From drought to flood - how climate change-fuelled extreme weather threatens India's poor

- India is highly exposed to natural disaster risks - with both high exposure to drought, heat and flood, and also high vulnerability to poverty. Without intervention, India will be a main location of extreme poverty by 2030.
- Economic losses from the 2018 floods in the Indian state of Kerala alone exceeded damage from all flooding in India in 2017, and reduced real GDP growth in the state by 1%.
- The poor are disproportionately impacted by climate change-driven extreme weather, with vulnerability to climate impacts determined by levels of economic development as well as exposure to natural disasters.
- Climate change will widen inequality within India between rich and poor, and between states.

Introduction

In his Mann Ki Baat radio address in 2017, Indian Prime Minister Narendra Modi acknowledged the plight of farmers suffering from the impacts of climate change. "Climate change, altered weather cycles, and transformations in the environment, are also having a big negative impact," Modi said. "Life goes completely topsy-turvy as a result of floods. Crops, livestock, infrastructure, roads, electricity, communication links – everything gets affected. In particular, our farmer brethren have to bear a lot of losses because of the damage to their crops and fields".[1]

It is not only Indian farmers that have their lives turned upside down by extreme weather. People living in city slums and workers in the tourism sector are also examples of groups that have their livelihoods threatened. The consequences are particularly stark for Dalit and other lower-caste communities that do not own land. Lost livelihoods combined with a lack of financial buffers and alternative economic opportunities have contributed to a worrying trend of suicides.[2]

The 2011-12 government estimate was that 269 million people in India (21.92% of the national population), were living under the poverty line.[3] Poor people are so disportionately affected by climate-driven extreme weather, one study observed that "vulnerability to risk, and degrees of suffering, are determined by levels of economic development, rather than simple exposure to natural hazards per se." [4]

As climate-driven extreme weather events gradually weaken the economic productivity of impacted regions, the number of people at risk of poverty will increase. In this briefing, we examine how climate change impacts on the poor, with particular focus on the extreme weather events that hit India in 2017 and 2018.

The deep inequality in the human cost of extreme weather

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[1] Jatin Gandhi, 'Sharp spike in natural disasters impacting agriculture, data shows', Hindustan Times, 31 July 2017. https://www.hindustantimes.com/india-news/sharp-spike-in-natural-disasters-impacting-agriculture-data-shows/story-Wv5ywWXx6U1X4hwVjnVFZK.html

[2] Rina Chandran, 'Feature: Heat and drought drive south India's farmers from fields to cities', Reuters, 20 Sep 2017. https://www.reuters.com/article/us-heatwave-india-migration/feature-heat-and-drought-drive-south-indias-farmers-from-fields-to-cities-idUSKCN1BV015

[3] Reserve Bank of India, Statistics Handbook 2018.

[4] Centre for Research on the Epidemiology of Disaster (CRED) and the UN Office for Disaster Risk Reduction (UNISDR), 'Economic Losses, Poverty and Disasters — 1998-2017', Oct 2018 https://www.unisdr.org/2016/iddr/CRED_Economic%20Losses_10oct_final.pdf

There is a pattern of deep inequality in how people are affected by natural disasters. Although absolute economic losses from extreme weather disasters are higher in high income countries, the human cost falls overwhelmingly on low and lower-middle income countries. People exposed to natural hazards in low income countries are seven times more likely to die and six times more likely to be injured or displaced, compared to equivalent populations in high income countries.[5]

Climate change has already caused global temperatures to rise about 1°C above pre-industrial levels.[6] Unless emissions are rapidly reduced, temperatures are expected to rise 1.5°C by 2040, 2°C by 2065 and 4°C by 2100.[7] The damage caused by climate change will increase as temperatures rise, and the Intergovernmental Panel on Climate Change (IPCC) warns that it will "disproportionately affect disadvantaged and vulnerable populations through food insecurity, higher food prices, income losses, lost livelihood opportunities, adverse health impacts, and population displacements". Climate change threatens to create a vicious cycle for the world's poor, as further warming pushes more people into poverty, increasing their vulnerability to climate impacts.

Nowhere is this clearer than in relation to climate-driven extreme weather events, such as floods, droughts, heatwaves and cyclones, which present a huge humanitarian challenge. An in-depth analysis of natural disasters published by the UN Office for Disaster Risk Reduction (UNISDR) found that climate related and geographical disasters have killed 1.3 million people worldwide and injured 4.4 billion in the last 20 years.[8] Extreme weather threatens critical services like electricity, housing, food production and water supply, healthcare and emergency services.[9] Recovery from large-scale disasters like floods and droughts can take months or even years, and can wipe out years of development progress and economic growth. All of these extreme events are expected to become worse as temperatures rise.[10]

The past few years have seen dramatic examples of climate disasters hitting the Indian subcontinent, underlining clear long-term trends. Each year in India around 5,600 people, or five individuals per million, die as a result of extreme weather events – about one quarter of all accidental deaths due to natural causes, a recent study based on government data suggests.[11] But this number is likely to be an underestimate because deaths from droughts are not included,[12] with about 330 million people affected by the Indian drought of 2015-16, for example.[13]

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[5] Centre for Research on the Epidemiology of Disaster (CRED) and the UN Office for Disaster Risk Reduction (UNISDR), 'Economic Losses, Poverty and Disasters — 1998-2017', Oct 2018 https://www.unisdr.org/2016/iddr/CRED_Economic%20Losses_10oct_final.pdf

[6] Global Temperature Report for 2017, Berkeley Earth, 2018. http://berkeleyearth.org/global-temperatures-2017/

[7] IPCC, 2014: Summary for Policymakers. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_summary-for-policymakers.pdf

[8] Centre for Research on the Epidemiology of Disaster (CRED) and the UN Office for Disaster Risk Reduction (UNISDR), 'Economic Losses, Poverty and Disasters — 1998-2017', Oct 2018 https://www.unisdr.org/2016/iddr/CRED_Economic%20Losses_10oct_final.pdf

[9] IPCC, 2014: Summary for Policymakers. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_summary-for-policymakers.pdf

[10] Olsson, L., M. Opondo, P. Tschakert, A. Agrawal, S.H. Eriksen, S. Ma, L.N. Perch, and S.A. Zakieldeen, Livelihoods and poverty. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. 2014. https://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap13_FINAL.pdf

[11] Mahapatra, B, Walia, M, Saggurti, N, Extreme weather events induced deaths in India 2001–2014: Trends and differentials by region, sex and age group, Weather and Climate Extremes 21, 2018. https://www.sciencedirect.com/science/article/pii/S2212094718301166

[12] Data on the number of accidental deaths by natural causes released by the Government of India as part of the National Data Sharing and Accessibility Policy (NDSAP), includes all accidental deaths for the following 15 climatic and non-climatic causes: avalanche, exposure to cold, cyclone, tornado, tsunami, starvation due to natural calamity, earthquake, epidemic, flood, heat/sun stroke, landslide, lightning, torrential rain, forest fire, and other natural causes.

