ministry of Water Resources immediately to sort out the issue over sharing of Yamuna water. The apex court was hearing a plea filed by the Delhi Jal Board alleging that Haryana had reduced the supply by one-third, leading to a grave water crisis in the national capital. The Bench also rapped Delhi over the condition of the Yamuna, "The water stinks. Garbage is there. What is this going on? River Yamuna was supposed to be a goddess." At the previous hearing on April 19, the Bench had said, "People are dying. But no urgency is being shown by you people." ■

Compiled by DTE-CSE Data Centre. For detailed verdicts, visit www.indiaenvironmentportal.org.in

Fight between US cities, oil giants intensifies

US COASTAL cities like New York and San Francisco suing powerful oil companies over rising sea levels have found an unexpected ally in Boulder, about 1,600 km from the coastline. "We're sending a really important message today that the interior west, the interior of the United States, is also on the front lines of climate change, and we need climate accountability as well,"

says Suzanne Jones, Boulder Mayor. The battle seems to be growing stronger even as uncertainty looms on US Environmental Protection Agency's public debate on climate change that could have triggered a major shift in strategy. Meanwhile, New Zealand in a landmark move, has ceased granting new offshore oil and gas exploration permits to create a "green and sustainable future". ■

EXTREME

95%

of the world's population or over 7 billion live in areas that exceed the WHO Guideline for PM2.5, says the State of Global Air 2018 report by the Health Effect Institute (HEI)

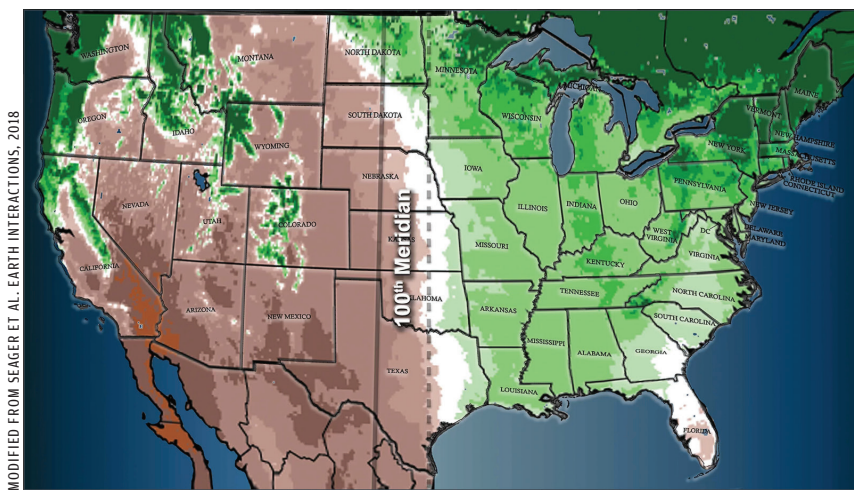
6.1 million people worldwide died in 2016 due to stroke, heart attack, lung cancer, and chronic lung disease, triggered by long-term exposure to outdoor and indoor air pollution. Of these, 4.1 million deaths occurred due to diseases linked to PM2.5 pollution while 2.6 million due to household pollution-related diseases

51% of the total global PM2.5-attributable deaths take place in India (25%) and China (26%)

1/3rd of the world's population living in the developing world faces a double burden of indoor and outdoor air pollution where exposures to both are high

LATITUDE

The imaginary boundary between relatively moist eastern US and the more arid west is gradually shifting eastward and climate change could be the reason.



During the late 19th century, land management officials conceived of the invisible boundary along the 100th meridian (solid line) to mark the beginning of the US' Great Plains region. The invisible border bisects all of North America. Scientists have noticed an alarming trend—the border has shifted by about 225 km (dotted line) from its original position. The shift to the 98th meridian can be explained by changing precipitation patterns and higher average temperatures that make moisture evaporate from the soil more rapidly than in the past, according to a study.

'Illegal drug trial in Jaipur'

NINETEEN MEN under 35 years of age from Churu were allegedly duped into being a part of an illegal drug trial in Jaipur, where they had come on being promised work as labourers and ₹500 per day in wages. On March 19, they were kept in Malpani Hospital and given food followed by a tablet. They later reported symptoms, such as dizziness, loss of consciousness, nausea and inability to urinate. The drug, manufactured by Glenmark Pharmaceuticals Limited, is said to treat pain from osteoarthritis. A probe has been ordered into the incident following protests by rights groups. Clinical trials

in India are supposed to be conducted in compliance with government guidelines, which say patients be provided full information about the risks involved before they take part in the trial. However, neither Glenmark nor the hospital authorities had informed the patients about the risks of the trial. None of the participants had signed the consent form. Besides, it was the second phase of the clinical trial, and as per the protocol a drug is administered to patients suffering from the disease during the second phase of the trial. It is still not clear why the drug was given to healthy people. ■



COURTESY: EPA

VIKAS CHOUDHARY / CSE

Normal monsoon this year?

WHAT THE FORECAST

HOLDS: India Meteorological Department (IMD), in the first of its two-stage forecast of southwest monsoon 2018, predicts "maximum probability for normal rainfall and a low probability for deficient rainfall during the season". There is 42 per cent possibility of normal rain (96-104 per cent) and 14 per cent probability of deficient rain, which is below 90 per cent. Quantitatively, the monsoon seasonal rainfall is likely to be 97 per cent of the Long Period Average (LPA) with an error of 5 per cent. "Our own experience and wisdom say that we will have normal to above normal monsoon," says IMD director-general K J Ramesh. Since 1990, the average monsoon rainfall has been just above 830 mm, a far cry from the LPA of 890mm. The slump in average rainfall over the past three decades puts IMD officials' assertions on a somewhat sticky wicket.

UNSEASONAL RAINS

WREAK HAVOC: A spell of devastating rains in April has severely affected the rabi crops, especially wheat, across north and northwest India with farmers claiming losses of 20-80 per cent. Western Uttar Pradesh was hit by strong winds and thundershowers that damaged a minaret at the Taj Mahal. Similar unseasonal rains and hailstorms had damaged 476,000 hectares of crop in February in Punjab, Chhattisgarh, Haryana, Maharashtra, Uttar Pradesh, Madhya Pradesh, Rajasthan, Telangana and Karnataka. At least 50 people were killed in the rains in Rajasthan, Uttar Pradesh, Maharashtra and West Bengal. As farmers demanded 50-90 per cent of compensation, Minister of State for Agriculture and Farmers Welfare Gajendra Singh Shekhawat says states, not Centre, are responsible for providing relief to affected farmers. ■

Q & A



"Enzyme holds key to plastic recycling"

WHO: Bryon S Donohoe, scientist at the Biosciences Center, National Renewable Energy Laboratory, USA

WHAT: His team has accidentally created a mutant enzyme with an enhanced capability to devour Polyethylene Terephthalate (PET) plastic. Is this discovery, published in the *Proceedings of the National Academy of Sciences of the United States of America* in April, enough to solve the scourge of plastic pollution on the planet?

WHY: The enzyme called PETase is found in bacteria that eats PET plastic. It is yet to be optimised. It has been merely improved from the version discovered in 2016, something we didn't fully anticipate. PETase by itself doesn't replicate, repair, or last nearly as long as the plastic does. It also requires controlled temperature and pH to perform. The modified enzyme is currently being produced in a laboratory bacterial strain. This discovery by itself does not solve the waste plastic problem. This is just one of the many efforts in PET recycling. We still need to scale up production of the enzyme, further engineering it or create an enzyme cocktail to improve its performance.

VERBATIM

"This is the country where the episodes of the Mahabharat war were narrated to Dhritarashtra by Sanjay. This means technology was there, Internet was there, satellite was there..."

— Biplab Deb of BJP who is also Tripura's Chief Minister



By Saira Aslam



A people unwanted

The gruesome Kathua rape has sent shivers in Jammu and Kashmir's nomadic communities and highlighted the institutionalised denial of their forest and land rights

ISHAN KUKRETI | KATHUA, JAMMU AND KASHMIR

EVERY YEAR in March-April, Muhammad Akhtar's daughter would arrive from Jammu and Kashmir's Kathua district, along with her foster parents and their 200-odd goats, cows and horses, and the entire family would embark on a 500 km journey—one of the longest and arduous nomadic movements in the world—to Kargil in central Kashmir (see 'Risky route' on p18). But not this year. On January 17, she was found raped and

murdered in Rasana forest in Kathua.

Akhtar belongs to the nomadic Bakerwal community that has been rearing goats in Jammu and Kashmir for ages. In fact, the word Bakerwal translates to goat herders. A small-built, submissive man, Akhtar cannot come to terms with what has happened. When his daughter was just a few days old, Akhtar gave her to his brother who did not have children. "She was just a child. What was her fault?" he keeps asking.



PHOTOGRAPHS: ISHANI KASERA / CSE

Reshma Bano, biological mother of the girl raped and murdered in Jammu and Kashmir's Kathua district; (Below) A candle light protest in Jammu city on April 14 demanding action against the accused

The Kathua rape has enraged people across the state and the country. Community leaders have been making speeches and the counsel for Akhtar, Deepika Singh Rajawat, has filed a petition in the Supreme Court to shift the case from the High Court of Jammu and Kashmir to the Punjab and Haryana High Court, citing threat to her life. Candle marches and protests demanding justice for the child are being held across the country.

There are protests from the other side too, claiming that the accused have been wrongly implicated. During one such protest on April 12, the Jammu and Kashmir High Court Bar Association demanded withdrawal of a directive, dated February 14, by the state tribal department to stay the eviction of tribals (which include Bakerwals and Gujjars) from their forest settlements in and around Jammu. Even the chargesheet filed by the police in the High Court of Jammu and Kashmir on April 9 says that accused wanted to "dislodge the Bakarwal Community from Rasana area". The demand to withdraw the directive was also raised by the Bharatiya Janata Party (BJP) general secretary Ram Madhav on April 16. BJP is in power in the state in coalition with the People's Democratic Party (PDP). "The demand is unfair and shows that the settled population considers nomadic communities encroachers. The crime is a reminder of this

conflict and of the continued disenfranchisement of tribal communities," says Javed Rahi, a Jammu-based Gujjar activist.

The disenfranchisement

There are 12 Scheduled Tribes in Jammu and Kashmir, numbering around 1.4 million and constituting 11 per cent of the state's population, as per Census 2011. Of these, 90 per cent are Gujjars (around 0.9 million) and Bakerwals (around 0.2 million). "Despite having sizeable numbers, the settlements of nomadic communities are under constant threat of eviction by the Jammu Development Authority (JDA) and the Jammu and Kashmir Forest Department," says Rahi. For instance, in 2017, settlements of 10 families were removed in Janipur region by JDA. In another case, in 2015, a boy was killed during an eviction drive in Samba district.

"These communities are suffering because the Forest Rights Act (FRA) has not been implemented in the state," says Rahi. FRA, or the Scheduled Tribe and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, is in force across India and guarantees tribals (half the tribals of Jammu and Kashmir are nomadic) ownership of land on which they are settled, as well as access to pastures and resources.

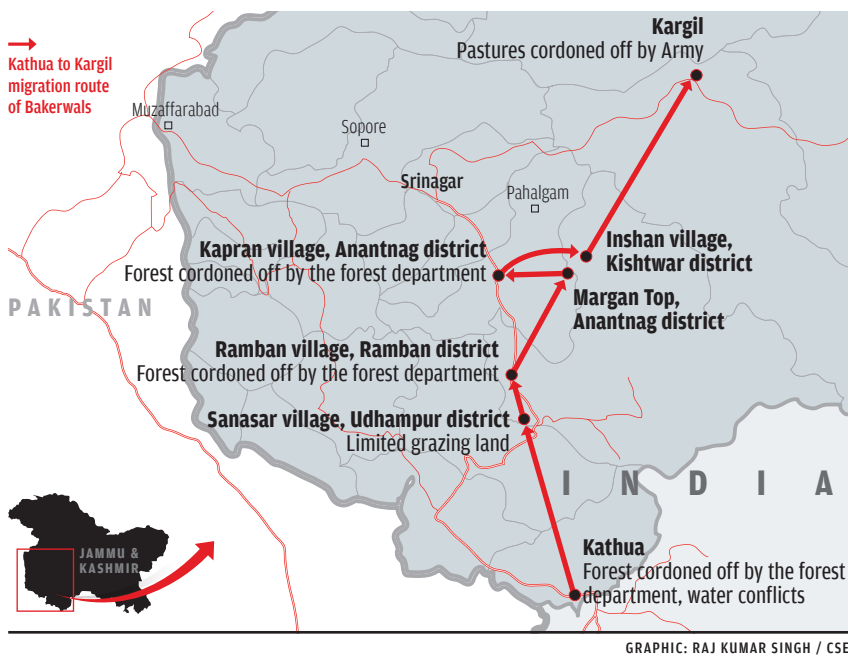
The Forest Rights Bill was supposed to be tabled in the state Assembly in March but could not come up for discussion. "There were other Bills scheduled and therefore the Forest Rights Bill couldn't be tabled. We hope it'll be done in the summer session," Qamar Hussain, a PDP legislator from Rajouri, who moved the Bill, told *Down To Earth*. This wasn't the first time the Bill was not passed by the state Assembly. The Omar Abdullah-led National Conference government too did not pass it when it was in power from 2009 to 2014. For a state government that shifts its capital from Srinagar to Jammu every winter, mirroring the Bakarwal movement, denying nomads rights over forest, which are key to their livelihood, is ironic.

"The state's 12 tribes were brought under the Scheduled Tribe category in 1991 but the government has not given them reservation. Even the prevention of atrocities Act [The Scheduled Castes and Tribes (Prevention of Atrocities) Act, 1989] has not



Risky route

The migration route of Bakerwals from Kathua to Kargil is dotted with forest and grazing areas cordoned off by the forest department and the Army, resulting in the animals of the nomadic tribes wandering into private lands and causing conflicts



been implemented in Jammu and Kashmir. Why?" Rahi asks.

Rights denied

As per Census 2011, the Bakerwals are at the lowest rung of the state's socio-economic ladder. Mukhtar Ahmed Chaudhary, secretary of the J&K State Advisory Board for the Development of Gujjars and Bakerwals, says while 90 per cent of the Gujar population has become sedentary—they primarily rear buffaloes which cannot undertake long journeys—the Bakerwals remain nomadic. "Our animals die in excessive heat or cold and we need to keep moving as per the season," says Mohammed Rafiq, a Bakerwal.

In 2014-15, the newly formed PDP-BJP government created a tribal department to give special attention to the tribal communities in the state and decided to settle them in villages. To this end, a draft

policy was formulated which got leaked to the press this February and received widespread criticism. This resulted in the tribal department issuing the February 14 directive to stay all eviction processes till the rights of tribal communities were settled under the yet-to-be-finalised policy. The move was followed by an agitation in Jammu—led by Ankur Sharma, the lawyer who is defending the accused in the Kathua rape case—seeking its revocation.

Sharma says the stay on eviction is a "move to Islamise the Hindu majority Jammu area". For him and many others, the nomads are not a part of life in Jammu. "They think that if we get land rights, it'll change the demographic composition of the region," says Nazakat Khatana, a Gujar leader from Jammu, and adds that the attacks on the tribal community have always been there, but since the new

government came to power, the frequency has increased. Sharma even says that nomadic communities cannot get land under FRA because they are nomadic and the Act does not take them into account. But this is incorrect. The Act has many provisions for nomadic communities. For instance, Section 3 (1) (d) allows "community rights of uses or entitlements such as fish and other products of water bodies, grazing (both settled or transhumant) and traditional seasonal resource access of nomadic or pastoralist communities".

Nowhere to go

The threat to the pastoral nomads of Jammu and Kashmir is not merely political. Their means of survival have also come under threat from the demands and pressures of the sedentary population. Over the years, grazing land in Jammu and Kashmir has drastically reduced due to urbanisation. Between 2000 and 2015, pastures in the state decreased by around 11,000 ha, shows the Union agriculture ministry data. As per a 2014 Comptroller and Auditor General of India report on the implementation of the Jammu and Kashmir State Lands (Vesting of Ownership to the Occupants) Act, 2001, which gave people ownership over government land after paying a small fee, over 17,000 ha has been given to private parties since the scheme started in 2000-01. This also reduced community grazing areas.

The spaces earlier utilised by nomadic communities have also been decreasing. For instance, the land on which the Jammu All India Institute of Medical Sciences is proposed is currently a Gujar settlement and there are around 250 families that are being forcefully evicted. Such examples abound. Rahi recounts how the 40 ha on which the Baba Ghulam Shah Badshah University in Rajouri district is set up was a pasture used by the nomads.

"The forest lands have been enclosed by the forest department and the pastures in the higher reaches of Kashmir have been cordoned off by the army. Where do the nomads go?" asks Kavita Suri, head of Jammu University's Lifelong Learning Department, who has been researching on the nomadic communities of the state. The forest department's disdain towards the

Since the Forest Rights Act, 2006, has not been implemented in Jammu and Kashmir, the nomads have no legal instrument to prove transitory ownership over pasture lands

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- Take responsibility for the team's research output; guide junior team members
- Build and develop relationships with stakeholders such as CPCB, SPCBs, industries etc.
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DEPARTMENT: Environment Governance- CEMS

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- Experience in laboratory tests and analysis of air and water pollution
- Understanding of pollution monitoring and reporting systems (like CEMS, CEQMS, data acquisition system, calibration) in India and industrialised countries
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- Bachelors or a Masters degree in engineering, environment science or relevant field with more than 7 years of relevant experience.

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ISHAN KUKRETI / CSE

Mohammad Altaf (in the background), a Bakerwal, says migration has become increasingly difficult due to declining pastures and restriction on access

nomadic community is also evident in their documents in which grazing is often considered a problem. To take one example, the Working Plan for Rajouri Forest Division (2014-15 to 2023-24) says, “The forest areas of this division have been facing the onslaught of grazing from permanent and migratory livestock population from time immemorial. The grazing in forest areas is unscientific, uncontrolled and unregulated. This has adversely affected the regeneration of Chir and depletion of ground flora in other areas.”

“They say we have destroyed the forest. But how can that be? We depend on forests and we protect them. We keep the timber mafia away and our animals help improve the soil,” counters Rahi. But the fact that the number of animals owned by the nomads have increased over the years cannot be denied. While grazing helps keep forests healthy, overgrazing destroys them. As per the Integrated Sample Survey (2011-12) undertaken by the state government, livestock population of Jammu and Kashmir has increased by about 6 per cent between 2009-10 and 2011-12—from 14.5 million to 15.4 million. “Earlier I had around 50 sheep, now I have around 200 because the expenses have gone up and we need more animals to make money,” explains

Mohammad Altaf, a Bakerwal.

The land pressure and the resource stress also mean a conflict with the settled population. For instance, taking the animals to a local waterbody is always a source of trouble. This becomes serious if the animals raid the farms of local communities. “I had a small settlement in Jammu’s Samba district but left because the people did not allow me to take water from the pond for my animals,” says Akhtar.

Under these circumstances it isn’t surprising that the nomads want to give up their livelihood. “I will not migrate again. I will sit and let Allah take care of me,” says Shaqina Begum, a Bakerwal. “Even if I stop rearing sheep, who will hire me? I am not educated, I don’t know anything other than my animals,” says 18-year-old Yusuf Chaudhary, standing in front of his herd of 100-odd sheep. Akhtar, however, hesitates at the idea of settling down. “All we know is how to rear animals. We do a little bit of agriculture too. But we cannot sustain our animals on a little piece of land,” he says. Suri says that the nomadic community’s plight will not improve unless it gets settled and educated. “The Gujjars have improved their lot because they have land and have received education. You’ll find many Gujjars in the administrative services of the state, but not

many Bakerwals,” says Suri.

The government did start a Mobile School Programme for the nomads in the 1980s. The idea was to employ a teacher from within the community who would travel with the nomads. “But the militancy and corruption in the system killed that programme. There is a need to revive it,” Suri says. The forest department of the state also needs to formulate a better policy for nomads rather than just cordoning off forest areas and branding the community as transgressors.

“The tribals of the state have been at the forefront of India’s struggle against infiltrators from across the border but are today bearing the brunt of the saffron wave in the state,” laments Rahi. Media reports too say that Bakerwals and Gujjars were the first to inform the Army about the Kargil infiltrations.

At Bakerwal settlements, children can still be seen chasing animals. At the Sanasar camp, a nine-year-old recounts his daily routine, “I wake up, drink *chai* with *roti*, take the sheep to graze, drink *chai* with *roti*, and go to sleep, leaving the sheep to graze. In the evening, I come back.”





That used to be the life of Bakerwals, one without worries. Not anymore. ■

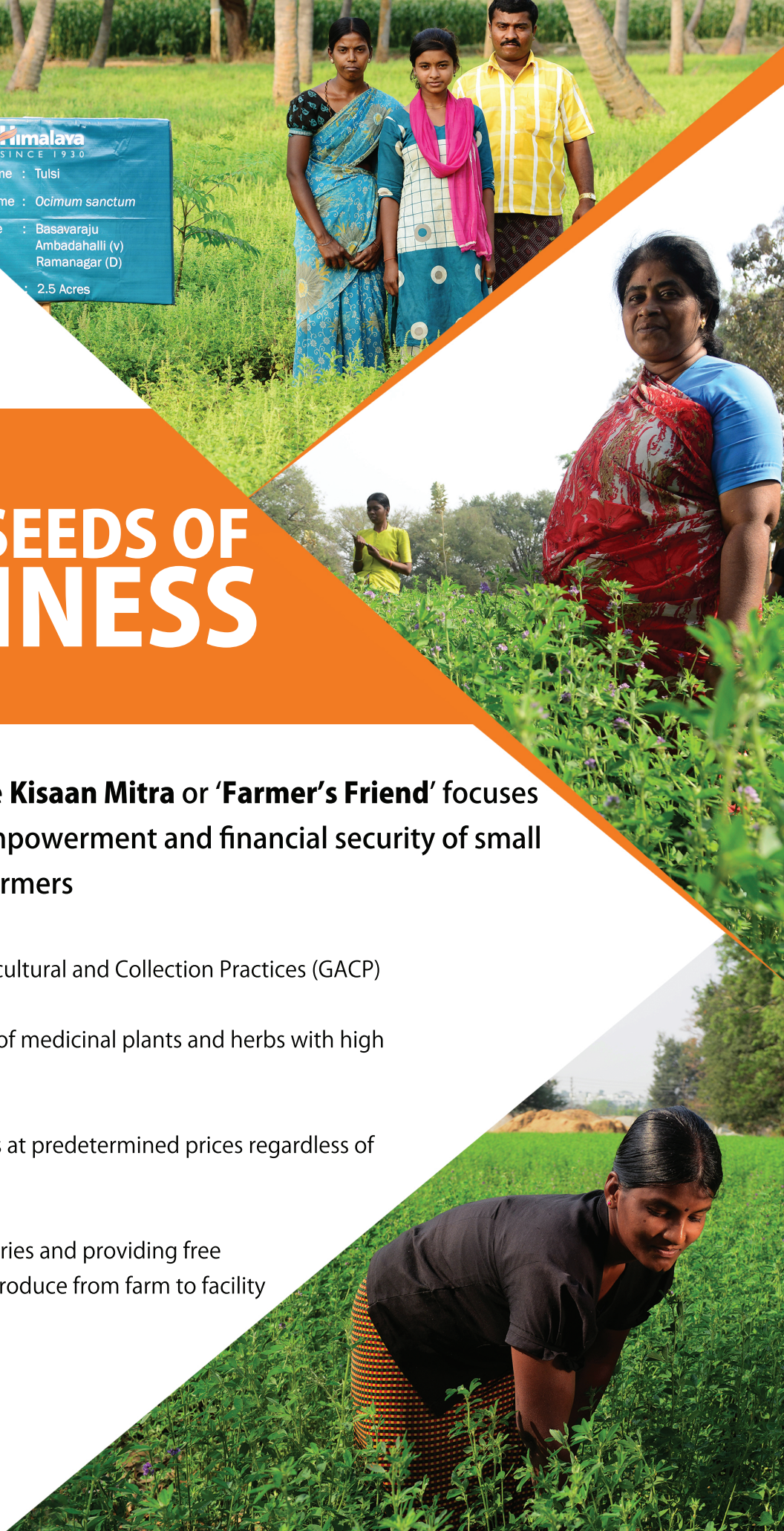
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SOWING SEEDS OF HAPPINESS

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-  Buyback arrangements at predetermined prices regardless of market fluctuations
-  Eliminating intermediaries and providing free transportation of the produce from farm to facility



Heavy-duty pressure

The government has stalled standards that could have made heavy-duty vehicles guzzle and pollute less. Is it hand-in-glove with the industry or under pressure from it?

