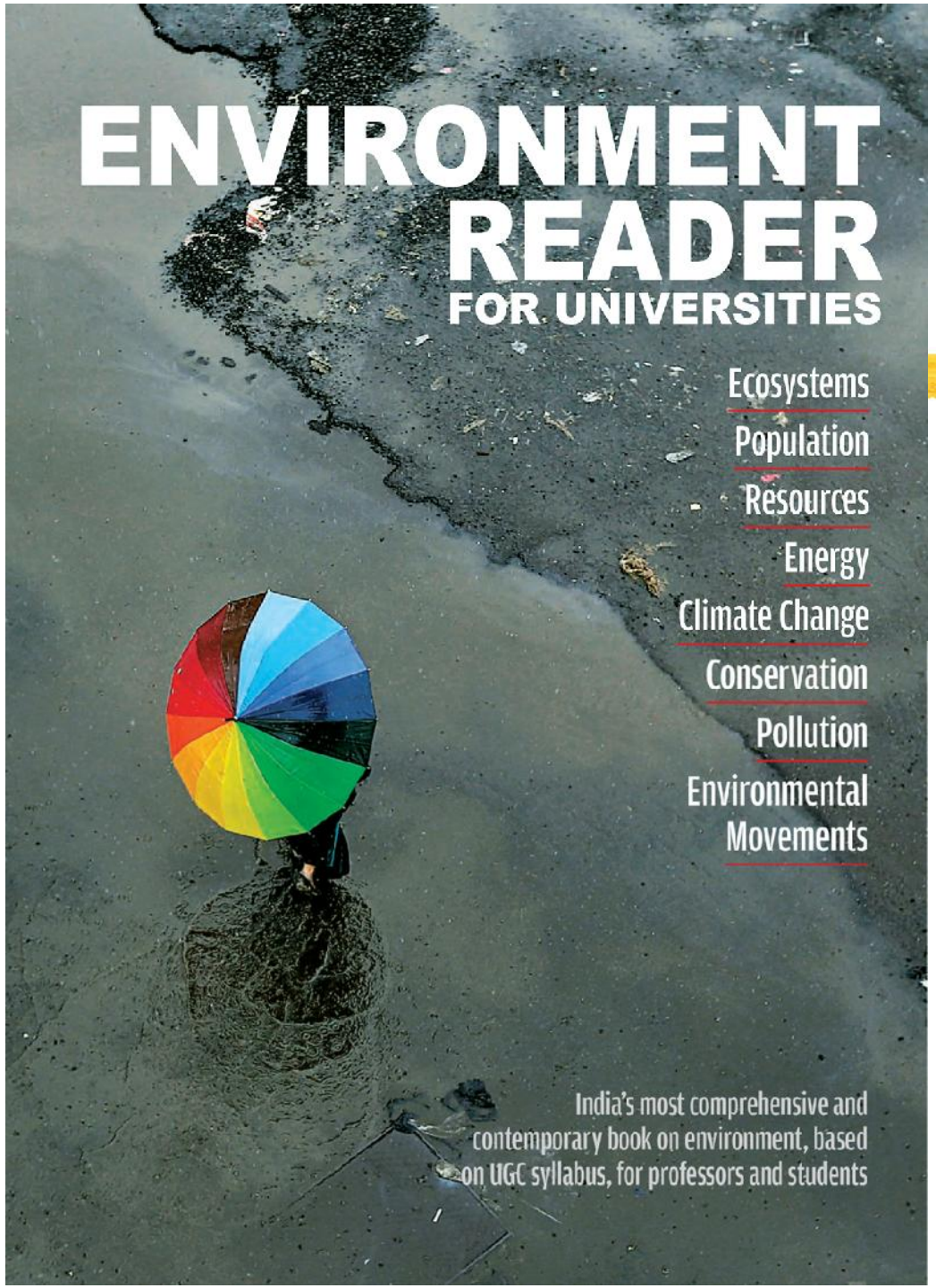

Challenge of environment

Sunita Narain
CSE

Down To Earth

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HOW TO NAVIGATE

The *Environment Reader for Universities* is not only based on the University Grants Commission (UGC) syllabus for environmental studies for undergraduates, it also replicates a classroom experience for better understanding and comprehension.

A short guide on how to read this book:

SUMMARY
A short analysis that helps you get a contemporary perspective on the subject

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They capture the basics and key recent developments like a teacher would explain a subject, offer an argument or pedal a perspective

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ENVIRONMENTAL LAWS
This section will help you explore the subject by explaining the relevant laws

Our Reader

CONTENTS

FOREWORD

Relearning our footprints

Environment is central to the business of achieving inclusive growth and development, because only then can it be made sustainable

This is the age of the environment. This is also the age of the anthropocene—a period during which human activities have been the dominant influence on the environment and climate. Globally, it is clear that climate change is happening and it has made economies and people insecure. Weather will change: it will become more variable, extreme; and, will lead to increased threats of disasters like cyclones, sea storms, droughts and floods. Climate change has been created because of human-made emissions, largely because of the fuel we use to run our industries, houses and economies. So, it is we who must now learn (or re-learn) the art and science of building futures, without destruction.

It is for this reason we must learn environmental issues. This is about our economies; our future survival; and, our well-being. Environment is not yesterday's concern. It is not peripheral to the real business of governance or the real business of providing basic services to meet the needs of all. In fact, it is central to the business of growth. But it is also (central to) inclusive growth, because only then it can be sustainable.

So teaching and learning environment is about everything in our lives. This is the connection we need to learn. Environmental studies are a textbook of the world around us. It is also about the inter-connections that make life—all subjects, from chemistry and geography to history and biology come together. The best way to imbibe environmental studies is then to learn from events that are happening around us.

But there is a reason environmental studies can never be a textbook. There is no one solution to the problem of environmental management. What works in some cases, may not work for another situation. Also, even as we find that we have a solution, another problem will emerge and take us back to the drawing board. The way to learn environment then is to learn to ask questions—being open, curious and, most importantly, humble enough to admit that we do not know enough about the environment.

Objective

Build understanding on the following

a. **Imperative of environment:** what is happening around us; why it matters

b. **What needs to be done?** Why is environment linked to development?

c. **How it needs to be done?** What is inclusive, affordable and so sustainable development?

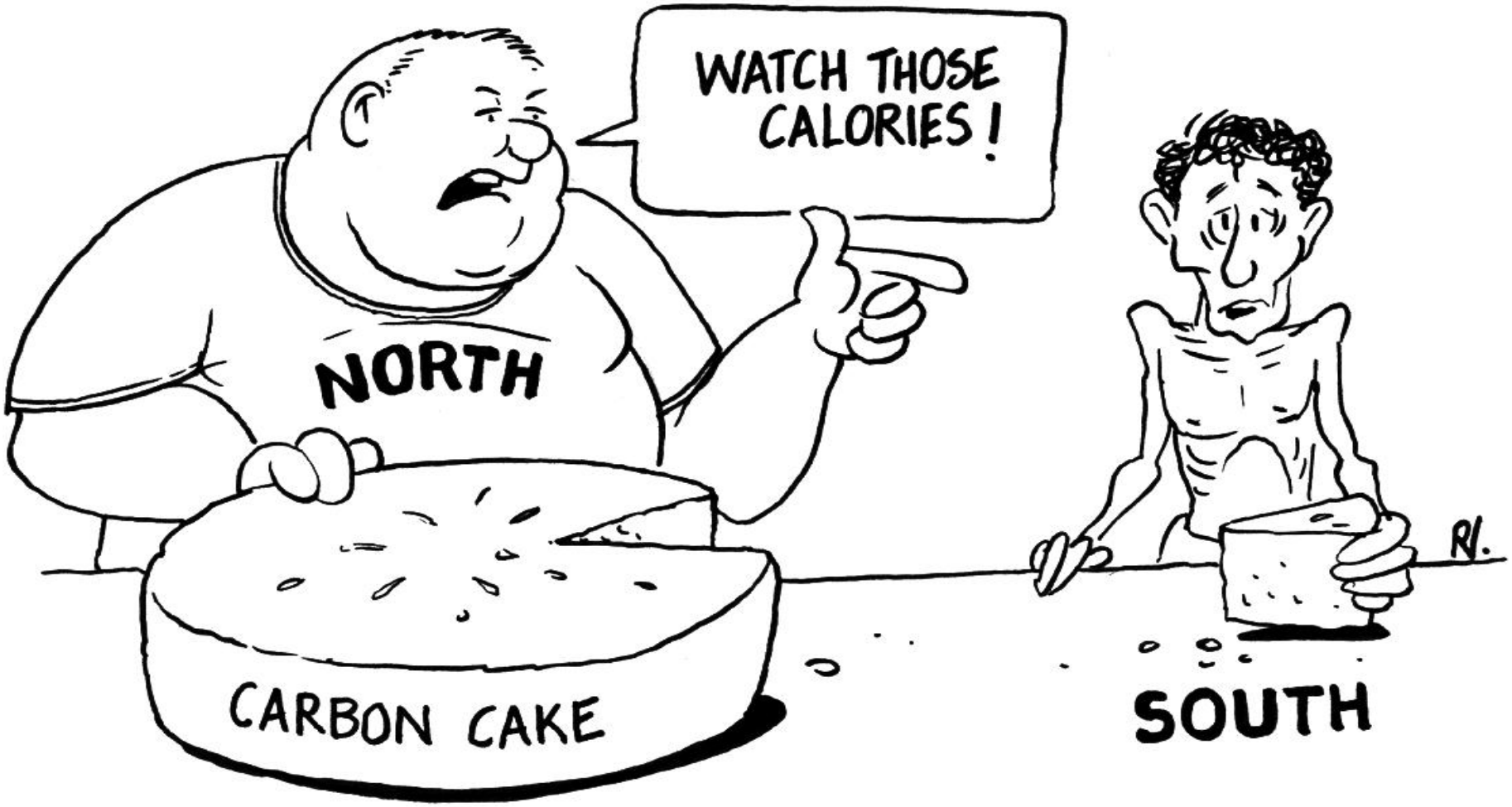
Our world today…

- Is in crisis
- Climate change is happening; not about the future. **But now**
- Leading to variable weather events
- Leading to devastating impacts on the poorest, who are not responsible for stock of emissions in the atmosphere

Growth-climate linked

- No country, as yet, has learnt how to get rich without emissions
- US is moving from coal to gas (still fossil); EU is moving back to coal;
- Effort is to keep energy costs low – consumption increases. Negates all efforts to curtail emissions
- Add challenge to **share that growth between nations**; between people

Acceptable???



Our challenge even greater

- We are seeing toxification of our environment at scale and pace never seen
- Growth is taking a toll
- We don’t have resources to spend to clean up after we have polluted
- **We don’t have resources to keep spending as we “clean” up**

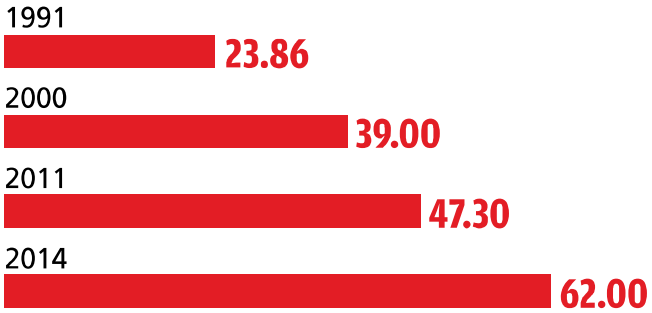
Drowning in our own waste: Cannot manage to clean as we produce

PILING PROBLEM

Studies show that India's waste has more than doubled in the past 25 years

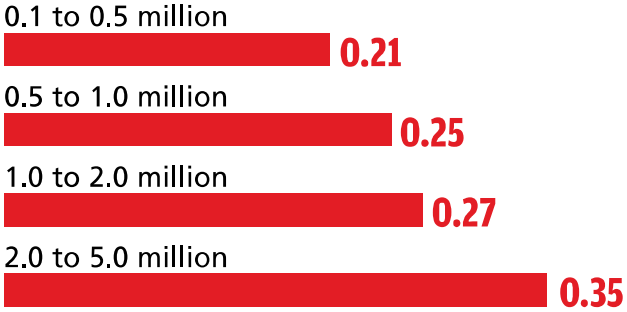
Solid waste generation in India

(Million tonnes/Year)



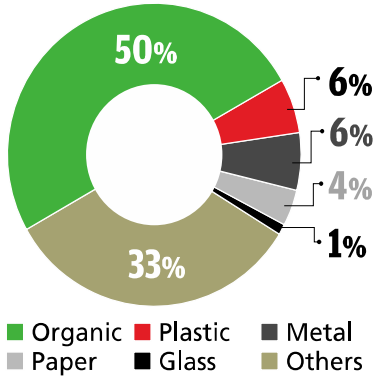
Source: Compiled from research papers and available documents (DEA and CPCB)

Per capita waste generation according to city population (Kg per capita per day)



Source: Strategy paper on solid waste management, 1995, NEERI, Nagpur

Composition of waste in India



Source: What a Waste, 2012, World Bank

STATE OF AIR QUALITY

Breathing toxins

Air pollution levels in all Indian cities far exceed permissible limits. An action plan is urgently needed

The World Health Organization (WHO), after studies conducted in 124 cities, revealed in 2014 the presence of high levels of microscopic air pollutants in the air we breathe in India. The level of particulate matter (PM) with a diameter of 10 microns or less, known as PM10, exceeded the WHO air quality standards of 20 $\mu g/m^3$ (microgramme per cubic metre) in all cities assessed. Fine particulates with a diameter of 2.5 microns or less, or PM2.5, too exceeded the WHO standard of 10 $\mu g/m^3$ in all cities, except Pathanamthitta in Kerala. Apart from the particulates there are other air pollutants like carbon monoxide (CO), nitrogen oxides (NO_X) and sulphur dioxide (SO_2) that are constantly spewed into the atmosphere due to human activities. Together, these air pollutants have become one of the top 10 killers in the world, says WHO's *Global Burden of Disease* (GBD) report, released in December 2012. According to the report, air pollution killed 627,000 Indians in 2012 and is the fifth largest killer in the country.