[13] Rina Chandran, 'Feature: Heat and drought drive south India's farmers from fields to cities', Reuters, 20 Sep 2017. https://www.reuters.com/article/us-heatwave-india-migration/feature-heat-and-drought-drive-south-indias-farmers-from-fields-to-cities-idUSKCN1BV015

In this context, the inequality of vulnerability between rich and poor is one of the most important aspects of how climate change will affect countries like India, which face an overlap of climate risks with large vulnerable populations.

India's climate today: Floods and drought, with the poor struggling to recover

India already faces a range of climate-related hazards that threaten the livelihoods of people living in the country, and which threaten to worsen other challenges, particularly for those living in poverty.

Floods and extreme rainfall

Globally floods are the most frequent natural disaster, affecting the highest number of people across the biggest geographical area. More than two billion people were impacted over the last 20 years, according to the UNISDR.[14] India is highly vulnerable to flooding, with more than 40 million hectares or 12% of India's total geographical area prone to floods, according to the National Disaster Management Authority (NDMA) - the central body for disaster management in India.[15]

In August 2017, heavy monsoon rains caused widespread flooding across India, Bangladesh and Nepal, leading to at least 1,200 deaths.[16] Four states in northern India[17] were extensively affected by the flooding, which damaged some 805,183 homes[18] and affected 18 million people.[19] A year later in July and August of 2018 Kerala was swept by heavy monsoon rains, leading to the worst floods in the southern state since 1924. 2,378 mm (2.4m) of rain was recorded over 88 days, four times more than normal.[20] Large parts of Kerala were devastated. According to national authorities, as of 6 November 2018 the death toll stands at 504, with 3.4 million people displaced into 12,300 relief camps, and 23 million people affected.[21]

In 2017, the total damage due to floods / heavy rains amounted to Rs.18,279.63 crores (US$ 2.5 billion), including damage to crops, houses and public utilities, according to data from the Central Water Commission.[22] Although 2018 national data on floods and heavy damage is not yet available, the estimated damage from the 2018 floods in Kerala alone (Rs. 20,000 crores, US$ 2.7 billion) has exceeded the damage from all the floods and heavy rains in the whole

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[14] Centre for Research on the Epidemiology of Disaster (CRED) and the UN Office for Disaster Risk Reduction (UNISDR), 'Economic Losses, Poverty and Disasters — 1998-2017', Oct 2018 https://www.unisdr.org/2016/iddr/CRED_Economic%20Losses_10oct_final.pdf

[15] National Disaster Management Authority, Government of India, National Disaster Management Guideline: Management of Floods. 2008. https://ndma.gov.in/images/guidelines/flood.pdf

[16] Kevin Lui, "Severe Flooding in South Asia Has Caused More Than 1,200 Deaths This Summer", Time, 30 August 2017. http://time.com/4921340/south-asia-floods-india-mumbai-bangladesh-nepal/

[17] Assam, Bihar, Uttar Pradesh and West Bengal

[18] "16 million children affected by massive flooding in South Asia – UNICEF", UN News, 2 September 2017. https://news.un.org/en/story/2017/09/564272-16-million-children-affected-massive-flooding-south-asia-unicef

[19] Government of India, Ministry of Water Resources, River Development & Ganga Rejuvenation, to Rajya Sabha (Parliament's upper house), Unstarred Question No. 2613, Answered on 19.03.2018. As obtained by Bhasker Tripathi and reported in 'Kerala Flood Of 2018 Less Intense Than Deluge Of 1924: So Why Was Damage As Great?', IndiaSpend, 24 Aug 2018 https://www.indiaspend.com/kerala-flood-of-2018-less-intense-than-deluge-of-1924-so-why-was-damage-as-great-27396/

[20] Government of India, Centrral Water Commission, Study report: Kerala floods of August 2018. September, 2018 Accessible at: https://reliefweb.int/sites/reliefweb.int/files/resources/Rev-0.pdf

[21] European Commission's Directorate-General for European Civil Protection and Humanitarian Aid Operations, ECHO Daily Flash, 09 November 2018. As reported in: https://reliefweb.int/report/india/india-kerala-floods-summary-monsoon-season-dg-echo-national-authorities-mediaecho-daily

[22] Government of India, Ministry of Water Resources, River Development & Ganga Rejuvenation, to Rajya Sabha (Parliament's upper house), Unstarred Question No. 2613, Answered on 19.03.2018. As obtained by Bhasker Tripathi and reported in 'Kerala Flood Of 2018 Less Intense Than Deluge Of 1924: So Why Was Damage As Great?', IndiaSpend, 24 Aug 2018 https://www.indiaspend.com/kerala-flood-of-2018-less-intense-than-deluge-of-1924-so-why-was-damage-as-great-27396/

country in 2017.[23]

These examples are typical of the damage and disruption flooding can cause. Knock-on effects like lost production or lost income due to business interruption are often greater than direct impacts, especially in communities with low economic resilience.[24] In the 2018 floods in Kerala, an assessment of economic impacts in the state found that for the 4.13 million affected working individuals in the five most affected districts, around 3.3 million workers had their employment placed in jeopardy. The tourism sector's 2019 economic projection was lowered as a result of the widespread devastation. Tourism sector workers are susceptible to indirect damage, as tourist attraction spots are destroyed by flooding and tourists avoid visiting impacted areas. [25]

Research by relief agencies into post-flood recovery has found that recovery from the impact of floods depends significantly on how quickly livelihoods are restored,[26] especially for poor people who have little financial buffer and often live a hand-to-mouth existence. Poor people are also disproportionately affected by flooding, as they are more likely to live in hazardous areas or in shelters that are poorer quality and less likely to withstand flood damage.[27]

In rural households, flooding destroys assets like seeds and tools that are difficult to replace. In urban areas, floods can cause large-scale disruption to food supply, leading to immediate shortages and price increases. The urban poor are particularly vulnerable because the highest share of their income goes to paying for food,[28] and may have no choice but to reduce their calorific intake,[29] or adopt risky coping strategies, like traveling to insecure areas for work, gathering food or firewood, taking out loans that they cannot pay back, or engaging in illegal activities like drug trafficking or prostitution.[30] The recovery of local economies can take months if not years, pushing people into deeper cycles of poverty. People living in slums are particularly at risk, as they have very limited coping capacity for dealing with the impacts of climate change,[31] and slums have minimal facilities.[32]

Droughts, water shortages and the rural economy

India is heavily dependent on the summer monsoon, which accounts for about 70% of annual rainfall. As climate change alters weather patterns, access to water in India faces an uncertain future.