**BANJOT KAUR AND
POLASH MUKERJEE**
NEW DELHI

IT SEEMS the automobile industry lobby has once again succeeded in undermining India's efforts to curb greenhouse gas emissions. Or else, why would fuel efficiency standards for heavy-duty vehicles (HDVs) be put on hold just three days before the roll out?

Word has it that on March 29, Nitin Gadkari, the Minister for Road, Transport and Highways (MORTH) held a closed-door meeting with the ministers and secretaries of the power and the petroleum and natural gas ministries and asked them to look afresh into the standards. These are the ministries that had deliberated for three long years along with industry body, Society of Indian Automobile Manufacturers (SIAM), to devise standards to reduce carbon dioxide (CO₂) emissions from HDVs as well to reduce the fuel import bill; India depends on imports to meet 80 per cent of its crude oil demand.

The proposed standards were in line with the government's attempt to create

fuel-efficiency norms for vehicle segments in different phases. In 2014, similar norms were introduced for passenger cars. Though HDVs have so far remained scot-free, estimates show that they emit more CO₂ than cars as they travel long distances and thus consume more fuel. Besides, almost all HDVs run on diesel, the most polluting fuel.

Going by the notification of the Ministry of Power in August 2017, the standards, applicable to HDVs weighing over 12 tonnes, would have limited the maximum fuel consumption of goods vehicles (belonging to N₃ category) to 2.76-6.82 km per litre. The maximum fuel consumption of passenger vehicles with nine or more seats (under M₃ category) was to be limited to 4.22-5.82 km per litre. A report by the sub-committee set up by the petroleum ministry in 2014 to draft the standards, the measures would have helped save 1.27 million tonnes of diesel between 2018 and 2023 (see 'Missed opportunity'). This means a reduction of

VIKAS CHOUDHARY / CSE



₹7,564.82 crore in the fuel import bill over five years. This also means prevention of 4.07 million tonnes of CO₂ during the period. The figure is significant for a country which under the Paris Agreement has committed to reduce its emission intensity of CO₂ by 33-35 per cent by 2030.

So, why did government bend?

To find the answer, *Down To Earth* (DTE) contacted all the three ministries involved in the drafting process of the standards as well as industry leaders like Ashok Leyland, Mahindra & Mahindra and Tata Motors. While the ministries dodged DTE queries, there was no response from HDV makers.

Industry insiders say the standards were put on hold after the automobile industry raised its objections related to the calculations based on which the standards have been drafted and would be implemented.

"The standards require each HDV to follow fuel-efficiency norms. But the industry wants to follow the Corporate Average Fuel Economy (CAFE) standards practised in the US," says Vishnu Mathur, director general of SIAM. Under CAFE, the average fuel consumption of the entire fleet of a manufacturer is calculated, irrespective of the vehicle model. So, even if some models of the manufacturer do not meet standards, the "sales-weighted" average fuel efficiency of its fleet sold in a particular year is maintained. However, Sumant Kumar, director of Delhi-based Petroleum Conservation Research Association that deals with energy efficiency, says, "India cannot follow the CAFE system as we do not have sufficient data on individual fuel consumption of vehicles." Though SIAM used to release fuel-efficiency figures of all vehicle models, it has discontinued the practice since 2008-09 and has been doing so for cars since 2015.

The other major gripe of the industry is about implementation of the standards. And this finds a mention in the 2017 report of the sub-committee. It says SIAM opposes using Constant Speed Fuel Consumption (CSFC) test as a method of calculation. As part of this test, a prototype model is made to run on a test track simulating real-life driving conditions for 4 kilometres at 40 km per hour and 60 km per hour to calculate fuel consumption. Three such tracks are available in India at Pithampur

Missed opportunity

The fuel-efficiency standards would have helped the country save ₹7,564.82 crore in the fuel import bill and 4.07 million tonnes of CO₂ in just five years

Year	Goods vehicles weighing over 12 tonnes, such as tractors (under N ₃ category)			Passenger vehicles with 9 or more seats; weighing over 12 tonnes (M ₃ category)		
	Fuel savings (in million tonnes of diesel)	Monetary savings (in ₹crore)	Carbon emissions savings (in million tonnes)	Fuel savings (in million tonnes of diesel)	Monetary savings (in ₹crore)	Carbon emissions savings (in million tonnes)
2018-19	0.13	753.58	0.41	0.03	158.64	0.09
2019-20	0.13	791.26	0.43	0.03	166.57	0.09
2020-21	0.14	830.82	0.45	0.03	174.90	0.09
2021-22	0.31	1890.68	0.94	0.07	396.66	0.21
2022-23	0.33	1,985.22	1.17	0.07	416.49	0.22
Total	1.04	6,251.56	3.37	0.23	1,313.26	0.70

Source: Development of draft fuel efficiency norms for diesel heavy-duty vehicles in India, a report by a sub-committee set up by the Union Ministry of Petroleum and Natural Gas in 2017

(Madhya Pradesh), Ahmednagar (Gujarat) and Chengalput (Tamil Nadu). But SIAM says CSFC is unscientific as it involves external factors, such as wind speed and humidity, that can impact the performance of the vehicle and can thus show different results when the test is repeated on different occasions. Instead, SIAM wants the VECTO method to be followed, in which all components of a vehicle that influence emissions, such as tyres, aerodynamics, engines, transmission and weight, are tested separately in the laboratory. The inputs are then fed into a software tool to calculate fuel consumption as well the emissions.

The sub-committee had quashed the suggestion saying the track at Ahmednagar is at par with those available internationally. Besides, says its report, the results are repeatable, "as they show no discrepancy when conducted in a different set of occasions". Though VECTO method of calculation is ideal for India to gradually adopt, it would require a lot of investment on behalf of testing agencies. So much so that if the process had started in 2016, the first set of guidelines would have come only in 2022-23. But India cannot afford to wait so long. Besides, Europe is still working to finalise its VECTO norms, the report adds.

Clean air campaigners oppose only lab-

based testing. "Lab-based results don't accurately reflect on-road performance of the vehicle. Therefore, it's important to conduct tests in real-world driving conditions while measuring emission and fuel efficiency," says Vivek Chattopadhyaya of Centre for Science and Environment, Delhi. The cheating by Volkswagen to pass USA's emissions tests (see 'Faux wagon', *Down To Earth*, 16-31 October, 2015) reinforces the need to test vehicles in real-world conditions, he adds.

Balraj Bhanot, former director of Pune-based Automotive Research Association, says the industry's demands are nothing but delaying tactics. The sub-committee report says all concerns of SIAM were resolved while drafting the standards. Then why is it again raising the issues? The industry is reluctant because to fall in line with the standards, manufacturers need to tweak the engines and re-design vehicle models which involves investing in research and development (R&D), he says. Other experts also doubt the industry's intention as it is now investing in R&D for developing technologies to meet emission norms of Bharat Stage VI, which will be in force from 2020. "The government, instead of giving in, should have enforced the standards. Any changes could have been introduced later," adds Bhanot. ■

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The Bt cotton fiasco

Monsanto's GM cotton patent has been revoked but this is of little help to farmers who have been let down by the technology

LATHA JISHNU
NEW DELHI

TIS a patently problematic issue. Agriculture biotech giant Monsanto's genetically modified cotton seeds are not patentable because India's Patents Act prohibits the patenting of plants and biological matter, a division bench of the Delhi High Court ruled on April 11 in the long-running case between Monsanto and its licensee Nuziveedu Seeds (NSL). As such, the US agriculture biotech's Bollgard-II Bt cotton seed technology, which is designed to resist the bollworm pest, cannot be enforced in the country. This means NSL and the dozens of other Monsanto licensees are free to use and sell the technology without being in violation of the many patents that Monsanto had been granted in 2008 in India.

The high court bench of Justice Ravin-

dra Bhat and Yogesh Khanna set aside Patent 214436 titled "Methods for transforming plants to express bacillus thuringiensis delta endotoxins". Bollgard-II seeds have stacked genes (Cry1Ac and Cry2Ab) extracted from the soil bacterium *bacillus thuringiensis*—hence the name Bt cotton—which is said to protect the plant against three pests: American bollworm, pink bollworm and spotted bollworm. The first generation hybrid seeds, or Bollgard as Monsanto calls it, contained only the Cry1Ac gene.

The bench cited Section 3(j) of the Patents Act which does not allow the patenting of plants to overturn the patent. Specifically, it bars patenting "plants and animals in whole or any part thereof other than micro-organisms but including seeds, varieties



VIKAS CHOUDHARY / CSE

Sadly, the public sector in India is persisting with variants of the Bt technology and are not offering new options

and species and essentially biological processes for production or propagation of plants and animals”.

As a result, the patent held by Monsanto, through its Indian arm Mahyco-Monsanto Biotech Ltd (MMBL) on Bollgard-II technology, is not enforceable in India, the court ruled. Any royalties on the technology will be decided by the Union Ministry of Agriculture. However, MMBL has been permitted to approach the Protection of Plant Varieties and Farmers' Rights Authority (PPVRA) for registering the Bt plants within three months, after which the Authority would decide on a benefit-sharing mechanism.

Tragically, the verdict comes as cotton farmers are finding Bollgard-II increasingly

useless against the pink bollworm which is ravaging cotton fields across the country. Over 90 per cent of the 12.2 million hectares under cotton is covered by Bt cotton hybrids, primarily Bollgard-II. The patents expire in 2019, that is, 20 years after the date of filing, November 1999.

The greater tragedy is that public sector in India is promising a solution to the deadly cotton pest through a variant of the same Bt technology. The apex research organisation, the Central Institute of Cotton Research (CICR), Nagpur, announced a couple of years ago that its Bt cotton would be in the market in 2017; but according to latest reports, the products are still in the pipeline.

Cotton farmers are thus caught in a technological vice which closed in on them in 2002 when the then National Democratic Alliance government of Atal Bihari Vajpayee regularised the illegal cultivation of Bt cotton with Monsanto's Bollgard which had not been subjected to the regular processes of approval. No large-scale field trials had been conducted when the illegal cultivation started in Gujarat. The state government, it was said, had turned a Nelson's eye on it because it did not want to stop the farmers from accessing the latest technology.

Since then states have been using various means to bring down the trait fees or royalty charged by Monsanto. Initially, Monsanto had levied a predatory trait value amounting to two-thirds of the cost of a packet of seed till the then Andhra Pradesh government of Rajashekhar Reddy used the Monopolies and Restrictive Trade Practices Act, the courts and the Essential Commodities Act to cut the fee. He was followed by a clutch of other states which also went to the court to make Monsanto less rapacious.

The genesis of the current legal wrangle is a dispute between NSL, the largest hybrid seed company in the country, and Monsanto over changes in the licensing agreement and a further reduction in trait fees. In 2015, Prabhakara Rao, Chairperson and Managing Director of NSL, sought a 10 per cent cut in royalties or trait fees levied by MMBL. It was a demand which was joined by other seed

firms which said it was impossible to pay the fee demanded by Monsanto because some states had fixed the total seed price.

As the stand-off deepened, MMBL terminated its agreement with NSL which is said to have owed it ₹140 crore. Rao, who was also the head of the National Seeds Association of India, then sought the support of the Rashtriya Swayamsevak Sangh (RSS), the inspirational force of the ruling Bharatiya Janata Party. A leading RSS outfit, the Swadeshi Jagran Manch (SJM), is opposed to multinationals and campaigns to promote indigenous products and technology. NSL was also backed by the Union Ministry of Agriculture which is headed by Radha Mohan Singh, a lifelong RSS member and a steadfast opponent of GM crops ever since he was agriculture minister of Madhya Pradesh. He introduced additional price controls that cut Monsanto down to size, reducing its profits by 16 per cent.

MMBL then sued Nuziveedu Seeds and its subsidiaries for continuing to sell seeds using its patented technology despite termination of its sublicense agreement. Nuziveedu then filed a counter suit challenging Monsanto's patent. Although Monsanto has not acted on its 2016 decision to pull out of India, there is uncertainty over the company's future. The question is whether there will be a Monsanto a few months down the line since it has been acquired by the German agrochemicals giant Bayer for US \$66 billion. Both the European Union and the US have given the green signal to the acquisition, but India's Competition Commission is examining the implications of the merger, which will result in a commercial behemoth with more monopoly power.

For cotton farmers though this might be of little interest as they wage a struggle with the bollworm, specially in Maharashtra, Madhya Pradesh, Telangana and Gujarat. The Centre cannot escape responsibility for the calamity since it was aware of the massive bollworms attacks that resurfaced in November 2015. It was clear then that Bollgard-II was ineffective since the pest had built up resistance. Monsanto's answer is a herbicide tolerant Bollgard which is yet to be approved by regulators. However, illegal planting of this crop is taking place in several states. India has come full circle on its BT cotton tangle. ■

@down2earthindia

The verdict comes at a time when farmers are finding Bollgard-II increasingly useless against the pink bollworm which is ravaging cotton fields across India

AFRICA AND CLIMATE CHANGE

EXIL BY EMISSIONS

Ghana: Joseph Opoku Gakpo and Kundan Pandey

Uganda: Lominda Afedraru

Kenya: Leopold Obi, Maina Waruru and Shruti Agarwal

Madagascar: Rivonala Razafison

South Africa: Munyaradzi Makoni

South Sudan: Julius N Uma

Ethiopia: Mekonnen Teshome Tollera

Malawi: George Mhango

Zambia: Christine Chisha

Tanzania: Saujanya Shrivastav

India: Vibha Varshney, Shreeshan Venkatesh, Swati Singh Sambyal, Snigdha Das, Rajit Sengupta, Akshit Sangomla, Aditya Misra and Ajay Kumar Saxena



ED

Down To Earth writers travelled across Africa to chronicle climate change. Their dispatches point to a great churning in the continent.

Starting from a herder to an environment minister, from a fishing community to a disaster manager, everybody is overwhelmed by the impacts of climate change. Africa is the least responsible continent for global warming, but it is the most vulnerable to its impacts. While many African countries are proactively taking up adaptation and mitigation steps, the developed countries need to support the continent in its existential crisis



CONTINENTAL CHANGES

Heat waves, droughts, floods and coastal erosion. Seven of the 10 most climate vulnerable nations in the world are located in Africa. By 2020, between 75 and 250 million people will be exposed to water stress and this will put over 50 per cent of the continent's population at the risk of undernourishment

MADAGASCAR IS, arguably, one of those countries on Earth that everybody will rush to protect. More than 80 per cent of unique flora and fauna species of the African continent are found here. But this biodiversity hotspot is staring at a meltdown. Recurring floods and droughts have taken a toll on not only its 26 million citizens, but also on its rich and rare biodiversity. The residents of Madagascar are paying for a crime they are not party to. With near zero per capita emission of greenhouse gases (GHG), the country is one of the worst victims of climate change.

"I can't describe the situation," says Nazaire Tsimanova Paubert, a social scientist based in Ambovombe city, who is overwhelmed by the severity of the three-year long drought that has gripped the southern region of the country. Most of the wells in villages have dried up. In 2017-18, the southern half of Madagascar received below average rainfall, says a forecast of the Famine Early Warning Systems Network. "We predict that the water reserves will dry up shortly," says Yves Rakotoarison, a water, sanitation and hygiene expert with Action Against Hunger, a French non-profit working in Madagascar. Residents in Ambovombe and adjacent districts are struggling to access water. They pay US \$0.6 for a container of 20 litres. Over 81 per cent of Madagascar's population subsists on the international poverty threshold of US\$1.25/day. "Their food stocks are about to be exhausted as there is little scope to farm due to deficit rain," says Paubert. Worse, the country simply doesn't have the capacity to meet this unprecedented scarcity of water. "We can only meet 15 per cent of the total needs," says Derry Mann Herindrainy, director general of Alimentation en Eau dans le Sud, the state-owned water supply company.

Drought has haunted southern Madagascar for centuries. But the impacts of climate change have aggravated the situation. Three years ago when the current spell of drought set in, the United Nations estimated that nearly 1.8 million people were food insecure. The poor people consume fruits of cactus which grows in the wild. The cattle too feed on cactus leaves. "Due to overexploitation, there has been a significant decrease in the cactus forests," says Mahatante Tsimanaoraty Paubert, an ecological expert.

Madagascar is the world's fourth largest island and has the highest risk from cyclones in Africa. Between 1984 and April 2018, it experienced 58 episodes of storms, torrential rains and strong winds—a three-fold increase over the previous 20 years—killing 2,102 people, displacing 1.5 million and affecting over 4 million people, according to the Bureau for Risk and Disaster Management. The country hasn't regularly calculated the loss and damages from climate-related events. Way back in 2008, there was an estimate after three consecutive severe cyclones that hit the country. It snapped 4 per cent of the country's GDP.



PHOTOGRAPHS: RIVONALA RAZAFISON

Contrasting weather in Madagascar such as prolonged dry spells and flash floods have caused soil erosion. This has degraded land for agriculture

The recurrence of hailstorms that seriously devastate fields and plantations has shocked communities. “Hailstorms were rare in the past and it never happened twice in a single season and in the same place. Hailing is now frequent, hitting the same place multiple times and the whole year round,” observes Daniel Razafindrakoto, a farmer in Morarano Gare, Moramanga, part of Madagascar eastern highlands. Analysis of temperature for the last 70 years shows that winter is getting shorter. Huge difference between temperature at ground level and that of the atmosphere results in hailing or heavy rains within

a short time. In effect, around three-fourths of Madagascar territory suffered from abrupt weather pattern changes due to the alternation of extended dry sequence and rainy season in 2016-2017.

Warming Africa

A churn is underway across Africa. An era of civil conflicts that followed centuries of colonial plunder across the continent seems like a thing of the past. Just as the majority of African nations were scrambling out of violent conflicts, the challenge of climate change has put the aspirations of the entire continent in serious jeopardy. The immediacy of

managing disruptive climate events has displaced governance priority of bridging the development deficit. More than 2,000 natural disasters have hit Africa since 1970 affecting 500 million people and killing 0.9 million.

People have one common query: why Africa? The irony is hard to miss. While Africa is responsible for barely 7 per cent of the total GHG burden of the world, climate change is both figuratively and literally reshaping the continent. Several reports have noted the particular vulnerabilities of African populations to climate change (see 'Changing face of Africa', p32). While the Intergovernmental Panel on Climate Change (ipcc) says that the rate of increase in temperatures across Africa is surpassing the global rate of temperature increase, analysis by Washington DC-based Brookings Institution says that seven out of the 10 most climate vulnerable nations in the world are located in Africa.

Warming in Africa has exceeded the limits of natural variability. According to the ipcc's Assessment Report 5 (AR5), the near surface temperatures have risen by 0.5° C over the past century. Despite the size and geographical spread of Africa, the only exception to the observed heating trend comes from the central and interior regions of Africa. But even here, there are problems. "It is very likely that mean annual temperature has increased over the past century over most of the African continent, with the exception of areas of the interior



THOUGH AFRICA IS RESPONSIBLE FOR BARELY 7% OF THE GHG BURDEN, CLIMATE CHANGE IS RESHAPING THE CONTINENT

of the continent, where the data coverage has been determined to be insufficient to draw conclusions about temperature trends," says AR5.

By the end of the century, most models show that temperatures across the continent under the "business-as-usual" scenario will be about 3-6° C higher than the average temperature observed at the end of the 20th century, which is already close to being 0.5° C more than average temperatures at the beginning. AR5 notes that the maximum change in temperature by the end of the century is likely to occur in the northern and southern parts of the continent. But the fastest rate of change is expected to occur on the western side. "However, in the tropics, especially tropical West Africa, these unprecedented climates are projected to occur 1 to

2 decades earlier than the global average because the relatively small natural climate variability in this region generates narrow climate bounds that can be easily surpassed by relatively small climate changes," says the report.

While the AR5 regional profile has singled out Ethiopia and parts of eastern Africa for higher incidences of heat waves, more recent studies have suggested that the problem is likely to affect the entire continent. A study published in *Environmental Research Letters* in 2016 found that even modest warming of 2° C in global average temperatures would be enough to make heat waves a completely normal occurrence. Since Africa is situated between the Tropics of Capricorn and Cancer, it is likely to be the worst affected.



Two and half million people living along Ghana's coast are at risk of losing their homes as a result of rising sea level

In 2017, the European Commission conducted the most comprehensive analysis of the risks of heat waves in the continent. It found that equatorial and sub-equatorial Africa will be particularly badly affected. Under the business-as-usual scenario, “the Gulf of Guinea, the Horn of Africa, the Arabian peninsula, Angola and the Democratic Republic of Congo are expected to face, every 2 years, heat waves of length between 60 and 120 days. Once every 30 years heat waves are projected to be longer than 180 days over parts of central Africa and the Arabian peninsula.”

Reeling from the impacts

People in Africa are being introduced to the impacts of climate change in innumerable ways. Take the case of the Karamojong farming community in Katanga village near Moroto town in northeastern Uganda. Every morning farmers gather around an old radio set. They attentively listen to the latest weather forecast. The region's landscape of lush grasslands has completely dried up. Most of the

listeners belong to the local Farmer Field School, an institution initiated by the Food and Agriculture Organization (FAO) to sensitise communities on the perils of erratic weather events and also to equip them to prepare for it. Many of them say: “We wait for early warning about impending disasters more than rain”.

“We usually receive rain once a year from July to October. But this year, there was no rainfall,” says Gloria Ato, a farmer who grows sorghum. One can sense the depression of farmers like Ato who have come to know through the weather forecasts that the dry spell would be longer this year.