According to the latest WHO data released in May 2016, some 10 of the 20 most polluted cities in the world are located in India. Gwalior, Allahabad, Patna and Raipur are in the top 10. Delhi is at 11. According to the daily Air Quality Index (AQI) that the Central Pollution Control Board (CPCB) released in 2016 for 32 cities, Kanpur, Lucknow and Faridabad had witnessed worse air quality than Delhi on different days in the first two weeks of November 2016. Varanasi and Allahabad also did not observe even a single day of "good" air quality in more than 220 days when measurements were taken.

Clearly, air pollution is a national crisis, and with growing concerns over the impact of air pollution on public health, the Union and state governments need to formulate strategies to curb pollution by enforcing stringent measures to combat air pollutants.

According to a study published in *Environmental Science and Technology* in 2015, 45 per cent of Delhi's premature deaths could have been avoided if the city took preventive measures. Across India, 400,000 premature deaths a year could be avoided if the authorities meet the WHO standard of 10 $\mu g/m^3$, which is four times more stringent than the national standard.

To achieve effective pollution control standards, India will have to first control dieselisation. The country will also have to speed up its technology roadmap to clean up diesel and ensure that the new technologies deliver on their intended emissions reduction targets. The unprecedented move to skip Euro V emission norms for vehicles and fuels altogether and leap directly to Euro VI or Bharat Stage VI (BS-VI) emission standards by 2020 guarantees enormous health benefits. Leapfrogging to BS-VI will bring clean diesel fuel to India—in case of cars, PM emissions will reduce by 82 per cent and NOx by 68 per cent from BS-IV levels. PM and NOx emissions from two-wheelers will reduce by 89 per cent and 76 per cent; and, PM and NOx emissions from trucks and buses will drop by 50 per cent and 89 per cent.

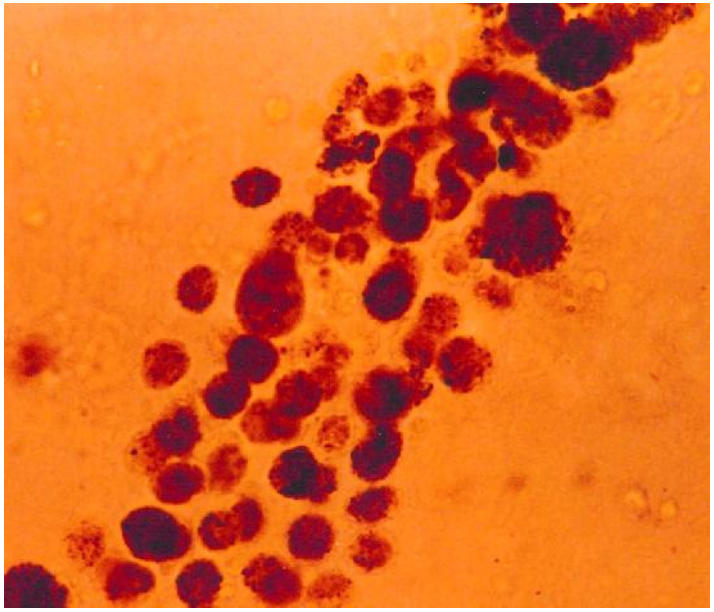
The switch to new standards by 2020 will also address the pollution caused by two-wheelers and trucks. Two-wheelers, though affordable and fuel-efficient, significantly contribute to the particulate load in cities. India will get PM emissions standards and on-board diagnostic systems for two- and three-wheelers that will give alerts about engine malfunction and wayward emissions. This is expected to lead to a paradigm shift in two-wheeler technology.

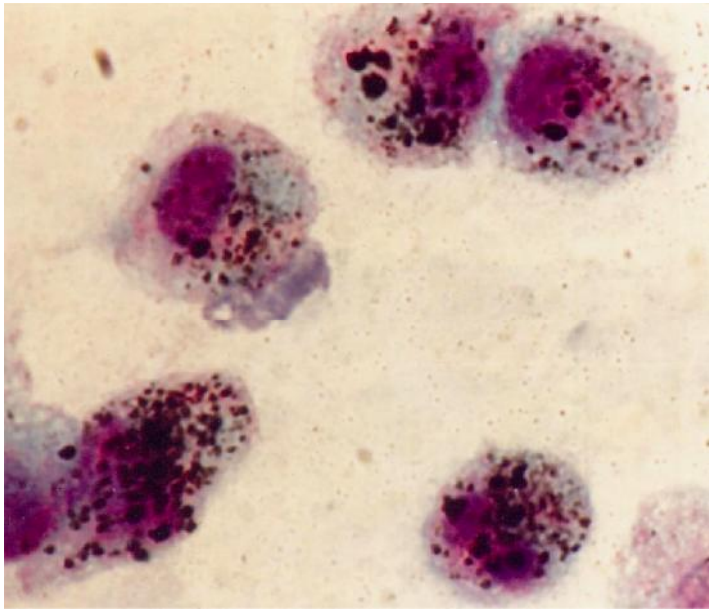
Deadly for our health
Not dust. But toxin in air

- **2012 epidemiological study on children in Delhi. Covered 11,628 school-going children from 36 schools**

- **Every third child has reduced lung function. Sputum of Delhi's children contains four times more iron-laden macrophages than those from cleaner environments, indicating pulmonary hemorrhage**

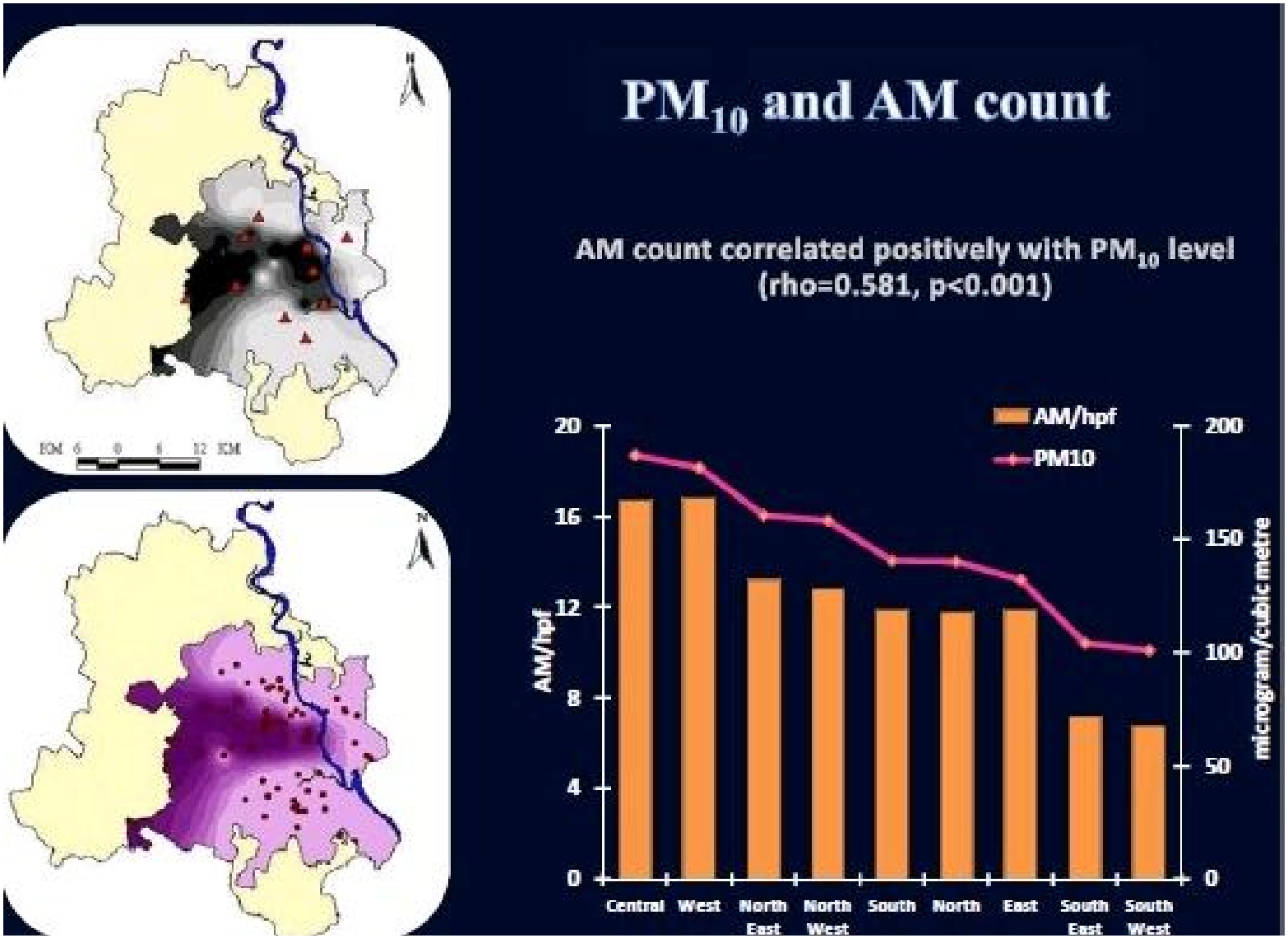
Alveolar macrophage: the biomarker of air pollution





Sputum cytology of a 14-year old girl, showing abundance of particle laden AM

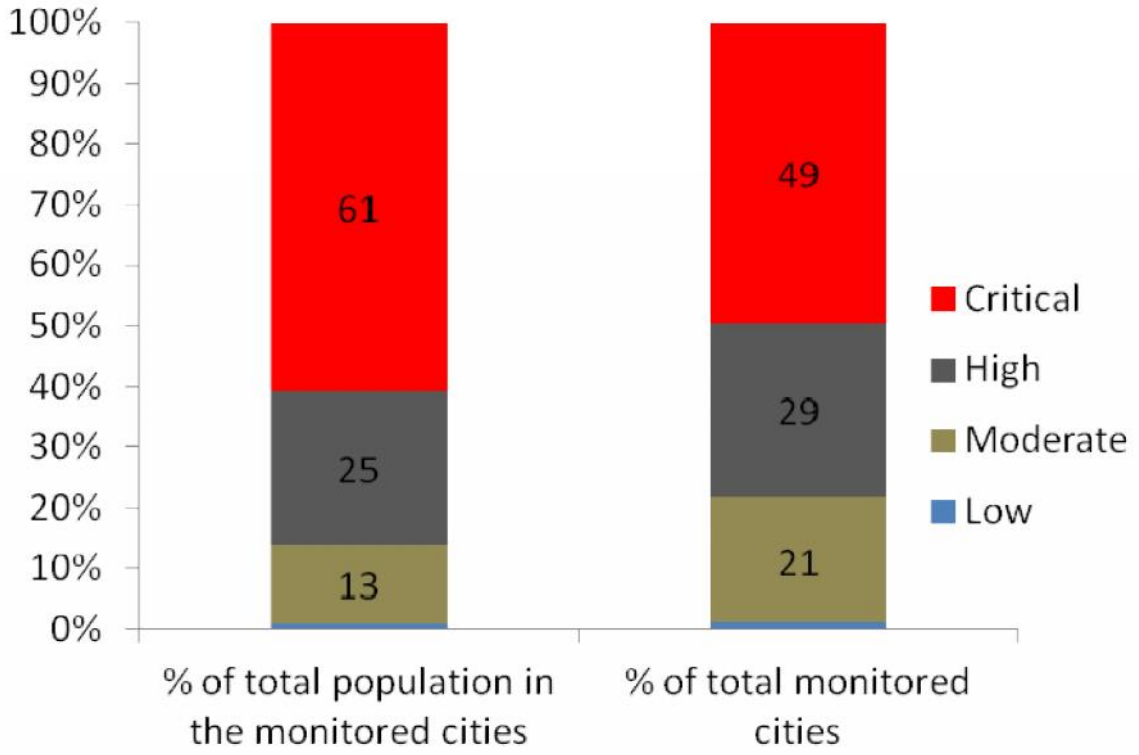
Study co-related lung damage high pollution levels in Delhi: global evidence even clearer



In Indian cities air is toxic: bad for health

50% of cities monitored are critically polluted for PM10

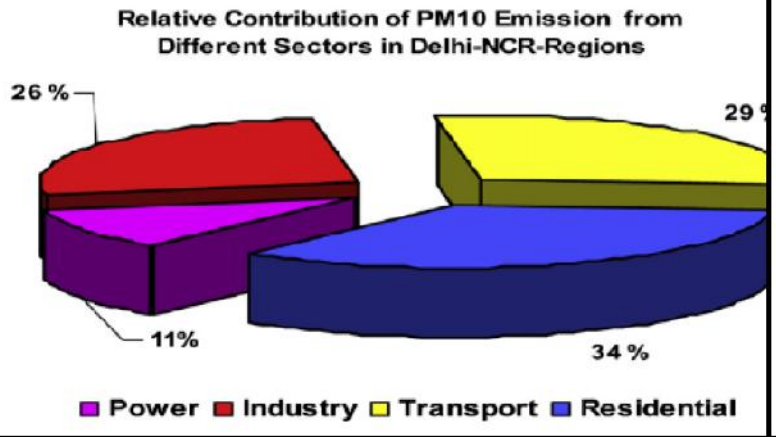
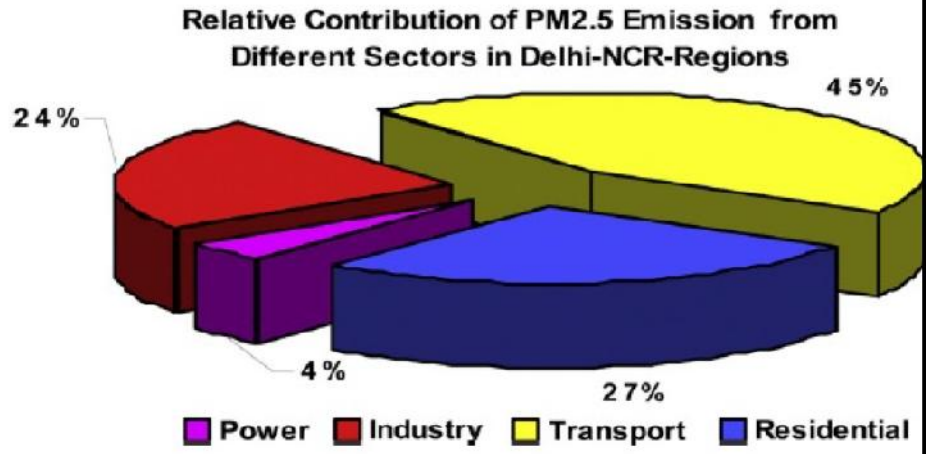
This is growing Public health burden



Source: CSE based on CPCB air quality data and Census population data

Why pollution?