600 million people in India already face acute water shortage, according to government thinktank Niti Aayog,[33] with 54% of India's groundwater wells in decline, and 21 major cities

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[23] Press Trusts of India, 'Kerala Floods Loss More Than Estimated Rs. 20,000 Crore: Pinarayi Vijayan', NDTV, 28 August 2018. https://www.ndtv.com/kerala-news/kerala-floods-loss-much-more-than-estimated-rs-20-000-crore-pinarayi-vijayan-1907709

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[26] ALNAP and Provention Consortium, Flood Disasters: Learning from previous relief and recovery operations, 2008 https://www.sheltercluster.org/sites/default/files/docs/alnap-provention-flood-lessons_1.pdf

[27] 'ACAP Disaster Summary: Floods', ACAPS, January 2012. Accessible at: https://www.acaps.org/sites/acaps/files/resources/files/disaster_summary_sheet-floods_january_2012.pdf

[28] David Sanderson, Paul Knox-Clarke, Leah Campbell, Responding to Urban Disasters: Learning from previous relief and recovery operations, 2012. https://reliefweb.int/report/world/responding-urban-disasters-learning-previous-relief-and-recovery-operations-0

[29] 'ACAP Disaster Summary: Floods', ACAPS, January 2012. Accessible at: https://www.acaps.org/sites/acaps/files/resources/files/disaster_summary_sheet-floods_january_2012.pdf

[30] ibid.

[31] Rajiv Panday et al, Climate change vulnerability in urban slum communities: Investigating household adaptation and decision-making capacity in the Indian Himalaya, Ecological Indicators, Vol 90, July 2018, Pages 379-391. https://www.sciencedirect.com/science/article/pii/S1470160X18301869

[32] T.V. Padma, Slum dwellers in Himalayas especially climate vulnerable, India Climate Dialogue, 26 Nov 2018. https://indiaclimatedialogue.net/2018/11/26/climate-vulnerability-increases-for-upland-slum-dwellers/

[33] NITI Aayog, Composite Water Management Index, June 2018. http://www.niti.gov.in/writereaddata/files/document_publication/2018-05-18-Water-index-Report_vS6B.pdf

expected to run out of groundwater as soon as 2020, affecting 100 million people.[34]

In 2017, due to rainfall deficiency in the monsoon in 2016, 5 states in South India faced water shortages: Karnataka, Kerala, Tamil Nadu, Andhra Pradesh and Telangana. Tamil Nadu, for example, received 62% less rainfall than usual, with the drought described as the worst in 110 years.[35] This year, India's pre-monsoon period saw 11% less rainfall than average,[36] the third consecutive year this has been the case. As well as below-average pre-monsoon rain, India's monsoon has also seen below-average rainfall in five of the last six years, particularly in 2014 and 2015.[37]

Water-fed agriculture is so important to India that any changes in rainfall patterns risk huge knock-on effects. The agriculture sector makes up about 15% of India's $2 trillion economy, employs more than half of the country's 1.3 billion people, and is particularly vulnerable to drought. Sectors like fertilisers, food processing, automobiles, agricultural machinery and tools and financial services, including insurance, are all affected if the rural economy is damaged.

60% of Indian farmers own 1-2 hectares of land - just enough for survival. Crop loss due to drought or other extreme weather events can force farmers to take loans at exorbitant rates, and a struggling agricultural sector means more farmers default on bank loans, forcing the government to write them off.[38] This has led to tremendous demand for the state to provide a financial safety net. 70% Of India's farm families spend more than they earn, according to an analysis using various government data by IndiaSpend[39]. In Punjab, for example, 88 percent of households are in debt, to the tune of Rs. 2.18 lakh (US$ 3000) per household, according to one study.[40]

One particularly grim consequence of such precarity is that the stress of heavy financial debt has driven many farmers to take their own lives. More than 12,600 farmers and agricultural laborers killed themselves across India in 2015 alone.[41] Water shortages are frequently cited as a major factor,[42] with the highest numbers of suicides in the drought-hit states of Maharashtra, Telangana and Karnataka.[43] Most of those who took their lives belonged to Dalit and other lower-caste communities that do not own land, and had been unable to repay loans from private lenders.[44]

A controversial 2017 study from the University of California, Berkeley examined links between

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[34] PTI, '60 cr people face high to extreme water crisis in India', Economic Times, 23 July 2018. https://economictimes.indiatimes.com/news/politics-and-nation/60-cr-people-face-high-to-extreme-water-crisis-in-india/articleshow/65106504.cms

[35] Chetan Chauhan, 'States stare at drought as 59% of India get deficit rainfall, food output at the lowest', Hindustan Times, 13 Sep 2017. https://www.hindustantimes.com/india-news/states-stare-at-drought-as-59-of-india-get-deficit-rainfall-food-output-at-the-lowest/story-L754PYi3N6HCoCVQ2lGXHJ.html

[36] All India weekly weather report 10-16 May 2018, Government of India, 2018. Accessible at: http://archive.is/dgU9Q

[37] All India weekly weather report 21-27 Sep 2017, Government of India. 2017. Table "Monsoon Season 2017 - All India % Rainfall Departure for last five years since June 1st to end of Sep" on page 11. Accessible at: http://agricoop.nic.in/sites/default/files/CWWG%20Data%2029.09.2017.pdf

[38] Debu C., What the Monsoon Holds for Indian Economy in 2016-17, My India, 11 June 2016. http://www.mapsofindia.com/my-india/government/what-the-monsoon-holds-for-indian-economy-in-2016-17

[39] 70% Of India's Farm Families Spend More Than They Earn–Debt Main Cause of Suicides, IndiaSpend, 27 June 2017. http://archive.indiaspend.com/cover-story/70-of-indias-farm-families-spend-more-than-they-earn-debt-main-cause-of-suicides-26738

[40] Singh, S., Bhopal, S., Singh, R., Magnitude and Determinants of Indebtedness Among Farmers in Punjab, Ind. Jn. of Agri. Econ. Vol.69, No.2, April-June 2014 https://ageconsearch.umn.edu/bitstream/206379/2/Singh69_2.pdf

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[42] Nita Bhalla, Hit by drought and debt, Indian farmers protest with human skulls and rats, Reuters, 27 Mar 2017. https://www.reuters.com/article/us-india-farmers-suicides-idUSKBN16Y1O8