Lawrence Biyika Songa, chairperson of the Uganda Parliamentary Forum on Climate Change, says, “We are reeling under the impacts of climate change. It is manifesting in the form of prolonged dry spell and flooding.” In Uganda, landslides have been reported in the mountainous areas in the east at the slopes of Mountain Elgon and in the west around Mufumbiro and Rwenzori ranges where there has been rampant deforestation. “Landslides

Changing face OF AFRICA

All five regions in Africa have been experiencing an increase in temperature. This trend is likely to worsen in the coming decades. There has also been a decline in precipitation indicating less rainfall, which could make the continent even more food insecure

Legends

Desertification vulnerability

Climate Change Vulnerability Index 2017

Medium risk

High risk

Extremely high

Western Africa

- » Temperatures across West Africa have risen rapidly over the last 50 years. Average annual temperature has increased by about 2°C over the last century
- » By the end of the current century, temperature increase could be between 3°C and 6.4°C relative to the 1961-1990 baseline, much higher than the global average
- » Precipitation is likely to reduce marginally by around 7 per cent by the end of the 21st century
- » A significant increase in the temperature of hottest days and coolest days has been observed in some parts. While an increase in drought in the region has also been observed, there is likely to be an increase in the frequency of hot days in the future

Central Africa

- » While observations are scarce, climate models suggest an increase of 0.6°C in the 20th century
- » Climate projections indicate that temperature could rise up to 5°C, compared to the 1960-2000 baseline values
- » Changes and projections regarding precipitation in the central African region and the Congo basin remain highly uncertain due to the lack of observational climate data
- » Although data is scarce and projections are highly uncertain, countries in the central African region are considered to be among the most vulnerable due to poor socio-economic indicators, lack of governance framework and low levels of infrastructural development



Northern Africa

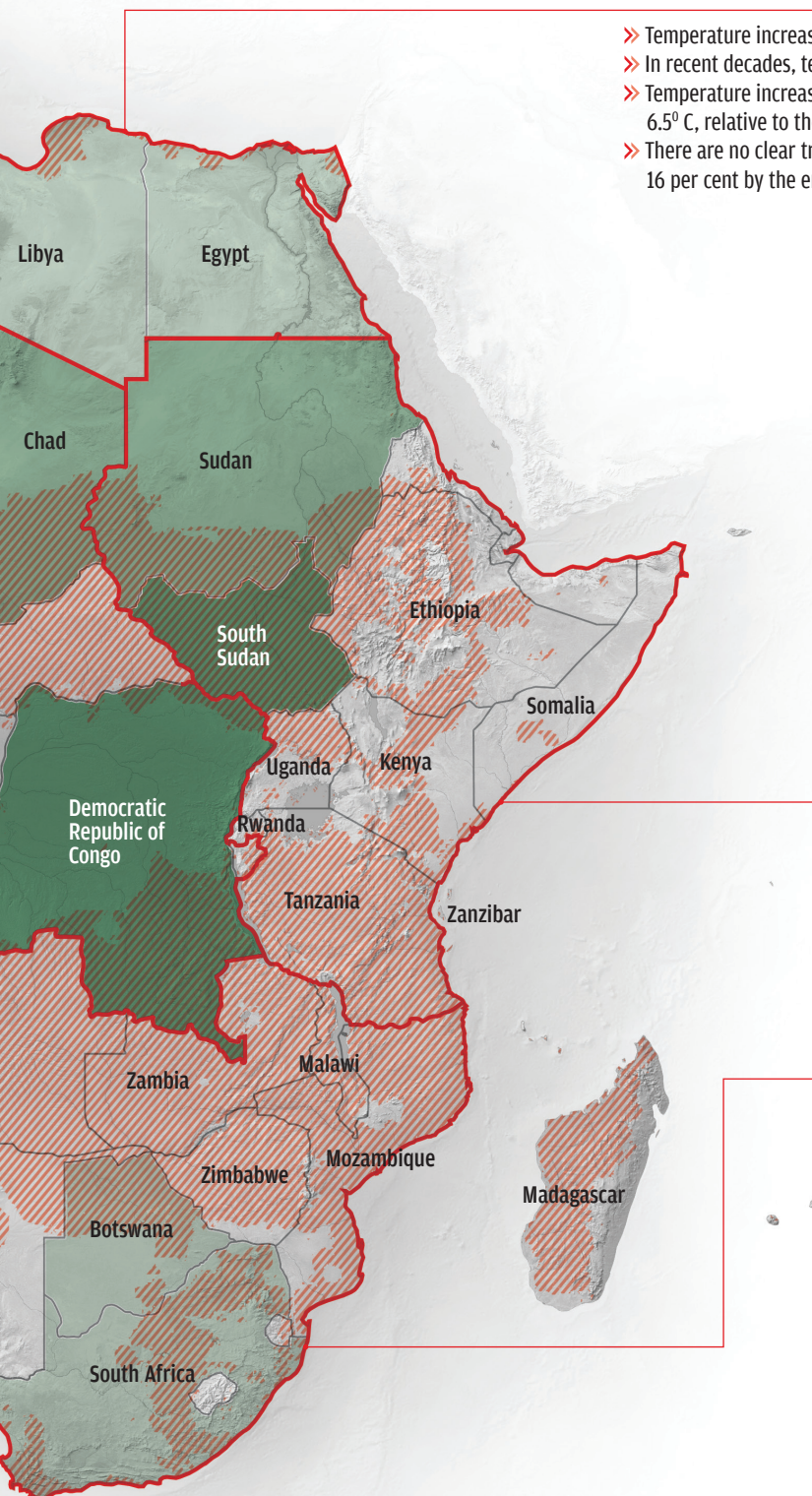
- » Temperature increases of about 2° C have been observed over the 20th century
- » In recent decades, temperature has increased by about 0.16° C per decade
- » Temperature increase by the end of the century is likely to be between 3.3° C and 6.5° C, relative to the 1961-1990 baseline, and higher than the global average
- » There are no clear trends in precipitation. However, it is likely to decline by around 16 per cent by the end of the century

Eastern Africa

- » The equatorial and southern parts of eastern Africa have experienced a significant increase in temperature since the early 1980s. Temperature in the region increased by 1.5-2° C in the 20th century
- » Projected maximum and minimum temperatures over equatorial eastern Africa show a significant increase in the number of days warmer than 2° C above the 1981-2000 average by the middle and end of the 21st century. Temperature is likely to be between 2.7° C and 5.4° C above the 1961-1990 baseline by the end of the century
- » Precipitation in eastern Africa is highly variable, however temperature and pressure in the Indian Ocean and the Mediterranean Sea have caused a significant decline in rainfall since the mid-20th century. As a result, there has been an increase in the number of droughts

Southern Africa

- » Southern Africa has experienced increases in temperatures of up to 2° C over the last century. The most rapid heating has been observed post-1980
- » Temperature is expected to continue to increase through the century, and is likely to be anywhere between 2.8° C to 6.3° C above the 1961-1990 baseline
- » Western parts of southern Africa, from Namibia to Angola and the Congo, received less summer rain in the second half of the 20th century, while other southern countries like Botswana, Zimbabwe and western parts of South Africa have also had modest decreases in rainfall



Prepared by DTE/CSE Data Centre

Infographics: Raj Kumar Singh

Analysis: Shreeshan Venkatesh

Data source: Assessment Report 4, IPCC, and Climate Change Scenarios for the Congo Basin

by Van Garderen, Ludwig F

For more such infographics visit: www.downtoearth.org.in/infographics

BONE DRY

Feeble efforts will not prevent the spread of desertification

THAT AFRICA'S deserts have been in a state of expansion is no secret. Archaeological records suggest that the continent has been becoming drier and more arid for nearly 5,000 years. Along with the massive deserts that stretch from the eastern to the western part of the continent, dry lands constitute more than two-thirds of the continent's surface area. According to estimates, these drylands are estimated to support nearly half-a-billion people. Two-thirds of Africa's cultivable lands, one-third of its grazing lands and 20 per cent of its forests have already turned to dust.

But while it may not be new, the rate and expanse of degraded and desertifying lands is unprecedented. In late March this year, a worrying fact came to light. The Sahara desert, approximately the size of the US, had expanded by a mind-boggling 10 per cent since 1923. All of it in the Sahelian belt and Central African region that stretches alongside the Sahara desert to its south. Across the Sahel, temperature increased by up to 2° C over the last century which is close to double the observed global average temperature increase. The risk of desertification affects from around 30 per cent of the total land area towards the western parts in Ghana and Nigeria to around 80 per cent in eastern countries like Ethiopia and Kenya.

And this trend is not limited to the Sahel and Central Africa. Two of Africa's three hot deserts are in the south, namely the Kalahari and the Namib deserts. While the Namib stretches along the coast in Namibia and South Africa, the Kalahari is more expansive, spreading across Botswana, Namibia, Zimbabwe, Zambia and Angola. Rainfall, in agreement with previously made projections, shows a declining trend in the already dry regions of southwest Africa. Intense droughts over the last 50 years, an especially in the last decade, have contributed to a creeping expansion of degraded and dry lands.

While the degradation of land is worrying in itself, it is compounded by population pressures. Sub-Saharan countries have among the fastest growing populations of the world with several countries exhibiting more than twice the global average. Worse, close to 80 per cent of the population is dependent on land-based natural resources and subsistence farming both of which are under-threat by expanding deserts and degraded lands. As the population continues to increase through the first half of the 21st century, the stress on natural resources is expected to exacerbate human conflict and migration.

The 1992 Earth Summit in Rio recommended the formation of a convention to combat desertification which came into force in 1996. But despite 20 years of its existence, the United Nations Convention to Combat Desertification (UNCCD) is yet to gather steam in its efforts to halt and ultimately reverse the terrifying trend of quickly degrading lands, especially in Africa. In 2007, the Great Green Wall Initiative was launched as a collaborative effort to reforest and restore a 16 km-wide corridor stretching 8000 km from west Sahel to the east with a total expected outlay of US \$8 billion. According to UNCCD, more than 20 million hectares have been restored under the initiative however success is not consistent across the Sahel.

In 2015, while the world was preoccupied with the Paris Agreement and its potential to address climate change, a first-of-its-kind pan-African initiative known as the African Forest Landscape Restoration (AFR100) was launched in relative obscurity. Under the initiative, 26 sub-Saharan African countries committed to restore 100 million ha of degraded and deforested land by 2030. More than two years since its launch, the focus now is to move beyond commitments and towards implementation and nations are actively developing restoration strategies.



have become frequent. This has never occurred in Ugandan history," says Songa.

Flash floods amid prolonged dry spells have caused soil erosion and this has degraded agricultural lands. What has made matters worse is disease and pest attacks on major food security crops such as cassava, banana, beans, rice and groundnuts among others. For instance, coffee, which is a key cash crop of the country, is affected by wilt disease and twig borer. On the other hand, heat waves are so severe that there are widespread local clashes over access to water resources. IPCC says that average temperatures in Uganda will increase by up to 1.5° C in the next 20 years and by up to 4.3°C by the 2080s.

Rising temperatures are altering the landscape of Africa. In March 2018, a study published in the *Journal of Climate* shows that the largest desert in the world—the Sahara—has been expanding due to shrinking rainfall and extended dry conditions (see 'Bone dry'). Armed with 93 years



While 95 per cent of the South Sudanese population is dependent on climate-sensitive activities for their livelihoods, the ongoing civil war has worsened the crisis

MORE THAN 2,000 NATURAL DISASTERS HAVE HIT AFRICA SINCE 1970 AFFECTING 500 MILLION AND KILLING 0.9 MILLION PEOPLE

of field and satellite data, researchers say that the Sahara has expanded by about 10 per cent—close to a staggering 1 million sq km. If it were a nation, the expanded area itself would be the 30th largest country in the world. In southwest Africa, there are reports that the hot Namib Desert too is expanding.

In the latter half of the 20th century, the continent has been witnessing extended spells of drought and extreme rainfall. The rapid and successive swinging between dry and wet conditions has devastated regions in the south and east of the continent. According to the IPCC report, it is “very likely” that the northern and southern parts of the continent will experience a decline in precipitation levels and undergo more intense

dry conditions in the future. At the same time, the eastern and central regions are set to have a wetter future. However, wetter doesn’t necessarily mean better. IPCC notes that over the last 30-60 years, extreme precipitation changes alternating between tempestuous rains and prolonged droughts have been observed with increasing frequency.

Vanishing farmlands

In Zambia, droughts, floods and other climate events inflict annual damages of around 0.4 per cent of the country’s GDP, says Zambia’s Minister of Agriculture Micheal Katambo. Without adaptation measures, the intensified effects of climate change and variability are expected to sap around one

per cent of annual GDP. “We are in deficit to fund own development. Climate change has added a new dimension,” he says. Yande Mwape, National Coordinator for Zambia’s Disaster Management and Mitigation Unit, confirms that government’s spending has increased for disaster responses. “We are moving money and resources meant for development programmes to disaster response and mitigation”, says Mwape.

In the east part of Zambia, the adverse effects of climate change are much more evident. In Feira, a village in the east of Zambia, the returns from farming have diminished due to severe droughts. Says Eva Mwanza, a local resident, “Rainfall is insufficient for cultivation and wild animals wander in the fields destroying crops.” “Rivers never ran dry earlier,” says Andrew Zulu, another Feira resident.

Frank Kayula, president of Small-scale Farmers Union, says most small-scale farmers are unable to venture into irrigation farming due to lack of financial support. Most products being

possible. “The lake has shrunk so much that there is a big landmass between my farm and the water area of the lake,” he says. Ethiopia has already lost one of its great lakes, the Haramaya Lake. The lake, which once covered 16 km and had a depth of over 9 metres has vanished. Harar city, which was dependent on its water, is now searching for an alternative source. Fishing communities have become climate refugees.

Ethiopia has 12 major river basins and most of its lakes and rivers are found in the Great Rift Valley, where the country shares cross boundary water with Kenya and with other lower riparian countries. Zinabu Gebre-Mariam, a professor with the Ethiopian Hawassa University, says that increasing water demand from many cities and towns located along the Rift Valley lakes is drying up the water sources. Debasu Bayleyegn Eyasu, director general of Climate Change Implementation Coordination wing of Ethiopia’s environment ministry, says high evaporation due to increasing temperature is adding to the problem of overexploitation. “Temperature is usually higher in the Rift Valley basins than in other highlands,” he says.

IN SOME COUNTRIES, YIELDS FROM RAIN-FED AGRICULTURE COULD DROP BY UP TO 50%

offered by financial institutions are suitable only for large-scale commercial farmers. “With the current climatic challenges, farmers need other sources of water to continue growing crops and stop depending on rain,” says Kayula. Climate change has also begun to affect Zambia’s tourism industry. If drying up of water sources continues at the current pace, the Victoria Falls—known as the seventh wonder of the world—could turn into an empty ravine in about 50 years. Mwape says extreme weather is affecting wildlife and flora alike.

By 2020, between 75 and 250 million people in Africa are projected to be exposed to increased water stress due to climate change. In some countries, yields from rain-fed agriculture could drop up to 50 per cent. This is because traditional water sources are drying up.

Take Ethiopia for instance. Known as the continent’s water tower, the country is confronting huge challenges of disappearing lakes and rivers. Zewudu Molla, a farmer who grows vegetables using water from the Lake Ziway in the Rift Valley Basin, says that tapping the lake’s water is no longer

Impending catastrophe

While extreme weather is exposing Africa’s infrastructural and economic frailties, another creeping risk that is

becoming more evident is the impact of changing climate on food security in the continent. Global warming of 2° C would put over 50 per cent of the continent’s population at risk of undernourishment. Projections estimate that climate change will lead to an equivalent of 2 to 4 per cent annual loss in GDP in the region by 2040. Currently, there are about 224 million undernourished people in the continent—jumping from 21 per cent in 2015 to 23 per cent in 2016, according to a 2018 FAO report.

Over the past decade or so, warnings of possible famines in parts of eastern and southern Africa following long periods of protracted droughts have become common. In 2017, such warnings were issued for several nations in eastern and southern Africa. Ocean warming and acidification are depleting marine ecosystems, which provides nutrition to millions of inhabitants living on Africa’s large coast (see ‘When oceans fill apart’ on p48). An analysis of fisheries in 132 countries by Edward H Allison *et al* in 2009 revealed that about two-thirds of the most vulnerable countries are situated in Africa. The worst affected are likely to

be coastal countries in West Africa where value of fish is expected to decline by more than 20 per cent, equivalent to an annual loss of US \$310 million per year by mid-century, according to AR5. The problem of nutrition depletion is not limited to marine ecosystems.

Cropping systems across Africa have been found to be incredibly stressed and are slated for significant declines in production in the coming decades. About 70 per cent of Africa is dependent on small and rain-fed agriculture that is expected to be badly hit by a changing climate. IPCC notes that maize yields are likely to reduce by about 22 per cent across sub-Saharan Africa, while Zimbabwe and South Africa are likely to experience yield declines of over 30 per cent by the mid-century. In the same period, wheat production would drop by as much as 35 per cent. Though some produce might show modest increases in the immediate future, this is likely to be offset by declines in the production of most cereals and horticultural crops.

The food shortage is linked inextricably with the availability and access to water. Satellite images of the receding Kilimanjaro glaciers or of rapidly shrinking major lake systems like Victoria, Chad or Turkana have in recent years gone viral on the social media. These images are representative of the widespread shortages of freshwater and surface water sources across the African landscape. Combined with an increasing population, which will see Africa's population nearly quadruple in a little more than 100 years, climate change is likely to put added stress on the availability and access to freshwater. There are already numerous reports of clashes and conflicts between different communities on access to water.

The escalation of clashes over natural resources into full blown armed conflicts is exemplified by the case of Boko Haram, the notorious militant group supposedly active in Nigeria, Chad, Niger and Cameroon. In fact, a 2017 resolution published by the UN drew direct links of the armed insurgency terrorising large parts of northern Nigeria with the drying up of Lake Chad—it has shrunk by about 90 per cent in just four decades and still supports around 17 million people. Early this year, the UN Security Council expanded on the resolution and declared that environmental changes, depleting resources and desertification were posing clear threats to the stability of West Africa and the Sahel. The two regions put together house 26 countries, which is nearly half of the continent.

Vanishing ecosystems

Climate change has also put coastal ecosystems under a serious threat. Across Africa, Ghana has the highest concentration of people and infrastructure along the coastal belt. More than 2.5 million Ghanaians have built their homes along the coast, which stretches for 550 km. Fishing is the main source of livelihood for these residents.

But over the last four decades, hundreds of these homes have submerged into the Atlantic Ocean. In fact, large parts of Ghana are now under sea water. Take Kporkporgbor for instance. It used to be a vibrant coastal community in the Keta Municipality of the Volta Region. The community



had more than 50 houses, a church, playground and a population of more than 500 people. Today, the sea has swallowed all, except one of the houses.

“Everybody is affected. There is no work. People have nowhere to sleep. A lot of them have moved out of the district,” says a former resident. It’s usually a gradual erosion of the land. High tidal waves sweep the ocean water onto the land. After some hours, the sea dissolves portions of the land into the water.

Close to the submerged town is another on the verge of extinction, Fuveme, which had a population of more than 1,500 people. Over the

The Sahara Desert has expanded by about 10 per cent, which is close to a staggering 1 million sq km

last 30 years, the local government representative, Oswald Etse Kpodo, says the sea has expanded by about 400 meters into Fuveme, swallowing more than 150 homes. He estimates that about 70 per cent of the community's land has already been lost to the sea. Like Fuveme, two and half million people living along Ghana's coast are at risk of losing their homes as a result of the increasing sea level.

In Keta Central in the Volta Region, a map that compares its land size between 1910 and 1999 shows about two-thirds of lands in the Keta Central Electoral Area have been lost to the sea. Chris Gordon, director of the Institute for Environment and Sanitation Studies at the University of Ghana, is worried that there is no end in sight to the problem of coastal erosion. "We are now operating in an environment of climate change-induced sea level rise... Under normal circumstances we are okay. But when we have high tides, coupled with a storm surge and high winds, then you find that the coastline has been overrun and the water comes in," he says.

23% OF AFRICA'S POPULATION IS UNDERNOURISHED. AND THIS FIGURE IS INCREASING

Over the past 15 years, several studies have warned of climate change and environmental stressors intensifying and aggravating regional, ethnic and resource-driven conflicts. Conflicts have been reported over land and water from Kenya, Tanzania, Uganda, Somalia, Sudan, Zimbabwe and Lesotho apart from West Africa and Sahel. In recent years, waves of dangerous migration across the Mediterranean into Europe have dominated the news. Outmigration from sub-Saharan and North Africa has been linked directly and indirectly to environmental changes and conflicts (also influenced by environmental changes). While migration depends on several complex social, economic, political and environmental factors, estimates suggest that by the mid-century, more than 200 million people could be on their way out of the continent unable to contend with the ground realities. This number would account roughly for 10 per cent of Africa's population in the mid-century.

Africa carries a double burden. One is to climate proof itself to save its natural resources-dependent economy. The other one is to maintain

the global economic growth because the continent is also a major exporter of raw resources that run the modern economy.

According to the World Bank, most of the shocks caused by climate change are also the causes for poverty in the continent. "The consequences of climate change for Africa are devastating and threaten to push millions of people into extreme poverty by 2030, largely due to lower crop yields and higher food prices, and negative health impacts," says Benoit Bosquet of the World Bank.

This projection is already playing out in South Sudan, the world's youngest country. According to the 2017 Climate Change Vulnerability Index, it is one of the five most vulnerable countries. Ask the 39-year-old logger, John Makuach Deng, who doesn't understand climate change, but admits that without cutting a tree he can't survive. About 35 per cent of the country's land was once covered with trees. Today it has dropped to just 11 per cent, according to the environment ministry.

South Sudan is currently embroiled in a conflict that has killed tens of thousands of people, displacing nearly two million of them. But, while up to 95 per cent of the South Sudanese population is dependent on climate-sensitive activities for their livelihoods, such as agriculture and forestry, the ongoing civil war has worsened the problem.

South Sudan has no forestry policy and its authorities are worried they could lose the country's tropical forests, unless stringent measures are put in place to curb rampant illegal logging.

"People are taking advantage of the insecurity," says Alfred Lado Gore, South Sudan's minister for the environment, adding that due to the ongoing conflict, there is no supervision at the country's borders, even though South Sudan has banned the export of charcoal. "The situation of uncontrolled illegal logging, mining, poaching, charcoal trade, and other natural resource exploitation in the country is getting worse," acknowledges Jaden Tongun Emilio, the chairperson of the Natural Resource Management Group of South Sudan. He calls for the enactment of a natural resource enforcement law.

Despite concerns from conservationists and authorities, for poor people, forest logging and charcoal production is their only livelihood source. This is the dilemma of countries that don't contribute to global warming but now have to reorient their livelihoods to mitigate it. ■

WEATHERING A POOR NETWORK

With extreme weather events becoming the new normal, forecasting has become more important than ever. It's time African nations invest in observation networks

I**T'S ODD.** Every year Africa bears a major brunt of natural disasters. Yet, its weather infrastructure system is both outdated and dilapidated. Worse, the continent has the lowest coverage of weather observation networks, making it difficult to generate reliable data to mitigate climate change impacts. According to a World Bank report published in September 2017, some 54 per cent of the continent's surface weather stations and 71 per cent of its upper-air weather stations (where sensors are released into the atmosphere through balloons) are unable to capture accurate data. This is due to negligence over the years and the lack of investment in upgradation of the infrastructure, the report says.

The fallout is countries are spending as much as 1 per cent of their Gross Domestic Product (GDP) every year to tackle weather- and climate-related disasters, such as floods, droughts, cyclones and landslides, which affect at least 10 million Africans annually. In the past 20 years, weather adversities have cost the continent a whopping US \$10 billion, according to a statement released at a forum of the African Ministerial Conference on Meteorology in Addis Ababa in September last year. Commenting

Over half of Africa's surface weather stations and 71 per cent of its upper-air weather stations are unable to capture accurate data



on the situation, Joseph Mukabana, director of the office for Africa and Least Developed Countries at the World Meteorological Organization (wmo), says due to the low coverage of weather stations, large parts of the continent cannot be monitored. These areas include parts of Central Africa, some of the most backward regions in the world when it comes to weather data reportage. "In Africa, there is one weather station per 26,000 square kilometres (sq km), which is eight times lower than wmo's minimum recommended level," Mukabana adds. This makes it difficult to address critical issues like poverty eradication and sustainable development.

Time to bolster weather network

Since lack of infrastructure and proper data hampers the ability of national meteorological and hydrological services in Africa to produce good, impact-based forecasts, including short-range, medium-range and seasonal ones, there is a need to strengthen weather monitoring network to tackle extreme weather events. "Weather stations help in water resource management, agricultural production, food security, development of hydro-

computers. As costs are high, several countries in the continent do not have upper-air stations. And Kenya is the only one that operates it in the East Africa region, Ambeje adds.

Kenya plans to have a total of 300 stations to ensure proper weather coverage. It has currently installed 72 automatic stations, besides another 40 manual ones. But when it comes to weather stations, automatic ones are better than manual stations. Unlike manual stations that collect data every hour, automatic stations are configured to transmit data every 10 minutes. The data is later coded and shared within a global network of meteorology for use by various sectors like aviation, agriculture, emergency response and aid agencies.

Govt must invest in robust system

"In the past when weather was predictable, Kenyan farmers could expect the onset of rains around March 15 every year. This is no longer guaranteed. So, demand for weather information has gone up," Ambeje explains. It remains to be seen whether innovative and cost-effective technologies will emerge to bridge the gap. To ensure that the continent does not turn into a dumping ground for cheap technologies, Mukabana says, governments are advised to use technologies validated by wmo (see interview on p41).

According to wmo, firms which manufacture equipment undergo an inter-comparison experiment to validate their performance and to ensure adherence to basic standards. "It is important to observe standards

because data is shared across the world to ensure real-time forecasting," says Mukabana. Though low-cost technologies can be used to measure rainfall, other instruments must be of high quality, sufficiently robust to last for at least 10 years in the hot and humid African climate. As meteorological equipment are precision instruments they are not cheap, and so, governments must be prepared to invest in them. An investment of \$1 to improve meteorological services has a maintenance cost of \$7-10. This is much less than hydro-meteorological disasters, such as droughts and floods, that put 10-20 per cent burden on a country's GDP, he adds.

The consequences of the lack of proper weather forecasting infrastructure are dire. With large parts of Africa facing impacts of climate change, robust technology is required to initiate adaptation measures for protection against disasters. ■

IN AFRICA, THERE IS ONE WEATHER STATION PER 26,000 SQ KM, WHICH IS EIGHT TIMES LOWER THAN WMO'S RECOMMENDED LEVEL

power generation and other renewable energy sources. They also help in early warning and real-time environment monitoring and air quality forecasts," Mukabana points out.

But for quality forecasts, good weather equipment are a must. According to Peter Ambeje, director of the Kenya Meteorological Department, wmo sets the standards for weather equipment across the world, both manual and automatic. Right now, owing to the high cost of equipment, weather stations' network is poor. While setting up a modern (automatic) weather station involves one-time cost of about \$30,000, managing an upper-air station costs the Kenyan government an additional \$400 daily. The latter costs more as the sensors launched into the atmosphere daily early morning with the help of balloons disintegrate after capturing information and transmitting them to

'Africa should not be a dumping ground'

JOSEPH MUKABANA, director in-charge of Office for Africa and Least Developed Countries at the World Meteorological Organization, on why African governments should invest in high-quality, robust weather forecasting technologies and not cheap ones

Please explain the overall weather infrastructure status across Africa?

In Africa, almost 90 per cent of natural disasters are hydro-meteorological. Although Africa is endowed with a lot of natural resources, governments do not have financial resources, technologies and expertise to initiate adaptation measures against such disasters. For instance, prolonged drought will affect agricultural production and impact food

security, causing malnutrition in children and triggering hunger and famine. But according to the World Weather Watch, Africa has only 1,152 weather stations; most of them are in dilapidated condition.