Size of particulate matters: smaller and more deadly comes from transport; larger from construction/residential

Sources of PM10 in Delhi	Sources of 2.5 in Delhi
	

Source: Ministry of Earth Sciences, 2009

Smart is not what we are doing today

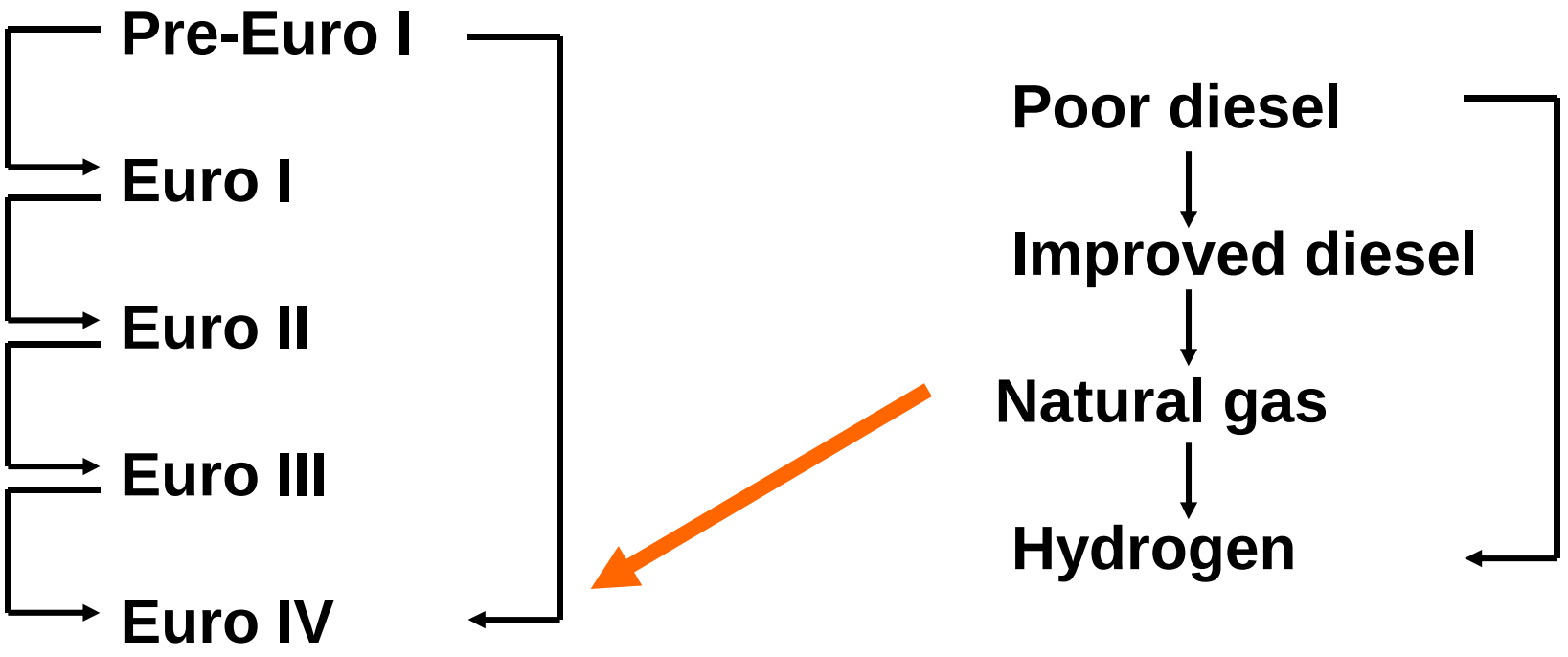
- How do we build really ‘smart’ cities
- Smart is as smart does
- This is not smart – cities with foul air and unacceptably high health burden
- **How?**

Trajectory of pollution: staying behind the problem

- Mid-1980s; **SPM** – cleaned fuel; invested
- Mid-1990s; **RSPM**; **PM10**; **PM2.5** – Improved engines; mass of particles went down; but so did size: again invested
- Mid-2000; **NOx** – higher temperatures for particulate control; again invested
- Now **black carbon**; **ozone**, **climate change…. No effort to reduce the number of vehicles**

Leapfrog

CNG leapfrog jumped us beyond Europe. Big solution; not incremental. What can we do now?