[43] Muralidhara Khajane, Successive droughts a main reason for frequent bouts of farm suicides, The Hindu, 2 Apr 2017. http://www.thehindu.com/news/national/karnataka/successive-droughts-a-main-reason-for-frequent-bouts-of-farm-suicides/article17763648.ece

[44] Rina Chandran, 'Feature: Heat and drought drive south India's farmers from fields to cities', Reuters, 20 Sep 2017. https://www.reuters.com/article/us-heatwave-india-migration/feature-heat-and-drought-drive-south-indias-farmers-from-fields-to-cities-idUSKCN1BV015

climate change and suicides in India.[45] Illustrating the extreme sensitivity of the Indian agricultural industry to spikes in temperature, the study found an increase of just 1°C on an average day during the growing season was associated with 67 more suicides. An increase of 5°C on any one day was associated with an additional 335 deaths. In total, the study estimates that 59,300 agricultural sector suicides over the past 30 years could be attributed to warming. Temperature increases outside the growing season showed no significant impact on suicide rates, suggesting stress on the agriculture industry was the source of the increase in suicides.

Droughts and water shortages across India have a broad and complex impact, which is not limited to agricultural workers. Children exposed to drought before they are born, or soon after, are more likely to be underweight and more likely to die before their first birthday.[46] Across the country, people are abandoning rural areas, sometimes entire villages, to escape water shortages in search of new lives in cities.[47] For example, of Uttarakhand's 16,793 villages, 1,053 have no inhabitants and another 405 have less than 10 residents as per Census 2011. The number of such phantom villages has surged particularly after the earthquake and flash floods of 2013, according to a 2017 report. [48]

Under huge public pressure, state governments have passed farm-debt waivers at enormous cost to the public purse. In FY18, farm debt waivers announced by five states together are likely to increase the combined fiscal deficit of India's states by Rs 1.077 trillion or US$15 billion (0.65% of India's GDP), according to India Ratings.[49]

In 2016 the Indian government approved a Rs. 11,054 crore (US$1.3bn) insurance scheme for farmers. The Pradhan Mantri Fasal Bima Yojana (PMFBY, Prime Minister's Crop Insurance Scheme) offers farmers insurance against crop failures at modest premiums. Demand has been enormous - state insurer New India Assurance (NIA) reported that claims rose around 92% in 2018, and 75% in the previous financial year.[50]

India's climate future: more intense rainstorms, higher risks of drought

Climate change is likely to cause wet places to get wetter and dry places to get drier.[51] Future rainfall in India is likely to be shaped by two trends – more frequent extreme rainfall events bringing more flooding, coupled with a weakening monsoon circulation and declining total rainfall over the central Indian sub-continent which will increase the likelihood of droughts.[52] For India this will mean more drought and flooding in a country that is already struggling to deal with both.

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[45] Carleton, T.A., Crop-damaging temperatures increase suicide rates in India, PNAS 114 (33), August 2017. http://www.pnas.org/content/114/33/8746

[46] Santosh Kumar, Ramona Molitor and Sebastian Vollmer, Drought and earth child health in Rural India, Population and Development Review, Vol. 42, Iss. 1, p. 53-68. https://onlinelibrary.wiley.com/doi/full/10.1111/j.1728-4457.2016.00107.x

[47] Neeta Lal, Climate Migrants Lead Mass Migration to India's Cities, Inter Press Service, 26 July 2016. http://www.ipsnews.net/2016/07/climate-migrants-lead-mass-migration-to-indias-cities/

[48] S.K. Singh and U. Panday, A logistics analysis between internal migration and the development: a study of Almora district in Uttarakhand, International Research Journal of Commerce, Arts and Science. 2017. http://www.casirj.com/article_pdf?id=5702.pdf

[49] Anuradha Basumatari, FY18 State Budgets: Continued Capex by State Governments Encouraging, but Farm Loan Waivers Could Destabilise Finances, India Ratings & Research, 18 Dec 2017. https://www.indiaratings.co.in/PressRelease?pressReleaseID=30167

[50] Prasanta Sahu, Modi government's selloff push: Sale of 10% stakes in GIC, New India Assurance may fetch Rs 10,000 crore, India Express, 4 Nov 2018. https://www.financialexpress.com/economy/government-to-sale-10-stakes-in-general-insurance-new-india-assurance-proceeds-may-cross-rs-10000-crores/1371802/

[51] Richard A. Betts et al., 'Changes in climate extremes, fresh water availability and vulnerability to food insecurity projected at 1.5°C and 2°C global warming with a higher-resolution global climate model', Phil. Trans. R. Soc. A, 2018. http://rsta.royalsocietypublishing.org/content/376/2119/20160452

[52] Roxy, M. K. et al. Drying of Indian subcontinent by rapid Indian Ocean warming and a weakening land-sea thermal gradient. Nat. Commun. 6, 7423, 2015. https://www.nature.com/articles/ncomms8423

More frequent and intense rainstorms will bring more flooding

Central India has already seen a threefold increase in widespread extreme rain events between 1950 and 2015,[53] and a study of extreme rainfall over a 110-year period (1901-2010) found "significant increasing trends of heavy to extremely heavy rainfall events over most parts of the country". [54] Another study analysed rainstorms over North India which lead to large-scale floods, and found that the frequency of these rainstorms increased 6% per decade between 1901-2009, with the duration of rainstorms increasing by 15 days over the period 1951-2015.[55]

Longer rainstorms will mean floods last longer, affect wider areas, and cause more extensive damage. Responding to these large-scale floods will be more challenging, and the increasing frequency means that regions can be impacted repeatedly or by multiple extreme weather events, meaning less time for recovery between disasters.

India's sensitivity to shifting rainfall patterns threatens more drought

The decrease in total rainfall seen over this decade is part of long-term changes in where and when rain falls in India, driven by climate change.[56] [57] Monsoon rainfall has been decreasing since 1870, with rainfall outside the monsoon increasing slightly, balancing the annual average. Rainfall during the monsoon has also decreased in particular regions, including Kerala and Madhya Pradesh.[58]

Some states have seen big changes in annual rainfall. For example, year-round rainfall in Chhattisgarh has fallen nearly 10%, while it has increased in Coastal Karnataka, Punjab and Haryana. Extreme rainfall is becoming more common in much of the country.[59] The poor monsoons of 2014 and 2015 resulted in severe drought and water shortages in much of the country, including parts of Andhra Pradesh, Karnataka, Maharashtra and Telangana.[60]

Increasingly variable rainfall patterns threaten food security in India, where 56% of the cultivated land and 40% of food production is rain-fed.[61] By further threatening farmers income, climate change will make these socio-economic problems worse, according to a study published by the Indian Ministry of Finance.[62] Rising temperatures, declining average precipitation, and increase in extreme precipitation events suggest that annual agricultural income could fall 15 to 18 percent on average, and up to 20 to 25 per cent in non-irrigated (rain-fed) areas.