How dilapidated weather network affects forecast in the face of climate change?

A poor network coverage often portrays weather data inaccurately. This affects forecasts and important decisions like fixing the time of water release from a dam, early warning in case of malaria prevention and planning agricultural man-

agement for crops sensitive to temperatures cannot be taken properly. To set right the deteriorating weather observation network, there is a need for maintenance and installation of new, automatic stations. Also, there is a requirement to improve data management and archival systems. Adequate infrastructure and quality data would help provide seasonal forecasts using models that incorporate historical and near-real time observations.

Are there innovations underway to help improve weather forecasting in Africa?

There are indeed innovative efforts taking place.

The World Meteorological Organization (wmo) helps member countries improve their understanding and assessment of climate change impacts, vulnerability and adaptation. The goal is to make informed decisions on practical adaptation measures. During its 15th Congress held in June 2010 in Geneva, wmo agreed to establish the Global Framework for Climate Services (GFCS) to enable climate adaptation and climate risk management through the incorporation of scientific climate information and prediction policy.

The GFCS established the National Framework of Climate Services that brings together all stakeholders to improve production, delivery, uptake and use of climate services by all weather and climate-sensitive sectors. This includes rural communities like small-holder farmers, fisherfolk, traders and pastoralists. wmo is also supporting the development of National Strategic Plans (NSPs) for national meteorological and hydrological services (NMHS) that take into account the global Sustainable Development Goals, linking them with the regional development agenda like the African Union's Agenda 2063. It is envisaged that the governments will find these NSPs relevant, up-scale the funding of annual budgets of NMHS and help strengthen meteorological infrastructure.

Are there instances of new technology being tried and replicated in Africa?

Yes. These include automatic weather stations on land and sea, airport weather observation systems, tidal gauges and buoys in seas and oceans to measure waves, swells, sea-level rise, sea surface temperature, salinity and wind to ensure the safety of ships, weather surveillance radars to monitor storms and high-impact events and satellite ground receiving systems to receive pictures at regular intervals. But the continent should not be a dumping ground for cheap technologies like plastic rain gauges that last only for a few months. Thus, governments are encouraged to invest in technologies tested and validated by wmo. ■



BLUE ECONOMY AT RISK

Even as West Africa struggles to plug rampant illegal, unregulated and unreported fishing, rising sea surface temperature poses new challenges

SITTING ON Ghana's Apam beach, fisherman Nana Ekow Pasnin is worried about his family's future. His canoe just returned without a single fish, after spending a marathon 12 hours in the sea. He has never seen such an acute fish shortage in the Atlantic Ocean in his 40 years of fishing. "Earlier, we could easily fill up the 150 crates in our canoe in every trip. Today, we consider ourselves fortunate if we are able to fill just 20 crates, and such an occasion arises only once or twice a year," says Pasnin. He says that in the past two decades or so, there has been a rapid decline in small pelagic fish in Ghana's waters. These fish, which includes species like sardinella, sardines, anchovy and mackerel, are found near the surface and closer to shore and form an important basis of livelihood to the country's 210,000 artisanal fisherfolk and another 2.1 million employed in allied industries. "In 2015, the county recorded the lowest small pelagic production of 19,608 tonnes. This was 14 per cent of the production in 1996, when the highest small pelagic production was recorded," says Socrates Apetorgbor, fisheries specialist with the sustainable fisheries management project of the United States Agency for International Development (USAID).

Francis Agbeshie from the Chokomey fishing community in Ghana's Bartianar area says members from his community tried to cope with the crisis by ditching the canoe for inshore vessels with engines that allow them to venture into deep seas. "The shift worked for a while, but now our catch is dwindling again," he says. Agbeshie and other artisanal fisherfolk, who form 80 per cent of the country's fishing community, blame the increase in industrial trawlers, both in international and Ghana's domestic waters, and their illegal activities for the shortage. "In the 1980s, Ghana had just 14 foreign vessels. Today, it is between 500 and 700," says Kofi Agbogah, director of Hen Mpoano, a Ghana-based non-profit which works with coastal communities. The situation is no different for the other West African countries along the Atlantic Ocean where artisanal fisheries is an important basis of livelihood; according to a January-February 2018 study by fisheries researchers at The University of British Columbia, Canada, published in *Conservation Letters*, the sector provides employment to 7 million people in the region.

Some experts, however, say the shortage could be partly because of climate change. Pelagic fish are highly sensitive to sea surface temperature. While some have an affinity for temperate waters others prefer tropical waters. As sea surface temperature rises with global warming, it affects the abundance and distribution of these species by altering their migratory paths. Besides, small pelagic fish feed primarily on plankton. As warming oceans slow plankton growth, it might also be affecting the abundance of the stocks, says a Unesco report. Hawa Bint Yaqub, deputy director at Ghana Fisheries Commission,

As they prepare to go to the sea, fisherfolk at Ghana's Apam beach say they are incurring losses with every trip due to a falling fish population



says the average sea surface temperature near Ghana beach increased from 26.2°C in 2000 to 27.4°C in 2010; that decade, the country's annual average pelagic production fell from 22,000 tonnes to 12,000 tonnes. Worse, several studies suggest that the situation will exacerbate with each passing year. A June 2017 research titled "Climate change and marine fisheries: Least developed countries top global index of vulnerability" says even in the most optimistic future scenario, sea surface temperatures are expected to increase substantially by the end of the century, and its impact on marine fisheries will be most visible in poor countries. Over 25 of the world's 31 least developed countries with coastlines are in the top half of the vulnerability index, says the paper, published in *Plos One*. Even under business as usual, sea surface temperatures are projected to increase by 0.62–0.85°C in the near future and 2.44–3.32°C over the long term, warns a 2016 paper titled "Climatic drivers of change and the future of African ocean". An increase of 1–2 °C is enough to "badly" impact fisheries stock, it warns.

Pushed by both industrial trawlers and climate

change, the artisanal fisherfolk of West Africa are now living on the edge. In the desperation for a good catch, many of them are embracing illegal, unregulated and unreported fishing practices (IUU), such as using light to attract fish and explosives to catch them, using nets with small mesh size to catch juvenile fish and fishing during the breeding season. Some have even joined hands with foreign industrial trawlers which have combed the ocean to feed the European and Asian markets, both legally and illegally.

Illegal everywhere

The genesis of the problem, to quite some extent, lies in the policies of West African governments. They have been selling the rights to fish their waters to rich European governments, who have already decimated their own seas. In recent years, fleets from China, the Philippines, Russia, South Korea and Taiwan have also expanded their presence in the region's territorial waters. Agbogah says these international trawler operators usually form partnership with local fisherfolk to enter the

Nana Kobina Caique (centre), chief fisherman of Ghana's Apam fishing community says international vessels, who bribe local officials, often escape after destroying the community's nets



domestic water for fishing. The local partner, in most cases, exists only on paper while the trawlers indulge in illegal activities, such as “*saiko*” where they indiscriminately harvest fish, before illegally trans-shipping the catch at sea to canoes to evade taxes (see “Ghana needs stronger laws” p47). “Their fleet includes a couple of dozen megatrawlers that target small pelagic fish to make feed for salmon, chicken, pigs and other animals grown at aquaculture and livestock farms around the world,” says Dyhia Belhabib, advisor for the University of British Columbia’s Sea Around Us research project, who has co-authored the *Conservation Letters* study. Each mega trawler, says Belhabib, can capture up to 20,000 tonnes of fish a year, equal to the annual catch of more than 1,700 traditional Senegalese *pirogues* (flat-bottomed, wooden dugout boats).

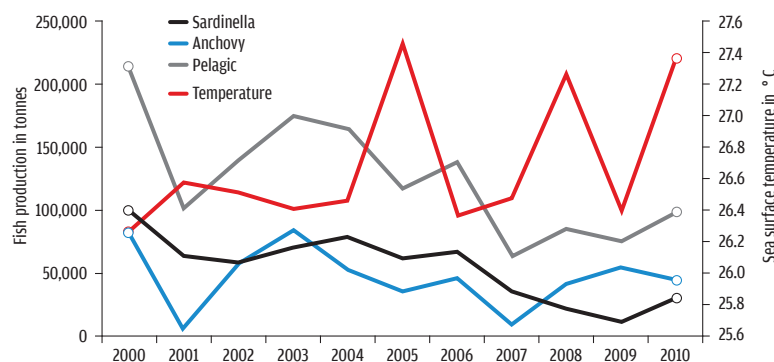
These industrial vessels also often intrude into waters reserved for artisanal fishers. A 2017 research by EU-funded Securing Sustainable Fisheries project in Ghana shows in 2016, thousands of cases were recorded where industrial vessels destroyed nets and canoes of traditional fisherfolk at sea. Yet only 5 per cent of these cases were reported to the Fisheries Commission, and less than 1 per cent resulted in compensation. “The vessels often escape after destroying our nets. If caught, they bribe the local officials and give us a part of their daily catch and leave,” says Nana Kobina Caique, chief fisherman of Apam community.

But their legally-sanctioned activity provides a cover for these IUU fishing activities. “Commercial trawlers that operate under flags of convenience, and unload in ports that do not record their catch, are engaging in organised theft disguised as commerce,” says former UN chief and Noble Laureate Kofi Annan, who now chairs the Africa Progress Panel. The panel estimates that IUU fishing accounts for between one-third and half of the total regional catch. The 2011 Food and Agriculture Organization (FAO) report also highlights that IUU is rampant across West Africa, which has some of the world’s richest tuna fishing grounds. “Over 50 per cent of the fisheries resources in the stretch of coast ranging from Senegal to Nigeria have already been overfished,” it says.

IUU fishing, which often accounts for a large proportion of the total catch, is now hitting the coffers of West African countries. A report by the Overseas Development Institute (ODI) in 2016 says Senegal lost around \$300 million in 2012 due to IUU fishing, which is equivalent to 2 per cent of gross

A hot problem

Rising sea surface temperature has impacted the production of small marine fish in Ghana



Source: Ghana Fisheries Commission

domestic product. Similarly, Guinea loses \$110 million a year and Sierra Leone loses \$29 million annually due to IUU fishing. The entire region faces a loss to the tune of \$2.3 billion a year due to IUU fishing, says a March 2017 study published in *Frontiers in Marine Science* journal.

The Chinese checkers

The threat is maximum from Chinese companies that have expanded their fishing operations in Africa from 13 vessels in 1985 to 462 vessels in 2013, or one-fifth of the total Chinese-owned distant water fishing (DWF) fleet, according to a Greenpeace report, “Africa’s fisheries Paradise at a Crossroad”. By 2016, it rose 2,600 vessels, which was 10 times that of the US, as per a *New York Times* story. This has been possible because China started a subsidy for DWF in 2006 and had spent \$431 million, says the Greenpeace report. Explaining the Chinese push to DWF fleet, an FAO report, “Fish to 2030: Prospects for Fisheries and Aquaculture” says China will consume 38 per cent of world’s fish production by 2030. It projects that Asia will account for 70 per cent of the global fish consumption by 2030.

The Greenpeace report further says that the Chinese flagged and/or owned vessels currently fishing in African waters are predominantly bottom trawlers, one of the most destructive fishing methods in the modern fishing industry. This, despite that China does not allow bottom trawlers on its own water. The ships are so large that they scoop up as many fish in one week as Senegalese boat catch in one year, says a March 2017 research published in *Frontiers in Marine Science*.

In April 2017, Greenpeace Africa and the Sierra Leone government inspected seven international vessels and found four of them to be illegal. Two of the illegal vessels were from China and the other two were owned by local people but funded by Korea and Italy. While all were using illegal nets, one vessel was also carrying shark carcasses. Earlier this year, South Africa detained three Chinese vessels and arrested 100 crew members for illegally entering its Exclusive Economic Zone.

The allied threat

Those dependent on the allied sectors also bear the brunt of IUU. As fishing communities use explosives to ensure a good catch, tissues of most fish get damaged, creating problems for the processing sector. When *Down to Earth* visited a processing community in Bartianar in July last year, most people said the poor supply is forcing them to

international non-profit Action Aid in Ghana.

Several West African countries are framing regulations to put an end to IUU fishing. In 2010, Ghana introduced fisheries regulations to prohibit the practice. The regulations has a provision under which fine of up to \$4 million can be slapped on the offenders. In recent years Senegal has stopped licensing fishing of small pelagic fish to foreign industrial trawlers. With limited resource and often corrupt officials and ineffective governments, these regulations are openly flouted. For instance, in 2013 the EU issued a Yellow Card against Ghana for the government's inability to check illegal fishing. The card means none of the 28 countries in the EU will import fish products from Ghana. Following the sanction, which deprived the country of over \$150 million, Ghana introduced the West Africa Regional Fisheries Programme (WARFP) to establish legal provisions and monitoring processes in place. It also sealed 150 industrial trawlers for illegal trade in 2014. A year later, EU revoked the ban even though, experts say, the government's drive against illegal trade has slowed down. In 2015, only 92 trawlers were sealed. "In 2016, only a few trawlers were sealed," says a Ghana fisheries department official on anonymity.

"West Africa needs to strengthen its fisheries management. The region's marine resources are being depleted at alarming rates, mainly due to too many boats competing for too few fish, and high rates of illegal, unreported and unregulated fishing," says Ahmed

Diame, Greenpeace Africa Oceans campaigner. This ongoing plunder is a threat to millions of people in the region who depend on the oceans for their food.

Maybe, they can learn from Liberia that has been able to curb IUU fishing through legislation and monitoring. In 2011, with the help of the World Bank, the country developed a six-nautical mile perimeter in its water where industrial vessels were banned. The move helped the country reduce 83 per cent of IUU, as per its ministry of agriculture and fisheries. This has revived the traditional fishing communities who have doubled their annual catch since 2011. Finally, West African nations need to wake up to the problem of climate change and include it in its fisheries policies to better prepare for the impact it will have on fish population, which provide the much-needed protein to the poor. ■

**THE AVERAGE SEA SURFACE
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move out of the industry. "July and August are the bumper seasons for us. But so far, I have not processed even a single fish," says Cecelia Agbesi, a 75-year old woman, whose family of 10 are involved in the sector. She adds that till about 15 years back, she used to sell 50-100 baskets of processed fish a day during the peak season. Now it has come down to 25 baskets. "We have sold two of our three canoes in the past few years and are thinking of selling the last one and finding a new livelihood."

Like Agbesi, there are 14,700 people struggling to make an honest living in the processing sector. "The people in the sector do not consume the fish captured through explosives as they know it is unhealthy. Still they process and sell it even though they know it will hamper their relationship with the customers in the long run," says Margaret Ottah Atikpo, a fisheries specialist working with



Ghana needs stronger laws

Fisherfolk blame big trawlers but they do not talk about the illegal trade they indulge in

KOFI AGBOGAH

IN GHANA, illegal, unregulated and unreported (IUU) fishing happens at two levels: international players operating in West Africa indulge in it to maximise profits and almost all local fisherfolk engage in one or the other way of IUU fishing.

Let me begin with local IUU fishing practices. If you go by the existing Ghanaian law, every fisherman is engaged in illegal fishing because the law says everyone has to be registered with the Ghanaian authority. Even the net they use has a smaller mesh size than the one cm size approved by the law. They also use crude methods to get more fish, which are illegal.

The law also says fisherfolk need to take prior permission to transfer fish from one boat to another. But nobody cares. People also fish in juvenile breeding areas, which are not clearly marked. The fish they bring is unreported because it is illegal.

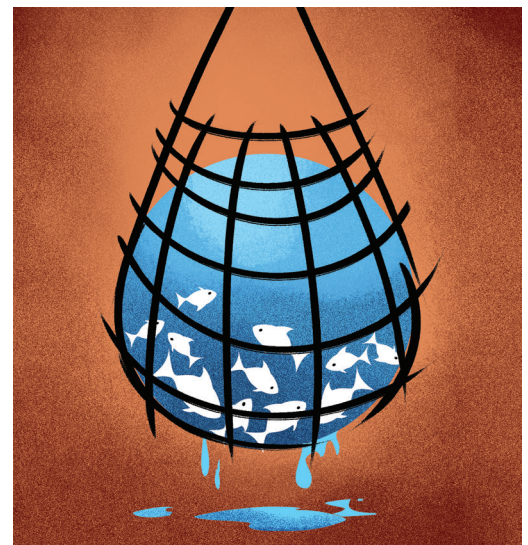
Then there are several fishing vessels from Asia that are operating in the domestic waters after forging a local partnership. The law says each vessel should have only 25 per cent foreigners and 75 per cent from Ghana. What is happening on the ground is that a Ghanaian gets the license and gives it to the foreigner and goes to sleep. Now the foreigner decides what, when and where to fish. Little wonder the number of international trawlers in West Africa has increased from just 14 in 1986 to over 700 today. These trawlers are supposed to engage in deep water fishing, but they do all kind of mid-water, surface fishing. Even they catch juvenile fish and small fish and then illegally sell it to traditional fisherfolk in the sea.

Organisation for Economic Co-operation and Development estimates that globally US\$ 23.5 billion dollars are being lost due to illegal fishing of which 37 per cent happens in West Africa. So, it becomes very difficult for our local fisherfolk to get fish. So they are indulging in anything to survive. This is the reason they have resorted to using light, dynamite, chemical etc just to ensure that they get fish.

So, there is the blame game. Fisherfolk blame big trawlers but they do not talk about what they are doing. They say that if these big vessels are moved out, they will be fine. Everybody knows that the locals who have entered into partnerships with foreign players have become rich people. What they do not realise is that they are selling their birthright to foreigners for money.

We don't have fisheries in Ghana. If we have to revive this, we have to take some pain. We need to focus on behavioural change which takes time. We have poor law enforcement for which the government needs to be blamed. Last week, few people were arrested for engaging in illegal fishing, but local politicians asked the officials to release them. In the nutshell, this is how the issues play out. The administration says something is being done but is that enough, that is the question. I think Ghana needs another yellow card from the European Union as during the last one between 2013 and 2015, the government took some prepared some documents to curb IUU. But whether they were implemented or not is different question. ■

The author is the director of Hen Mpoano, a Ghana-based non-profit which works with coastal communities. As told to Kundan Pandey



TARIQUE AZIZ / CSE

WHEN OCEANS 'FILL' APART

Plastic debris in oceans is a potential threat to Africa's food security, economic development, marine ecosystems and establishment of a vibrant blue economy

THE FISHERIES crisis due to climate change is exacerbated by the fact that the world produces 300 million tonnes of plastic every year, of which about 8 million tonnes end up in the ocean from where it is almost impossible to retrieve. These trillions of plastic pieces last for hundreds of years, affecting the livelihoods and health of people in coastal countries, not to mention the impact on marine life. Africa, which has the world's highest population growth rate, especially in coastal areas, has a poor record of managing waste—only 10 per cent of its rubbish reaches the dumps, as per UN estimates, while the rest is left to rot in communities or burned in acrid bonfires. In 2010, annual mismanaged plastic waste for the continent was about 4.8 million tonnes and could reach 11.5 million tonnes in 2025, experts say. Five African countries are among the top 20 highest contributors to plastic marine debris in the world.

The problem is exacerbated by the growing middle class in Africa, creating large markets for consumer plastic goods and packaging. Eighty per cent of Africa's gross domestic product (GDP) depends on just 11 countries—Nigeria, South Africa, Egypt, Algeria, Angola, Morocco, Sudan, Tunisia, Kenya, Ghana and Libya—all of which

COURTESY: GREENPEACE

By 2025, the annual mismanaged plastic waste in Africa could be as high as 11.5 million tonnes. Consumer waste forms 93 per cent of plastic marine debris globally



have prominent coastlines. Globally, consumer waste forms a staggering 93 per cent of plastic marine debris, 80 per cent of which is generated on land, according to the US Consulate General, the South African Maritime Safety Authority, the International Ocean Institute-African Region, the V&A Waterfront and Operation Phakisa, which has mobilised different agencies in Africa to work on plastic waste. Going by the current recycling technology, 80 per cent of plastics, including single-use products like earbuds, sweet wrappers, straws and coffee cup lids, have little or no value at the end of life. Pollution from this sector alone could greatly impact fisheries that employs over 12 million Africans. Moreover, as subsistence fishing is significant in African countries, marine debris is a potential threat to food security, economic development, marine ecosystems and the vision of a blue economy. Due to lack of clean drinking water, single-use sachets are popularly used. Plastic litter had clogged drains in the Ghanaian capital of Accra during heavy rains in 2015, causing flooding that killed at least 150 people. The most common policy at country-level is the ban or taxes on plastic bags which was promulgated after 70 per cent of livestock in Mauritania was lost to plastic ingestion in 1970s. Over 20 African countries, including Mauritius, Kenya, Senegal, Ethiopia, Zanzibar (Tanzania), have enforced bans and taxes. In Zanzibar islands, plastic bags are banned and any breach attracts a fine of up to 100,000 TZS (US \$44) or six months in jail. Rwanda has been implementing the ban for quite a few years with significant success. Kenya, in its third attempt, is pushing hard to implement the ban this year, while Cameroon and South Africa have adopted taxes.

Small steps

Eight social enterprises in four African countries are helping authorities manage waste better. In Lagos, Nigeria, Wecyclers and Recycle Points collect recyclable waste like plastic bags and bottles, cans, glass and paper from users directly. They incentivise consumers to sort their recyclable waste at home by exchanging it for points that can be redeemed for household items, food or cell phone minutes, turning their waste into value. TakaTaka Solutions in Nairobi, Kenya, asks consumers to segregate waste into organic (used to create high-quality compost which is sold to local farmers) and inorganic (sold to recycling industries or used to create tumblers). It collects 10 tonnes of waste per

day and recycles up to 95 per cent of it. Proplast, which began in Senegal in 1997 by 14 women to collect and process plastic waste, now employs 100 women and processes 1,650 tonnes of plastic per year turning it into granulated plastic sold to local processing firms, and has set up drop-off centres in Dakar for public. In South Africa, non-profit USE-IT works on a holistic approach to solid waste management through recycling programmes. Polyco, also in South Africa, has set up a mobile kiosk where people can give their polyethylene plastic for a cash card. All Women Recycling makes Kliketyklikbox—an eco-friendly gift box recycled from 2-litre plastic cool drink bottles. This initiative upcycled over 500,000 plastic bottles in 2016 while providing salary and skill development to marginalised women. Repurpose Schoolbags creates bags from billboard material and plastic bags in South Africa and gives them to schoolchildren in need. The bags have a portable solar panel that can be used as a desk lamp at night. In Ethiopia, SoleRebels creates fairtrade footwear using recycled tyres and handloom techniques. Similarly, Ocean Sole in Kenya collects over 400,000 discarded plastic flip flops annually and recycles them into art. Technology, especially mobile technology, can also come to the rescue. For instance, Ecopost in Nairobi encourages people and businesses to collect and sort their waste in return for points on an app that can be redeemed for products. Ecopost collects both plastic waste and agricultural waste like rice husks, wheat bran, sawdust to create plastic lumber that can be used for fencing. This helps reduce deforestation while creating jobs for locals besides creating value. Although some of these initiatives are of a small scale at the moment, they have the potential to become successful.

To tackle plastics, the road ahead is to focus on innovation of alternate materials. Also, to reduce marine plastic waste, Africa should use Information, Education and Communication strategy along with campaigns for behavioural change in the public. All this, tied with policy that ensures plastic use is minimised will lead to efficient waste management. ■

SOCIAL INITIATIVES, ALONG WITH POLICY AND BEHAVIOUR CHANGE, CAN TACKLE PLASTIC WASTE IN AFRICA



Unify ocean governance

Political will is needed to address marine pollution and climate change in Africa

ABOUD S. JUMBE

AT THE UN Conference on the Human Environment in 1972, the world community laid down the common principles that linked our environment and sustainable livelihoods. These principles were reaffirmed 20 years later in the first Earth Summit at Rio de Janeiro. Agenda 21 became a blueprint for environmental and sustainable development in the 21st century. Since then, a lot has happened on the global platforms to save the planet—from the inception of the UN Framework Convention on Climate Change in 1992, the formulation of the Kyoto Protocol in 1997, the Paris Agreement of 2015, the Sendai Framework for Disaster Risk Reduction of 2015, the landmark Agenda 2030 for Sustainable Development, to the Sustainable Development Goal (SDG) 14 of 2017 about conserving the oceans. All these goals remind us that without eradication of poverty or addressing injustices, and striving to advance human and socio-economic progress, there can never be that “Future We Want”.

