Indian Droughts, Drought Policy and Climate Change

By Sohini Sengupta

Introduction

The Intergovernmental Panel on Climate Change (IPCC) released their most recent report, the first instalment of the sixth assessment report (AR6), in August 2021, as the world reeled under the coronavirus pandemic. Through this the force of evidence on the argument about anthropogenic effects on the changing global climate received further affirmation. Climate change implicates human societies in problems of loss, depletion, disappearance and collapse,[1] while the more broadly conceptualised Anthropocene describes a new epoch in Earth's history to mark the boundary that describes accelerated change based on stratigraphic indicators and 'human forcing'.[2] Anthropocene argues Dipesh Chakrabarty,[3] entails rethinking of human history enabled by the collision of human and geological timescales such that stories of human injustice must now be encapsulated not within the relatively short period of modern capitalism but include diverse planetary sufferings.

Chakrabarty's thesis highlights the scale of human influence and the depth of human predicament, while other commentators find the focus on 'planetary epochs' and the abstract level of 'species-life' as limiting the scope of engagement and empathy. [4] In this context, living with perpetual crisis has emerged as the new emulative paradigm, associated with non-western or indigenous worlds, promotion of policies of 'de-growth' by strong states to reduce the impact of human activities on the planet.[5] For some critics, visions of geo-historical transformations aid a global agenda of securitisation aided by northern fears of planetary collapse,[6] for others, it enables environmental populisms that foreground technocratic-eco-centrism rather than democratic deliberation.[7] Discourses about planetary transformation create political and ethical obligations 'to develop viable modes of living' and the need to engage with diverse ecologies that some believe gets restricted by the apocalyptic frames of ecological disasters or 'foreclosed visions of future'.[8] A discourse that centers 'humanity as a species-agent' avoids engaging with the 'differentiated scales of vulnerabilities at all levels of human societies' induced by climate change.[9] Changing processes and methods of measurement and evaluation of droughts, dependent on big data and remote technologies prevent what some authors describe as 'textured' understanding of social landscapes and 'alternative experiences of disasters'.[10] Discourses that connect climate change with disruptions such as conflicts mask other precipitating causes[11] and leads to 'mystification and political paralysis.[12] While many social scientists have criticised the homogenous and essentialised representations of the Anthropocene, others have advised 'curious engagement', alongside attention to 'specific landscape histories and structures' rather than using the 'planet' as the sole unit of analysis.[13]

This position paper will draw insights from such unsettled debates about public policy and climate change, to understand and articulate how the interpretations of natural and social aspects of droughts, including causation, implication and accountabilities, in the context of India, have been articulated in policy narratives. Droughts are among the least visible of all climate hazards. The effects of climate hazards are slow, long drawn, chronic and mostly less dramatic and can be interpreted as an adaptation problem. Situated within climate debate, drought has been moving away from agriculture centric perspective to a range of impacts associated with the competing use of water, land and environmental resources.[14] Anxieties about deforestation, aridity and desiccation have preoccupied colonial administrators in India from the early nineteenth century.[15] What role did natural environments play in such accounts? What were/are the diverse and contested narratives of nature and natural calamities that view humans as peripheral or incidental rather than central actors in the stories of collapse hastened by arid conditions?

Discourses of environmental collapse and climate catastrophe that inform these policy discussions are based as Hulme (2008)[16] argues on 'ideas of control and mastery of planet, global governance and individual and collective behaviour' and 'attempts at 'engineering future climate'.[17] The notion of 'collapse,' 'often dramatises long past events, ignores human agency….serves to mystify and 'orientalise' the past intellectually. Tales of mysterious and abrupt collapse…generate catchy parable for our own

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times, especially when our contemporary relationship with the natural environment is so fraught with concern'. Local knowledge about calamities is not best obtained through a concept of 'closed culture' but found in complex human encounters with the natural world linking biophysical and social processes. Influential policy narratives play an important role in understanding and shaping public and private actions around drought management and interventions that may transform the interactive relations and spaces between human and natural worlds in unprecedented ways. While the article focuses on Indian droughts, scenarios, and policy experiences from elsewhere in the world are referred to examine some of the common dilemmas of public policy turns based on narratives of climate science but embedded in the neoliberal reforms and increasing financialisation - of the present century that disrupts public support to key sectors and constituencies of the twentieth century that involve 'land and water management' such as agriculture and irrigation, through changing approaches on how best to define, anticipate, predict, manage and respond to droughts.

This article is based on the desk review of published articles and policy reports on drought and agriculture covering key drought events, mainly from the 1960s till the present, though some discussion on colonial era droughts, especially catastrophic ones like 1899 -1900 is also included. The remaining article is divided into six sections.

DROUGHT IN RECENT POLICY: MEASUREMENT, PREDICTION, AND PLAN OF ACTION

Drought occurs when highly deficient rainfall, compared to normal or standard levels, result in insufficient water for meeting various societal needs. Whether a deficit in water is defined or recognised as drought depends on the criteria that are used.[18] Based on rainfall or water deficit values set as standard, some areas of the world are arid, some have wet and dry seasons and some experience droughts in some years, being located in semi-arid or sub-humid environments.[19] International policy documents describe droughts as among the most prevalent disasters in the context of climate change, whose ubiquity is disguised by the failure to detect, prepare for, and address the risk parameters. Definitions of drought constitute the starting point for actions by communities of interest, national governments, and concerned international agencies. According to the GAR (global assessment report on disaster risk reduction) – special report on drought, 2021, a population of 1.5 billion have been affected by droughts in the present century and the affected population would increase further due to 'climate change, environmental degradation and demographic shifts'.[20] The EM-DAT database shows that 2.2 billion people were affected by droughts between 1950 and 2015 (cited in The German drought monitor 2016).[21] A document called 'Drought in Numbers' released as part of COP-15 proceedings in 2022, declared that 650,000 deaths were caused by drought events from 1970-2019 and 55 million people were affected by drought annually. Within this, the brief argued, health, nutrition, education and sanitation would be severely affected and lives of children, girls and women would be severely affected.[22]