The geography of climate change and poverty

An in-depth study into the relationship between natural disasters and poverty by the Overseas Development Institute (ODI) has found that droughts and floods are the most potent shocks that causes long term impoverishment.[63] Rural populations are much more vulnerable to

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[53] Roxy M. K., S. Ghosh, A. Pathak, R. Athulya, M. Mujumdar, R. Murtugudde, P. Terray and M. Rajeevan, A threefold rise in widespread extreme rain events over central India. Nature Communications, 8, 1, 708, 2017. http://www.rocksea.org/bin/research/roxy_monsoon_extreme_rainfall_nature_2017.pdf

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[57] Auffhammer, M., Ramanathan, V. & Vincent, J.R. Climatic Change (2012) 111: 411. https://doi.org/10.1007/s10584-011-0208-4

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[59] GUHATHAKURTA, P., SREEJITH, O.P. & MENON, P.A. J Earth Syst Sci (2011) 120: 359. https://doi.org/10.1007/s12040-011-0082-5

[60] Debu C., What the Monsoon Holds for Indian Economy in 2016-17, My India, 11 June 2016. http://www.mapsofindia.com/my-india/government/what-the-monsoon-holds-for-indian-economy-in-2016-17

[61] Suresh, A., Raju, S.S., Chauhan, S., Chaudhary, K.R., Rainfed agriculture in India: an analysis of performance and implications, Indian Journal of Agricultural Science 84 (11), 2014. https://www.researchgate.net/publication/276279383_Rainfed_agriculture_in_India_An_analysis_of_performance_and_implications

[62] Ministry of Finance, Economic Survey 2017-2018. http://mofapp.nic.in:8080/economicsurvey/

[63] Andrew Shepherd, et al, The Geography of Poverty, Disasters and Climate Extremes in 2030, ODI, 2013.

impoverishment than urban populations. The risk of impoverishment is connected to factors that help people to cope and rebuild, such as access to market, capital, and insurance, that are scarce in rural areas.[64]

Exposure to extreme weather risks is also unevenly distributed between states. Some face heightened risks from multiple climate disasters, particularly Assam, Madhya Pradesh, Odisha, Uttar Pradesh and West Bengal.[65] If a state is hit by multiple extreme weather events, it can weaken the local economy and reduce its competitiveness compared with other states. As farmers leave their land, and businesses move to other states, the risk of impoverishment within the state will further increase.

The ODI study finds that India is highly exposed to natural disaster risks - with both high exposure to drought, heat and flood, and also high vulnerability to poverty. In the numerous models ODI use to look at future poverty rates, they found that all projections agree: without intervention, India will be a main location of extreme poverty (US$1.25 or Rs. 88 per day) in 2030, along with sub-Sahara Africa.[66]

The Intergovernmental Panel on Climate Change has found that limiting global warming to 1.5°C, compared with 2°C, could reduce the number of people exposed to climate-related risks and susceptible to poverty by up to several hundred million by 2050.[67]

Conclusion

The economic and social consequences of recent droughts and flooding in India are enormous, and both the frequency and intensity of these kinds of extreme weather events are projected to rise. Further rise in global temperatures will disproportionately affect disadvantaged and vulnerable people through food insecurity, higher food prices, income losses, lost livelihood opportunities, adverse health impacts, and population displacements. India has a large vulnerable population that may find itself particularly hard hit.

Prime Minister Narendra Modi's vision of "doubling farmers income by 2022" will be hard to deliver in a climate stricken world. Limiting climate change by cutting emissions will bring enormous benefits for India - minimising further economic damage from climate change means less hunger, healthier people, less air pollution, more economic growth, more jobs and reduced inequality,[68] [69] and for a country with such overlapping vulnerabilities, climate mitigation and poverty eradication will need to go hand in hand.

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https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/8633.pdf

[64] Ibid., p. viii.

[65] Ibid., p. x.

[66] Ibid., p. 11.

[67] Intergovernmental Panel on Climate Change (IPCC), Global Warming of 1.5°C: Summary for Policymakers, 2018. p. 11.

[68] Pursuing the 1.5°C limit: Benefits and opportunities, International Climate Initiative. 2017.

[69] Multiple benefits from climate change mitigation: Assessing the evidence, Grantham Resarch Institute on Climate and Environment, London School of Economics, 2017.

ANNEX:

Major extreme weather events in India in 2017-2018

Floods and extreme rainfalls

Case study: Floods in Northern India: Bihar, Assam, Uttar Pradesh, West Bengal in 2017
Date: August 2017
Total deaths: over 700
Total affected: 18 million

Heavy monsoon rains in June to August 2017 caused widespread flooding across India, Bangladesh and Nepal and caused at least 1,200 deaths in summer 2017.[70] Four states in northern India[71] have been extensively affected by the flooding. Some 805,183 houses were either partially or fully damaged as well 15,455 schools, which meant children couldn't go to school.[72]

In Bihar, flooding affected 21 districts with over 17 million residents. Araria, the district of Jogbani, was the worst affected. At least 514 people died from the floods and landslides in the state in August. Although deaths due to flooding have been recorded in Bihar every year since government started releasing data in 1979, this flooding has been described as the worst to affect the state since 2008.[73] 7,000 villages were affected, forcing 400,000 people to seek refuge across 1,358 relief camps.[74] Bihar's state government estimated that crop damages to be Rs 1,093 crore, and sought Rs 10,000 crore from the central government to cover the damages in flood hit areas.[75]

In Uttar Pradesh, the flood caused the death of 104 people, with over 280,000 people affected in 24 districts.[76] In West Bengal, 152 people died in the floods and 400,000 people displaced and housed in 800 relief camps.[77] Chief minister Mamata Banerjee said that the state has incurred an estimated total loss of Rs 14,000 crore because of the floods. Around 4.23 lakh hectare of agricultural land in southern districts and nearly 3 lakh hectare in northern ones were affected. The estimated loss to the agriculture sector is more than Rs 6,500 crore.