Today, climate change and marine pollution are the most pressing “cocktail” of environmental problems ever to face humanity. In fact, the impacts of climate change are threatening to reverse decades of technological success that the world fought so hard to achieve. These existential challenges have already forced us to invest more in securing our future while simultaneously striving for sustainable livelihoods. This is not easy.

The climate and ocean degradation trends in Africa augment its story of despair. The UN Economic Commission for Africa’s Blue Economy Policy Handbook notes the continent is highly vulnerable to the impacts of climate change. Increasing floods and droughts, erratic and extreme weather, sea level rise, coastal erosion, saltwater intrusion, warming sea waters, ocean acidification, coral bleaching and an upsurge of invasive species are some of the almost insurmountable challenges facing our countries and have affected livelihoods dependent on ocean and freshwater resources. These impacts are expected to worsen. The current course to a 4°C increase in global temperature by 2100 leaves Africa, whose existing coping mechanism is modeled for only 1.5–2°C threshold, staring at a catastrophe. The 2050 Africa’s Integrated Maritime Strategy of the African Union says it all: for a continent that has undergone severe climate change and natural disasters, a road to recovery requires a dedicated global agenda and the political will of our governments. Looking closer, this is a never-ending story of failing economic systems affected by drought-induced migration; catastrophic cyclones threatening islands and coastal areas of the Western Indian Ocean region; destruction of coral reefs and mangroves due to unplanned coastal and marine development; destruction of critical coastal habitats on which livelihoods depend; lack of strong national ocean policies; limited scientific capacity to inform policy decisions; and illegal, unreported and unregulated (IUU) fishing.



Indeed, our coral reefs are dying (see “Dying reefs cast shadow on tourism” on p52-53). And, it is the small island states, and communities of the Indian Ocean that continue to bear the brunt. Ocean acidification, marine pollution and coastal tourism have added to reef stress levels. Competition, and sometimes conflicts, between poor artisanal fisherfolk and the tourism industry have triggered concerns for the resilience of the coral reefs, which should be seen as the currency that could define our countries’ goals in sustainable development. Without healthy oceans and reefs, there will be no alternative for the islands of the Western Indian Ocean. Hence, conservation of environment and our limited marine resources should be at the centre of our development plans.

The Regional State of Coast Report analyses the conditions of the ecosystems, resources and human activities, and their stated evolution in this part of eastern and southern coasts of Africa and the Indian Ocean island states. The area consists of 10 coastal and island states that are the contracting parties to the UN Regional Seas Programme called the Nairobi Convention. Besides fisheries and tourism, recent oil and gas exploitation trends in some of these countries can boost GDP, but also expose the marine ecosystems to new human-induced threats in the region that already faces rising sea surface temperatures, surface air temperatures and increasing wind speeds that precipitate record-breaking cyclones.

For Tanzania, the challenges include rapidly growing population along coastal zones; land-based sources of pollution, microplastics, marine dumping, IUU fishing, lack of alternative livelihoods, destruction of mangroves and coral reefs. Besides creating awareness, we need to adopt an integrated development plan for a national ocean governance policy; marine spatial planning alongside integrated coastal and marine management; and, strengthening enforcement of existing laws. Establishing a mechanism to monitor and evaluate the targets under SDG 14 should be a part of our ocean governance framework, and include regional collaboration on combating marine pollution; sustainable management of shared fish resources; transition to a low carbon pathway; and, integrated ocean governance. At the same time, enhancing engagement with communities, private sector and other partners is vital.

So, what should be the course of action for Africa and the region? We need to start acting on microplastics and develop a marine waste management plan that integrates the upstream habitats and ecosystems. We must invest more to combat invasive species and marine pollution, and go back to the 2011-2020 Strategic Plan of the Convention on Biological Diversity, called Aichi Target 11 on coral reefs. We also have to work towards protecting the high seas and Areas Beyond National Jurisdiction as part of our efforts to collectively protect our oceans and understand their dynamics. One ocean approach is the only way to fight climate change. These two oppo-

site pillars are inseparable. Fisheries and marine protected areas must be treated as one component of resilience. The proposed “Blue Commonwealth Charter” for marine sustainable development to foster ocean regeneration should be adopted in the regional and even global context of ocean-climate nexus. Citing from *The Mont Fleur Team’s Scenarios* exercises—an experiment first conducted in 1991 that brought together society representatives to envision an end to apartheid—if we achieve this together, then we attain the flight of the flamingos. If we continue to go our separate ways, then we fall from the sky like Icarus. ■

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One ocean approach is the only way to fight climate change. Engaging with communities remains vital



SHADOW OVER CORAL REEFS

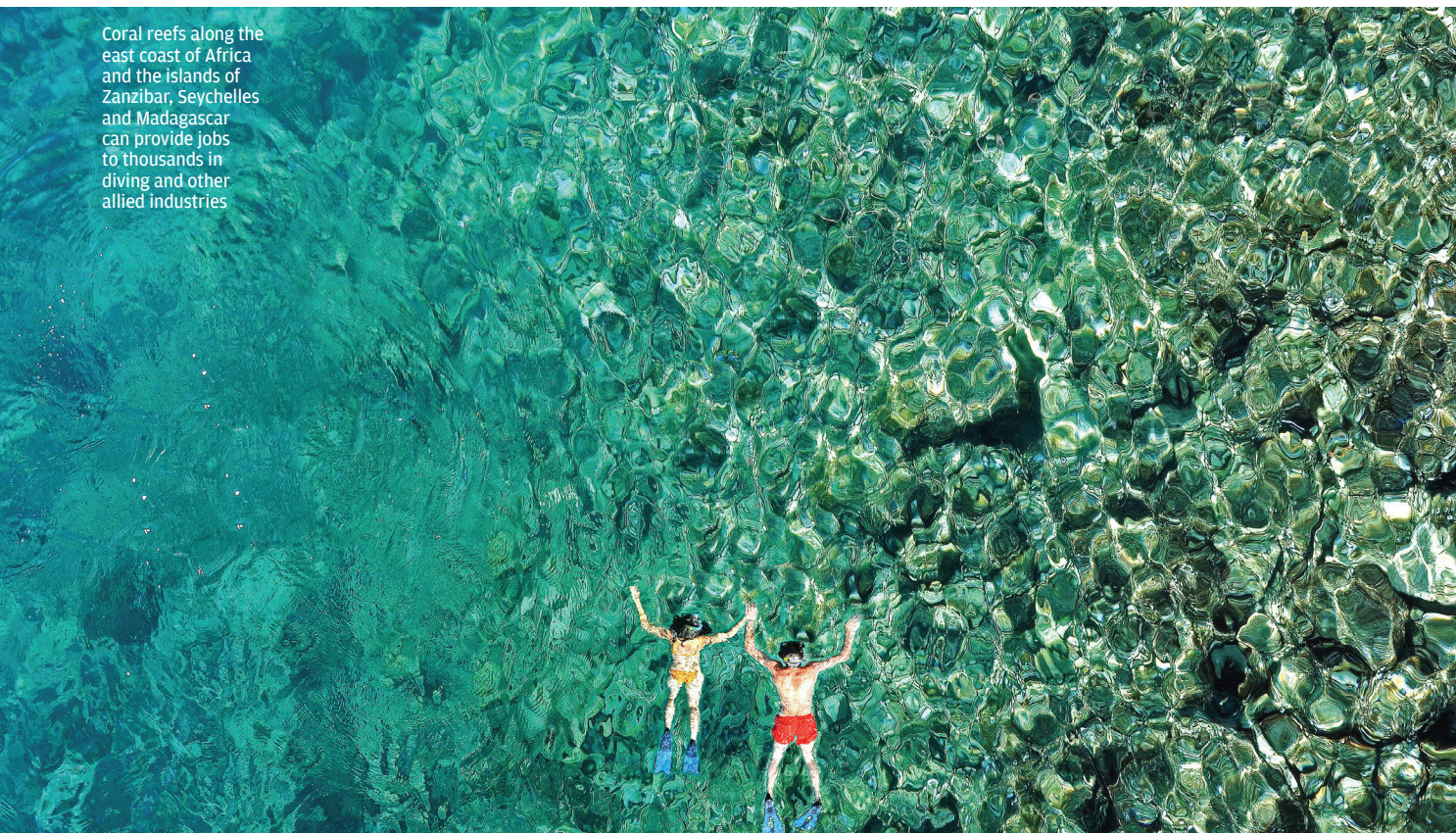
Coral reefs along the east coast of Africa have been badly hit due to ocean warming and acidification. This has hit tourism badly. Some efforts, however, are underway to revive them

THE MOST extensive coral bleaching event from 2014 to 2017 affected reefs across the world, including the Great Barrier Reef in Australia where the damage was intense; and also those found along the east coast of Africa; where the intensity of destruction was slightly less. Talking to *Down To Earth*, David Obura, director of Kenya-based non-profit Coastal Oceans Research and Development-Indian Ocean (CORDIO), explains the extent of damage in Africa. "Seychelles was the worst hit country, followed by Madagascar, while parts of Mauritius, Kenya and Tanzania were badly impacted. Comoros showed only a slight impact," he says.

Bleaching is a process where corals lose their vivid colour and turn white. This happens when the zooxanthellae algae, which is in a symbiotic relationship with corals and provide them with food, die due to ocean warming and acidification. If bleaching continues for an extended period of time, corals eventually die. Coral bleaching and mortality exacerbated by climate change are one of the biggest threats to oceanic biodiversity. Coral reefs, which are mostly found in shallow oceans along the coastline, provide the perfect place for marine life to thrive, especially colourful fish.

The first-ever recorded coral bleaching took place in 1998. That year the

Coral reefs along the east coast of Africa and the islands of Zanzibar, Seychelles and Madagascar can provide jobs to thousands in diving and other allied industries



El Niño Southern Oscillation, which occurs every three to seven years in the Western Pacific Ocean, caused massive bleaching of corals along the east African coast. Due to this, almost 20 per cent of corals were lost in the region. The fallout of bleaching and coral death is an increase in the growth of fleshy macro algae in reefs. The algae do not allow corals to revive by taking up their space. The 1998 event increased such algae cover in the oceans by 2.5 times. "Due to the bleaching event, coral cover in the region declined by 20 per cent and fleshy algae cover increased by almost 35 per cent," says Obura, who also chairs the International Union for Conservation of Nature's Coral Specialist Group.

Tourism hit hard

So, how does bleaching of corals, also referred to as underwater rainforests because of their important role in supporting marine life and biodiversity, affect the African economy? African corals are a big tourist draw. Reefs along the east coast of Africa and the islands of Zanzibar, Seychelles and Madagascar provide jobs to thousands in diving and other allied industries. Amidst civil wars and ethnic violence, it is only the tourism sector that offers Africans a stable and viable economy.

Widespread coral bleaching has badly hit the African scuba diving industry. According to a World Bank estimate, losses amount to US \$2.2 million in Zanzibar and \$15.09 million in Mombasa till now. Even Seychelles has lost considerable coral reefs and the country's profits from dive tourism have dipped. The reefs around Dar es Salaam, a major city in Tanzania, have recorded 6 per cent mortality since 1998, according to Leonard Chauka, a coral expert at the Tanzania-based non-profit, Western Indian Ocean Marine Science Organisation.

As dive tourism across Africa has declined considerably, these days organisers bank upon novices or amateur divers, who cannot readily differentiate between healthy and non-healthy coral reefs. But on the whole, the dive industry is not dealing with the issue of bleaching and taking measures to generate public awareness. They are more concerned with dwindling visitors than with climate change, the real culprit behind reduced tourist footfall. "They don't want word to spread that their reefs are declining due to climate change. They fear tourists will go elsewhere, and so it is a bit of a head in the sand approach," says Obura.

However, things have started looking bright.

Concerned tourism organisers are taking an interest in coral restoration. For instance, the dive industry in Zanzibar has approached CORDIO to help them with training for monitoring coral bleaching and overall reef health. "We are trying to present forecasts during the high risk season for bleaching that will help the dive industry as well as others to prepare for such events. There is also more coverage and awareness about the issue in tourism magazines and global discussions. So, things are picking up," Obura points out.

Healthy future?

Chauka is optimistic about coral reef recovery vital for the earth's ecosystem. He says that Acropora, a coral species found near Dar es Salaam, was affected the most due to bleaching. But it is fast at recovery. "There are also mild bleaching events that cause no mortality. Such reefs take a few months to recover," Chauka explains. In the midst of gloom and despair, there is good news for scuba divers. Experts say despite the extent of bleaching, coral mortality is not as extensive as it could have been. There is indication that corals have developed a certain amount of resistance to heat stress. This can help them recover in the future, if ocean pollution, over-fishing and dynamite fishing are kept under control.

But recovery is a matter of many years. Obura says it will take another 15-20 years for coral reefs to recover fully under natural conditions. Another cause of concern is that the time gap between bleaching events is decreasing, thus not allowing corals to recover. Some experts also say that the reefs may never come back to their original state.

Meanwhile, the tourism industry is doing everything it can to divert visitors' attention from corals. For instance, in Tanzania, there is an effort to promote national parks like Serengeti and Ngorongoro. In Zanzibar, historical place like the Stone Town and the Jozani Forest Reserve are being promoted. Oceanic activities have been limited to dolphin viewing and kite surfing. ■

CORAL BLEACHING HAS AFFECTED THE DIVING INDUSTRY. THE WORLD BANK SAYS LOSSES AMOUNT TO \$2.2 MILLION IN ZANZIBAR AND \$15.09 MILLION IN MOMBASA

AN INFECTIOUS SPREAD

The impact of climate change on the spread of diseases in Africa is well established but there is little data available for action

EVERY WEEK, the World Health Organization (WHO) releases information on disease outbreaks across regions. On April 6, the epidemiological alert from the Americas gave an update on the situation of merely one disease, measles, in the region. The same day, an alert from the African region reported 49 disease outbreaks. These included reports of 23 diseases including cholera, Crimean Congo haemorrhagic fever, dengue and meningococcal disease. Though these diseases are not new, their incidence and pattern has changed due to climate change.

For example, in the first three months of this year, there were 7,403 cases of the airborne bacterial disease meningococcal meningitis in the meningitis belt of Africa. Meningitis outbreaks have links with weather patterns, such as strong El Niño events, which result in lower than normal rainfall. Dry season, dust winds, cold nights and upper respiratory tract infections combine to damage the nasopharyngeal mucosa, increasing the risk of meningococcal disease caused by bacteria *Neisseria meningitidis*. Just like meningitis, vector-borne diseases too are expected to grow with climate change. In Tanzania, the burden of trypanosomiasis could increase because of the changing climate and land use changes in the Maasai steppe ecosystem. African trypanosomiasis or sleeping sickness is caused by a protozoa, *Trypanosoma brucei*, which is transmitted by the tsetse fly. Rising temperatures can increase the number of tsetse fly vectors and rates of infection. Similarly, Rift Valley Fever, which is endemic to East and West Africa, is transmitted by mosquitoes *Aedes* and *Culex*, and outbreaks are linked to altered rainfall patterns due to changes in ENSO and La Niña events, and elevated Indian Ocean temperatures that cause heavy rainfall and flooding. Even Ebola that ravaged the continent and claimed over 11,000 lives between 2014 and 2016 in West Africa has links to climate change. The outbreaks coincided with dry seasons followed by heavy rainfall that produced an abundance of fruit. These fruits attract bats (the suspected carriers of the Ebola virus) and apes and provide opportunities for the disease to jump between species. Humans can contract the disease by eating or handling an infected animal.

Cholera, another climate sensitive disease, is prevalent in areas where sewers overflow after rainfall and contaminate drinking water. Clean water sources also may not be easily available in dry conditions and people are forced to consume water from contaminated sources. Climate change can worsen the situation. A December 2011 paper on Tanzania published in the *International Journal of Environmental Research and Public Health* found that 1°C rise in temperature increases cholera risk by 15 to 29 per cent. Based on climate change projections, by 2030, Tanzania may see a rise in costs associated with cholera equivalent to 1.4 per cent of GDP, the researchers say.



Due to climate change, vector borne diseases such as malaria, Rift Valley Fever and trypanosomiasis will increase. Use of protective measures such as bed nets would have to increase multifold to avoid vectors

Heat stress is also a possible repercussion of climate change. Temperature increases in Tanzania are higher than the global average. In Sub-Saharan Africa, temperatures have increased by over 0.5°C or more during the past 50 to 100 years. Other than the direct impact on health, the increase in temperature is likely to lead to malnutrition. Yields of crops like maize and wheat are expected to go down due to high temperatures, suggest models. Major grains show yield losses in the range of 2.5 to 16 per cent for every 1°C increase in seasonal temperature. This has been observed across the Sahel, where rising temperatures have led to poor production of maize, sorghum and millet. High levels of carbon dioxide in the environment too can reduce the nutrients in crops.

Other than the cost to human health, these diseases also impact the country's economy. The Ebola outbreak resulted in US \$2.2 billion in GDP losses for Guinea, Liberia and Sierra Leone. It has often been pointed out that climate change

increase resilience to diseases. They found that in dry land ecologies in Botswana, South Africa and Zimbabwe, community knowledge on the trends of malaria and schistosomiasis can help assess situation quickly. In Kenya, the researchers found that the community was not aware of Rift Valley Fever and this made them more vulnerable to outbreaks. To counter this, the researchers recommended that the veterinary department should set up sentinel herds of cattle which could be tested routinely to alert authorities.

To achieve these, robust environmental health data is of utmost importance to help African countries prepare for diseases emerging due to climate change. Though environmental health data exists in Africa, it is not always in a form that is immediately “user-friendly” in scientific research, says Caradee Wright, researcher with the Environment and Health Research Unit of the South African Medical Research Council, South Africa. “Evidence-based decision making should underpin all climate change and health mitigation and adaptation activities, policymaking and planning,” she says. The evidence, along with stakeholder engagement helped the South African Medical Research Council identify that there was a need for a heat-health action plan. Working across sectors in one of the hottest towns in South Africa, Rustenburg, researchers developed a heat-health action plan template for the government. This template can now be rolled out to all towns across the country to help them plan for extreme heat and periods of “very hot days” which are predicted to increase in the future, says Wright.

The usefulness of data has also been underlined in a March 1, 2018 report published in *The Lancet*. The researchers mapped cholera incidence in Sub Saharan Africa (excluding Djibouti and Eritrea) from 2010 to 2016 from data sets of WHO, Médecins Sans Frontières, PROMED, ReliefWeb, ministries of health and scientific literature. They found that in the study area, an average of 141,918 cholera cases were reported per year, but only 4 per cent of the districts had higher cholera incidence. They suggested that by focusing on these districts first, interventions could eliminate 50 per cent of the region's cholera cases.

Unfortunately, even now Africa might not have woken up to the immediacy of the problem. The first progress report of the chairperson of the commission on the African Center for Disease Control published in March 2018 does not even mention the risks due to climate change. ■

AFRICA NEEDS ROBUST ENVIRONMENTAL HEALTH DATA TO PREPARE FOR DISEASES EMERGING DUE TO CLIMATE CHANGE

can also reverse the gains made in controlling diseases. Regions with the triple combination of high exposure to climate change impacts, extensive poverty and dense populations will most probably face major adaptation challenges. Malawi, Mozambique, Zambia, Zimbabwe and the Lake Victoria region in East Africa are examples of places which will face these problems. However, most of these countries do not have adequate policies for adaptation. In most of the countries, the health components in the climate change adaptation plans are very weak. To rectify this, WHO has worked with 34 countries to strengthen their resilience to the adverse effects of climate change by establishing multi-sectoral country task teams. A variety of initiatives have been taken in the region to address climate change. These include the Libreville Declaration and the WHO's Adaptation to Climate Change in Africa Plan of Action for the Health Sector. WHO's research has produced evidence in seven countries on how to



Disease baskets

Climate change is likely to increase the spread and incidence of tropical diseases in Africa

ANDREW K GITHEKO

THE AFRICAN climate is a natural incubator of many tropical diseases, such as malaria, cholera, Rift Valley Fever (RVF), meningitis, yellow fever, dengue and chikungunya. These diseases are caused by pathogens that are temperature-sensitive. It is predicted that the frequency of these anomalous events will increase as the planet becomes warmer. The most dramatic impacts of climate change and variability in Africa were probably best observed in the 1990s when multiple El Niño and La Niña events occurred. These events were associated with a temperature rise of 2–5°C and excessive flooding. During these events malaria cases increased between 100 and 700 per cent while RVF caused significant livestock mortality and economic losses in Ethiopia, Somalia and Kenya to the tune of US \$132 million due to a ban on exports of livestock products to West Asia.

Over 90 per cent of the global malaria burden occurs in Africa and is associated with considerable mortality and morbidity. Climate scenario indicates that the geographic range of these diseases may contract in some areas and expand in others. Of particular concern are African highlands where the temperatures for a long time were below 18°C, prohibiting malaria transmission. For example, malaria became endemic in the Central Kenya highlands after 1993 when the mean temperature permanently exceeded 18°C. Prior to the ongoing malaria control efforts, severe epidemics occurred in the East African highlands during El Niño years, resulting in 100 per cent increase in hospital admissions.

In the 1990s, it was recognised that malaria control in Africa required a global effort and special programmes were initiated. The prevalence of asymptomatic malaria fell by 50 per cent and that of symptomatic clinical cases fell by 40 per cent between 2000 and 2015. In the highlands of Western Kenya, the prevalence of infections fell by 80 per cent. Among other strategies, the development of malaria epidemic early warning systems made it possible to minimise the impacts of the epidemics.

Cholera, a water-borne disease, is also associated with climate variability. The largest epidemics observed in eastern Africa were associated with El Niño that cause water temperatures in lake and coastal waters to elevate. Cholera bacteria thrive under such conditions. In most countries in Africa, water and sanitation programmes have contributed significantly towards the quantity and quality of drinking water. RVF, a viral disease transmitted by several types of mosquitoes, is associated with flooding. It is endemic in East Africa, Mauritania in North Africa and South Africa and disease transmission occurs during periods of extreme flooding. Recent observations suggest that its geographic range is expanding. The most effective control strategy is vaccination but this was restricted because the vaccine was being produced only in South Africa. Now, it is being produced in other countries such as Kenya. Since mass vaccination began in Kenya, no major outbreak has been reported.

Meningococcal meningitis is associated with dry conditions and 350 million people are at risk. In 2010, a vaccine was deployed in Burkina Faso, Mali and Niger, and was found to be suitable for public health use. Vector control, effective medicines and vaccines have had success in reducing the impacts of climate sensitive diseases. These efforts must be sustained through investments in health and research. It must be recognised that climate change impacts are increasing and must be addressed robustly. ■

The author is head of Climate and Human Health Research Unit of Kenya Medical Research Institute, Nairobi



TARIQUE AZIZ / CSE

FIGHTING A LONELY BATTLE

African countries are embarking on ambitious adaptation measures because for them it is a lonely fight against an existential crisis

\$ **50 BILLION** a year. That's the kind of money Africa requires to survive the onslaught of extreme weather events, diseases and loss of livelihood sources in case the global temperature rise does not exceed 2°C, says the World Bank's Africa Climate Business Plan. The amount will rise to a humongous US \$200 billion if global warming continues unabated over the next few decades. But just the way world leaders show no commitment to contain the temperature rise, there is no commitment as to who will bear the cost. This is worrying as the continent accounts for just 9 per cent of the global carbon emissions (including emissions from land-use changes), according to non-profit World Resources Institute. But it will be hit the hardest as almost 80 per cent of the population directly depends on natural resources. "The funding needs to address climate change effectively, in particular for adaptation, are high in the region, and will increase as climate change unfolds in the coming years," warns the Bank.

Such predictions have rattled African leaders, who frequently voice the urgency for climate adaptation and mitigation at domestic, regional and international forums. Adaptation means measures that make people and governments resilient to climatic vagaries. This includes everything from diversifying agriculture to developing early warning systems for natural disasters. Mitigation measures, such as switching to cleaner sources of energy, are the other half of climate action. So far, 63 per cent of African countries have estimated their needs for adaptation financing in their Nationally Determined Contributions, compared with 27 per cent in the rest of the world. Yet, financing adaptation measures remains grossly inadequate for Africa; as of now, just \$3 billion a year has been made available to the continent. First, almost 70 per cent of the funds committed by developed countries to finance climate action are tied to conditional loans and credit lines. Besides, several countries are yet to link the risk factors to climate change. For instance, Ghana, despite enough research showing climate change has pushed incidence of water- and air-borne diseases, has failed to link the 2012 National Climate Change Adaptation Strategy with its National Health Policy of 2007, and there are no projects to address the health risks due to climate change.