Droughts not only damage livelihoods and ecosystems but 'may trigger famine, displacement and conflict,' mentions the United Nations Convention to Combat Desertification (UNCCD), on its Drought Initiative webpage.[23] Even though all incidents of drought are not severe, argues the 'initiative', countries need to plan in advance to anticipate, prevent and prepare for droughts through 'drought action plans,' in order to move away from 'reactive' and 'crisis-based' response.[24] Although the emphasis on drought-prevention rather than response after the event, is not a novel approach, the strategies that are recommended as part of pro-active preparedness, prioritises new forms of predictive measures and methodologies as 'drought preparedness systems'. This section discusses how some of these measures anticipate and understand drought that include future loss, and mitigation based on the occurrence of droughts in the past. Important changes in drought definition and interventions in the last decades has shifted focus from maintaining 'stocks of food and water' to generating alternate ideas of the management of risk. Building 'resilience' of communities and the ecosystems to drought through land and ecosystems restorations, education and training, influential 'media stories' and limiting global warming, is recommended by recent reports.[25] It is important to trace these shifts and its interaction and correspondence with events, policies and actions at specific national and sub-national levels, where both drought events and mitigation have a long history.

Measurement of drought is challenging due to a range of factors, from slow onset, length or duration, connection with crop growth and water needs of different and increasingly competing sectors. Quantifiable measures that are commonly used to ascertain a drought event indicates some of these complexities and challenges. In most developing countries, SPI (Standard Precipitation Index) that calculates deviations from normal rainfall pattern is used as the default index for evaluating meteorological (precipitation) droughts. In addition to this, Standardised Runoff Index (SRI) is used to measure hydrological drought, Standardised Soil Moisture Index (SSI) for soil moisture and Vegetation Condition Index (VCI) for vegetative drought. Based on a combination of these indices,[26] Zhang et al. (2017) classified the decadal droughts that affected the wheat-growing season in India as follows:

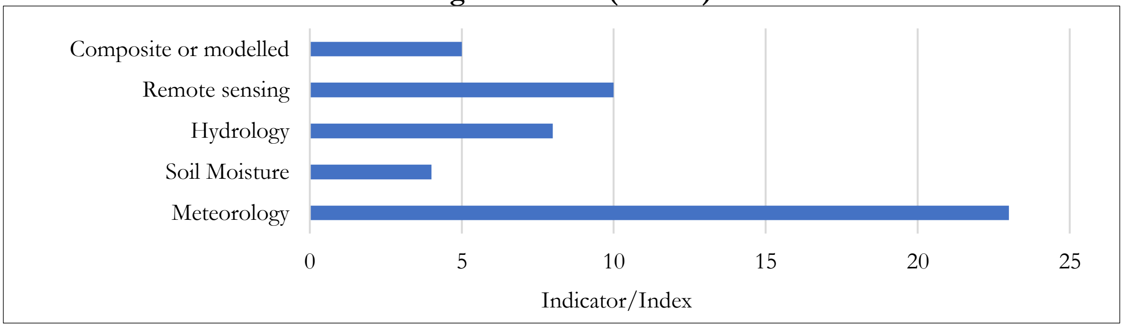
Table 1: Occurrence and Classification of Droughts

Decades	Meteorological Droughts	Hydrological droughts	Soil Moisture Drought	Vegetation Drought
1981-89	2	13	5	20
1990-1999	5	21	10	8
2000-2009	11	11	10	9
	18	45	25	37

Source: Data from X. Zhang, R. Obringer, C. Wei, N. Cheng and D. Niyogi, "Droughts in India from 1981 to 2013 and Implications to Wheat Production," Supporting Information, *Sci Rep* 7, no. 44552 (2017), 20, table S7, https://static-content.springer.com/esm/art%3A10.1038%2Fsrep44552/MediaObjects/41598_2017_BFsrep44552_MOESM62_ESM.pdf

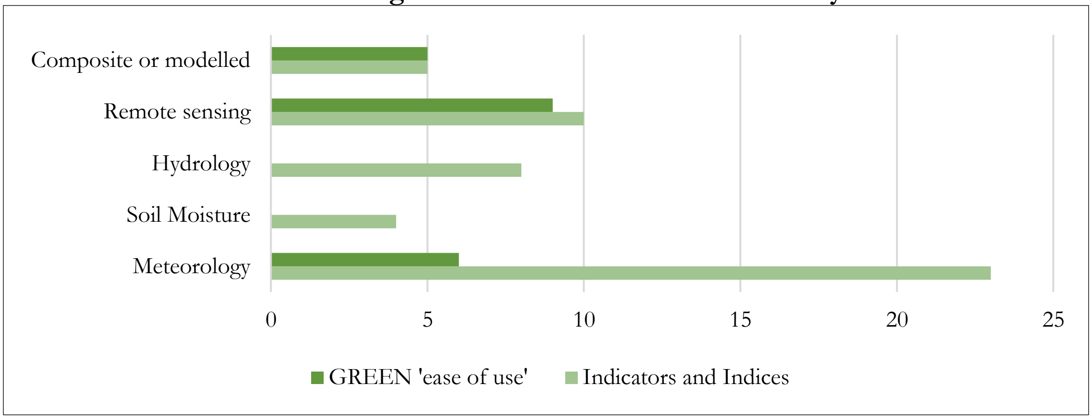
Table 1 shows that the number of meteorological droughts was the highest in the decade of 2000-2009, most hydrological droughts occurred in 1990-99, soil moisture droughts were persistently high from 1990-2009. Surprisingly, vegetation drought occurred mostly in the earlier period, 1981-89. Overall, meteorological droughts have been increasing in number, every decade, while hydrological and vegetation droughts have declined. A simple explanation of the puzzle is the increasing spread of irrigation that has limited the expression of drought despite increasing rainfall variability in recent decades. The authors explained the data trend as emerging from changing farm management practices. The use of fine-grained indices that focus on particular crops, growing season and monsoonal patterns, in the measurement of drought may affect how the crisis (especially in the context of agriculture) will be understood and interventions designed. The study by Zhang et al (2017) focussed on four wheat growing states (Punjab, Haryana, Uttar Pradesh and Bihar). The authors recommend a 'systems' approach that considers 'crop phenology, drought evolution and local management practices' to create an appropriate drought management practice. They also argue that, use of rainfall deficit measured by SPI for predicting loss of crop yield or adverse food security due to future variation in climate may not produce reliable results. For the purpose of the present review article, it is important to note that the reference point being crop cultivation and yields, leads drought assessment and selection of indices in a particular direction. Crop phenology, in turn, is used as an indicator to measure the effects of climate change on agricultural crops, and linked to other indices such as 'growing degree days' (GDD) used in the emerging research area of the use of plant genomics for climate adaptive agriculture to ensure crop productivity. Phenology is the study of recurrent biological events, such as flowering in plants or migration in birds, and the factors that determine their occurrence.[27]