Overall, in 2017 India was hit by a series of floods. Floods were recorded in June at the start of the monsoon season in Nagaland, Assam and Jharkhand, and across India in July (Assam, Manipur, Arunachal Pradesh, Gujarat, Bihar, Uttarkand, Uttar Pradesh and Orissa states), finally leading to widespread flooding in Bihar, Uttar Pradesh and West Bengal in August.[78] Records showed 2017's monsoon floods were the worst since 2007, with 41 million people affected.[79]

Case study: Kerala flood of 2018

[70] Kevin Lui, "Severe Flooding in South Asia Has Caused More Than 1,200 Deaths This Summer", Time, 30 August 2017. http://time.com/4921340/south-asia-floods-india-mumbai-bangladesh-nepal/

[71] Assam, Bihar, Uttar Pradesh and West Bengal

[72] "16 million children affected by massive flooding in South Asia – UNICEF", UN News, 2 September 2017. https://news.un.org/en/story/2017/09/564272-16-million-children-affected-massive-flooding-south-asia-unicef

[73] Aman Sethi, 'Bihar's scary new flood', Hindustan Times, 18 September 2017. https://www.hindustantimes.com/interactives/bihar-floods-2017/

[74] Saif Khalid, 'India's Bihar state reels under unprecedented flooding', Al Jazeera, 21 Aug 2017. https://www.aljazeera.com/news/2017/08/india-bihar-state-reels-unprecedented-flooding-170820174216830.html

[75] Anirban Guha Roy, 'Flood hit Bihar farmers to be compensated for crop damage within a month', Hindustan Times, 13 Sep 2017. https://www.hindustantimes.com/patna/flood-hit-bihar-farmers-to-be-compensated-for-crop-damage-within-a-month/story-zKhmeaFHAIqmpPhGKZyrgL.html

[76] Press Trust of India, 'Uttar Pradesh floods: Four more die as death toll rises to 108; over 28 lakh still affected', First Post, 1 Sep 2017. https://www.firstpost.com/india/uttar-pradesh-floods-four-more-die-as-death-toll-rises-to-108-over-28-lakh-still-affected-3998307.html

[77] Press Trust of India, 'West Bengal estimates loss of Rs14,000 crore due to floods, situation improves', Livemint, 27 August 2018. https://www.livemint.com/Politics/NNnJpJt2zGCnmKWuX7XW1M/West-Bengal-estimates-loss-of-Rs14000-crore-due-to-floods.html

[78] Situation Report Series on India: Floods and Landslides 2017, Relief Web https://reliefweb.int/disaster/fl-2017-000064-ind

[79] Subodh Varma, 'This year's floods worst in a decade', Times of India, 6 Sep 2017 https://timesofindia.indiatimes.com/india/this-years-floods-worst-in-a-decade/articleshow/60384123.cms

Date: 7-20 August 2018
Death toll: 504
Total affected: 23 million
Economic impact: Rs 20,000 crore

The Southern state of Kerala was swept by the heavy monsoon rain in July and August 2018, leading to the worst floods in the state since 1924. 2,378 mm of rain was recorded over 88 days, four times more than normal[80]. Rainfall first peaked on July 20 and again reached abnormally high levels between August 8 and 16, according to analysis of satellite data by the NASA Earth Observatory. In the first 20 days of August, the region experienced 164 percent more rain than normal.[81]

On the ground, the devastation was widespread as large parts of Kerela was flooded from 8 to 20 August. Red alerts were issued in all 14 districts by the India Meteorological Department (IMD)[82], and 33 out of 39 dams in the state were opened as the water reached dangerously high levels[83]. In the worst impacted districts, landslides were recorded in the northern districts of Malappuram and Wayanad, and the central district of Idukki. In addition to the army and navy, civilians also joined in the rescue efforts, some 600 fishermen boats came inland to help rescue stranded villagers.[84] Many parts of the state were without power, drinking water for days.

According to the national authorities, as of 6 November 2018, the death toll stands at 504, 3.4 million people were displaced in 12,300 relief camps and 23 million people were affected.[85]

Total damage due to the devastating floods reached Rs. 20,000 crore (USD 2.7 billion), Chief Minister Pinarayi Vijayan said at the end of August.[86]

Agricultural crop loss was estimated to be Rs 1,345 crore and the loss of animals was estimated to be Rs 110.57 crore, according to Kerala Agriculture Minister V S Sunil Kumar.[87] The flood submerged 45,000 hectares of farmland, including 20,000 hectares of rice paddy out of a total of 57,000 in the state[88]. With just over half of the population (52.3%) in Kerala live in rural areas and depend on rural livelihoods,[89] the loss of the Kharif crop has impacted on the livelihoods of millions. Dairy farmers were affected too, after the flood the daily milk procurement in the state decreased by 2-2.5 lakh litres a day, out of around 13 lakh litres per day, Kerala Cooperative Milk Federation said at the end of August.[90] The timber industry also suffered heavy loss, with an initial assessment reportedly showing 50 plywood companies suffered a loss of nearly Rs 80 crore.[91]

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[80] Government of India, Centrral Water Commission, Study report: Kerala floods of August 2018. September, 2018 Accessible at: https://reliefweb.int/sites/reliefweb.int/files/resources/Rev-0.pdf

[81] Kasha Patel and Joshua Stevens, 'A Flood for the Century in India - Image of the day for August 22, 2018', NASA Earth Observatory. https://earthobservatory.nasa.gov/images/92638/a-flood-for-the-century-in-india

[82] 'IMD sounds red alert for entire Kerala', Onmanorama, 16 August, 2018. https://english.manoramaonline.com/news/kerala/2018/08/15/heavy-rainfall-kerala-imd-forecast.html

[83] Anonna Dutt, 'Early release of dam water could have reduced Kerala flood damages, say experts', Hindustan Times, 21 August 2018. https://www.hindustantimes.com/india-news/early-release-of-dam-water-could-have-reduced-kerala-flood-damages-say-experts/story-iknyHxWN1l51nuXPFAUSBJ.html

[84] Adam Withnall, 'Kerala floods: More than 1m evacuated as fleet of civilian fishing boats race to rescue and death toll rises', The Independent, 20 August 2018.