Must recognise the threat and opportunity

Cars occupy 90 per cent of road space in cities

Cars have not replaced the bus, the bicycle or walking

Cars have only marginalised the bus

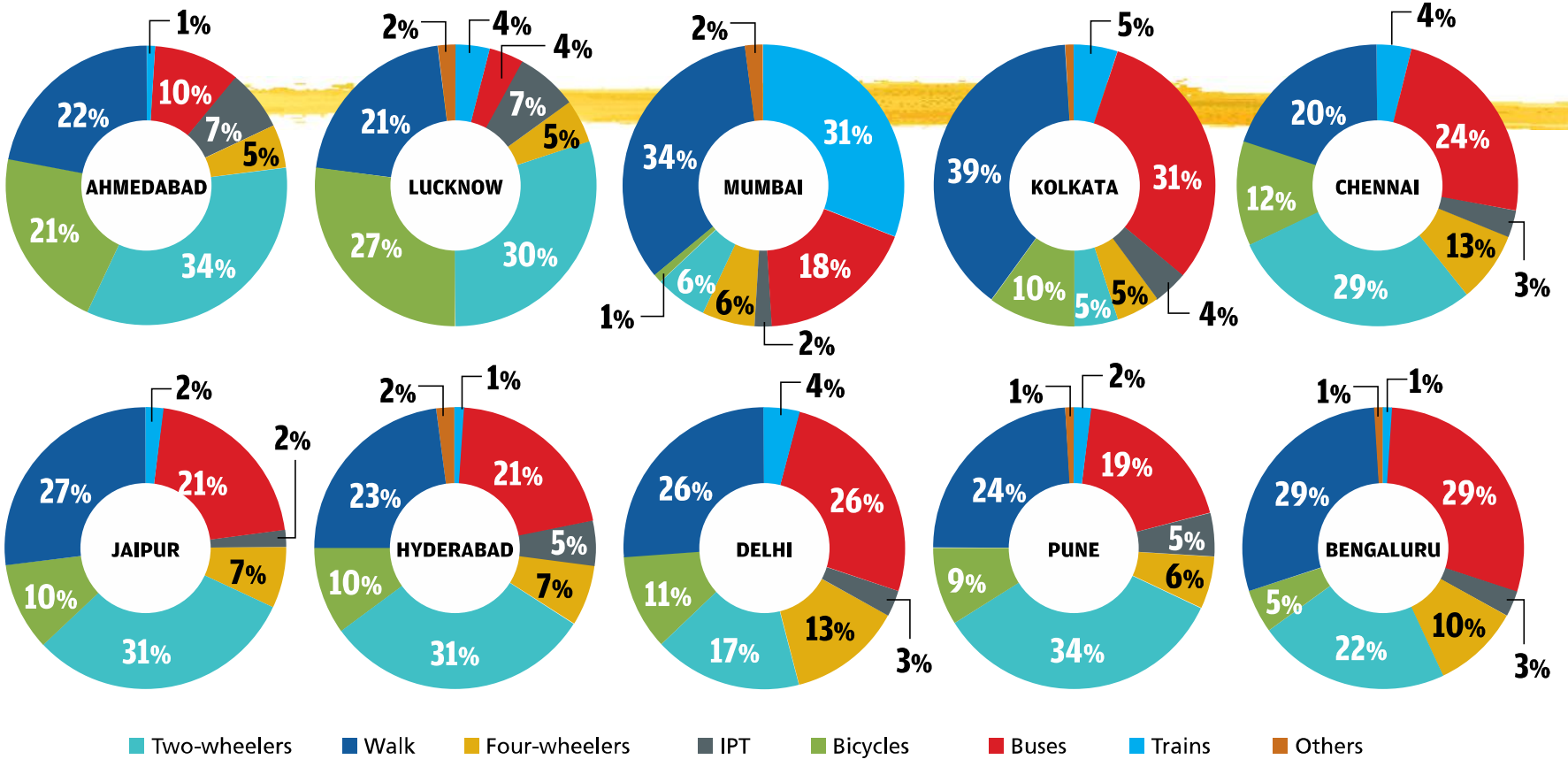
40-60% use bus

10-20% cycle

20-30% walk

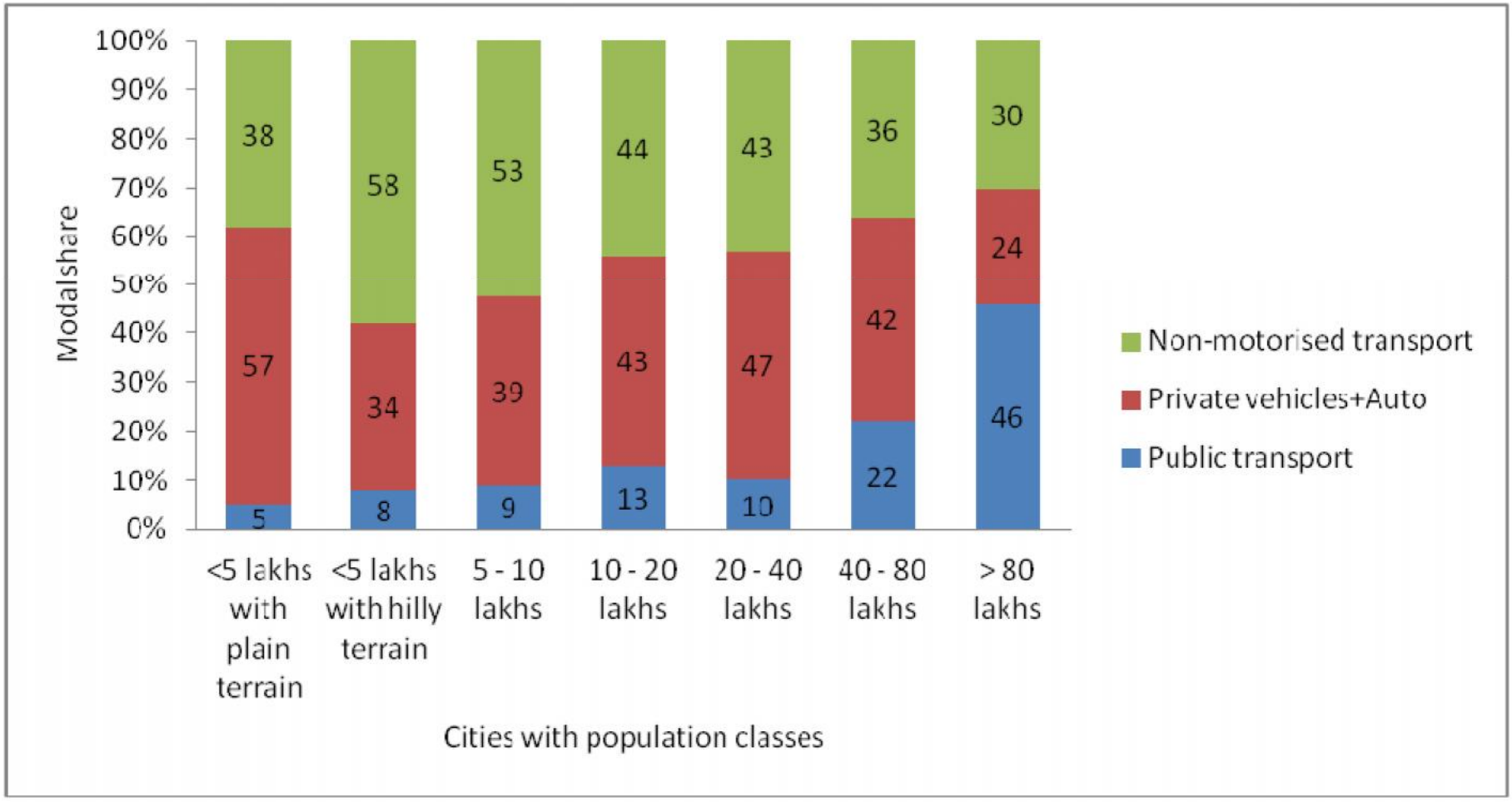
Only **10-20% use car+2-wheeler**

MODE OF TRAVEL TO WORK IN MAJOR MILLION PLUS POPULATION INDIAN CITIES



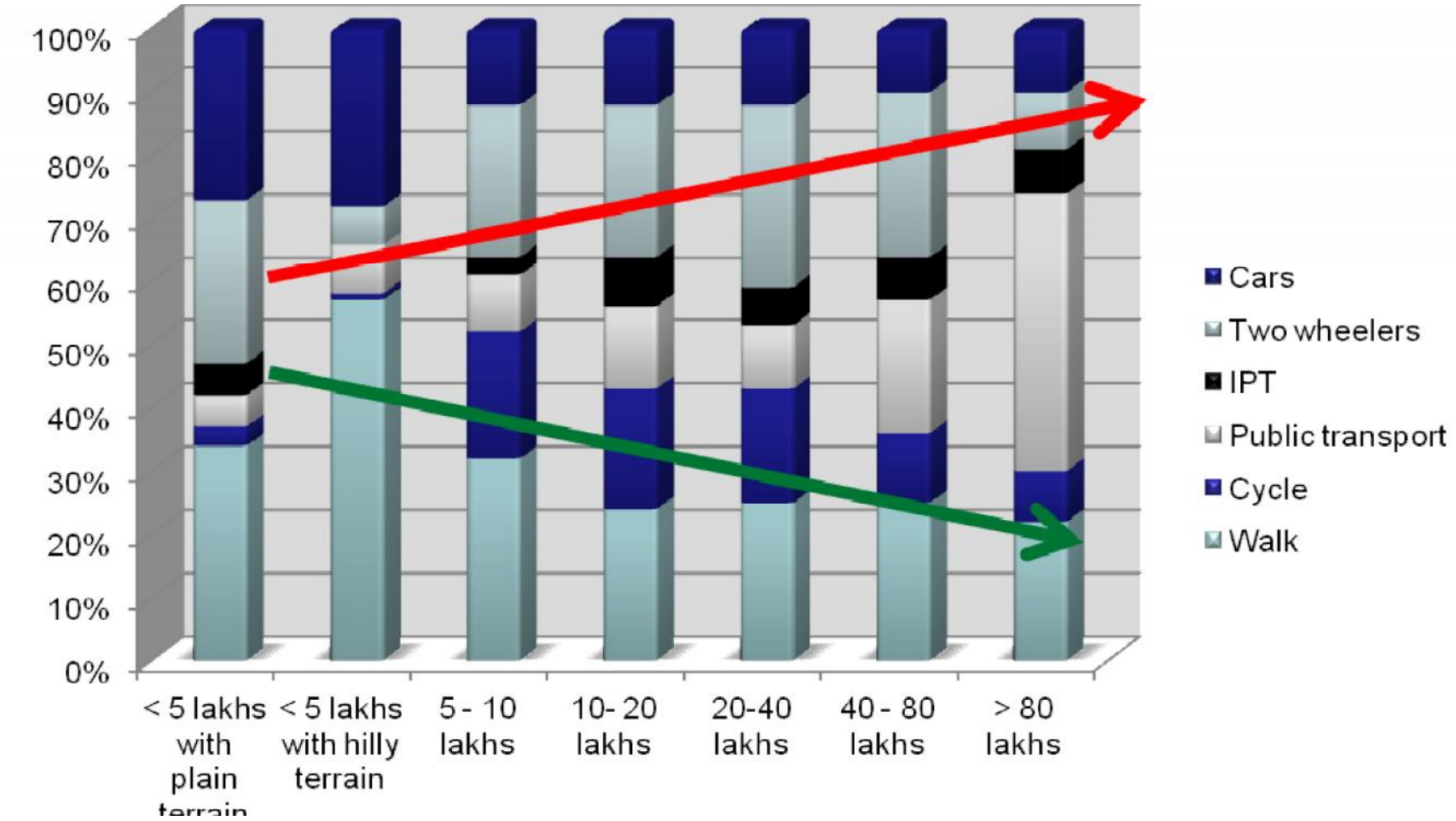
Source: Census 2011

The opportunity
We walk and cycle because we are poor



Source: Based on: MOUD 2008, Study on traffic and transportation policies and strategies in urban areas in India, Wilbur Smith Associates, Ministry of Urban Development, May

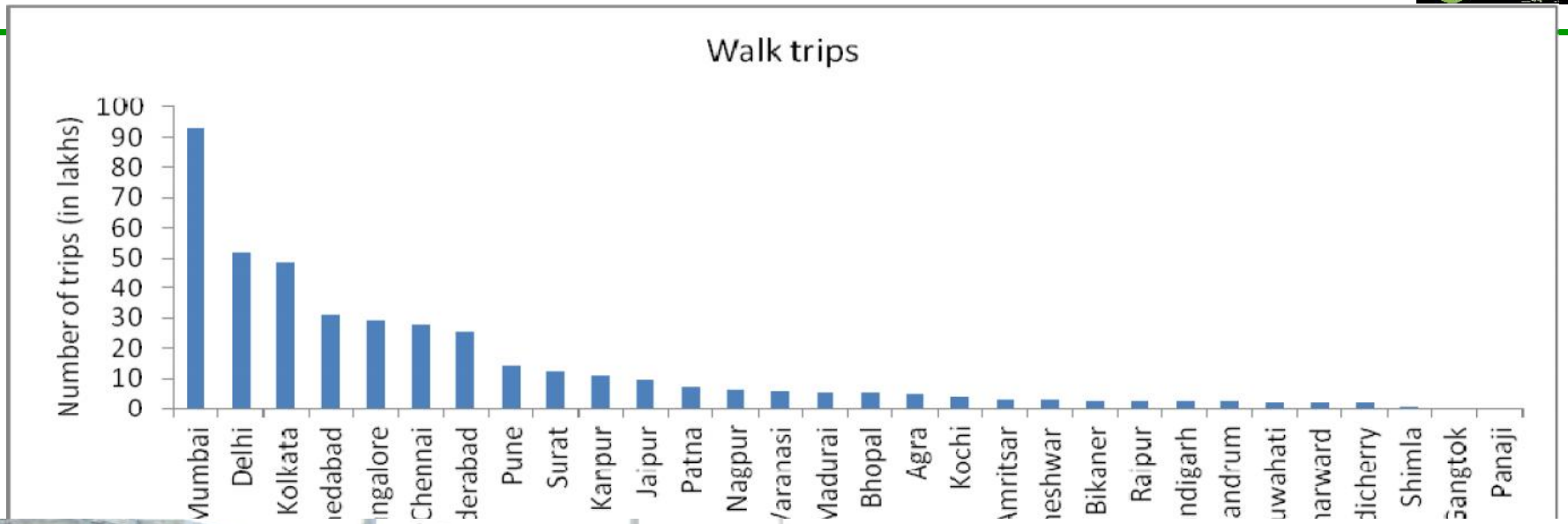
How can we walk, cycle, bus when and because and when we are rich?



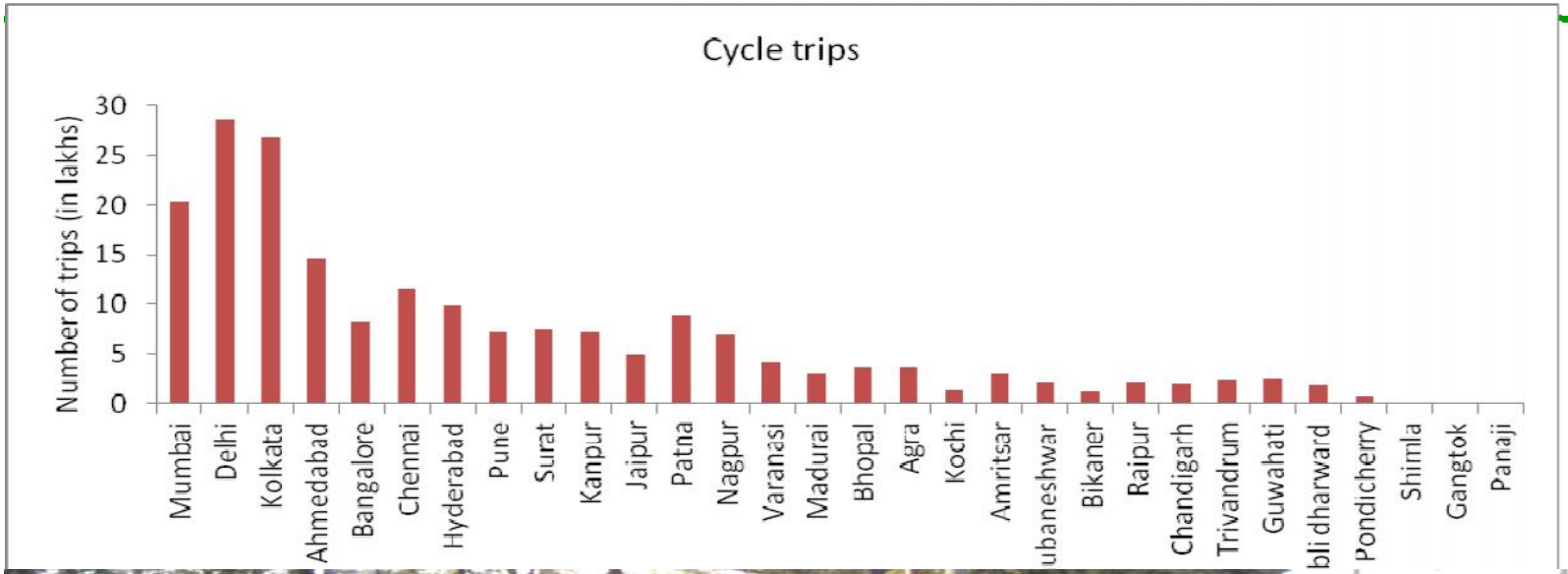
Each and every trip begins and ends as walk trip. No right to clean air without right to walk

Source: CSE

Mumbai, Delhi, Kolkata, Chennai: Still very high count of walk trips

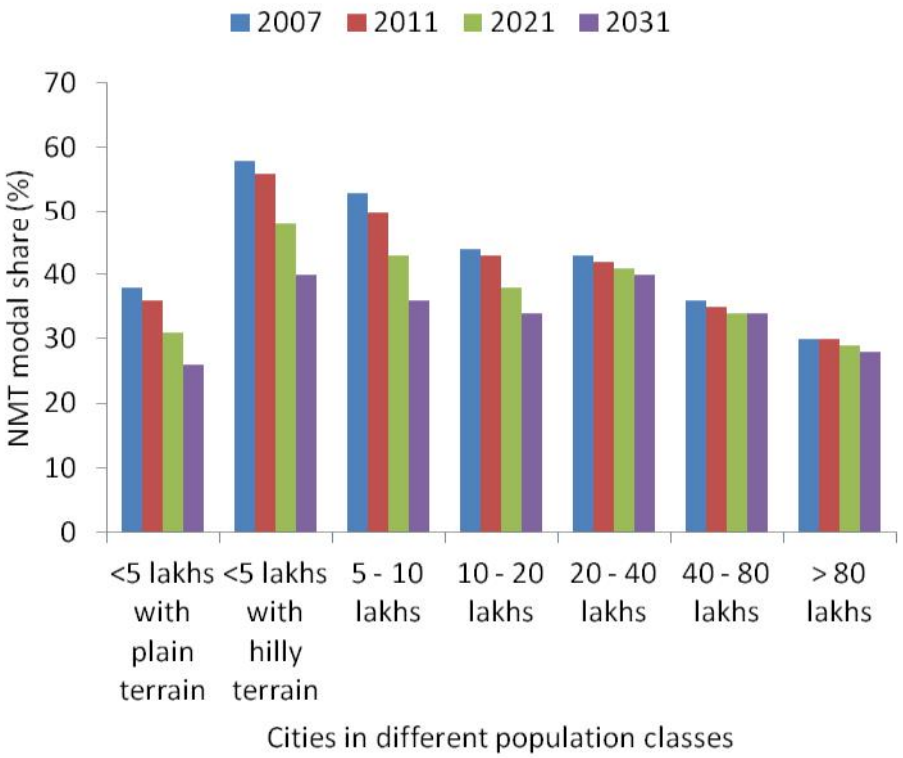


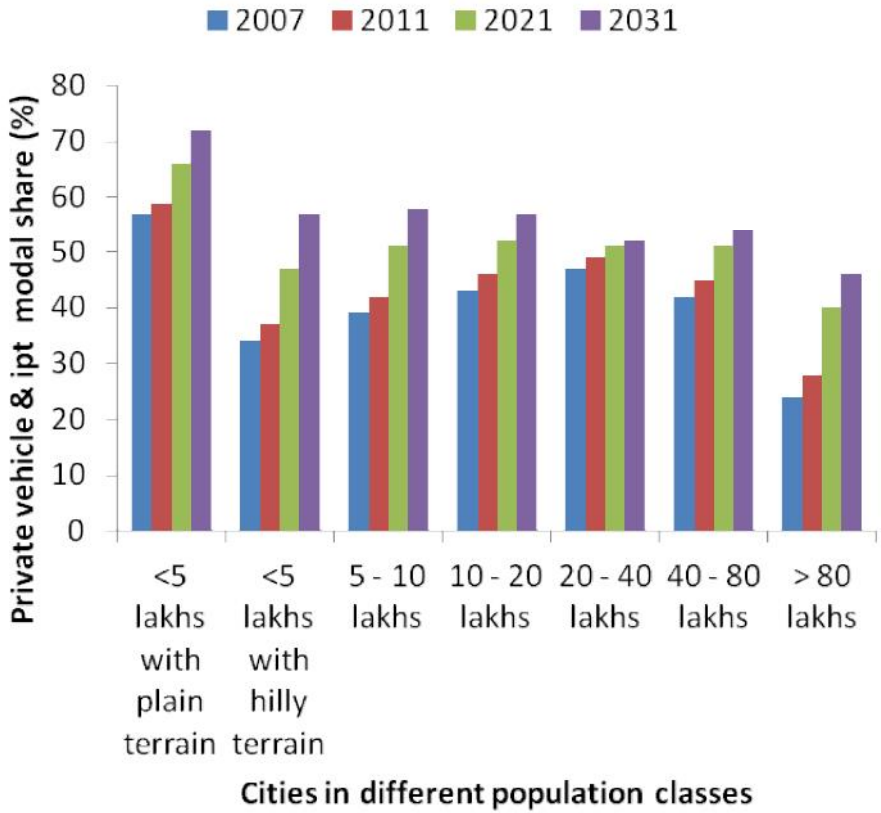
Delhi, Kolkata have the highest count of cycle trips