CHART 1: Relative Use of Drought Indices based on World Meteorological Organisation (WMO)



Source: Data from M. Svoboda and B.A. Fuchs, *Handbook of Drought Indicators and Indices*, Integrated Drought Management Programme (IDMP), Integrated Drought Management Tools and Guidelines Series 2 (Geneva: World Meteorological Organisation and Global Water Partnership, 2016), 7-9, https://library.wmo.int/doc_num.php?explnum_id=3057

CHART 2: Drought Indicators recommended by WMO



Source: Data from M. Svoboda and B.A. Fuchs, *Handbook of Drought Indicators and Indices*, Integrated Drought Management Programme (IDMP), Integrated Drought Management Tools and Guidelines Series 2 (Geneva: World Meteorological Organisation and Global Water Partnership, 2016), 6-9, https://library.wmo.int/doc_num.php?explnum_id=3057

The WMO handbook lists a large list of indicators and indices that are used for 'determining appropriate actions' for 'types of drought'. These are marked 'green', 'yellow' or 'red' based on 'ease of use'. The 'Green' category is based on easy availability of data and the handbook indicates that remote sensing and composite modelled indices are labelled green due to this, although local or regional conditions maybe better understood by other indices.[28] Selection of an indicator or index is based on sectoral requirements rather than comprehensive understanding about a type of drought; 'there is no one-size-fits all definition of drought, there is no single index or indicator that can account for or be applied to all types of droughts, climate regimes and sectors affected by drought'.[29]

The increasing complexity around the accounting and management of drought for various sectors is belied by the uniformity imposed by the public communication of drought based on newer influential indicators, the 'composite' or 'modelled and remote sensing.' For instance, the United States (US) government's national aeronautics and space administration's (NASA) Gravity Recovery and Climate Experiment (GRACE) mission and the GRACE Follow-On (GRACE-FO) mission, since 2018, monitors changes in Earth's water cycle (ice-sheets, glaciers, near-surface, under-ground, large lakes and rivers, changes in sea levels and ocean currents), that can be applied to predict the incidence of hydrological droughts.[30] A combination of precipitation data from the India Meteorological Department (IMD) and observations from the GRACE and GRACE-FO was used to examine the 2016-18, droughts in southern India caused by the failure of South Eastern Monsoon (SEM). The GRACE data computed the total loss in water storage in southern India during this period attributing this to 'significant depletion of ground water'.[31] Standard precipitation index (SPI) has been recommended by the WMO in 2009 as the key meteorological drought index to be followed by all countries and is considered as the 'starting point for meteorological drought monitoring, and is labelled green because of "easy calculation"'.[32] SPI is calculated through the use of historical rainfall record of a region.

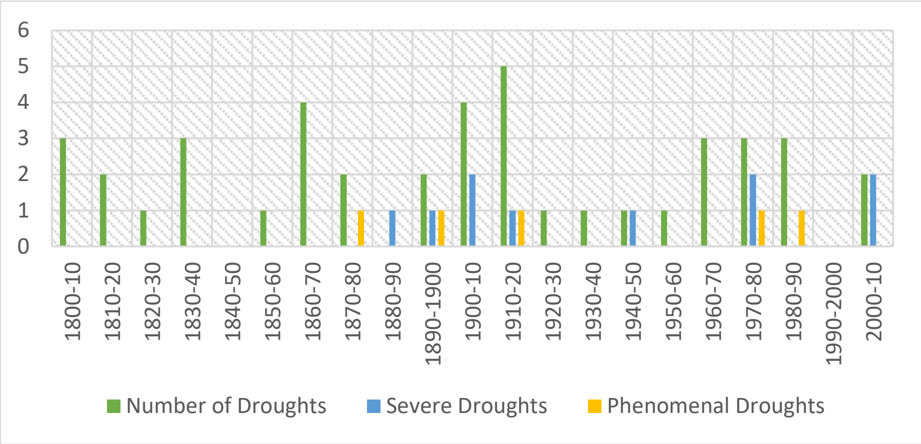
The IPCC, AR6 report provides the following definitions of drought. 'Agricultural and ecological drought (depending on the affected biome: a period with abnormal soil moisture deficit which results from combined shortage in precipitation and excess evo-transpiration, and during the growing season impinges on crop production or ecosystem function in general. Observed changes in meteorological droughts (precipitation deficit) and hydrological drought (stream flow deficits) are distinct from those in agricultural and ecological droughts.'[33]