[85] Adam Withnall, 'Kerala floods: More than 1m evacuated as fleet of civilian fishing boats race to rescue and death toll rises', The Independent, 20 August 2018. https://www.independent.co.uk/news/world/asia/kerala-floods-latest-evacuate-fishing-boats-rescue-deaths-a8499141.html

[86] Press Trusts of India, 'Kerala Floods Loss More Than Estimated Rs. 20,000 Crore: Pinarayi Vijayan', NDTV, 28 August 2018. https://www.ndtv.com/kerala-news/kerala-floods-loss-much-more-than-estimated-rs-20-000-crore-pinarayi-vijayan-1907709

[87] Shaju Philip, "Kerala floods: Standing crops destroyed, state's food production to take a hit", Indian Express, 24 August 2018. https://indianexpress.com/article/india/kerala-floods-standing-crops-destroyed-states-food-production-to-take-a-hit-5321983/

[88] Press Trusts of India, 'Kerala floods damage 45,000 ha of farm fields; Paddy, banana, spices among worst hit', Hindustan Times, 27 August 2018. https://www.hindustantimes.com/india-news/kerala-floods-damage-45-000-ha-of-farm-fields-paddy-banana-spices-among-worst-hit/story-bF0Iully9ppN6vWnuDcGHL.html

[89] Census 2011. https://www.census2011.co.in/census/state/kerala.html

[90] Shaju Philip, "Kerala floods: Standing crops destroyed, state's food production to take a hit", Indian Express, 24 August 2018. https://indianexpress.com/article/india/kerala-floods-standing-crops-destroyed-states-food-production-to-take-a-hit-5321983/

[91] "Kerala floods hit 45,000 hectares of farmland; paddy, banana badly affected", The Week, 27 August 2018. https://www.theweek.in/news/biz-tech/2018/08/27/kerala-floods-45k-hectares-farmland-paddy-banana.html

Destruction of properties and infrastructure was also extensive. Authorities said the floods had completely destroyed 10,000 houses, and 110,000 houses were partially damaged, leaving 220,000 people are left homeless.[92] 83,000km of roads, including 16,000km of major arteries were also damaged by the floods and the landslides, posing further challenge to food and aid distribution, as well as transportation of materials for the reconstruction efforts.[93]

Care ratings carried out an assessment on Kerala flood's economic impacts and found that for the 4.13 million affected working individuals in the five most affected districts, around 3.3 million workers would have their employment in jeopardy. Tourism sector's projection in 2019 has been lowered as a result of the widespread devastation. The state's real GDP growth rate (discounting for inflation) could be affected by up to 1%, depending on the rehabilitation and construction time especially for the tourism sector. For the Agricultural output the growth will likely be negative.[94]

Droughts

Case study: Droughts in 2017

Early 2017
Due to rainfall deficiency in the monsoon in 2016, 5 states in South India faced water shortages in early 2017: Karnataka, Kerala, Tamil Nadu, Andhra Pradesh and Telangana.

Tamil Nadu received 62% less rainfall and the drought was described as the worst in 110 years.[95] The Tamil Nadu government declared a state-wide drought on 10 January, 2017.[96] The drought affected 21 of 32 districts in Tamil Nadu.[97] 144 farmers ended their lives between October and December 2016, prompting the National Human Rights Council (NHRC) to issue a notice to the State Government asking for a report within six weeks explaining the steps taken or to be taken by the State Government.[98]
The government soon announced a host of relief measures to support farmers, including waiving the land tax for the year, exemptions to farmers from paying Cooperative Bank loans, seeking support from center for relief funds, set at Rs 5,465 per acre for paddy and Rs 7,287 for long term crops. Had the farmer suffered 100% crop loss, the relief fund would be between Rs 21,500 to Rs 26,000.[99]

However, despite the relief measures, at least another 200 farmers in Tamil Nadu died or killed themselves between December 2016 and June 2017 because of distress related to the drought, according to state data reported in the media.[100] Most of those who took their lives belonged to Dalit and other lower-caste communities that do not own land, and had been unable to repay loans from private lenders.[101]

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[92] Sphere India, Kerala Floods 2018 Joint Detailed Needs Assessment Report, September 2018. Accessible at: https://reliefweb.int/report/india/kerala-floods-2018-joint-detailed-needs-assessment-report

[93] Amy Kazmin and Simon Mundy, 'Damage wreaked by Kerala floods to cost $2.7bn', Financial Times, 19 August 2018. https://www.ft.com/content/4e3a74da-a36d-11e8-8ecf-a7ae1beff35b

[94] Economic and industrial impacts of Kerala floods, Care ratings, 21 August.
http://www.careratings.com/upload/NewsFiles/SplAnalysis/Economic%20and%20Industrial%20Impact%20Kerala.pdf

[95] Chetan Chauhan, 'States stare at drought as 59% of India get deficit rainfall, food output at the lowest', Hindustan Times, 13 Sep 2017. https://www.hindustantimes.com/india-news/states-stare-at-drought-as-59-of-india-get-deficit-rainfall-food-output-at-the-lowest/story-L754PYi3N6HCoCVQ2lGXHJ.html

[96] Abhishek Waghmare, 'Tamil Nadu declares drought as 144 farmers die amid worst North East monsoon in 140 years', IndiaSpend, 10 Jan 2017. As carried in First Post: https://www.firstpost.com/india/tamil-nadu-declares-drought-as-144-farmers-die-amid-worst-north-east-monsoon-in-140-years-3197616.html

[97] Ibid.

[98] Dharani Thangavelu, 'NHRC notice to Tamil Nadu on growing number of farmer deaths, LiveMint, 6 Jan 2017. https://www.livemint.com/Politics/cnNqUn2yPyyD0eK2W2rcZI/NHRC-notice-to-Tamil-Nadu-on-growing-number-of-farmer-deaths.html

[99] Pramod Madhav, 'CM O Panneerselvam declares entire Tamil Nadu drought hit, announces various schemes', India Today, 10 Jan 2017. https://www.indiatoday.in/india/story/o-panneerselvam-tamil-nadu-drought-hit-schemes-water-cauvery-water-954220-2017-01-10

[100] Rina Chandran, 'Feature: Heat and drought drive south India's farmers from fields to cities', Reuters, 20 Sep 2017. https://www.reuters.com/article/us-heatwave-india-migration/feature-heat-and-drought-drive-south-indias-farmers-from-fields-to-cities-idUSKCN1BV015

[101] Ibid.

A large number of farmers also reportedly left the land to find work in cities,[102] leaving a third of the fields in the state not sown as at January 2017.[103]

In **Kerala**, with the 2016 South West monsoon was deficient by 33.7% (July to September) and the North East monsoon short by 61% (October to December), the drought was described as the worst in 115 years.

In October 2016, **Andhra Pradesh** announced that 245 of its districts were drought-hit due to a deficiency of 4 percent rainfall.[104]

Late 2017
Overall, the summer monsoon of 2017 recorded a rainfall deficiency of 6%, but it was really unevenly distributed. 59% of India recorded significantly less rainfall[105] while other parts including Bihar and the West Bengal received heavy to extremely rainfalls.

Haryana, Punjab, Uttar Pradesh and **Madhya Pradesh** received up to 36% less rainfall than the long-term average rainfall.

Case study: Drought in 2018

India's pre-monsoon season, from March to May, has seen 11% less rainfall this year than the average.[106] This is the third consecutive year in which pre-monsoon rain has been below average. As well as below-average pre-monsoon rain, India's monsoon has also seen below-average rainfall in five of the last six years, particularly in 2014 and 2015.