But we will take the car as we get rich

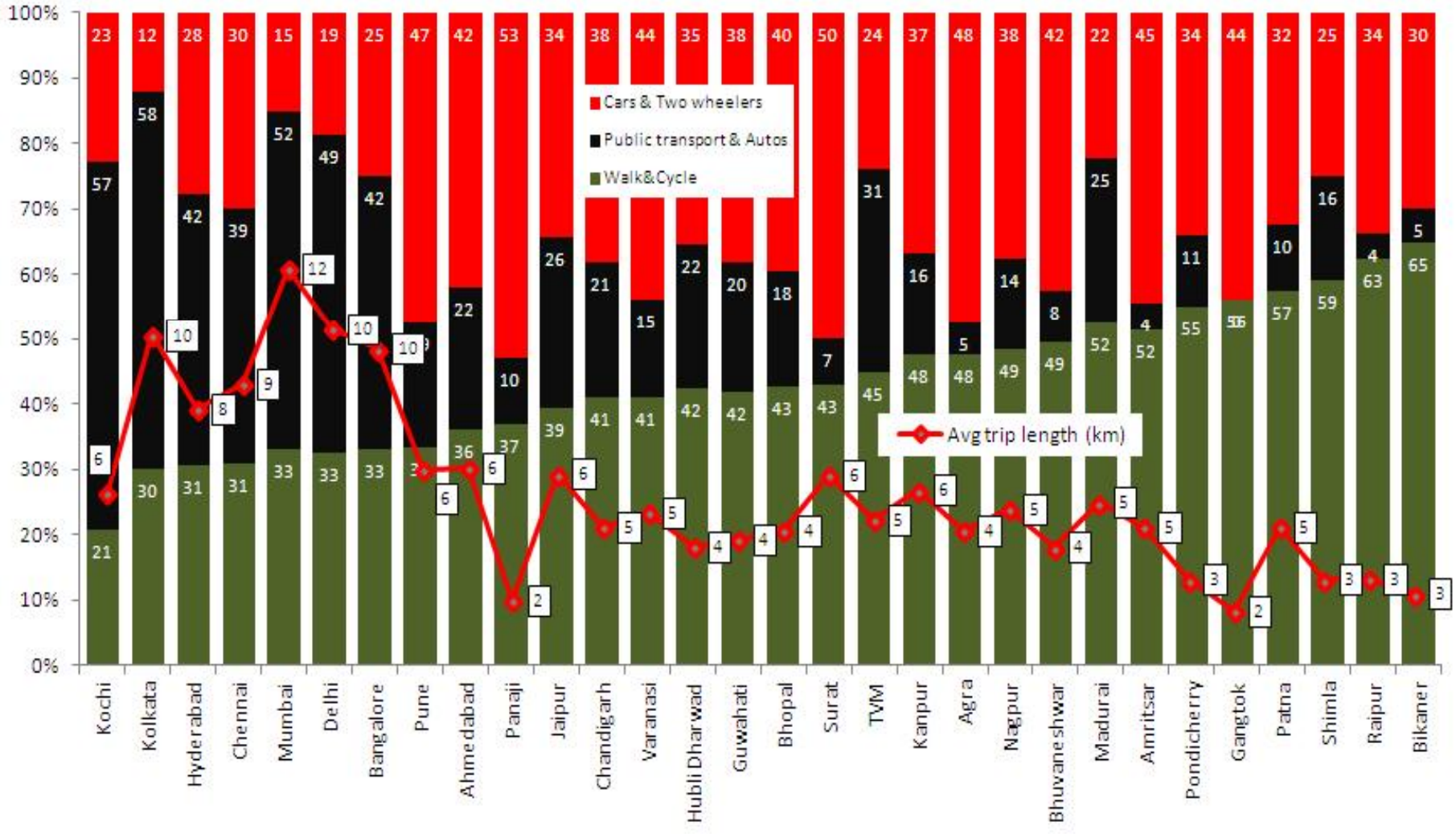
Personal motorised travel to gain about 20% additional modal share in most city categories until 2031. Deadly for air. **NOT SMART**





Source: CSE based on MOUD/WSA data 2008

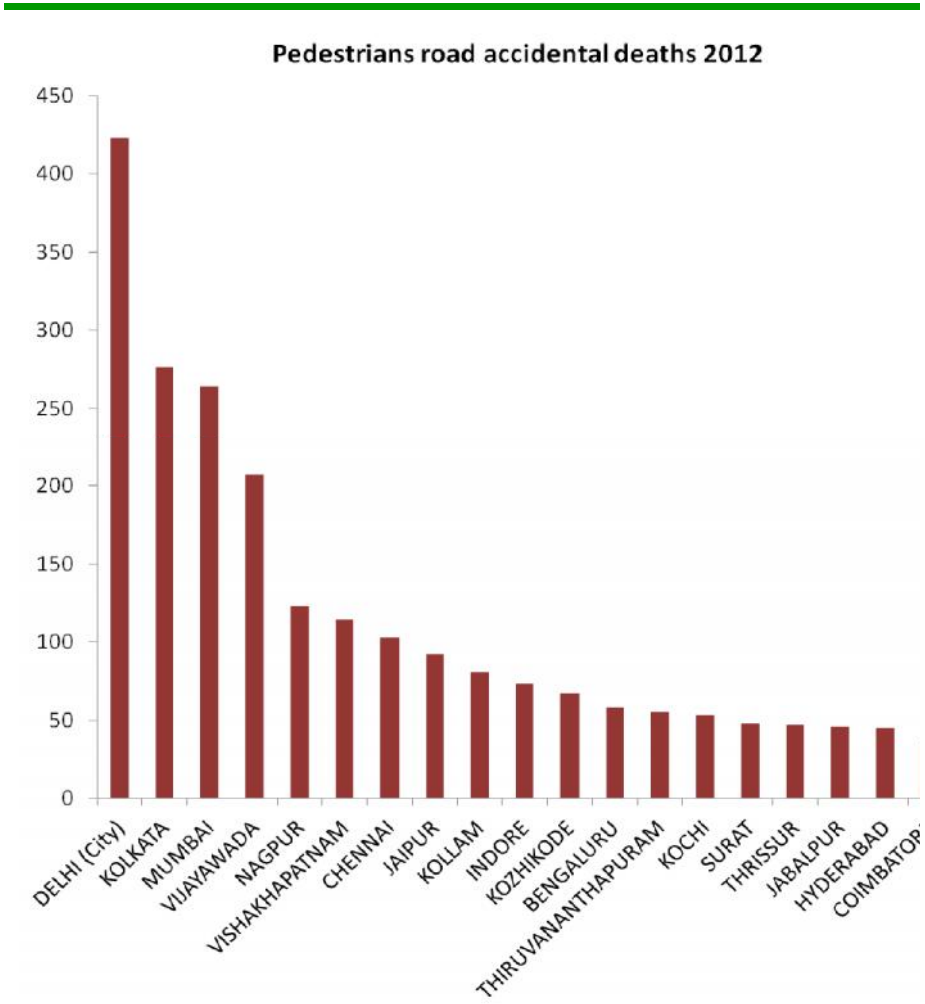
Compact cities have shorter trip length, more walking and cycle share and less CO2 emissions

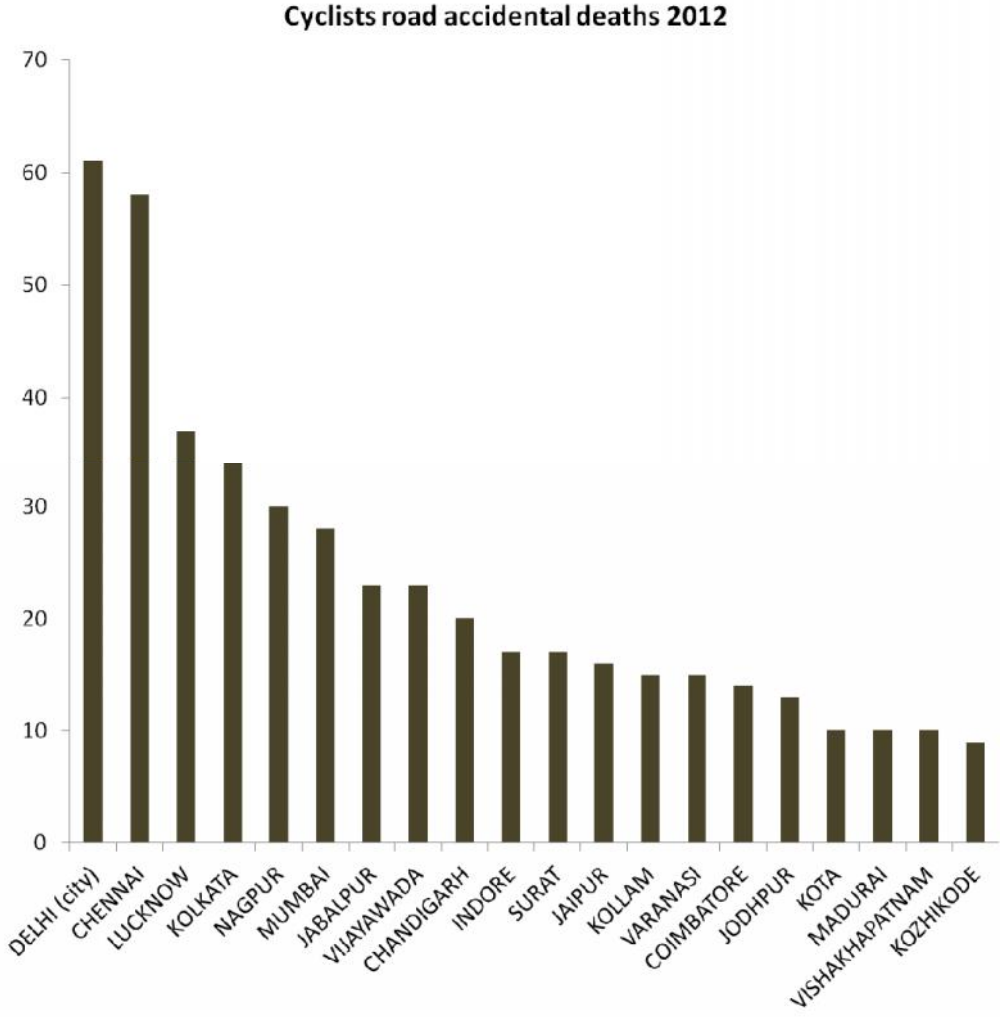


Source: Based on analysis of data provided in reports: 1) ICLEI-South Asia 2009 2) WSA/MOUD 2008

We build unsafe killer roads

Walkers and cyclists are the largest number of victims ranging from 40-50% in big cities





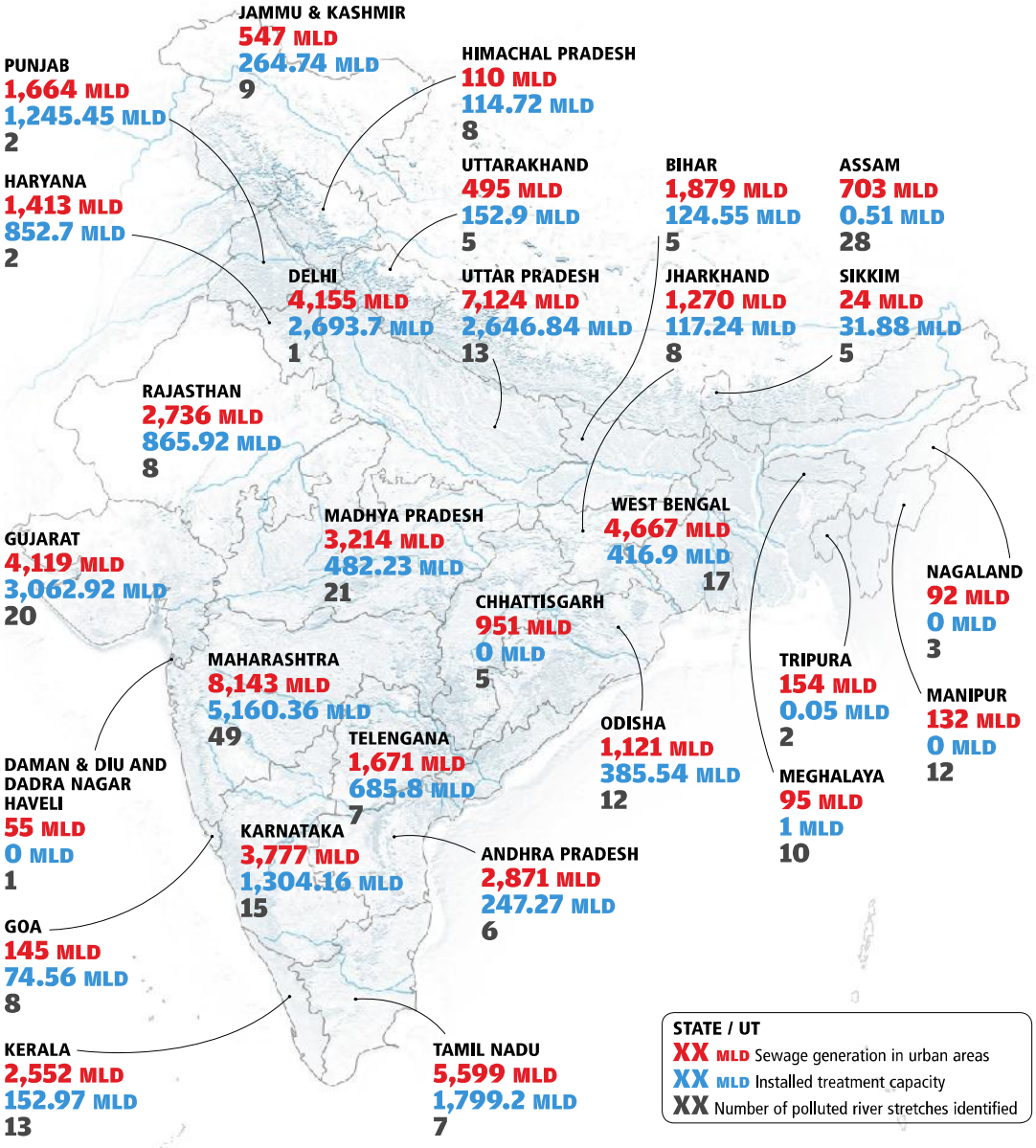
Source: National Crimes Records Bureau 2012 http://ncrb.nic.in/CD-ADSI-2012/table-1.8.pdf

Rivers are dying..