OCCURRENCE AND MEASUREMENT OF DROUGHT IN INDIA

Types of Monsoon – South-West Monsoon (brings rain to northern and central India from June-September - Summer) and North-East Monsoon (brings rains to peninsular, southern India from October to December - Winter). Droughts can take place if rainfall is deficient or erratic in either of the two monsoon periods. Severe droughts that affected all regions of India has been identified by recent meteorological scientific research as the following years: 1966, 1972, 1986 and 2002 (Saharwardi et al. 2022).[34] Three of these drought events occurred in the twentieth and one in the present century. The EM-DAT database identifies 13 drought years (1964, 1967, 1973, 1979, 1983, 1987, 1993, 1996, 2001, 2002, 2009, 2016, 2019) in India from 1950-2022.[35] Based on this, two major droughts occurred every decade with the exception of 1950. These numbers match with the information provided on the 2016 Drought manual. According to the Indian Drought Manual, 2016, seven droughts occurred between

1899-1920, three droughts between 1941-1965 and ten droughts between 1965-1987, due to El Nino Southern Oscillation (ENSO).[36] Data from the Indian meteorological department lists greater number of droughts.

CHART 3. Occurrence and Intensity of Droughts



Source: Based on Table 1. Drought Intensity, Drought Research Unit, Indian Meteorological Department (IMD), Pune. Cited in GOI, National Disaster Management Authority: Management of Drought. September 2010, p.3.[37]

The revised Indian drought manual, 2016 introduces several new indicators and indices that would be used to monitor drought conditions to create a system of early warning. Observers have argued that the more stringent criteria for drought event in the manual made it difficult for state governments to declare drought and obtain resources for relief and mitigation from the central government.[38]

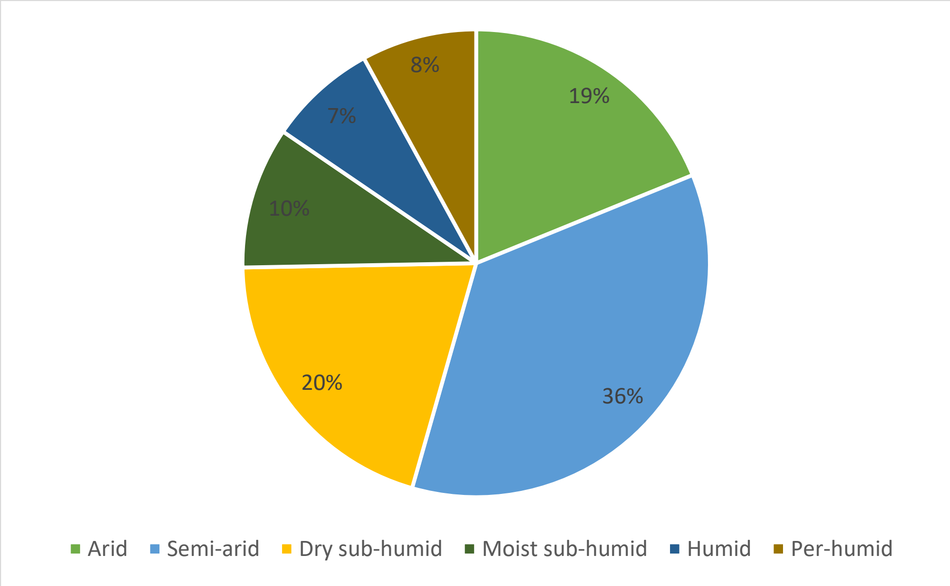
Table 2. Revised Drought Indicators introduced in the 2016 Drought Manual

Variable	Indicator and Indices
Rainfall	Rainfall Deviation/SPI dry spell
Crop sown area	Deviation from Normal
Satellite based crop condition	NDVI, NDWI deviation from no VCI form of NDVI/NDWI
Stream Flow	SFDI
Groundwater Level	GWDI
Reservoir Level	NA (data from CWC, irrigation department)

Source. Department for Agriculture, Cooperation and Farmer's Welfare. Government of India, Manual for Drought Management, 2016, p.26[39]

El-Nino/La Nina Southern Oscillation (ENSO) – A naturally occurring phenomenon that involves fluctuating ocean temperatures in the central and eastern equatorial Pacific accompanied by changes in the atmosphere. Based on scientific models of this phenomenon climate patterns leading to heavy rains, floods and drought can be predicted one-nine months in advance.[40] Effects of El-Nino events include warm and dry conditions and (generally) less than summer normal monsoon rainfall in India. Climate change is believed to be increasing the impact of E-Nino – intense heat and heavier precipitation.[41] (Meteorological and Oceanographic data) South Atlantic Oscillation (SAO): SAO is the atmospheric counterpart of fluctuating oceanic temperatures, El-Nino and La-Nina and hence the term ENSO (WMO 2014).[42] Largescale fluctuations in air pressures is known as the Southern Oscillation (WMO 2014:3). Indian Ocean Dipole – Difference in sea surface temperatures in the opposite parts of the Indian Ocean.[43]'In ..the positive phase, warmer than usual temperatures in the Western Indian ocean bring heavy rains to East Africa and India, and colder than usual waters bring drought to Southeast Asia and Australia. In the negative phase, ocean and monsoonal conditions reverse.[44]' Gregory (1986) discusses five major droughts in India, in which three coincided with major El-Nino episodes.[45]