Major reservoirs were on average 10% below normal capacity across the country, some states and local areas are facing droughts and other particularly acute water shortages in May 2018.[107]

In **Gujarat**[108], major reservoirs began running dry in early 2018. The Narmada river, the main source of water in the state, was at its lowest level for 13 years, despite heavy rainfall last year. The government announced that water could not be used for irrigation.[109] Across the state, reservoir water levels were 40% below normal in May 2018.
In **Himachal Pradesh** water storage is 56% below normal, following poor rainfall[110] throughout the first months of 2018.[111] The government is introducing measures to address shortages of drinking water.[112]

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[102] Ibid.

[103] Abhishek Waghmare, 'Tamil Nadu declares drought as 144 farmers die amid worst North East monsoon in 140 years', IndiaSpend, 10 Jan 2017. As carried in First Post: https://www.firstpost.com/india/tamil-nadu-declares-drought-as-144-farmers-die-amid-worst-north-east-monsoon-in-140-years-3197616.html

[104] Imran Qureshi, 'South India's Drought Part 1: Five states face severe water crisis made worse by the onset of summer', First Post, 2 May 2017. https://www.firstpost.com/india/south-indias-drought-part-1-five-states-face-a-severe-water-crisis-made-worse-by-the-onset-of-summer-3394636.html

[105] Chetan Chauhan, 'States stare at drought as 59% of India get deficit rainfall, food output at the lowest', Hindustan Times, 13 Sep 2017. https://www.hindustantimes.com/india-news/states-stare-at-drought-as-59-of-india-get-deficit-rainfall-food-output-at-the-lowest/story-L754PYi3N6HCoCVQ2lGXHJ.html

[106] http://archive.is/dgU9Q

[107] Central Water Commission, 'Brief note on live storage status of 91 reservoirs', 17 May 2018. Accessible at: http://202.159.215.252:83/DocumentUploadRoot/DocumentId_24320/17.05.2018.pdf

[108] https://timesofindia.indiatimes.com/city/ahmedabad/gujarat-facing-severe-water-crisis/articleshow/63230418.cms

[109] http://www.thehindu.com/news/national/other-states/summer-of-discontent-water-crisis-looms-in-gujarat/article23357979.ece

[110] https://timesofindia.indiatimes.com/city/chandigarh/himachal-cm-calls-meeting-to-discuss-looming-water-crisis/articleshow/62610650.cms

[111] http://archive.is/dgU9Q

[112] https://timesofindia.indiatimes.com/city/shimla/meet-held-to-form-strategy-against-drought-in-lower-himachal/articleshow/63873570.cms

Bengaluru, in **Karnataka**, is facing water shortages in 2018, with suggestions it could face similar restrictions on water use to those in Cape Town.[113] Across Karnataka nearly all reservoirs are below 40% total capacity, although this is only 8% below normal levels at this time of year. Last year migration to cities from rural areas was reportedly running at around twice the normal rate.[114]

Bundelkhand, in **Madhya Pradesh**, has suffered repeated droughts in recent years[115] with thousands of water bodies drying up in the last decade.[116] Many people from the region have migrated to escape the crisis[117] - reportedly as many as 10,000 a day during the 2017 drought.[118]

Parts of **Maharashtra**, such as Marathwada and Vidarbha have frequently been in drought in recent years. In the first four months of 2017, more than 850 farmers killed themselves in the state;[119] some women have to spend most of their days collecting water.[120] The Godavari river, which mostly gathers water from Maharashtra and **Telangana**, is also running dry.[121]

Water shortages in **Odisha** are affecting people across the state, including in Rourkela[122] and the Bonda tribal people,[123] with some villages reportedly empty of farm workers, who have left to find work in cities.[124]

In **Punjab**, major reservoirs are 39% below normal levels. Water shortages in the state are affecting agriculture, such as cotton planting,[125] and could hit electricity production.[126]

In **Tamil Nadu**, major reservoirs are 67% below normal levels - every major reservoir is below its average for this time of year. The state has allocated Rs 200 crore from the Disaster Relief Fund to tackle the crisis.[127]
In **Uttarakhand**, water storage is 53% below normal levels. Residents do not have enough water to meet minimum World Bank standards in nearly half of the state.[128]

113 https://timesofindia.indiatimes.com/city/bengaluru/water-crisis-is-bluru-heading-for-day-zero/articleshow/62893432.cms
114 https://www.firstpost.com/india/south-indias-drought-part-6-parched-rural-karnataka-sees-mass-migration-but-officials-stay-in-denial-3408386.html
115 https://www.firstpost.com/india/bundelkhand-water-crisis-fourth-successive-drought-and-vanishing-water-bodies-compound-farmer-misery-trigger-migration-4468313.html
116 http://www.dailypioneer.com/state-editions/lucknow/4250-water-bodies-have-vanished-in-last-one-decade-in-bundelkhand.html
117 https://www.ndtv.com/india-news/empty-locked-houses-a-common-sight-at-this-drought-hit-village-1238490
118 https://www.hindustantimes.com/india-news/drought-triggers-large-scale-migration-in-bundelkhand/story-PNPNypioJGoFhQQ8CO5uvN.html
119 https://timesofindia.indiatimes.com/topic/drought-in-maharashtra
120 https://edition.cnn.com/2015/07/16/asia/india-water-wives/index.html
121 http://www.thehansindia.com/posts/index/Andhra-Pradesh/2018-05-19/Reservoirs-in-Krishna-Godavari-basins-dry-up/382453
122 http://www.newindianexpress.com/states/odisha/2018/apr/25/odisha-drop-in-ground-water-level-mounts-water-crisis-in-rourkela-1806102.html
123 https://www.telegraphindia.com/states/odisha/tribal-people-hit-by-water-shortage-230020
124 https://in.reuters.com/article/migration-india-drought/as-drought-fuels-indian-migration-those-left-behind-suffer-the-most-idINKBN1H51CY
125 http://indianexpress.com/article/india/punjab-agri-secretary-visits-canal-sites-as-water-scarcity-hits-cotton-sowing-5180879/
126 https://timesofindia.indiatimes.com/city/chandigarh/low-water-level-in-reservoirs-shortage-of-coal-threatens-power-generation-in-punjab/articleshow/64137928.cms
127 http://www.newindianexpress.com/states/tamil-nadu/2018/apr/25/tamil-nadu-rs-200-crore-under-state-disaster-relief-fund-allotted-to-tackle-water-crisis-1806051.html
128 https://www.hindustantimes.com/dehradun/long-term-plan-to-resolve-water-scarcity-in-uttarakhand/story-QxTZIFYaEfiSA1jgbsouIK.html