As a result, several African countries are trying to be self-reliant in climate change adaptation. The continent is already spending more than its fair share for climate adaptation, says a 2017 UNDP-Africa report. Public expenditure on adaptation by African countries constitutes 20 per cent of their total needs presently, which is significantly higher than the adaptation resource flow from international sources. "Although the level of investment as a proportion of GDP expenditure varies among countries, it ranges between 2-9 per cent of GDP, and represents more than other forms of expenditure in public services such as healthcare and education," says the report. South Africa plans to introduce a carbon tax bill to meet its adaptation and mitigation commitments, while Kenya has developed a fund to accelerate adaptation in priority areas (see 'Cost to survive climate change' on p62). The voices for self-reliance in climate finance are not new, but

Innovative mechanisms to fight chronic water shortage have helped farmers in Kenya. Peter Ndabi of Makueni county in east Kenya says he uses a chisel-shaped plough that digs deeper and allows rainwater to reach lower layers of soil



for the first time, there seems to be some collective motion beyond the voice.

KENYA: Community digs farm ponds, stores rain

Under the blazing sun, small farmers of Nakuru, a semi-arid village some 150 km from Nairobi, are harvesting bumper crops unperturbed by the fact that the monsoon has eluded them in recent years. Patrick Ndung'u, who has harvested bulb onions and potatoes from his 5-acre (a little over 1 hectare) land, is neatly packing the produce in sacks for traders to collect from his farm. On an average he earns Sh4,000 (\$40) a week by selling vegetables, which he grows on a rotational basis. Just three years ago, when parts of Kenya, including Nakuru, were hit by a severe drought, Ndung'u was among the worst affected. "I had planted Irish potatoes and the entire crop got nearly burned. But it taught me a lesson," he points out.

After the incident, Ndung'u divided farms in the village into 40 small plots of 0.5 ha each and grew a variety of crops. He formed a self-help group

along with other small farmers, and together, they dug small ponds, of 400,000 litre capacity, in all farms in the village. "Hiring labourers is too expensive for us. So we did all the work ourselves," says Kariuki Wachira, another farmer. "It took us a week to dig a pond in every homestead. But the challenge was nothing compared to what we face during droughts," he says. The ponds, then lined with an ultra-heat treated polythene sheet to prevent percolation, were then used to store harvested rainwater. To minimise wastage, farmers acquired drip irrigation kits that directly feed water to the crop roots. Tillage was kept to the bare minimum so that soil retains moisture for long. The farmers are also shunning traditional water-guzzling crops like maize and growing drought-tolerant crops. Ndung'u says he grows red and white bulb onions that require watering only twice a week.

In Makueni, part of the arid Eastern Kenya, farmers are innovating to survive against all odds. "I use a chisel-shaped plough, known as spring plough, which digs deep into the soil beyond the hard pan. This increases rainwater infiltration into

In Malawi, Conservation Agriculture has become quite popular. It is based on building and storage of soil organic matter by minimum mechanical soil disturbance and no tillage



deeper layers,” says Peter Ndabi of Makueni.

Kenya’s current per capita water availability is less than 600 litres per day, which is below the global threshold of 1,000 litres, making it one of the chronically water-scarce nations. But a study by the World Agroforestry Centre (ICRAF) and the UN Environmental Programme shows that Kenya’s rainwater potential is above 350 trillion litres, which means farmers can benefit from investing in rainwater harvesting. Victor Gitonga, a water engineer at Netherlands Development Agency-Kenya, says farmers can increase their productivity by at least 20 per cent by increasing water storage and use of technologies, such as lined ponds, drip-irrigation kits and solar-powered water pumps.

Micheni Ntiba, former permanent secretary with the ministry of agriculture, says a combination of right technologies such as water harvesting,

hybrid seeds, timely planting, crop diversification and post-harvest management will help farmers adapt to climate change impacts.

MALAWI: Climate smart farming gets popular

Land is a valuable possession around Blantyre, the commercial capital of Malawi. Grace Manda owns 1 ha of farmland here but has lived most part of her life complaining about acute poverty. She lives in a mud house and struggles to arrange food, clothes and school fees for her three children. “The region hardly receives any rain, which has made the soil hardy and barren. Even if I take up cultivation, the land cannot grow enough for us,” she would say. But that was some 10 years ago.

In 2009, Manda attended a meeting on conser-

FARMERS IN KENYA CAN IMPROVE PRODUCTIVITY BY 20% BY USING LINED PONDS, DRIP IRRIGATION TECHNOLOGIES



vation agriculture organised by the National Smallholder Farmers Association, and since then her life has changed for the better. Now she grows crops twice a year. She is not only able to afford her children’s school fees but also has built a better house and is taking care of her mother. Due to her farming prowess, she now gets invited to training programmes on promoting farming as business, climate smart agriculture and market exploration, and in the process has become a role model to most women farmers in the country.

“All I did was practise conservation agriculture,” Manda adds. This new method of farming promoted by the TerrAfrica Sustainable Land and Water Management partnership, popularly known by its acronym CA, is “a concept for resource-saving agricultural crop production that strives to achieve acceptable profits together with high and sustained production levels while concurrently conserving the environment”. The Food and Agricultural Organization (FAO) has determined three key principles for CA: minimum mechanical soil disturbance or no-tillage; managing top soil to create a permanent organic soil cover; and crop rotation with more than two species.

The simultaneous application of the three principles help boost yields. With regards to climate change, CA advocates building and storage

Cost to survive CLIMATE CHANGE

43 African countries have prepared national adaptation plans. While they target to raise 20 per cent of the funds on their own, the remaining needs to be funded by the international community, which has in the past defaulted on aid commitments

Legends

Estimated adaptation cost in US\$ million

AFRICA'S ADAPTATION COST

\$200 billion[#]

Northern Africa

Mauritania **9,400**
Tunisia **1,900**

NORTHERN AFRICA
\$3.1 billion

WESTERN AFRICA
\$54 billion

Western Africa

Benin **18,350**
Senegal **14,270**
Burkina Faso **5,800**
Cote d'Ivoire (Ivory Coast) **1,762**
Niger **1,607**
Togo **1,540**
Guinea **1,100**
Mali* **50**
Guinea-Bissau **42**
Sierra Leone* **30**
Gambia* **15**
Ghana **4**



Prepared by DTE/CSE Data Centre

Infographics: Raj Kumar Singh;

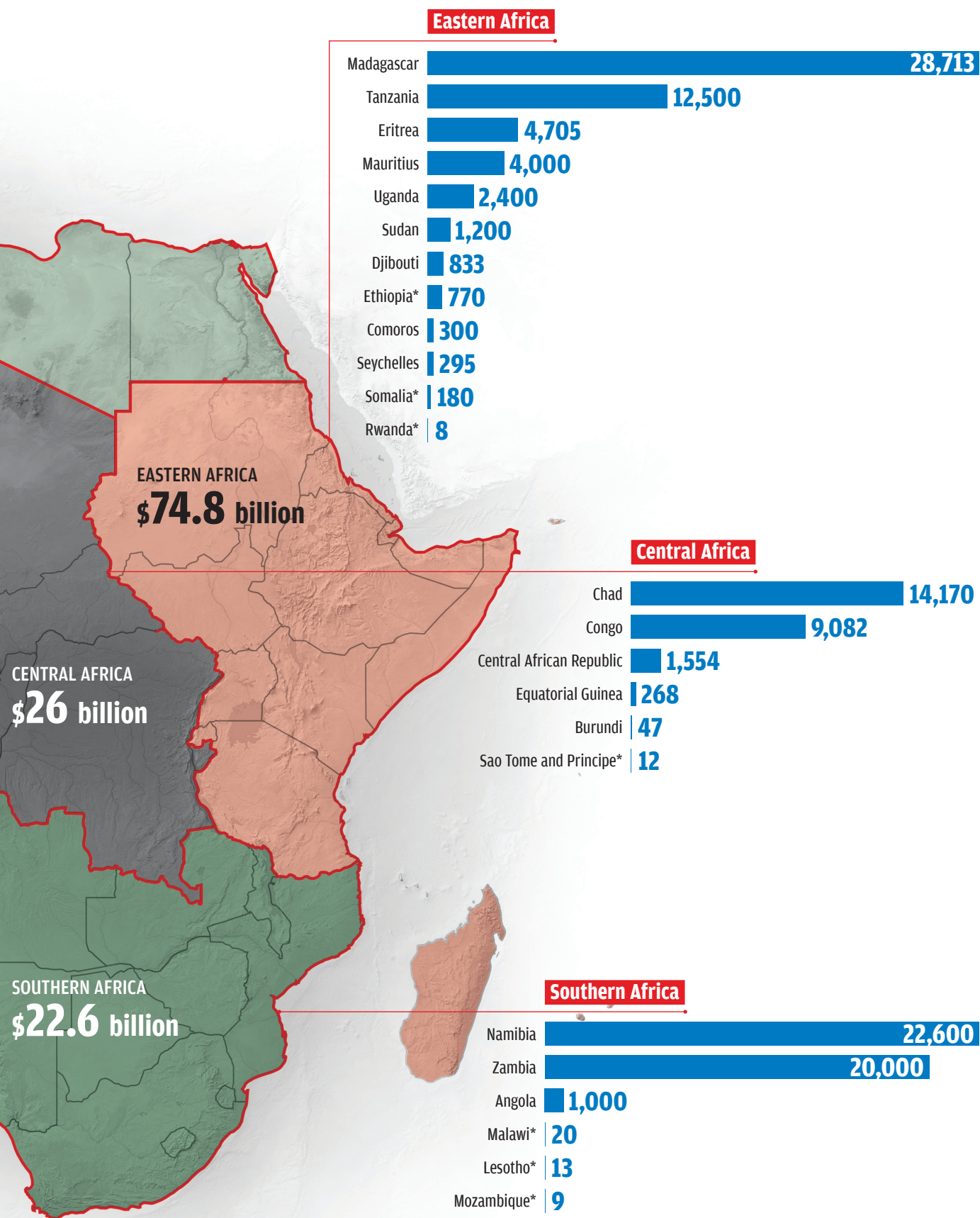
Analysis: Shreeshan Venkatesh and Rajit Sengupta

Data Source: World Bank and UNFCCC

Note: [#] Estimate for all African countries, but individual estimates for all not mentioned here

* The countries do not have a total adaptation cost, so estimates of priority projects have been considered

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of soil organic matter, which is important for sequestration of carbon in soil. Carbon is derived from the atmospheric CO₂ taken up by the plant and added to the organic matter when the plant dies. In a world concerned with the buildup of atmospheric greenhouse gases (GHG), CA presents an opportunity for reversing the GHG buildup, says a 2009 FAO report titled, “Scaling up conservation agriculture in Africa: strategy and approaches”.

The practice is not limited to Malawi. At a recent CAADP Africa Forum, a platform of exchange for people working in agriculture, held in Johannesburg in South Africa, various speakers backed CA as key to sustain agriculture in Africa.

SOUTH AFRICA: Industries take the lead

As the impact of drought continues to unfold, water shortage is compelling industries to innovate to stay in business. Globally, South Africa is the

Western Cape, they have not come to a complete standstill and where possible we are completing dry work on our developments,” says Wikus Lategan, chief executive officer of Calgro M3, adding that the company recoups the 8,500 litres of water used to build each housing unit in three months by various initiatives including rainwater harvesting. “Rain harvesting is the easiest way to gather ‘free’ water and to conserve water usage in the construction phase,” he says. “Unfortunately for this to be successful we do need rain in the Western Cape.”

Located in the water-scarce region of Epping, industrial suburb of Cape Town, pharma giant GlaxoSmithKline (gsk) is reaping the rewards of water conservation measures. It demonstrated a 42 per cent reduction in water usage from 2010 to 2016, a figure that has reduced by another 8.04 per cent in the past two years. “The success can be attributed to gsk’s water reduction targets for all factories in water-scarce regions of the world. This

RAINWATER HARVESTING IS THE EASIEST WAY TO GATHER “FREE” WATER AND TO CONSERVE WATER USAGE IN THE CONSTRUCTION PHASE OF BUILDINGS

30th driest country, and climate change is going to hit it hard. This became evident recently when Cape Town, the country’s second-most populous metropolis, was in the throes of recurrent droughts, with the severity of water scarcity peaking by the year. The message that water shortage is the new normal hit home, and prompted both the industry and communities to act.

Ian Neilson, the city’s executive deputy mayor, says Capetonians are now using less water for daily needs and recycling grey water. The city authority has also diversified its supply system by sourcing water from groundwater, desalinated plants and recycling units. This changing culture is also influencing the business community. In June 2017, the city proposed water reduction measures after clouds failed to precipitate and analysts said that the city would run dry in weeks. Responding to the situation, Calgro M3, a real estate company, scaled down the developments of its 1,750 residential units.

“While the water shortages have presented hurdles and have delayed our projects in the

encourages constant improvements in our ways of working with water,” says Brighton Ochieng, Cape Town site director, adding that gsk has a team dedicated to reduce water footprint of the factories. In fact, Ochieng says, their site plans for 2018 include the recovery of certain wastewater streams for treatment and re-use. A large cooling tower will be decommissioned and a rainwater harvesting and treatment system will be installed. “The site is targeting a 20 per cent water reduction in 2018 and a further reduction of 20 per cent in 2019,” he says.

Industries are hesitant to invest in water efficiency improvements just based on the resource cost as often pay backs are not there, says Kevin Cilliers, senior project manager at National Cleaner Production Centre in KwaZulu Natal, a division of the Council for Scientific and Industrial Research. “However, we have seen a shift in thinking. Some organisations are now looking at investment payback more from a risk perspective of not having water at all and not being able to operate,” he adds.

Calgro M3, a South Africa-based real estate company, recoups the 8,500 litres of water used to build a housing unit in three months by various initiatives including rainwater harvesting



UGANDA: FAO steps in

At the 2015 UN Climate Change Conference, dubbed COP21, the Uganda government committed to reduce carbon emissions by 22 per cent in a bid to transit to a low-carbon climate resilient economy. Today, the country has both adaptation and mitigation strategies in place as part of its climate change policy. As part of the mitigation strategy, the country plans to improve its forest cover, which has declined from 35 per cent to 15 per cent of the land surface between 1890 and 2005, with an estimated annual forest cover loss of approximately 88,000 ha a year. Recently, Mary Goretti Kitutu, the state minister for environment, presidential directive to give out tree seedlings to all Uganda's legislators for planting in their constituencies. The plan is to bring some 400 ha under green cover, with a focus on Sango bay areas in central Uganda which have been affected severely, Kitutu adds. Since firewood harvesting and charcoal production have been major drivers of deforestation and forest degradation in Uganda, the government is also promoting renewable energy. The government estimates that Uganda would need \$2.9 billion to implement mitigation strategies, which involve increasing renewable electricity generation by



UGANDA NEEDS \$2.9 BILLION TOWARDS MITIGATION, WHICH INVOLVES INCREASING RENEWABLE ELECTRICITY GENERATION, IMPROVING FOREST COVER

3,200 MW by 2030 and improving forest cover by 21 per cent and wetland coverage by 12 per cent.

At the same time, Uganda's climate change policy has laid out strategies to make communities resilient to climate change. Consider the semi-nomadic herders of Karamoja. The community believes that their god, Akuj, had given them all the cattle in their known world. To them, cattle are royalty and the number of cattle one owns measure the value and recognition of an individual. And they would go the extra mile to find new pastures and water spots for their cattle in this arid region of Uganda. But dry spells and erratic weather have further pushed them to the brink. Lokonoia is one such Karamojong who lives in Laboktom village of Amudat district. Till a few years ago, he was notorious for causing road-side ambushes using

AK rifle ammunition and killing people to raid cattle. Today, he is a farmer.

Surrounded by dry grassland, his lush green sugarcane field appears like a mirage in the desert. He irrigates the farm using solar-powered pump. On part of the farm, he grows vegetables, such as amaranth, cowpea, cabbage, onion and tomato, using drip irrigation. Along with the other farmers, he sells the produce in a ready-market in Kenya, across the border. "We sell the vegetable as a group and the money goes to the village saving scheme where the profit gets shared among the residents by the end of the year. This helps us in paying our children's school fees," says Lokonoia. Such income from farming was not heard of in the region till about eight years ago when FAO set up farmer field schools to change the community's mindset and



Farmers in Laboktom village of Uganda's Amudat district irrigate the farm using solar-powered pumps

help them market their produce. "The dry, harsh weather is not new to us. But we are glad that development partners have drilled water facilities for us. Previously we couldn't grow anything as we would rely on rainwater which is so scarce," narrates Lokonoia. Animals are also kept at water collection points. He has also been able to purchase solar power system which he uses for lighting his house. "I can now avoid bush fires which are so rampant in Karamoja during the dry season," he says.

ZAMBIA: Finds solace in renewables

"Climate change affects not only the environment but also agriculture, energy generation and infrastructure development among several other sectors, and hence the prioritisation of interventions," says Alexander Chiteme, Zambia's Minister of National Development and Planning. Chiteme's views are particularly true for his country, where agriculture is primarily rain-fed and 84.5 per cent of the electricity is generated through hydropower plants that are rain-dependent. In 2016, acute water shortage had hit its power plants. "The

average load-shedding is eight hours a day and out power imports have increased by 178.26 per cent," says Chiteme. The country is now investing in renewable energy both on and off-grid. This, it believes, will also improve rural electrification which currently stands at just 4 per cent. "We are taking measures to invest in renewable energy sources and enhance our technology to invest in agricultural production that can circumvent climate change variabilities, however, the rate at which we are being affected by climate change is faster than our capacity to cope," he adds.

The country has started a project to help farmers switch to drought-resistant crops and reduce their vulnerability due to climate change, he says. The government says a resilient agriculture sector will contribute to food security and job creation. Agriculture and electricity generation are now the priority sectors under the Seventh National Development Plan, which utilises the Green Climate Fund. In 2008, Zambia became one of the first three African countries whose climate adaptation plans was funded by the Climate Investment Fund, the world's oldest and largest global climate finance mechanism. ■

REDD ALERT

A UN-backed mechanism to curb carbon emissions through forest conservation needs much reform to benefit forests as well as the communities living around them

ONE MAY call it a huge leap of faith. In December, when the world leaders meet in Poland to finalise the rulebook of the Paris Agreement, a document that governs global climate action starting 2020, they will enshrine in it a mechanism over which the dust is yet to settle. The mechanism of REDD+, short for Reducing Emissions from Deforestation and Forest Degradation, where “+” stands for conservation and sustainable forest management, provides financial incentives to communities, regions and countries for keeping their forests intact. The rationale behind the mechanism is simple: forests lock up a lot of carbon. Going by *The Economics of Climate Change*, a 700-page report by economist Nicholas Stern in 2006, deforestation contributes more to global emissions of greenhouse gases (GHG) each year than the transport sector. So halting deforestation is an immediate and highly cost-effective way to curb GHG emissions.

But the fundamental fear is that to achieve its environmental objective, REDD+ will impose restrictions on communities who depend on forests, especially those with insecure land tenure, and encourage evictions from forests. There are also doubts whether the mechanism, elaborated in just two paragraphs in Article 5 of the Agreement, would adequately compensate these communities for forgoing deforestation, which they rely on for subsistence and livelihood earning. In 2007, when REDD+ was formalised at the 13th United National Climate Change Conference in Bali, dubbed COP13, the cost of compensating forest users for forgoing deforestation and degradation—referred to as opportunity costs—was a distinguished feature of the mechanism. It was estimated that the opportunity cost of forest protection in eight countries, responsible for 70 per cent of the emissions due to deforestation, was some US \$5 billion a year. A decade later, direct payments to forest stakeholders remain rare, and there is a global recognition that the implementation and operational costs of REDD+ are much higher than initially expected. Concerns about community rights are also growing. As the implementation of REDD+ graduates from small projects to large-scale programmes, the mechanism has moved the goalposts and the opportunity costs have stopped appearing in REDD+ discussions. Jutta Kill, a Berlin-based researcher, says REDD+ is now looked upon as a mechanism to address the drivers of deforestation and forest degradation, instead of compensating for opportunity costs.

These fears are not unfounded, suggests a recent analysis by Delhi-based Centre for Science and Environment (CSE) whose researchers have visited REDD+ projects in Kenya, Tanzania and India to assess the ground situation.



The pastoral land of the Maasai is part of Chyulu Hills REDD+ project, which earned US \$237,600 in carbon revenue. But the cash won't be shared with the community.

PROJECT CHYULU: Fortress conservation

Spanning 410,534 hectares (ha), the Chyulu Hills REDD+ project in southern Kenya is an ambitious project seeking to prevent 37 million tonnes of carbon dioxide (CO₂) emissions in 30 years. The project area is as striking as the volcanic mountains and the Maasai tribe who have traditionally been living in the region. It was conceptualised in 2013 by seven conservation groups and two government agencies—the Kenya Forest Service and the Kenya Wildlife Service—to prevent deforestation and land degradation in Chyulu Hills National Park, part of Tsavo West National Park, Kibwezi Forest Reserve and communal grazing land of the Maasai.

Project developers say the Maasai pastoralists are abandoning their traditional lifestyle to cope with frequent droughts. They are moving into the protected areas in search of greener pastures and are leasing their land to agriculturists for additional income. Following the drought of 2009, which claimed 70 per cent of the community's livestock, several households, especially women, have taken to making charcoal by felling forests. Both charcoal making and conversion of grassland into farmland lead to carbon emissions. So, while project developers have deployed rangers to bar Maasais from entering the protected areas, they are also showing them ways, on a pilot basis, to restore their degraded land and improve fodder production. In 2016, an independent verifier certified that in three years the project had prevented 2.03 million tonnes of CO₂ from being emitted into the atmosphere, and allowed

it to trade as many carbon credits in the voluntary market with those who want to offset their GHG emissions.

Till December 2017, the project managed to sell 19,800 credits at the rate of \$12 to the American jewellery retailer, Tiffany and Co. Though the communal land of Maasais constitutes a significant part of the project area and they have to forgo their living for making the project successful, the project has no mechanism to channelise the carbon revenue directly to the Maasai. The project developers claim the revenue will be reinvested in the

project, but infrastructure for forest protection, such as vehicles and equipment, top their priority list. But this will mean more restrictions for the Maasai and reinforce the controversial fortress conservation.

PROJECT KASIGAU: Wildlife wins, people lose

Located further east of Chyulu Hills, this was the first REDD+ project in the world to sell carbon credits in 2011. Spanning 200,000 ha, the project area forms a corridor between Tsavo East and Tsavo West national parks and comprises mostly large ranches. The premise of the project is simple: as climate extremities increase in frequency and

BENEFIT-SHARING IN KASIGAU CORRIDOR REDD+ PROJECT

Carbon credits generated annually: 12-13 million
Carbon credits sold: 1.2 million
Estimated carbon revenue (\$5 per tonne of CO₂):
\$6 million
Share of ranch owners: 33% or \$2 million
Operational costs: 53% (includes salaries of employees)
Project developer's share: ~6%
Community share: 6% (paid through welfare programmes)

BENEFIT-SHARING IN CHYULU HILLS REDD+ PROJECT

Carbon credits generated: 2.03 million
Carbon credits sold (till Dec 2017): 19,800
Carbon revenue earned: \$237,600
Operational costs: 33% or \$78,408
Revenue earned by each of the nine project developers:
7.5% or \$17,820
Community share: Nil

crop failures become rampant, almost 90 per cent of the forests in the ranches would be lost in over 30 years due to slash and burn cultivation and charcoal production by communities, mostly Taita agriculturalists, living around them. So, along with Wildlife Works Carbon (wwc), a for-profit organisation, the ranch owners have prohibited cultivation, charcoal production, poaching and bushmeat hunting in the project area and have deployed rangers to report cases of violation. wwc is also creating employment opportunities for the residents, and teaching them how to produce charcoal sustainably and improve agricultural productivity.

Project developers claim that their aim is to

prevent 52 million tonnes of CO₂ over 30 years. As of now, the project generates 1.2–1.3 million carbon credits a year, which is sold at \$5 per tonne of CO₂. Initially, the ranch owners and the community received 33 per cent of the carbon revenue each, while an equal amount was kept aside to pay for the operational costs. While the ranch owners received their revenue share as cash, wwc would use the community's share to improve water and school infrastructure and to provide bursaries (scholarships) to schoolchildren. In 2016, wwc changed the revenue-sharing mechanism. While the ranch owners continue to receive 33 per cent of the carbon revenue, wwc also takes a share now. A 2016 paper titled, *Roots of inequity: how the implementation of REDD+ reinforces past injustices*, says operational costs of the project account for some 53 per cent of the revenue. The remaining revenue is shared equally between wwc and the community, with the share of the latter reducing to a meagre 6 per cent.