CHART 4. Classification of zones in percent-area based on Moisture Index



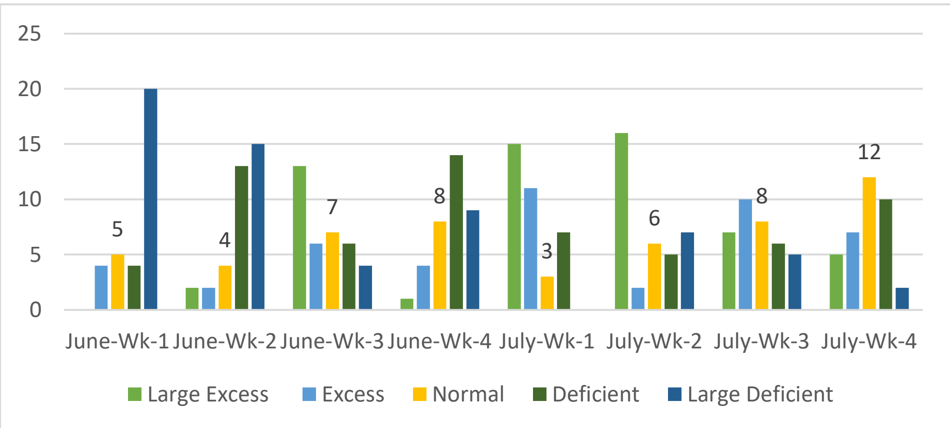
Source: DPAP Evaluation Report (H.Rao Committee). P.33.[46]
Moisture Index (MI) = [P-PE]/PE X 100.
P=precipitation, PE = Potential Evaporation.
MI < -66.7 – Arid, -66.6 to -33.3 – Semi-Arid, -33.2 to 0 – Dry-Sub-Humid, 0 to +20 – Moist-Sub-humid, +20.1 to +99.9 – Humid, 100 – Per-Humid.

The H.R committee recommended that based on MI values, arid, semi-arid and dry-sub-humid areas should be included under DPAP and DDP. Proportion of irrigate area was also to be included in these zones to determine eligibility.

GOVERNMENT DROUGHT POLICY

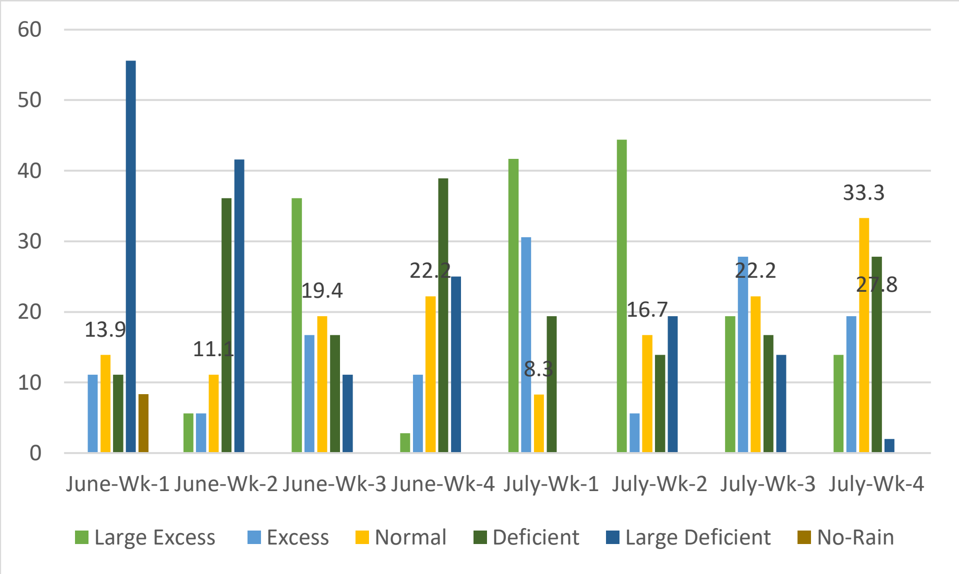
On July 30, 2022, the IMD was quoted in Indian press, as follows: 'a pause in the monsoon over the Indo-Gangetic plains is likely to impact paddy sowing across north and eastern Indian states.'[47] Based on the progress of monsoon over 36 sub divisions, (see chart) above, monsoon was 'normal' only in 33 percent and 27.8 percent had deficient rainfall, of all divisions in the fourth week of July. The period in which rice would be sown and transplanted was getting reduced according to private forecasters. At the time of submitting this draft report, another drought season, based on summer agricultural season, appears to be unfolding in India. According to press reports, the Ministry of Agriculture was assessing the changes in area sown under kharif rice and the possibility of lower output (HT 2022, July 30).

CHART 5. WEEKLY PROGRESS OF SOUTH-WEST MONSOON IN IMD SUB-DIVISION 2022



Source: Prepared by author based on IMD week forecast https://mausam.imd.gov.in/imd_latest/contents/week_rainfall_activity.php

CHART 6. WEEKLY PROGRESS OF SOUTH-WEST MONSOON IN IMD SUB-DIVISION 2022 (PERCENTAGE) n=36



Source: Prepared by author based on IMD week forecast https://mausam.imd.gov.in/imd_latest/contents/week_rainfall_activity.php

The drought prone areas programmes:[48] Based on average annual rainfall data and potential evo-transpiration rate, the Ministry of Rural development developed criteria to establish eligibility of districts to be included in the drought prone area programme (DPAP) and Desert Development Programme (DDP) in 1994. Climate change literature of this period found evidence of 'rising mean average annual surface temperature of 0.21 degrees Celsius/10 years, after 1970 as compared to 0.51 degrees Celsius/100 years during the last century. 'On the other hand average annual monsoon rainfall is found trendless over an extended period starting from the year 1871, though significant spatial variation is found at division level. At the macro level rising temperature along with no significant trend in monsoon rainfall may cause aridity to rise. …at a smaller geographical scale district level there may be different trends at district level (Raju et al 2013).' The Hanumanth Rao committee evaluating the DPAP and DDP submitted its final report in 2018, with the following key observations.[49] 54 districts and parts of 18 adjacent districts, were included for special attention and government investment through rural works programme, dryland farming, land treatment, afforestation and minor irrigation under the DPAP, after the droughts in the 1970s (ibid:4).