- …**dead** in many stretches
- Challenge is that many do not have sanitation; then toilet if provided is not connected to underground pipe; if connected then drain is not connected to sewage treatment and if all this happens that treated waste of some is mixed with untreated waste of many **= pollution**

Extent of contamination

Spending enormous money, creating awareness and building sewage treatment plants have not helped cleanse India's polluted river stretches. The estimated polluted riverine length is 12,363km, about 5 times the length of Ganga main stem



Options? **Excreta does Matter**

- file://localhost/Users/sunitanarain/Desktop/Excreta matter vol.1 PDF/Final chapters for book/Master Excel Checked.xls

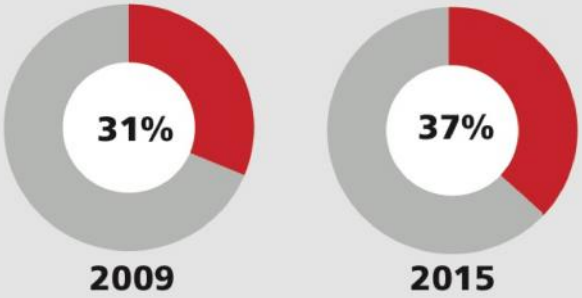
71 city data analyzed
City water-waste profiles
Where does water come?
Where does waste go?
Simple questions
But not asked
Never answered

THE OTHER STORIES

SEWAGE GENERATION INCREASED BY 62%, TREATMENT CAPACITY BY 19%

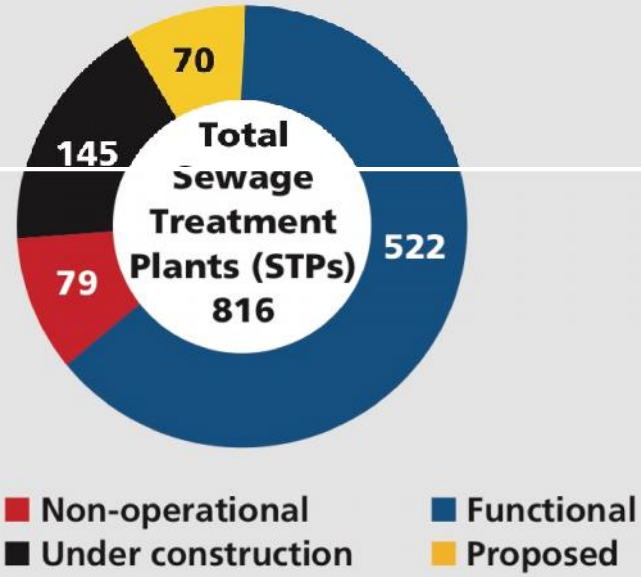
Sewage generated by Class I & II cities (MLD)

Capacity to treat



Source: State of India's Environment in Figures 2016

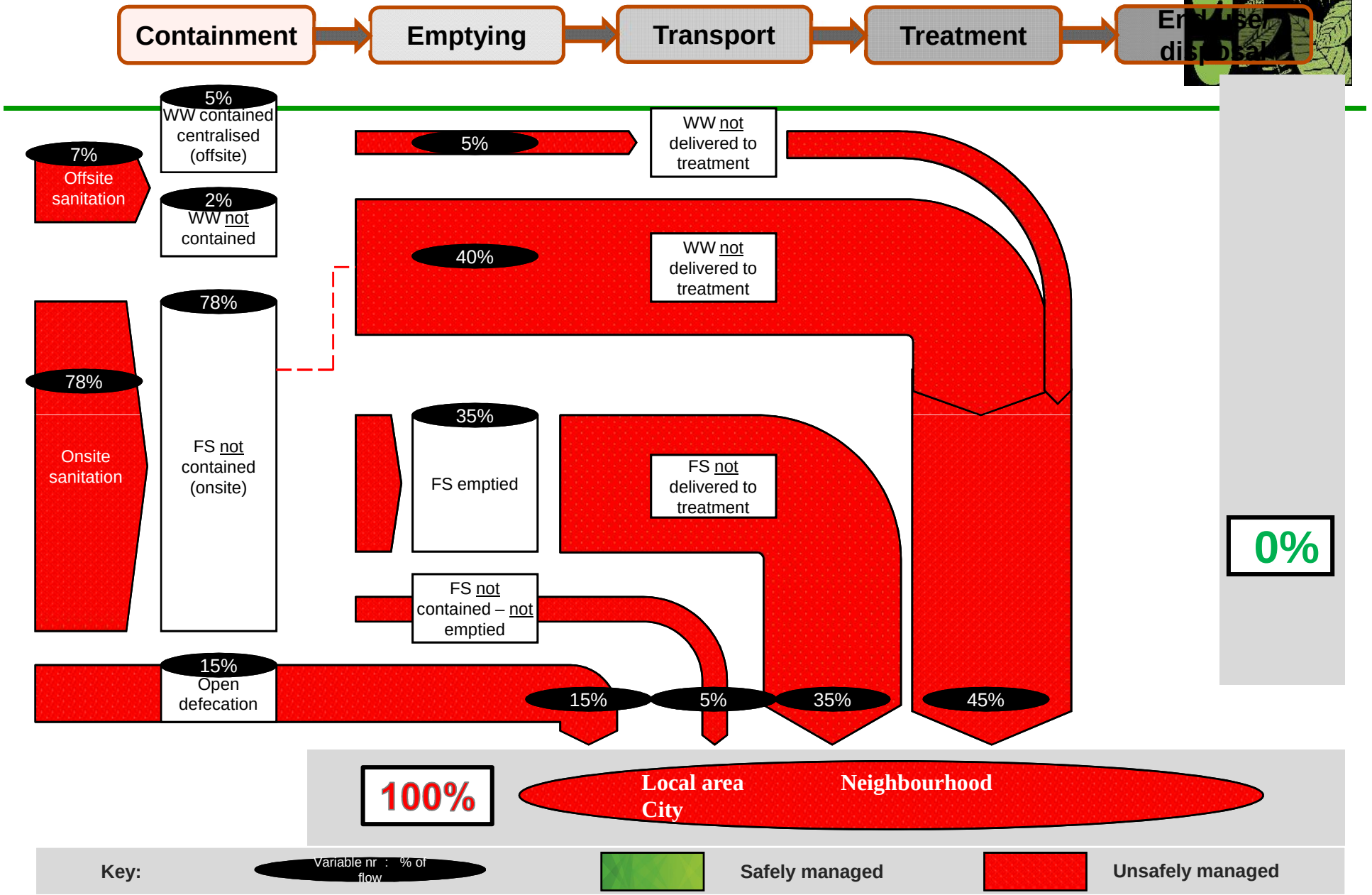
More than one-third facilities not working



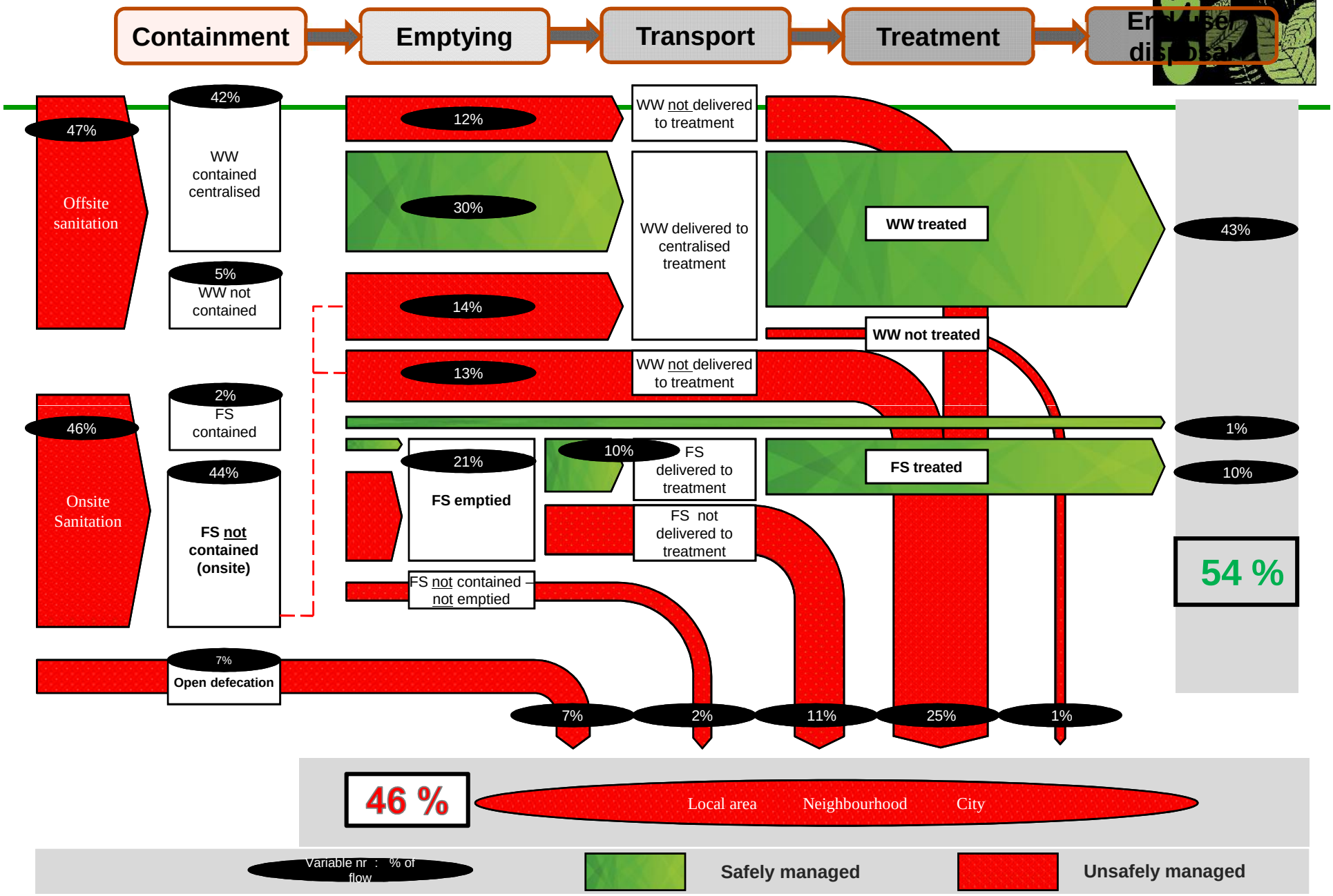
Shit-flow diagrams (SFD)

- All cities; **majority of people** use “on-site” treatment systems
- Septic systems; now often just deep containers in the ground that are cleaned; waste is ‘dumped’ in rivers; rivers; open areas. Pollution grows
- No regulations for this
- **Not considered part of ‘sanitation’ reality**

Srikakulam- 31 July 2015
Desk based



Agra – 21 October 2015
Desk based



Opportunity:
re-invent future sanitation solutions

- If India can jump-skip-leapfrog the landline-grid route in connectivity in telephones and energy access then why not in sanitation?
- **Are cost-effective** (do not have to plan for underground sewerage for door-to-door conveyance)
- **Already exist** – do not have to re-engineer entire cities for sewerage networks

Opportunity: Modernize old for new approach

- **Water-based** sewage systems destroy the nitrogen-cycle of world
- Water used to flush excreta; water as conveyance; water for disposal
- Nutrients lost
- Food security lost
- Water polluted
- **Land-based** sewage systems better: return nutrients to ground

Climate risked world increased vulnerability

- Across our world farmers are hit twice
- Once because of increasing cost of agriculture and decreasing returns
- Twice because of increasing extreme and variable weather events
- Adding to loss
- **Destroying coping ability**

Tragedy: our making

- Today we cry when it does not rain
- Today we cry when it does rain
- Go from cycle of crippling drought to back-breaking flood
- Double whammy
- Mismanagement of water resources + changing character of rainfall
- Must know this change

RELEVANCE

Rapid urbanisation is the cause of increasing urban floods

CASE STUDY #3

Chennai Floods

Unplanned urbanisation can lead to catastrophic disasters, bringing to fore the constant tussle between nature and human encroachments

ON DECEMBER 1, 2015 houses on the ground floor in Jafferkhanpet, a neighbourhood in southern Chennai, started to inundate because of torrential rains gradually engulfing 80 per cent of the city under four metres of water. The situation continued for the next 72 hours, killing over 500 and destroying infrastructure worth ₹500 crore. On December 1, Chennai received 300 mm rainfall, making it the wettest December day ever recorded in the city. The normal rainfall for Chennai in December is 191 mm. The India Meteorological Department (IMD) in mid-October issued a forecast that predicted 11-12 per cent above normal rains in the southern states with a probability of about 90 per cent.

ARUN SHARMA

Enough reasons for disaster

A 2014 analysis by the Indian Institute of Science, Bengaluru, shows that the rate of urbanisation in Chennai has increased by 20 times in the past four decades—and the city has expanded at the cost of destroying the city's natural flood sinks, such as marshlands and river channels. The concrete jungles obstruct and encroach upon the natural flow of waterbodies and create pockets that trap water, which increases the flood intensity. Concerned citizens groups have moved courts several times to save the wetlands. In September 2015, the Madras High Court ordered all the authorities concerned to remove encroachments from the marsh of Pallikaranai lake. Laws, such as the Tamil Nadu Protection of Tanks and Eviction of Encroachment Act, 2007, have not been able to save the wetlands in the city, say experts.

The existing rules and regulations are not strong enough to protect the urban lakes. This is the reason the three rivers in Chennai—the Cooum, Adyar and the Kosathalaiyar—are highly encroached upon. The city has four sewage treatment plants, but the treated water that flows through natural channels often gets mixed with untreated wastewater from colonies and industries on the way. The sewage generated by the people gets mixed with the water runoff and clogs the natural channels and storm water drains. Even the city's numerous water bodies and marshlands that should have acted as sponges are either encroached upon or over polluted.

The management of untreated sewage and solid waste should be done on a war footing to avoid choking of drains. Strong regulations should be implemented to stop encroachment of the wetlands and water channels.