This is too little to improve the lot of the residents who are now bearing the brunt of the project. With improved forest protection, wildlife populations in the project area has increased, resulting in frequent raiding of farm lands and loss of livestock. "This year, communities have asked us to use the carbon money to address human wildlife conflict," says Laurian Lenjo, community relations manager of wwc. But can it achieve this with a meagre share allocated to the community?

PROJECT LINDI: Initial enthusiasm fails

In 2009, two conservation bodies—Tanzania Forest Conservation Group (TFCG) and Community Forest Conservation Network of Tanzania (MJUMITA)—partnered to implement the first REDD+ pilot project in the country, which was experiencing deforestation at an astounding rate of 1 per cent a year, largely due to agricultural expansion. The project area covers 41,924 ha of coastal forests in 10 villages in Lindi district where forests were at risk from shifting cultivation traditionally practised by the village communities. But at the outset, the project got a patron. The Norwegian government provided it \$5.9 million for five years till 2014. TFCG and MJUMITA followed three key strategies to make the project work. First, they set aside a small portion of the funding as "trial REDD+ payments". Second, all residents of the villages were treated as "shareholders" with

equal rights to carbon payments. Third, the project established community forest reserves with well demarcated boundaries. The villages were required to protect the forests and improve productivity of their farmland. In return, they were promised cash payments. Over the next five years, the project prevented 40,178 tonnes of CO₂. In 2014, the project developers paid 199 million Tanzanian Shillings (\$89,068) from the "trial fund" in cash to the communities; each household received almost \$30. "Our model works because it gives the community members individual responsibilities towards conserving the forests," says Rahima Njaidi, executive director of MJUMITA. The strategies did help improve the economic conditions of the communities, but it did not last.

The project failed to sell a single carbon credit in the voluntary market. As the Norwegian funding dried up, communities could not be paid. Community leaders claim that people have not gone back to shifting cultivation, hoping that someday they would again get paid for protecting their forest. "The biggest challenge with the carbon markets lies in the fact that buying carbon is not mandatory, and therefore getting buyers for carbon is not easy," explains Njaidi. The case is similar for eight other REDD+ pilot projects in Tanzania.

PROJECT MAWPHLANG: Leakage defeats purpose

It is one of the few REDD+ projects driven by communities. Started in 2011, it spans 27,139 ha of biodiversity-rich land owned by 62 communities in 10 *himas* (village kingdoms) in Meghalaya's Khasi Hills. It hosts sacred groves where community regulations ensure that primeval forests remain almost untouched. Yet, forest fires, fuel-wood collection, grazing, small-scale mining of coal and other minerals, encroachment, charcoal burning and soil erosion were causes for concern.

Communities then identified

BENEFIT-SHARING IN TANZANIA REDD+ PROJECT

Carbon credits generated: 40,178
Carbon credits sold: 0
Operational costs: 40%
Community share: 60% (paid in cash)
Payment made to communities (from initial funding): \$89,068

BENEFIT-SHARING IN MAWPHLANG REDD+ PROJECT

Carbon credits generated: 118,404
Carbon credits sold (till 2016): 60,542
Carbon revenue: Not available
Operational costs: ~40%
Community share: ~60%
Payment made to communities (till 2016): \$37,607 (paid through welfare programmes)

9,270 ha of dense forests which they monitor to reduce incidents of forest fires. An additional 5,947 ha of degraded forests is being regenerated for fuelwood and other needs with financial support from Germany-based WeForest. Till 2016, the project generated 118,404 carbon credits. Satellite imageries show forest loss in the project area was 2.8 per cent per annum during 2006-10, almost 50 per cent less over the previous period of 2001-05. Incidents of forest fires have also reduced. The project manages to sell most of its carbon credits, and the carbon revenue is distributed in two ways: as cash to villages for community development works like restoration of waterbodies, and in kind, such as LPGs and smokeless *chulha*.

Mark Poffenberger, executive director of non-profit Community Forestry International that supports the project, says carbon and its price is not central to the community motivation to protect and restore forests. "It is linked more strongly to people's desire to restore the environment and the services forests provide, such as springs, non-timber forest produce, micro-climate benefits and biodiversity," he adds. Despite the achievements, the project faces challenges as some from the communities have started buying charcoal from outside the project area to meet their fuel needs. This defeats the efforts to reduce overall deforestation and emissions.

THE PRIVATE SECTOR WAS EXPECTED TO PROVIDE MUCH OF THE FINANCE FOR REDD+. WHERE ARE THEY?

Has REDD+ turned into a dead cause?

By ensuring carbon sequestration as well as biodiversity conservation and sustainable forest management, REDD+ was meant to provide a win-win deal. But implementation experiences show there are trade-offs involved. First, the carbon prices are too low. On an average 33 per cent of the carbon revenue earned goes into meeting the operational costs, which involves costs of measuring, verifying and marketing carbon credits. As a result, communities' share of carbon revenue reduces significantly. This casts a serious doubt on the ability of REDD+ to compensate the opportunity costs to give up deforestation.

In Chyulu Hills project, say local people, the Maasai earn up to 60,000 Kenyan shillings (\$600) a year from leasing a hectare of grazing

land for agriculture. The project helps reduce 3.3 tonnes of CO₂ per ha per year. Even if all the carbon credits were sold at \$12 per tonne—the average price is close to \$4.5 per tonne in the voluntary carbon market—the carbon revenue will not exceed \$40 per ha per year. Now do the math! Similarly, in Khasi Hills, the carbon price would have to be \$45 a tonne if fuelwood were to be substituted with LPG, shows CSE's analysis.

The price has been low outside the voluntary market as well. For instance, the World Bank has signed emissions reduction purchase agreements with a number of countries in the Congo Basin for large-scale REDD+ programmes, spanning a province or a landscape. Under the agreements, countries will achieve emission reductions over 20 years and the Bank would buy a pre-specified volume of the carbon credits at \$5 per tonne.

The quantum of global finance for REDD+ has also been extremely poor. A study by Washington DC-based Centre for Global Development shows that global pledges for REDD+ initiatives averaged just \$796 million annually since 2010, largely from government sources. This compares poorly to the annual requirement of \$5 billion predicted by the Stern report. "The private sector was expected to provide much of the finance for REDD+, but where are they?" asks Kill. Little wonder that there is no convincing evidence to establish reversal in global deforestation trends, even after more than 10 years of REDD+ existence.

Some experts, however, say it is too early to dismiss the mechanism. "We have to dig deeper to understand what works and what doesn't in policies aimed at reducing land-based emissions," says Christopher Martius of Indonesia-based Centre for International Forestry Research. In terms of finance too, new pledges have been made. At the start of COP21 in Paris, the governments of Norway, Germany and the UK collectively committed another \$5 billion for REDD+ over the next five years. "Governments could also do a lot more to incentivise the private sector to finance REDD+ efforts," says Chris Stephenson of UK-based Plan Vivo Foundation.

The clock is ticking, and a lot of issues need to be addressed. "We need a REDD+ mechanism that meets the opportunity costs without selling our forests cheap and enables sustainable forest management without re-centralising forest governance and compromising community rights," says Chandra Bhushan of CSE. ■

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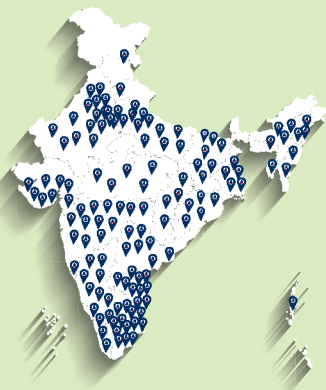
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OR MONEY REFUNDED

UNIQUELY SUITED TO RENEWABLES

Since Sub-Saharan Africa is largely off grid, it has a great opportunity to skip installing fossil fuel-based power generation infrastructure and jump to renewables

A PERSON LIVING in a remote village in northern Nigeria spends 60 to 80 times more to purchase a unit of electricity than somebody living in New York. That's how expensive electricity is in Sub-Saharan Africa (ssa), a geographical grouping of 49 African nations lying south of the Sahara desert. The reason behind the high cost is acute shortage of electricity. Over 62 per cent people (609 million) in ssa do not have access to electricity, says the World Bank's 'State of Electricity Access Report' published in 2017. The region has the largest number of countries with the lowest rates of electrification, states another 2017 report by international non-profit Oxfam. But this lack of access to power from the grid puts Africa in a unique position. Can it skip the process of setting up fossil fuel-based power generation infrastructure and move straightaway to renewables?

Efforts to provide electricity to ssa have not borne result in the last one-and-a-half decade. About 26 per cent people in ssa had access to electricity in 2000 and in 2014 the figure was still just a little over 37 per cent, as per the World Bank report. In the same period, the figure for South Asia, which is second in the list of regions without access to electricity (ssa is at the top), jumped from 57 per cent to 80 per cent. Rural communities in ssa will have to wait for another 20-30 years to have access to grid-based electricity, the World Bank report says. That would ensure that the continent fails to meet the United Nations Sustainable Development Goal (UNSDG) of providing universal access to power by 2030.

Africa needs to add 7,000 MW capacity every year till 2030 to meet the goal. This seems unlikely because to achieve the target, it will need to invest \$41 billion every year, but it currently invests \$5 billion a year. At current growth rates and government policies, 680 million people in the world will lack access to electricity in 2030, and 80 per cent of these will be in ssa, says an April 2018 report published by the International Renewable Energy Agency (IRENA), an intergovernmental organisation that supports countries in their transition to a sustainable energy future (see 'Energy poverty hurts women' on p77).

Fossil fuel failures

One of the main roadblocks in generating electricity in ssa is expensive fossil fuel-based power utilities. What's worse, the use of diesel generators is quite common in the region. In Nigeria, for instance, the installed power capacity is 10 GW while



Over 62 per cent people in
Sub-Saharan Africa have
no access to electricity and
clean cooking fuel

electricity produced by diesel generators owned by households and businesses is 14 GW, as per a report published in *The Economist* in April 2018. According to a January 2018 report published in *ESI Africa*, a South Africa-based media organisation, the country has 100 million diesel generators, the largest diesel generator network in the world. As a result, the region's fuel subsidy bill is quite huge. In 2013, SSA spent US \$32 billion on fossil fuel subsidies, states 'Fossil Fuel Subsidy Reform in Sub Saharan Africa: from rhetoric to reality', a working paper published by the Global Commission on the Economy and Climate, an international initiative that examines how countries can achieve economic growth while dealing with the risks posed by climate change. The figure came down to US \$26 billion in 2015, but the reason was a fall in crude oil price,

In last few years, SSA has slowly moved towards renewables. During COP21 in 2015, African heads of state set up the Africa Renewable Energy Initiative (AERI) to enable "installation of large-scale renewable energy capacity" in the continent by 2020. Germany has pledged €3 billion to the initiative. In 2016, the African Development Bank announced its New Deal on Energy for Africa to provide access to clean cooking for 130 million households by 2025.

Even individual countries have set targets to promote renewables. Ghana, an SSA country, in April, announced \$230 million to promote the use of renewable energy particularly in off-grid communities across the country. Kenya announced its target to add 1,745 MW of geothermal generation by 2025 earlier this year. The country has also prepared Kenya Vision 2030 which talks about

how majority of its electricity will come from renewables in the coming years. In its new energy policy, it has directed state-owned and private energy companies to focus on renewables. "Kenya is the leading country in geothermal energy and even oil producing countries in Africa are now attracted towards renewables," says Amin. Angola, the second in terms of oil production in Africa, wants to increase its hydropower generation capacity from

1,200 MW currently to 9,000 MW by 2025. It also plans to set up 100 MW of solar power projects by 2025. With such developments, the installed capacity of solar energy in Africa is expected to increase at 174 per cent, from 10 GW in 2017 to 27.4 GW in 2019, says a 2018 report by IRENA.

"It just makes sense for SSA countries to opt for renewables. This poses major financial challenges because the cost of setting up renewable energy plants is huge and the countries are poor. But financial institutions like the World Bank can be a big help," says Jeremy Gaines, co-ordinator, Nigerian German Energy Partnership, a joint initiative of Germany and Nigeria to promote renewables in Nigeria. Moreover, people are more willing to pay for decentralised renewable power sources than for grid connection, states a 2016 paper published in *Social Science Research Network*.

"10 years ago, there was no legislation in West Africa related to renewable, no feasibility status done, no market. Hydro was considered as the only renewable. But now things have changed and I am clearly seeing the massive transition in coming 10 years," says Jeremy Gaines. ■ @down2earthindia

THE INSTALLED SOLAR CAPACITY IN AFRICA IS EXPECTED TO INCREASE AT OVER 170 PER CENT, FROM 10 GW IN 2017 TO 27 GW IN 2019

not efforts by governments to reduce carbon emissions. The paper also said that the subsidies to cover the financial losses of power utilities (both fossil fuel and renewables) in Africa is US \$11 billion a year.

Another major barrier to electrification is the cost of grid connection in SSA. In Kenya, for instance, a grid connection costs \$400, which is one-third of the country's average per capita income, says a paper published by the Kenya's National Bureau of Economic Research. A large population of the country also lives in informal settlements, and grid connection requires formal address.

Directly to renewables

These factors make SSA extremely suited for renewable energy infrastructure. Talking to *Down To Earth*, Adnan Z. Amin, Director General of IRENA, says that the continent can source an additional 10,000 GW of solar energy, 1,300 GW of wind power and 15 GW of geothermal power. "If harnessed, this power can solve not just Africa's energy problems but of many other nations," he says.



‘Energy poverty hurts women’

Women’s participation should be considered while making policy on access to energy and management

LINDA DAVIS

IF WE talk about Sub-Saharan Africa, the challenge posed by energy poverty is quite serious. Of 1.2 billion people living without electricity across the globe, 0.8 million are in SSA. What does it mean? It means that these many people are relying on inefficient way of lighting. For instance, they use kerosene which is detrimental to health and environment and also a drain on the finances of the family. When it comes to cooking, the same unhealthy ways are followed. People use charcoal and dung which are again harmful for health. So, power shortage is a big crisis impacting human life in big way. And it exist in 2018, when the rest of the world has made significant advances to provide electricity, LPG and other cooking gas solutions that have no negative health impact on people.

The biggest victim of this energy poverty are women who are engaged in a number of works that require energy. Other than cooking on inefficient fuel, they are the victim of another sort of energy crisis. For example, if there is light in one room only, the room will be used by the male members of the family. So we need to create awareness about the impact of energy poverty on women and also their participation in the whole energy access debate. Women’s participation should be considered while making policy regarding access to energy and management.

I live in Kenya where the statistics are quite troubling. Around 1,500 Kenyans die every month due to indoor air pollution. Any big disaster attracts our attention but if one compares these deaths with those reported during disasters, we will realise this is a bigger crisis. Thus we need to get our priorities right.

As far as energy transition is concern, it is happening. Countries are leap-frogging towards solutions, especially off grid solutions, and moving towards renewables like solar energy. When it comes to electrifying Kenya, hydro and geothermal energy play significant role. People are also realising the importance of renewables. So the transition is there but it is not happening on a big scale.

Governments’ policies are the main culprits behind Africa’s energy crisis. These governments should also prioritise energy crisis with similar eagerness as they are prioritising health and education for the masses.

The second big challenge in energy transition is funding. And funding needs to be done for the set target keeping efficiency in mind. The third big challenge is the conflict in Sub-Saharan Africa. Many countries are witnessing conflict and it is a big hindrance. Take the example of South Sudan. We had an understanding to establish 20 MW solar power plant in the country but just when we were about to begin the work a war broke out that has continued for five years. Our investments were lost.

Conflict also creates barrier for foreigners to come to the community and bring solutions. However, this cannot be an excuse because the conflict in South Sudan does not mean Kenya, Uganda or Namibia cannot prosper. Why is there no investment in these countries for energy transition? Diesel generator is the most common off grid solution but it is not a solution we can continue to rely on. ■

The author is Strategic Partnership Director, wPOWER, partnership on women’s entrepreneurship in renewables



TARIQUE AZIZ / CSE

LIFE & NATURE



FRAGILE, **BLUE MOUNTAINS**

For four years, two academics and a photojournalist researched urbanisation in the Himalayas to bring out the deadly scams of human activities in the world's youngest mountain range

RAJAT GHAI | NEW DELHI



NAINITAL

1880

The northern ridge around Naini lake in Nainital collapses after heavy rain, killing more than 150 people



1910

The northern ridge has recovered from the 1880 landslide which flattened the lower hill area where construction can be seen



2017

Residential and tourist housing have mushroomed in the vulnerable hillside. It is now used as a cricket and sports pitch. It is also home to the town hall and a mosque. In case of a landslide, tens of thousands could die



NMAY 2017, when the Himalayan nation of Nepal held its first local council elections in 20 years, access to water became a highly political topic at Dhulikhel town. Located on a mountain ridge 35 km from Kathmandu, Dhulikhel's strategic position allows one to behold a long range of the scenic Himalayas. As the town rose to prominence, a number of hotels, lodges, restaurants, new houses and public and private institutions have replaced the tiny traditional settlements, putting unprecedented pressure on the water supply. As expected, water politics influenced the outcome of the elections—the town's new mayor came to power on the promise that he would make locally sourced water available to all at affordable prices. A 14 km pipeline now brings water to the community, but the laying of new pipes has been disruptive for the settlements and farms through which it pass, triggering protests.

This and several such compelling stories were brought to life at a recent photography exhibition in Delhi by Bhaskar Vira and Eszter Kovacs, academics at the University of Cambridge, UK, and British photojournalist Toby Smith. Titled "Pani, Pahar: Waters of the Himalayas", the exhibition was the result of four years of academic research led by Vira and

Kovacs who have tried to assess the impact of human activities on the fragile Himalayan landscape and on its water sources that are sensitive to climatic changes. “Based on the pressure on these resources due to social and environmental changes and the willingness of people to respond to the resulting challenges, we zeroed in on six locations in the Lower Himalayas for our research,” says Vira, who is the director of the Conservation Research Institute at the University of Cambridge. These are Palampur and Rajgarh in Himachal Pradesh, Mussoorie and Nainital in Uttarakhand, and Dhulikhel and Bidur in Nepal. To highlight the scale of human intervention, Smith’s photographs were juxtaposed with archival

prints sourced from the university’s library and its Centre for South Asian Studies. And the effect was striking.

“Over a billion people across Asia rely on Himalayan water. We take this water for granted. But human activities are stressing the Himalayan water system,” Vira says. The impact of tourism on the fragile ecosystem is vivid in almost all photographs. One series shows a multitude of tourists taking a dip in the Kempty Falls near Mussoorie. “On the scheme of things, this is just a small attraction. But the scale of development balanced on this single resource is unsustainable and dangerous,” says Smith. India has the diversity of these very productive natural landscapes. But if managed badly,



MUSSOORIE 1890

The Himalaya Club in Mussoorie, referred to as the queen of the hills, was a popular tourist destination during the British Raj



2017

Over the past decade, Mussoorie has grown at a rate of over 15 per cent. It currently sources its water from over 20 separate springs, but high season demand far outstrips supply capacity

SHIMLA

1915

The fabled Mall Road in Shimla, the summer capital of the British Raj



2017

The city is home to over 200,000 people. While its growth in recent decades has been steady, access to essential services like power and water is ad-hoc



it can become a curse, he warns.

The works on display capture another aspect of the crisis that Vira refers to as the “somewhat invisible migration” within the mountains. Migration from the rural Himalayas is taking place in two ways. One is to big cities, such as Delhi or Dehradun, and the other is to local urban centres within the mountains, which have better educational institutions, administrative and other services. “These small towns have been the focus of our research. Over time, what might have been just a bus stop and a shop has grown into a small town, with all the associated demands for infrastructure and services (especially water). This level of urbanisation is neglected from the vision of planners and governments,” he adds.

Smith’s photos illustrate Vira’s statement. One series displays three photographs of the same spot in Nainital. The first print shows Nainital soon after September 16, 1880, when a landslide occurred at the north end of town, burying 151 people. The next photo, from 1910, shows that the area has recovered and is being used heavily again.

“The final photo, which I shot last year, shows immense development in the area which is just as unstable now as it was then. If a disaster occurs, nobody should be surprised,” Smith warns.

In another group of photos, Smith shows the much-talked about devastation of Nainital’s once-picturesque Naini Lake. “We planned that I visit locations in winter and summer to get a difference in aesthetic. When I went to Naini in the winter, the lake was dry. There was a popular protest. People were energised, angry and vocal. It was an environmental response. The minute the lake filled up with the monsoon, the protests died down. I generalise slightly but the solution, the energy and the efforts, needs to be measured in years. A knee-jerk response to the crisis is not going to help,” says Smith.

He says the project has reinforced his respect for water. “There is a connection between Indian and Nepalese people and where their water comes from. You can sense their spiritual attraction to it.” ■

[@Timsah_al_Nil](#)



Pulse with potential

As health connoisseurs turn to horse gram, **CHANDRA PRAKASH KALA** hopes that the lesser known crop can help transform Uttarakhand's farm sector, in a big way

TWAS like a double bonanza. Last month, a childhood friend from my village in Uttarakhand's Pauri Garhwal district came to see me in Bhopal—my current place of residence. And true to the Garhwali custom, he brought me some *gath* or horse gram—a pulse that I relished in my younger days.

Known as *Macrotyloma uniflorum* in scientific lexicon, *kulath* or *kulthi* in Himachal Pradesh, *kollu* in Tamil Nadu, *ulavalu* in Andhra Pradesh and *haruli* in Karnataka, the pulse comes packed with nutritional values. But over the time, these flat seeds, bearing light red, brown and grey tints, have fallen out of favour with most people, especially urbanites. This is probably because the pulse has traditionally been utilised to feed horses, and hence the name, or probably because it has not been marketed well. However, it has not lost its charm for the Garhwalis, who still prepare different delicacies using *gath*.

Going by the ayurvedic principle, a food item has either heating or cooling effect on our body. But *gath* can have both the effects depending on how one prepares it. For instance, during winters most Garhwalis prepare a delicious *dal* recipe using *gath*. This dish, called *gathoni*, is usually consumed with

PHOTOGRAPH: VIKAS CHOUDHARY / CSE

Phanu, a favourite Garhwali dish made from *gath* or horse gram. The pulse is said to keep the body warm in winters and help one get rid of kidney stones



rice or *chapattis*. People believe the dish keeps the body warm even when the temperatures dip to sub-zero in the higher altitudes.

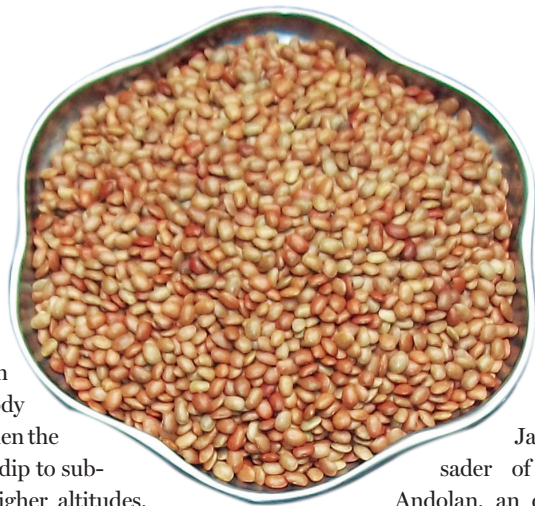
Parathas stuffed with cooked-and-crushed *gahath* are also a hit in Garhwal. However, if the pulse is cooked after soaking it overnight, it has a cooling effect on the body and can be consumed at any time of the year. *Phanu* is one such popular Garhwali dish made from soaked *gahath* (see 'Recipes'). Those fond of its unique earthy flavour even prepare *vadis* (sun-dried fritters made out of soaked and grounded *gahath*) for making instant dishes.

While these dishes are rarely relished outside Uttarakhand and regions where *gahath* is cultivated, the pulse is slowly becoming popular among health connoisseurs. Vaidya Sohan Lal Badoni, ayurvedic healer from Maletha village in Tehri Garhwal, shares a medicinal property of *gahath* that makes it no less than a drug. "Regular consumption of the water in which the pulse has been boiled can help one get rid of kidney stones," Badoni says.

Antidote for farmers too

Traditionally, this super pulse has always been favoured by the farmers of Uttarakhand and adjoining Himalayan regions, where *gahath* is grown as a kharif crop up to a height of 1,800 metres. During my interaction with farmers in Tehri Garhwal, I was told that like most pulses, *gahath* grows well in arid areas and does not require much water. Once sown, it is ready to harvest within four to five months depending on the altitude. It is grown solo or at times mixed with other crops as part of *baranaja*—a traditional cropping method in which 12 varieties of crops are grown together for farm diversification, soil fertility and overcoming adverse climatic conditions.

However, the production of *gahath* has diminished in recent decades following large-scale exodus of farmers from the hills.