A committee in 1982 (Swaminathan) emphasized the development of 'productive agriculture', ecological restoration and creation of fodder banks in DPAP areas. The latest committee observed that the programme had deviated from the original purpose of 'ecological restoration' and 'drought proofing' towards income generation and infrastructure building, from poultry farm, silk rearing to dairy development and groundwater survey. The report also observed that the investment was low and widely dispersed over irrelevant programmes (relevant programmes being soil and water conservation, afforestation and pasture development) and high administrative costs leading to 'dilution of objectives' that is 'restoration of ecological balance' (ibid). During 1992-97, it was recommended by another committee (Jain) that the programmes be transferred to the state government and NGOs (as part of decentralization), but the programmes were retained as centrally sponsored schemes. The Hanumantha Rao committee set up in 1994-95, lists the following as inappropriate programmes that have been implemented under DPAP: 'deep bore wells for individual farmers, pipelines for supplying drinking water and rural electrification (ibid:9).'[50] Four key programmes under DPAP and DDP, include 'Land shaping and land development including soil conservation', water resource development and Afforestation and Pasture development. The authors of the report argue that 'drinking water and forest depletion problems were not resolved by the DPAP and pumping of groundwater was faster than recharge in dryland areas due to cheap electricity for pumping water (ibid:15).

Influential environmental magazine, Down to Earth, articles criticised drought relief as the means for corrupt officials to siphon government resources. Citing the findings of the H.Rao Committee report. The article argued that the emphasis should be on 'drought-proofing' and not reactive emergency relief once a crisis erupts and droughts threaten to turn into famines. Audit reports showed that while the money spent under programmes like DPAP had increased over the years, the areas identified as drought prone and affected by desertification had also increased during the same period, concluding that the resources were mis-utilised or failed to meet stated objectives. Financial and environmental arguments were used to argue that the programmes were both ill-designed and failed to meet the stated objectives.

'The government's drought relief programmes are bound to fail in the long run. Even the Planning Commission acknowledges that funds for the drought relief is becoming illegal income for officials, politicians and contractors.'[51]…'Drought becomes an annual disaster when effort is not made to drought-proof -- provide long-term relief against drought. This can be done by regenerating the natural asset base in villages, in other words, good management of land, water and forest so that there is a buffer for times when rains are below normal. But when drought occurs in the absence of drought-proofing, the only thing to do is to make sure that it doesn't become a famine. In times of famine, food for work programmes are used to provide employment, so that the people have money to buy food, water and fodder. Over the years, the Indian government has devised numerous schemes built on this concept.'[52]

Changes in government policy on drought mitigation and response is reflected in the drought manuals created by the Ministry of Agriculture and Farmer's welfare. The following table provides a comparison between the older, 2008 version and the most recent policy guideline. Area development programmes like DPAP and DDP are discontinued in the 2016 manual. Public works programme and the public distribution system is retained as the means to ensure entitlement protection of vulnerable occupational groups in rural areas. New components such as monitoring and risk mapping is introduced. Till 2010, declaration of drought by the government was based on crop cutting experiments. Based on the results of this exercise, drought affected farmers were provided relief in agricultural loan payment and subsidised farm inputs for the next agricultural season. The National Drought Management Plan (NDMP), 2010:27, suggests changing the drought declaration method since crop cutting took a long time and led to delays.

The National Crisis Management Plan for drought published in 2022 by Government of India's Ministry of Agriculture and Farmers Welfare (NCMP), states that the state governments were expected to follow the guidelines in the drought manual 'an objective, transparent and timely declaration of drought (NCMP 2022, p.6).' The NCMP contains fairly simple criteria for predicting drought that is linked to agricultural seasons of summer monsoon (Kharif) and winter monsoon (Rabi)[53] Important additions in the check list (below), indicates inclusion of temperature, humidity and soil moisture in addition to precipitation and monitoring water availability for purposes other than agriculture. The NCMP reiterates the primary responsibility of drought declaration and relief to the state government. State governments have to follow the instructions in the drought manual. Declaration of drought is associated with the organization and distribution of relief. Droughts are expensive. In 2015, the Supreme Court had to issue a notice to the Central Government and 11 state governments to ascertain the steps that they had taken to provide relief to drought affected population of the state.[54] State government's are hesitant about declaring drought as it involved additional financial burden beyond budgeted expenditure. [55] According to a WB assessment report, less than 26 percent of farming households were covered by crop insurance, less than 35 percent of crop loans were combined with insurance, government subsidies on premium payment was around $4 billion in a year – low coverage of agricultural insurance made it an ineffective 'policy tool' to protect farmers against shock and provide disaster relief (p.12).'

TABLE 3. DROUGHT DECLARATION CRITERIA IN KHARIF AND RABI SEASON

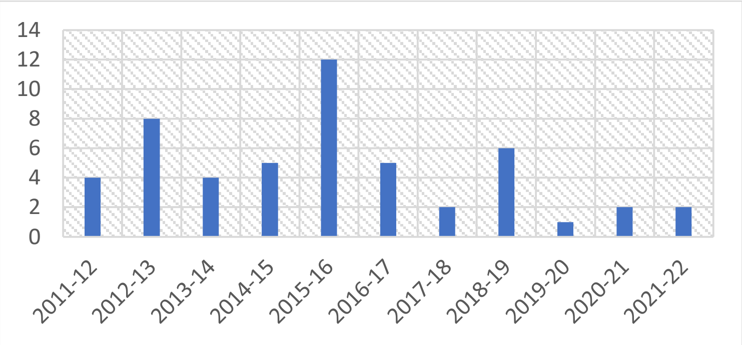
Kharif Season	**Rabi season**
Delay in onset of South-West Monsoon.	Deficiency in closing figures for South-West Monsoon (30th September).
Long 'break' during the of South-West Monsoon season.	Serious depletion in level of Ground Water compared to figures for "normal years".
Insufficient rains and skewed spatial distribution, particularly during the months of June and July.	Fall in the level of reservoirs compared to the corresponding period in 'normal years' – indication of poor recharge following SW Monsoon.
Temperature and relative Humidity (subject to availability).	Indication of marked soil moisture stress.
Rise in price of fodder.	Temperature and relative Humidity (subject to availability).
Absence of rising trend in reservoir levels and / or reduction	Rise in price of fodder.