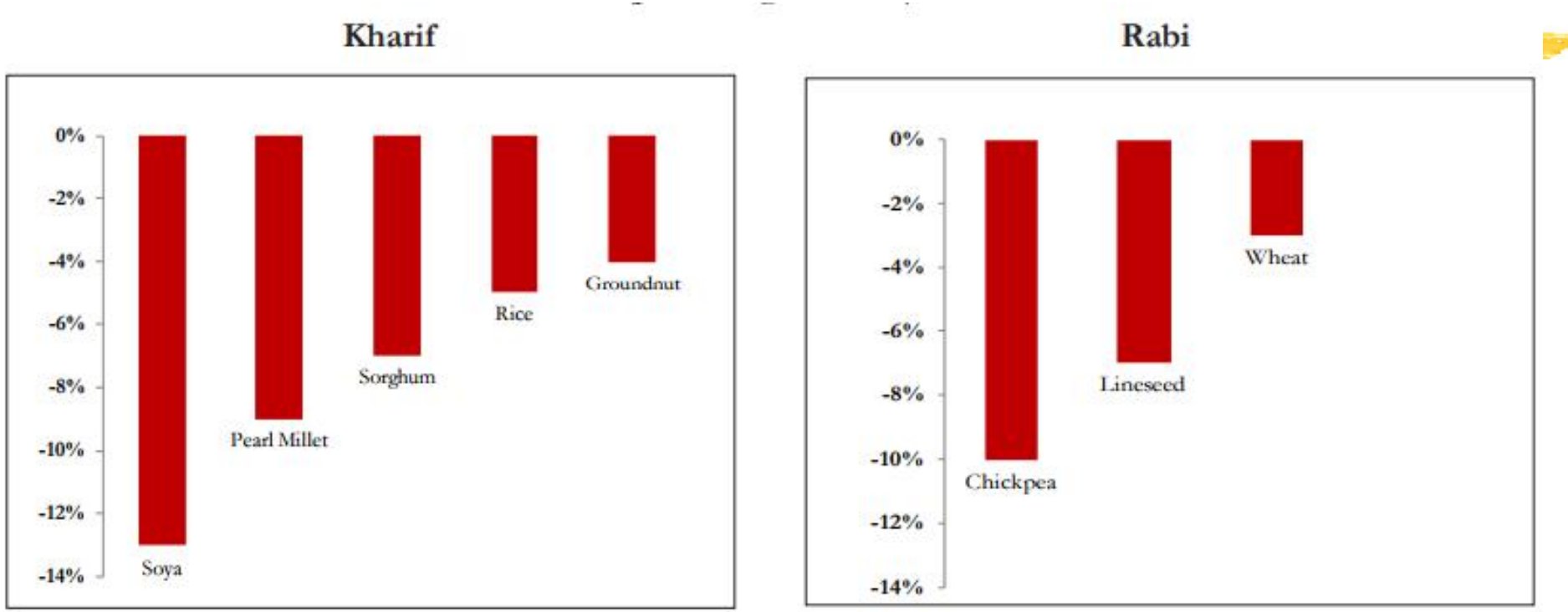
LESSONS

- **Urban floods can happen due to unplanned urbanisation as it hardly leaves space for natural flow of water**
- **Encroachment of wetlands and other small water bodies does not let water to be absorbed; results in flooding**
- **Improper sewage treatment results in the clogging of storm water drains which lose their capacity to carry extra load of water**

Now more variable, extreme

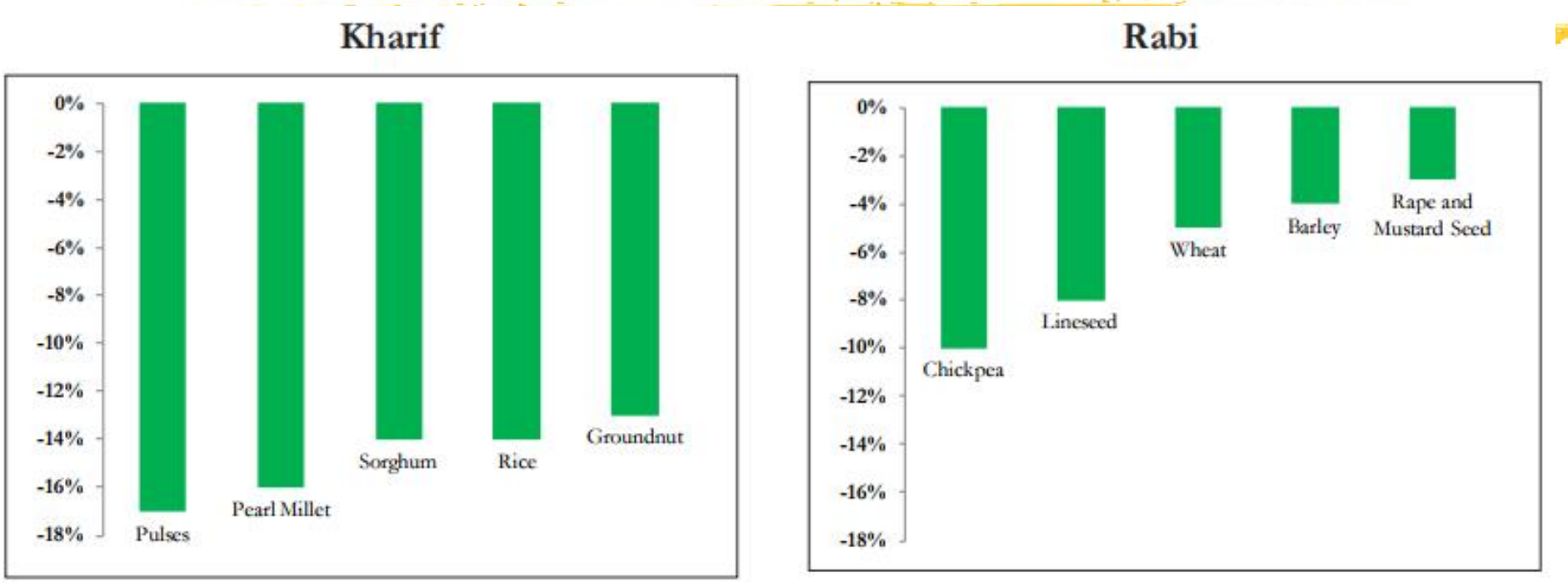
- Weird weather has become the ‘new normal’
- Unseasonal rain
- Abnormally high rain that comes in short periods
- Unseasonal and deadly hailstorms; cold and heat spells
- **2017: Flood in the time of drought**

Economic Survey 2018: Accepts that Extreme Temperature will Impact our Crop Yields (percentage decline)



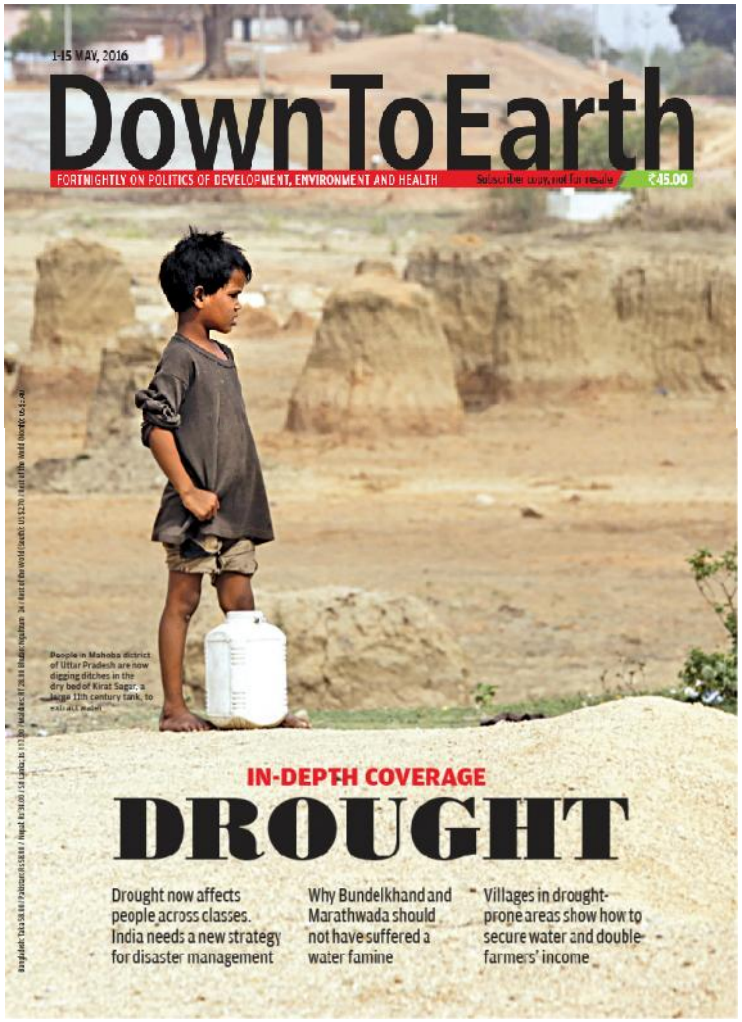
Source: The Economic Survey of India, 2017-18, *http://mofapp.nic.in:8080/economicsurvey/pdf/082-101_Chapter_06_ENGLISH_Vol_01_2017-18.pdf*

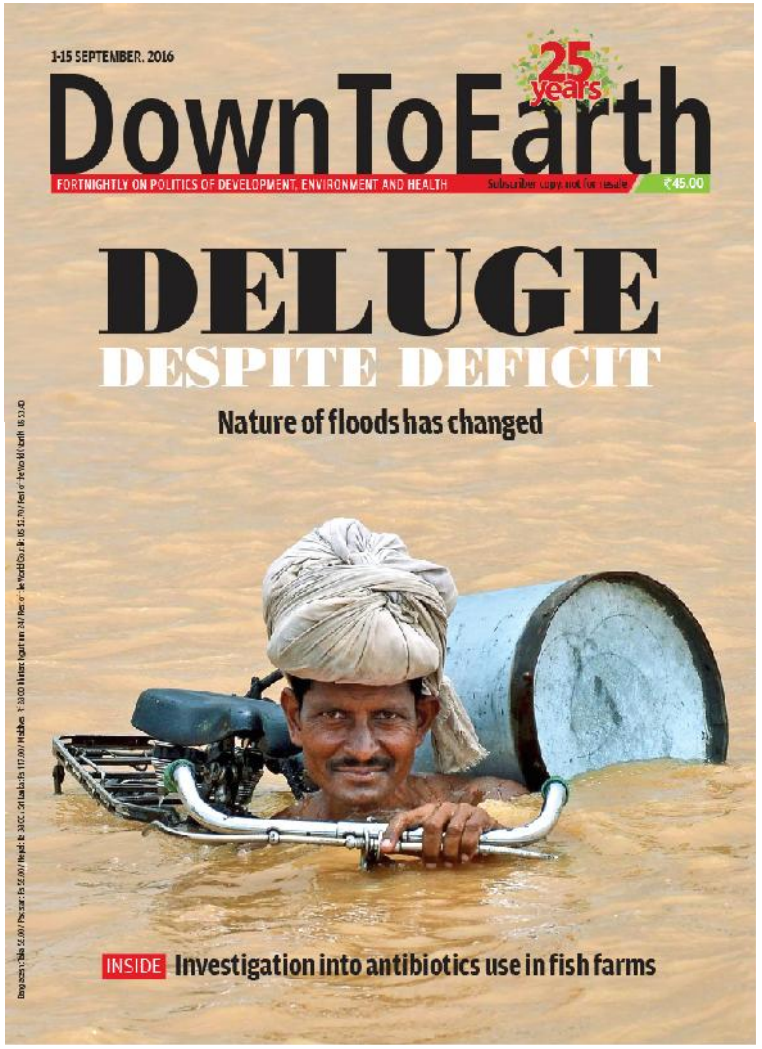
Economic Survey 2018: Extreme Rainfall will Decrease Crop Yields (percentage decline)



Source: The Economic Survey of India, 2017-18, *http://mofapp.nic.in:8080/economicsurvey/pdf/082-101_Chapter_06_ENGLISH_Vol_01_2017-18.pdf*