But those staying back continue to grow the pulse. Vijay

Jardhari, the crusader of Beej Bachao

Andolan, an organisation that promotes conservation and cultivation of traditional seeds, explains why farmers are increasingly favouring *gahath*. "Farmers in most Uttarakhand villages today are discouraged from growing crops due to monkey menace. But monkeys do not raid *gahath* fields," he says. In Maletha village, about 80 per cent of the farmers now grow *gahath*. They mostly sell their produce in Srinagar town, some 8 km away. "I harvest 70 kg of *gahath* from five *nalis* (a local land unit under which 1 *nali* equals 0.02 hectare). The cost-benefit analysis shows a 70 per cent profit margin in *gahath* farming," Dayal Semwal, farmer from Maletha, tells me. "On an average each family in the village earns ₹30,000 per year by selling *gahath*," says Mrinal Semwal from Maletha, who plans to set up an enterprise to sell crops unique to Uttarakhand.

Gahath has also made a comeback in Dal Ghati lying between Teen Dhara and Saknidhar in Garhwal. Narrating a popular anecdote about *gahath*, Ganesh Khugsal, editor of Garhwali magazine *Dhad*, says: "A widow here did not have resources to plough the fields. So, she scattered *gahath* seeds on mountain slopes. Blessed with a good yield, she sold *gahath* to travellers plying between Rishikesh and Devprayag. Since then, others also started growing the pulse."

Jardhari points out the drawback of growing too much *gahath*. The pulse cannot be stored for long as it is prone to pest attacks. So, most farmers end up selling their produce at local markets at lower price, Jardhari says. When I visited Bhopal's New Market area, I found *gahath* being sold at ₹160 per kg under the brand name of Tulsi Gold. Compared to this, 1 kg of *gahath* costs ₹100 in Srinagar. Wholesalers at Rishikesh sell it for just ₹70-80. *Gahath* definitely has a market potential. And there is definitely a

RECIPES

Phanu

INGREDIENTS

Gahath: 250 grams
Onion (chopped): 1
Garlic (chopped): 3-4 cloves
Ghee/mustard oil: adequate to fry
Coriander powder: 1 teaspoon
Chili powder: 1 teaspoon
Salt: to taste

METHOD

Soak *gahath* in water overnight so that it becomes tender. Drain the water and crush it to make a smooth paste. Heat *ghee* or mustard oil in a cauldron, and add onions and garlic to it. Fry till they turn brown. Add the *gahath* paste to it, along with coriander, red chilli powder and salt. Mix them well. Add a glass of water and cook for 30 minutes. Serve hot with rice or *chapatti*.

Gahath chutney

INGREDIENTS

Gahath: 50 grams
Lemon: 1
Chilli powder: to taste
Salt: to taste

METHOD

Roast *gahath* on a pan till it turns dark brown and become crispy. Grind it coarse. Mix it with lemon juice, red chilli powder and salt, and the *chutney* is ready. It is best savoured with rice.

way to share the profit with farmers. As rural management expert Prateek Kala points out there is a need to set up farmers' cooperatives on the lines of Amul so that farm produce can be marketed well. An assured income will not only help check migration from the hills but also ensure that mountain lands are utilised properly. ■

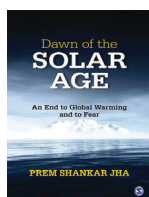
The author is faculty member at the Indian Institute of Forest Management, Bhopal



Lighting up a solution

Prem Shankar Jha makes a case for solar energy while tracing the history of global warming

RAJAT GHAI



DAWN OF THE SOLAR AGE: AN END TO GLOBAL WARMING AND FEAR

Prem Shankar Jha

SAGE Publications | 308 pages | ₹ 288

IN HIS latest book, *Dawn of the Solar Age*, political economist Prem Shankar Jha, seeks to bust the myth that the world just can't do without fossil fuels; the reasons behind why the myth has been circulating for so many years, and, what a world without fossil fuels could look like. The author, who has been researching about alternative fuels since 1980, offers unique insights into the politics of global warming and dives deep into his main interest: technologies.

The world is at a critical crossroads today. On the one hand, fossil fuels have increased the concentration of greenhouse gases like carbon dioxide and methane in the atmosphere, which has caused polar ice caps to melt, sea water levels to rise and increased the number of extreme weather events. On the other hand, increased consumption is depleting the reserves of polluting fossil fuels such as coal, petroleum and natural gas. So why has the world, which has known about solar electricity for more than four decades and alternate transport fuels for almost a century, not adopted them wholeheartedly? Jha says that politicians and climate sceptics know that this will require an energy shift. And they also know such a shift would create new winners and losers and the biggest losers would

TARIQUE AZIZ / CSE

FOSSIL FUELS

be those who have heavily invested in the existing political and economic world structure. Hence, they have used multiple strategies to discredit climate science and created various roadblocks to deny space for clean alternative energy sources.

The author says that it is the free market which has encouraged attempts to discredit solar thermal in the US in the last decade. For instance, in the second term, President George W Bush Jr, allocated US \$385 million to six projects for the production of cellulosic ethanol under pressure from the US farm lobby, instead of methanol, which can be made from any kind of biomass. In Spain, the right-wing Partido Popular, which came to power in 2011, withdrew subsidies for solar energy producers, allegedly under the influence of the country's five big utility companies who wanted to protect their investment in "combined cycle gas turbine" plants during Spain's boom years. Jha reasons that a free market economy usually turns into an "oligopoly", where the established producers slow down the pace of technological changes. The most powerful route they employ is through the corridors of power.

Chosen solutions

At the same time, the author is critical of the scope of renewable energy technologies. On wind power, he says there is not enough space. With wind generation requiring a quarter of a square kilometre of land per MW—a ratio unlikely to change by much in the future—this would require a minimum of 700,000 sq km of the Earth's surface to produce 18 per cent of the world's demand

for electricity in 2050. And suitable winds are available for only 21 per cent of the year. On solar photovoltaic, he says it cannot generate power when the sun is not shining and the efficiency of solar panels decreases by half a per cent for every degree Celsius rise in temperature above ambient room temperatures.

According to Jha, only two technologies can make the difference—concentrated solar power (CSP) and biofuels like methanol generated from biomass like municipal solid waste and crop residues through a process called gasification, instead of fermentation. He says CSP does not need rare earth minerals and the performance of a CSP plant improves when the ambient temperature rises. This makes CSP especially suited for installation in tropical, equatorial, desert and arid regions, where most of the world's poor live. Replacing coal and nuclear power with CSP will not raise the cost of transmission as it does not need special steam or gas turbines.

Methanol can be produced from any kind of biomass waste, be it sewage sludge, municipal solid waste like plastics or agricultural residues. Therefore, it does not cause any disruption of the foodchain and of food prices, unlike ethanol. The book's true legacy is that it chronicles the genesis and development of the science of global warming and the often-caustic interplay of forces. ■

 @Timsah_al_Nil

Fossil fuel industry has been misdirecting people

PREM SHANKAR JHA speaks to *Down To Earth*

You are a political economist. What made you write a book on climate change?

I ventured into climate change through political economy. The twin oil price shocks of 1973 and 1979 created a serious foreign exchange crisis that had forced us to go to the International Monetary Fund for a bail out. I feared that India would be a permanent hostage to fortune and began looking for ways in which it might free itself of its bondage. I began researching on technologies that could offer an alternative such as coal gasification used by the Germans in the World War II. I realised if technologies could be brought to India it would not only end the foreign exchange constraint, but cause an agricultural revolution by making it the supplier of energy for industry and transport.



You have written about how the nexus of governments and big corporations has scuttled the adoption of sustainable technologies to replace fossil fuels.

I have mentioned about the scuttling of a project of the Massachusetts Institute of Technology to run cars on methanol in 1973 and a virulent campaign against solar thermal power in technical journals in the US in 2016 based upon the teething troubles of a single project in California. Most of the fossil fuel industry's strategies have been misdirection. In doing so, they have constantly reinforced the belief that there are no adequate substitutes for fossil fuels. That has forced governments to choose between telling the people the truth, creating panic and postponing alternative technologies.

Do you think climate skeptics, whom you term as the Business-As-Usual (BAU) lobby, have lost their argument? Or are they gaining ground once again after Trump?

The BAU lobby has lost the argument. The reason is not only the huge volumes of data gathered by the Intergovernmental Panel on Climate Change, but the dramatic rise in the number and intensity of extreme weather events in the past decade. President Trump is an aberration: he reads next to nothing, is interested in almost nothing, and, mistakes prejudice for knowledge. The US intelligentsia feels shamed by the way in which he has abdicated the global leadership role of his country.

PATENTLY ABSURD LATHA JISHNU

Those brilliant forgotten women

Women scientists were part of life-changing discoveries but they were sidelined by male colleagues in awards and patents

BEHIND MANY famous inventions or patents is a woman. Often, she is barely identified with the breakthrough that earns her male colleagues fame and fortune despite her substantial role in it, if not critical. Think of Rosalind Franklin or Lise Meitner. They were women, who made great discoveries that changed the world, and yet their names were kept out deliberately by male scientists, who took the credit and glory.

This year the annual World Intellectual Property (IP) Day, observed on April 26, was dedicated to women. At the World Intellectual Property Organization (WIPO), there were several exhibitions showcasing innovations by women. There was a screening of *Bombshell: The Hedy Lamarr Story*, a 2017 documentary celebrating the Austrian-born actress, who took Hollywood by storm in the 1940s. Lamarr created a radio system that is considered the basis of Wi-Fi and Bluetooth.

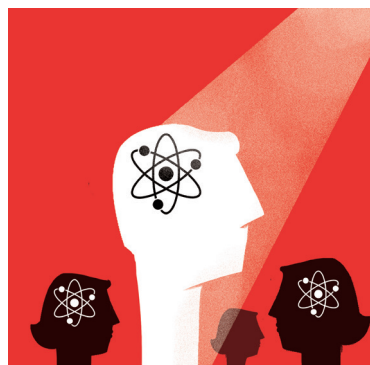
Other brainy women scientists, who worked in laboratories at a time when these were male bastions, were not so lucky. Their work was appropriated, their names erased from research. Almost everyone knows the heart-wrenching story of Rosalind Franklin and her X-ray crystallography work. When James Watson and Francis Crick published their landmark article on the discovery of the DNA's double helix structure in *Nature*, which won them a Nobel Prize in 1962, Franklin's role in it was buried in the footnotes though she was the first to capture a photographic image of deoxyribonucleic acid or DNA. Franklin, a British biophysicist at King's College, had used her especially honed technique to closely observe molecules using X-ray diffraction. Her breakthrough was captured in what was known simply as Photo 51. She was undone by an estranged male colleague, who secretly showed her photograph to Watson and Crick. It would

take Watson 40 years to admit publicly that Photo 51 had been critical in shaping their thesis.

A more harrowing story, which comes to my mind, is that of Lise Meitner. A pioneering physicist, who studied radioactivity and nuclear physics, Meitner was part of a team that discovered nuclear fission—a term she coined. But it was her colleague Otto Hahn, who was awarded the Nobel Prize in Chemistry in 1945.

She was an extraordinary woman who studied science when women were generally not encouraged to pursue higher education. Privately educated since her family could afford it, Meitner later studied physics at the University of Vienna after it opened its doors to women and focused her research on radioactivity. She was the second woman to receive a doctorate degree from the University of Vienna in 1905. But the world did recognise Meitner's crucial role and several consolation prizes were given to her. The most special was the naming of element No 109 as meitnerium in her honour.

WIPO notes that women are making a mark as inventors and patent owners, mostly in biotechnology, pharma and chemistry, but a "pronounced gender gap" persists even today. In India, a few women researchers have entered the process of patent filing and even fewer have been awarded patents for their discoveries. This was noted in a global study released by WIPO on the World IP Day. It turns out that women opted out of the patenting process midway. No reasons were given, but surely the Council of Scientific & Industrial Research ought to look into this. After all, there is now a concerted campaign to promote IP in India even in schools where it has been made part of the curriculum. With the Prime Minister canvassing regularly to make IP awareness part of Make In India consciousness, there will perhaps be a change. ■



TARIQUE AZIZ / CSE



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EDUCATION NOT ENOUGH

As a means of bringing long-term change in public attitudes, education at present is too weak and demands radical improvement

KRISHNA KUMAR

TALK ABOUT air pollution, water crisis or any other environmental problem, and someone will inevitably say, “Education is the answer.” How can you disagree with that? But I wonder if people know about the role education can play and the problems it faces in the process. Over the past 30 years, considerable effort has gone into introducing problems of the environment in the school curriculum. There are two main reasons why the effort has not impacted much—the first has to do with the larger ethos and the place of education in it, while the second lies in the system of education itself.

Let us start by looking at the first reason, recalling that the time during which environment-related concerns began to find space in the curriculum was also when economic policy emphasised increase in consumption to improve economic growth rate. Let us be a little more specific. The first wave of curriculum reform based on the National Policy on Education, 1986 began to make its presence felt in schools in the early 1990s—exactly when liberalisation and globalisation became the dominant discourse of the economy. While textbooks and teachers tried to persuade the young to conserve, the economic environment influenced people to buy, consume and dispose off.

Nothing illustrates this state of affairs more sharply than the message announced at the end of every journey of the Shatabdi Express trains: “Destroy the mineral water bottle or take it with you.” A few seconds later, one would hear a crackling sound all over the compartment—a resounding proof of the compliant, middle-class culture that education has helped in promoting.

Let us now turn to the second reason. Those who destroy the bottle act like good citizens who obey whatever the State says. Neither their upbringing nor education has trained them to apply their minds critically, else they would be concerned about the future of that crumpled plastic bottle. Had their teacher taken them for an excursion to the 60 metre-high mound of garbage at Samaypur Badli on the outskirts of Delhi, they might have spotted crumpled bottles burning away slowly, adding to the poisonous smog of the nation’s capital.

The train example shows how the two reasons I have cited work together. They tell us why environment education fails to cope with the scale at which the environment crisis is growing. The social and economic ethos impels citizens to be reckless and indifferent towards how debris of their consumption is disposed off. So long as garbage is removed from the vicinity of resi-



People who destroy plastic water bottles after hearing a train announcement obey the State. Their education has not trained them to apply their minds critically



NCERT published project books which were different from textbooks as they offered hands-on experience but carried no marks in exams. They hardly sell

dential areas, few care about where it goes and what is done to it.

Conservation of fuel and electricity is also propagated, but that persuasion is a lot gentler. As for caring for the wider geography, including rivers, forests and mountains, there are a few scattered examples of hard measures being taken, but they are not enough to counter the reckless destruction. Nothing illustrates the latter better than the Art of Living fest held in the Yamuna floodplains in 2016. The National Green Tribunal could not stop it and when it imposed a fine, it was grudging.

If we expect school education to overcome the impact of such examples set by society's venerated leaders, we must revisit our notions about education. It cannot work in isolation. Nor can it work like magic which is what people widely believe it to be. It is expected to cure every ailment, be it the malfunctioning of democracy, the decline of values or the environment crisis. It is true that there is widespread dissatisfaction with our education system which finds seasonal expression every year—once in January at the time of nursery admissions, then in March around the Board exams, and finally in July when college admissions take place. If we examine this sporadic discontent, we will grasp the individualised nature of the expectations people have from education. This kind of concern cannot translate into pressure for reforms in the system. And that is what might help in making education capable of creating common, yet deep, anxiety about the crisis related to the environment. For school education to make a difference in a matter like environmental protection, they will need to have real-life opportunities to engage with problems arising out of the present crisis.

Such opportunities mean two conditions: local inquiry, and they be given as much importance as exam-related work. These sound like asking for the moon. However, a fine example already exists in the form of the Green School Programme initiated by the Centre for Science and

Environment a few years ago. The project is an annual activity-based environmental audit as part of which children assess the school infrastructure and sources of energy. Careful record-keeping and well-organised monitoring have made it a great success story.

There are other similar stories, but the education system continues to be too rigid to assimilate them. Efforts to create greater space for dynamic work on environmental education have failed to take root. One such major effort was mooted by NCERT (National Council of Educational Research and Training) in 2009, with the publication of project books for different levels. These are not textbooks, therefore, they hardly sell. They offer hands-on experience, but carry no marks in an examination (NCERT doesn't conduct exams). There are few takers for such ideas in our school system. At the undergraduate level too, the scene is not very different, and no one seems to be particularly concerned. That, I feel, is the real problem.

Delhi presents a similar case. Residents say they are concerned about air pollution, but it does not reflect in their actions. Getting sick every now and then is accepted as life's reality. An equilibrium has been reached between occasional alarm and routine apathy. Educational effort can't break it or make an immediate impact on it. Nor can education by itself settle the conflict of interest. Public awareness and anxiety on environment issues will have to rise to a much higher level before the interests vested in polluting industrial production and exploitation of scarce natural resources can be effectively challenged. As a means of bringing long-term change in public attitudes, education demands radical improvement within its own system. Today, it is too weak to serve as a means of fighting the crisis of environment which is getting graver and deeper by the hour. ■

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Quotable Marx

On the 200th birthday of Karl Marx, an abridged selection of his memorable statements on the environment

THE WORLD is celebrating the 200th birthday of Karl Marx, interestingly with unusual celebratory moods. The contemporary context of the deep polarisation on environment-capitalism line has added a new dimension to the much talked about notion of Marx as an anti-environment theorist. There are lots of writings on his understanding of environmental issues. *The Ecologist* magazine wrote on him: "Environmentalists found value in Marx, but not in his ecological analysis." Taking a break from the usual format of this column, here are some of his notable observations on the environment.

- "As for the farmer, the industrial capitalist and the agricultural worker, they are no more bound to the land they exploit than are the employer and the worker in the factories to the cotton and wool they manufacture; they feel an attachment only for the price of their production, the monetary product."
- "Nature is man's inorganic body, that is to say, nature in so far as it is not the human body. Man lives from nature, i.e. nature is his body, and he must maintain a continuing dialogue with it if he is not to die. To say man's physical and mental life is linked to nature simply means that nature is linked to itself, for man is a part of nature."
- "The 'essence' of the fish is its 'being', water... The 'essence' of the freshwater fish is the water of a river. But the latter ceases to be the essence of the fish and so is no longer a suitable medium for existence as soon as the river is made to serve industry, as soon as it is polluted by dyes and other waste products and navigated by steamboats, or as soon as its water is diverted into canals where simple drainage can deprive fish of its medium of existence."
- "We presuppose labour in a form in which it is an exclusively human characteristic. A spider conducts

operations which resemble those of the weaver, and a bee would put many a human architect to shame by the construction of its honeycomb cells. But what distinguishes the worst architect from the best of bees is that the architect builds the cell in his mind before he constructs it in wax."

- "[i]n London...they can do nothing better with the excrement produced by 4 [and a] 1/2 million people than pollute the Thames with it, at monstrous expense."

- "The combustion of a pound of coal or wood restores to the air not merely the elements needed to reproduce this pound of wood or, under certain conditions, coal, but the process of combustion in itself transforms a certain quantity of nitrogen in the air into a nutrient indispensable for the production of bread and meat."

- "Even an entire society, a nation, or all simultaneously existing societies taken together, are not the owners of the earth. They are simply its possessors, its beneficiaries, and have to bequeath it in an improved state to succeeding generations."

- "Association, applied to land,...reestablishes, now on a rational basis, no longer mediated by serfdom, overlord-

ship and the silly mysticism of [private] property, the intimate ties of man with the earth, since the earth ceases to be an object of huckstering."

It is said that Marx was just 40 when scientists started theorising on human-induced climate change. His writings always insisted on the perils of alienation of human society from nature. That is precisely what is happening now. ■

(Note: Above quotes have been excerpted from various published papers by historians and also from a few essays by Marx)

@richimaha

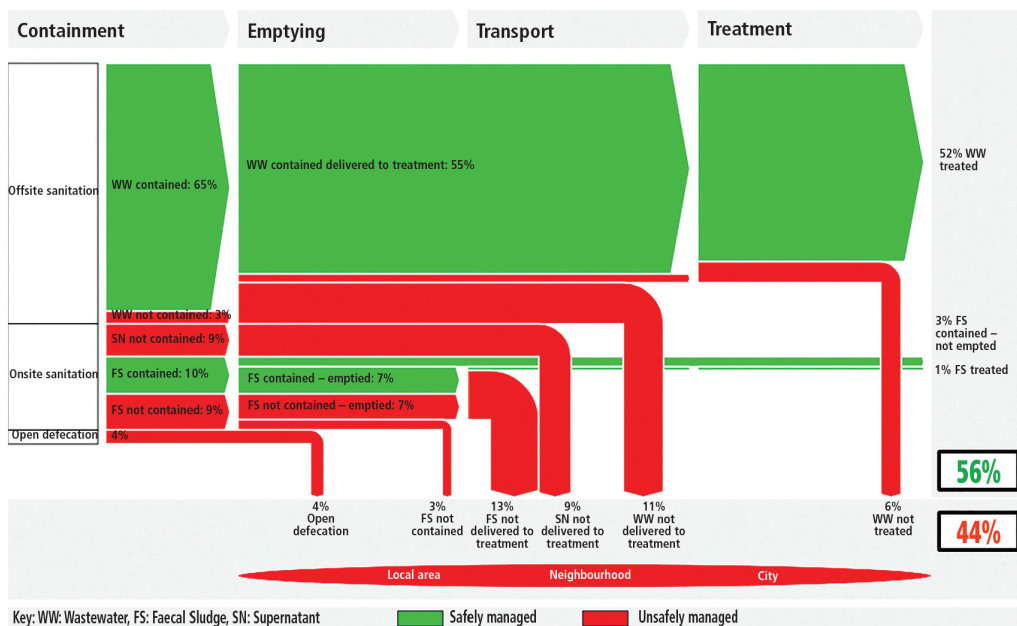


TARIQUE AZIZ / CSE

SHIT FLOW DIAGRAM (SFD)

The School of Water and Waste Management, AAETI is launching an online course on preparation of Shit Flow Diagram. The course is designed for practitioners, academicians, consultants, students and researchers.

Safe or unsafe? A shit flow diagram for Delhi that tracks excreta through four stages



To know more about SFDs, visit <http://sfd.susana.org/>

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Excreta flow diagrams (also often described as shit flow diagram, SFD) are increasingly being used to analyze the sanitation situation in urban areas. Where the SFD is a visualization tool that summarizes complex information into an easy-to-understand graphic, as it simply shows how excreta is or is not contained along the sanitation chain.

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Register here

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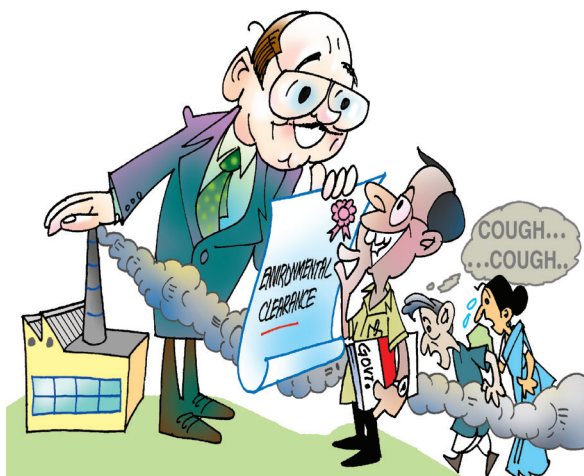
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The Center for Science and Environment (CSE) is conducting a five-day training programme aimed at giving practical exposure to participants on Environmental Management and Compliance in Mines for mining and mineral industry from 25–29 June 2018.

The minerals sector is a key driver of the country's industrial growth. However, it has brought in its wake severe environmental repercussions and social conflicts. One of the greatest challenges, therefore, is how to make mining environmentally and socially acceptable.

There is a genuine need to develop the capacity of those involved in the mining industry, including environmental consultants, mining professionals, project proponents, compliance authorities, academics and NGOs to understand the issues, and identify and implement solutions for the overall interest of communities and the nation.

Take away from the programme

1. Legislative framework—Acts and policy for mine management and compliance.
2. Advancement in mining technology and how technology is used for environmental management.
3. Overview of mining operations, issues, impacts and challenges.
4. Air quality management in mines.
5. Water Management in mines (ground and surface water including mine's seepage water management).
6. Waste management.
7. Mine closure plans—International and National best practices.
8. Star rating, key performance indicators for mines rating.
9. Mine inspection, audit and its reporting.
10. Mine safety management and its compliance reporting.
11. Key performance indicators to assess environmental and social sustainability reporting.
12. Preparation of an environmental management plan (EMP), including budget estimates.
13. Benefit sharing practices like District Mineral Foundation (DMF), Corporate Social responsibility (CSR), etc.

For registration: kindly email at Sujit@cseindia.org



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