in stream flows and depletion rate of groundwater.	
Drying up of sources of rural drinking water supply.	Increased deployment of water through tankers
Declining trend in the progress of sowing as compared to total normal sown areas.	
Out migration of rural population.	

Source: The National Crisis Management Plan 2022[56]

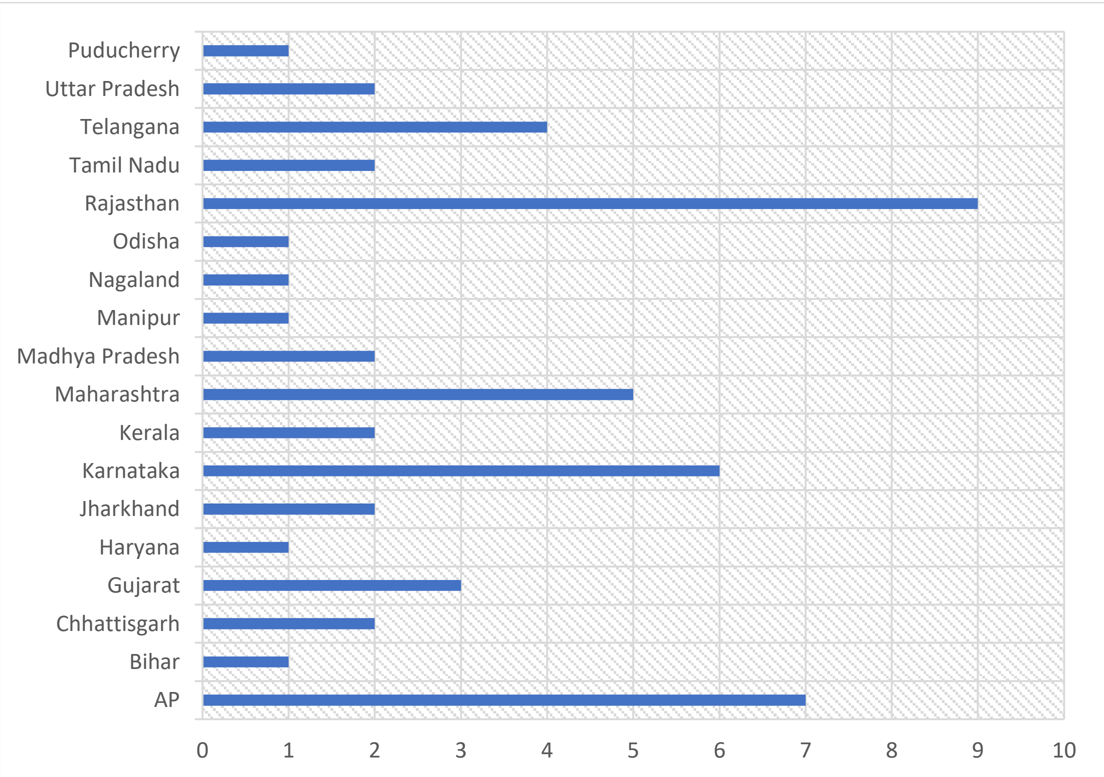
Based on the data on district wise drought declared provided in the NCMP, 2015-16 is the year when most of the states had some districts under drought. Eighteen states are represented in this data. Rajasthan, AP, Karnataka and Maharashtra are the top four states where drought was declared in most years in the decade under discussion.

CHART 7. Number of States where Drought Declared in Kharif - 2011-22



Source: Based on National Crisis Management Plan (CMP) 2022. [57]

CHART 8. Droughts Declared in Kharif - 2011-2021



Source: Based on NCMP 2022. Number of Years drought was declared in the Kharif season – pertaining to some districts of the state. [58]