From crippling drought to deluge

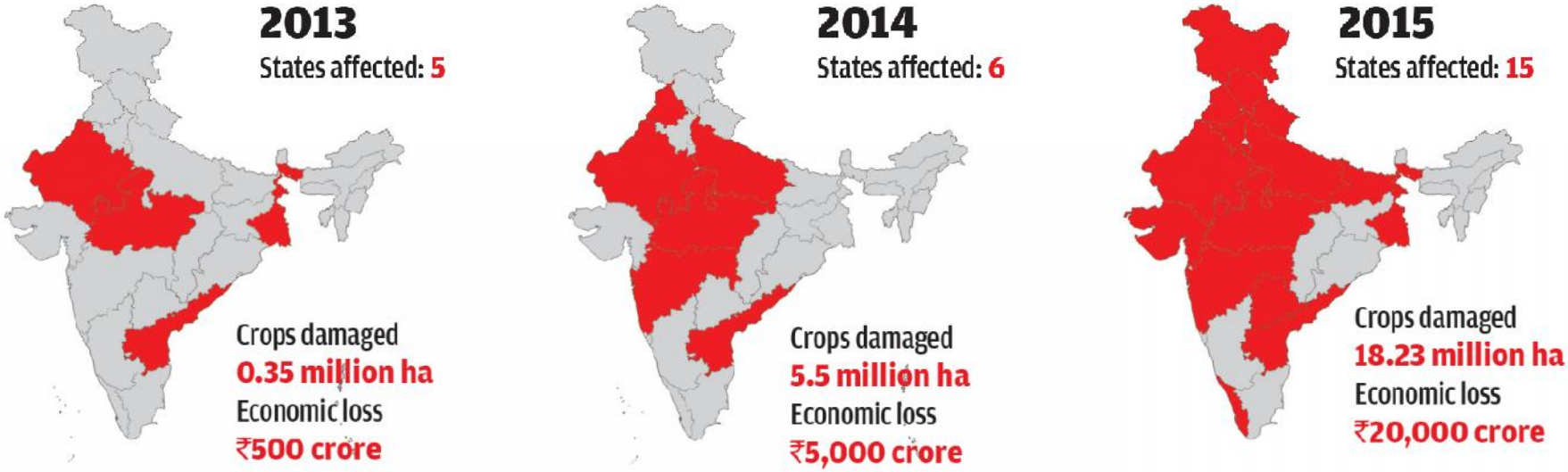




Killing fields: Season of despair for farmers

When freak becomes norm

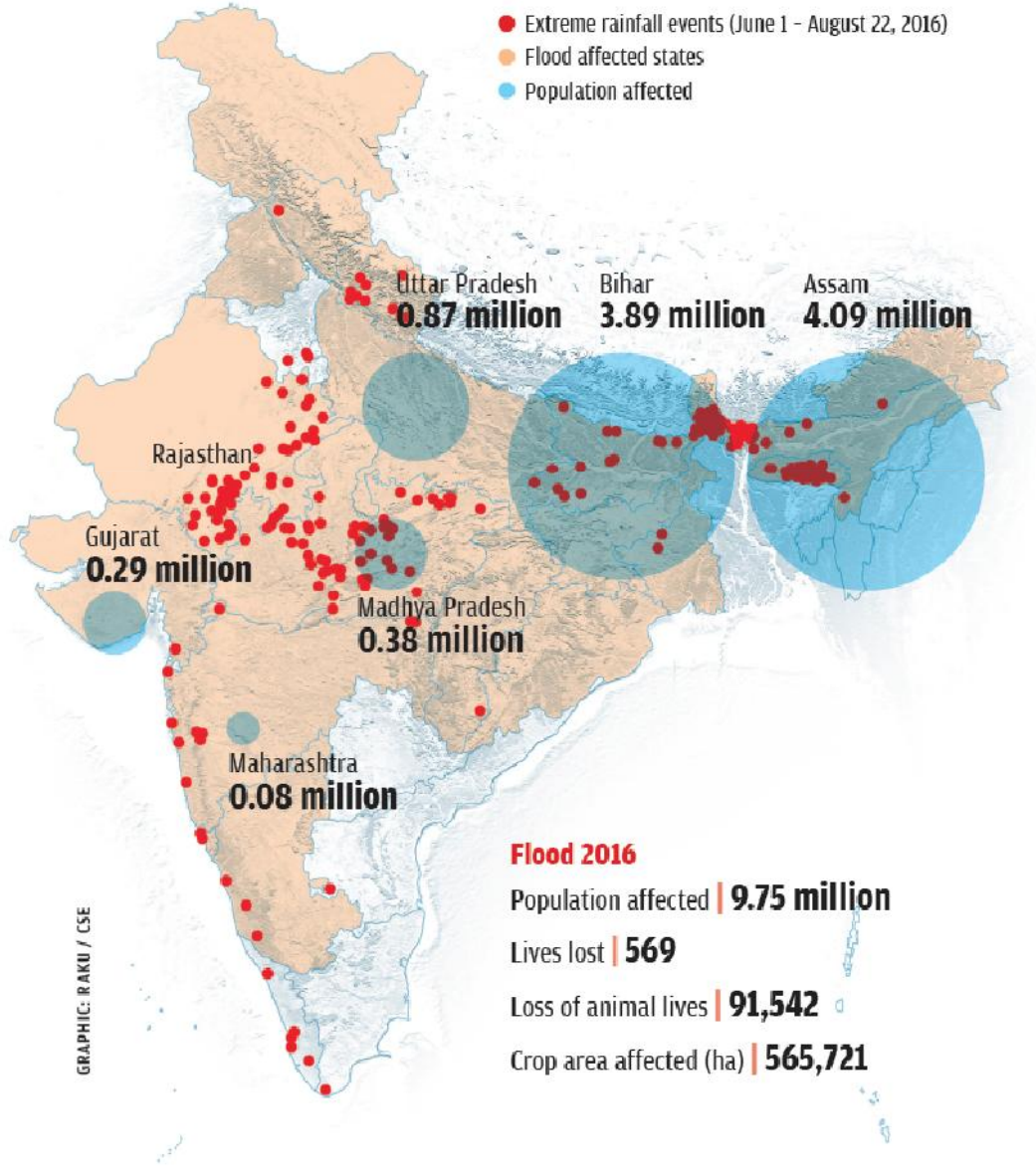
When hailstorms and unseasonal rains destroyed large swathes of rabi crops in 2013, they were thought to be freak weather events. But they hit again in 2014, and then this year, each time with more intensity, and causing more damage



Source: Based on state estimates

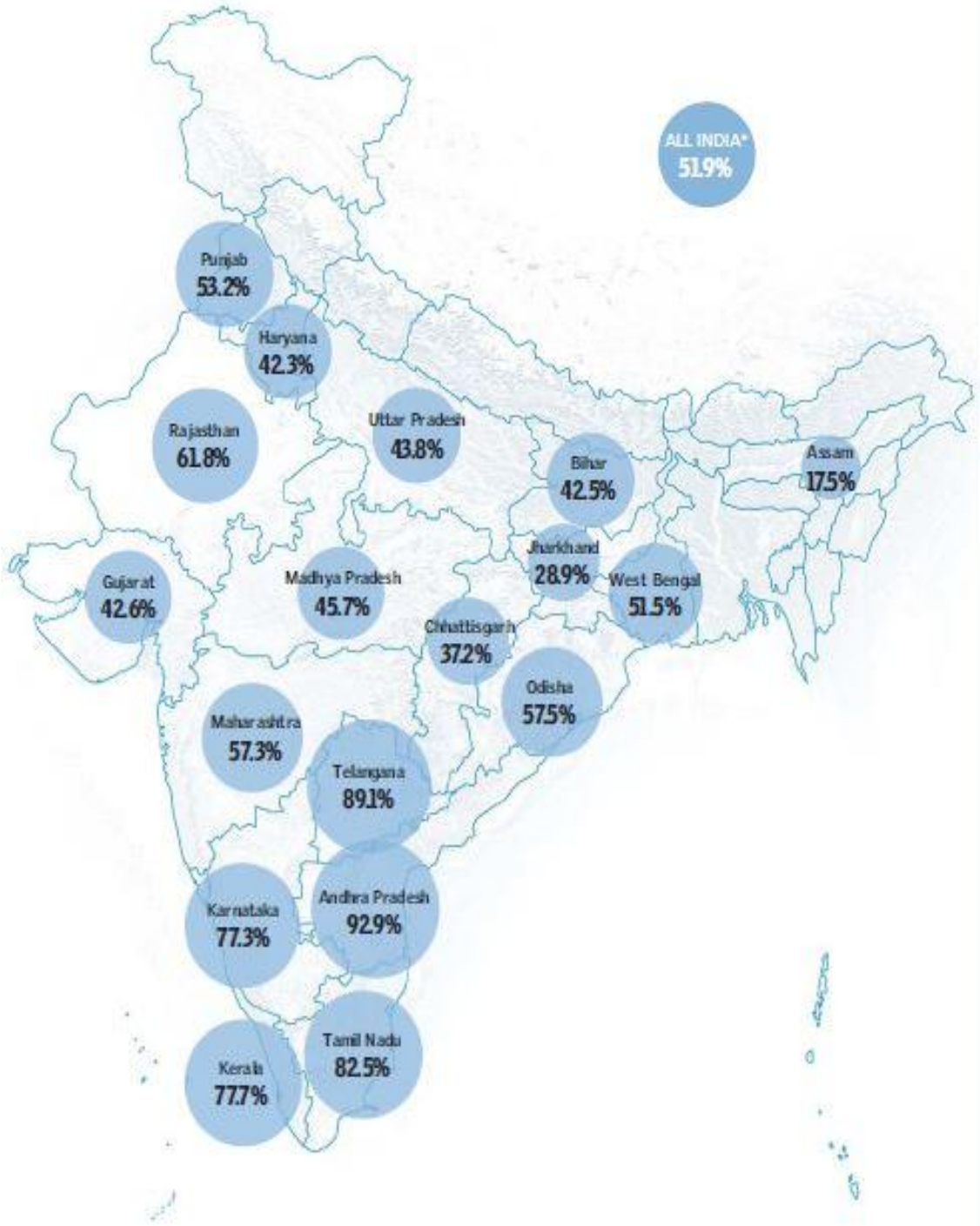
Under water

Most of the floods in 2016 were preceded by extreme rainfall events—a precipitation of 124.5 mm or more in a day



Future: Link method with resilience

- Increase of productivity has to low-cost
- Higher cost, higher risk, higher loss
- Measure resilience as managing risks
- **Resilience is about multiple crops; need crops that are water resilient; need systems of agriculture that can improve coping abilities of farmers**



- 52 per cent of India's agricultural households are in debt.

Indebtedness in some states touches 93 per cent

*Based on information from all states and Union Territories, including those not shown in this map
Source: 70th round: National Sample Survey (Report titled 'Situation Assessment Survey of Agricultural Households' January–December 2013)

Re-invent agriculture

Learn to value agriculture that is **low-input** and so **low-output**

Modern agriculture is expensive and so subsidized **across the world**

Modern agriculture is industrial and so built for large volumes of low-cost food; **discounting consumer safety**

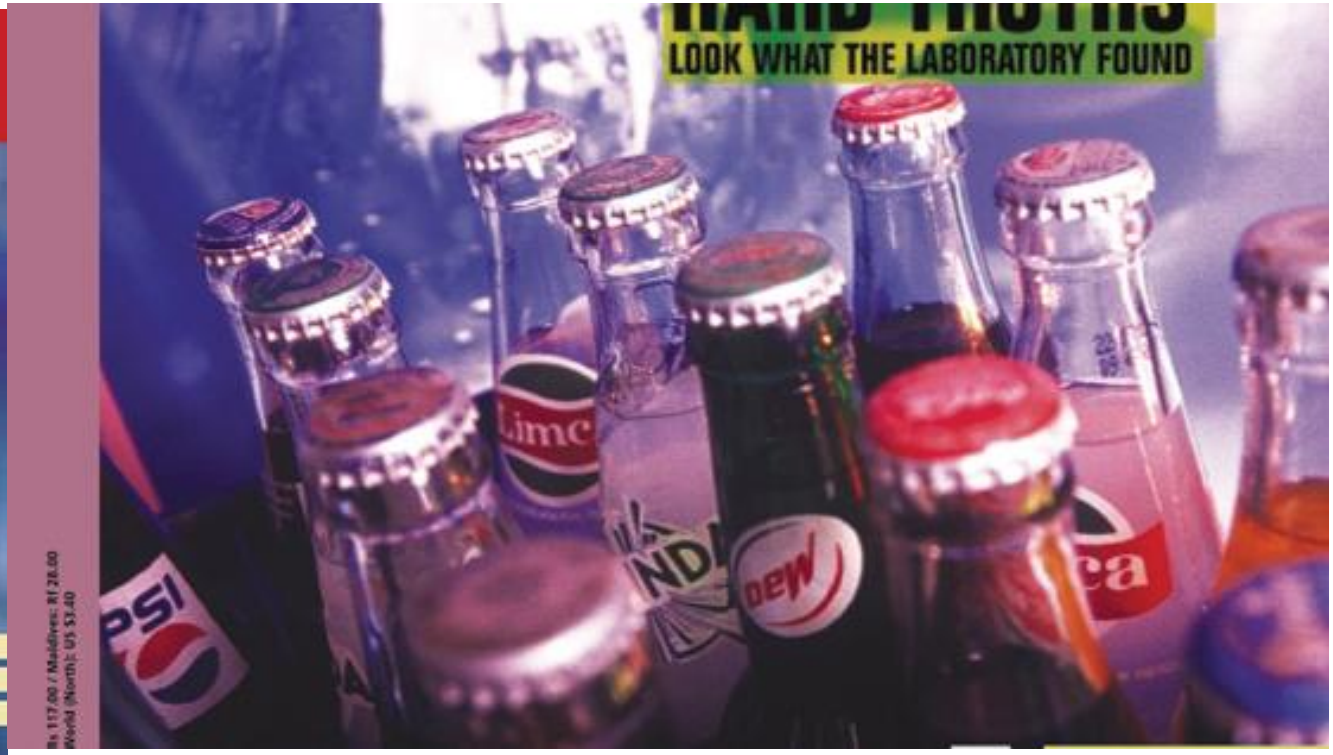
Link Farmers to our Food

- Not just about taste

- About nutrition
- About safety
- About biodiversity

Toxins used in agriculture
In our water, our food
In our bodies – deadly health implications

Pesticides in our food



Pesticide in blood

Antibiotics in Honey

- **In 2010 tested 12 brands of honey, including two popular International brands. Found to contain antibiotics from the banned Chloramphenicol to the broad spectrum Ciprofloxacin and Erythromycin.**
- **Found that we regulate antibiotics in the honey we export, but not in the honey sold domestically.**
- **FSSAI issued standard stating no antibiotics and pesticide residues are allowed in honey. The advisory has also specified maximum limits for heavy metals in honey.**

Food-sustainability link

- Sustainability is about what we grow – biodiversity rich and nature-friendly
- Sustainability is about who grows – local food for livelihood security
- Sustainability is about how we grow – less intensive and less toxic
- Sustainability is about what we eat – less processed and more bio-diverse and local

Resilience is not technology

- It is about cropping pattern
- It is about food we eat
- **Diets are about food we are ‘sold’**
- Need to make this link
- Need to change nature of food industry in climate risked world

Food: Connecting the many dots

Grow

Eat

Celebrate

Diversity

Culture

Cuisines

Food

- Is nature
- Food diversity about biological diversity

- We lose one, we lose the other
- We lose culture, we lose nature

One airshed; one planet

- **One airshed**
- Rich and poor
- Urban and rural
- **We need to have affordable and inclusive growth for all**
- Otherwise will not succeed

Our real objective

- Help us to build multipliers
- Help us to change the way the young ‘understand’ environment
- Move from being middle-class environmentalists to real environmentalist
- Move from being arm-chair (social media) environmentalists to doing things in their real world – whichever the profession.