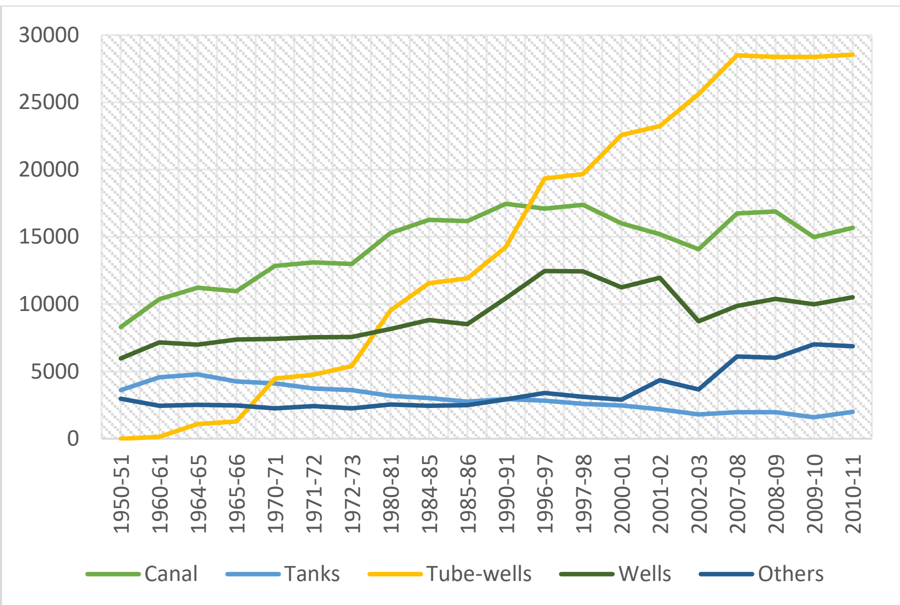
WATER STRESS AND IRRIGATED AGRICULTURE

Irrigated agriculture is identified as one of the main consumers of freshwater resources globally. For instance, in the United States, irrigated agriculture consumes 80% of all ground and surface water annually.[59] 'In 2010 India was the world's largest agricultural water consumer at nearly 700 billion m^3 per year. **India's agricultural water consumption has been growing rapidly** — almost doubling between 1975 and 2010 — as its population and total food demand continues to increase. China is the world's second largest user, at approximately 385 billion m^3 in 2015, although its agricultural freshwater use has approximately plateaued in the recent past.[60]

Net irrigated area in India from all sources increased from 20,853 thousand hectares to 63,601 thousand hectares from 1950 to 2010. A little more than 40 percent of the irrigated area came from ground water sources in 2010-11. Nearly 40 percent was from canal irrigation in 1980. According to a recent World Bank report the protective role of irrigation towards agricultural production and yields has reduced over time. 'While irrigation can provide a good buffer against rainfall variability and bolster crop yields, it is not a prudent response to water scarcity everywhere. The best and most productive sites to build infrastructures has been exhausted in many parts of the world, and most of the world's river basins are highly stressed…as many as 4 billion people already live in regions that suffer severe water stress during at least part of the year (Mekonnen and Hoekstra 2016)…where net surface and ground water withdrawals exceed available supply. These basins are …effectively 'closed'….addition of new irrigation infrastructure becomes a zero sum game, where new users receive water at the expense of current users (WB 2017:28).[61]'

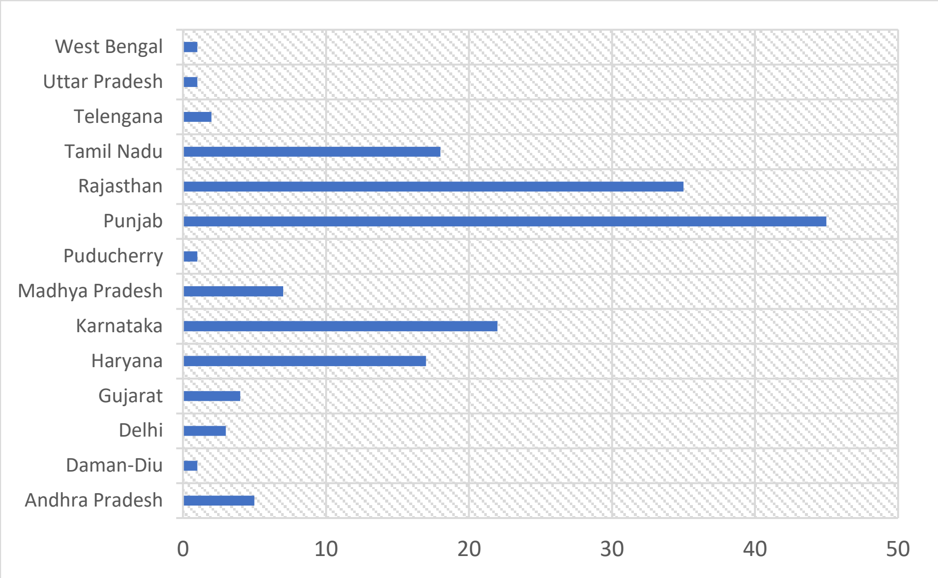
The World Bank's solution predictably is the treatment of water as an economic commodity and use financial instruments such as pricing and user charges to ensure efficiency of use which in turn will lead to sustainability. In this report the authors make the now familiar argument about how the supply of 'free or under-priced water' in arid areas lead to the cultivation of water intensive crops such as (rice and sugarcane) in arid areas which increases the 'vulnerability to drought which in turn magnifies the impact of dry shocks (ibid:28).' The report describes this phenomena as 'maladaptation.' Policy reports such as this one, written after 2012, tend to expand the historical scale, say from ancient Mayan civilisation to the twenty first century, to make a general argument about 'historical precedent' around civilizational collapse associated with 'over reliance on irrigated drought sensitive crops'.

CHART 9. Area Irrigated by Source in thousand hectares



Source: FAO stats.[62] The chart (by author) shows the rise of canal irrigation in till the 1980s – with dips in the severe drought years, 1965-66, 1972-73, 1985-86, 1996-97,2002-03, 2009-10 and overall decline from 1990-2010. Tube well (ground water) increased during this period, with dips in severe drought years. Irrigated area decreased from all sources (esp. canals, tanks and wells) in 2002-03. Directorate of Economics and Statistics, Department of Agriculture and Farmer's Welfare. Government of India. https://eands.dacnet.nic.in/LUS-2010-11/All-India-3.pdf

CHART 10. Notified Areas where Ground Water Extraction is not Permitted



Source: Based on information in CAG Report No.9. 2021. P.5. 162[63] areas are on not-permitted list in accordance with 2015 guidelines. Groundwater maybe extracted from these areas only for drinking. 'Groundwater areas' are aquifers or administrative blocks depending on the on rock geology. Practice of notifying areas has been discontinue ed in 2020 (ibid). Groundwater samples were found highly contaminated with high levels of Arsenic, Fluorides, Nitrates and Iron (CAG 2021, p.29).

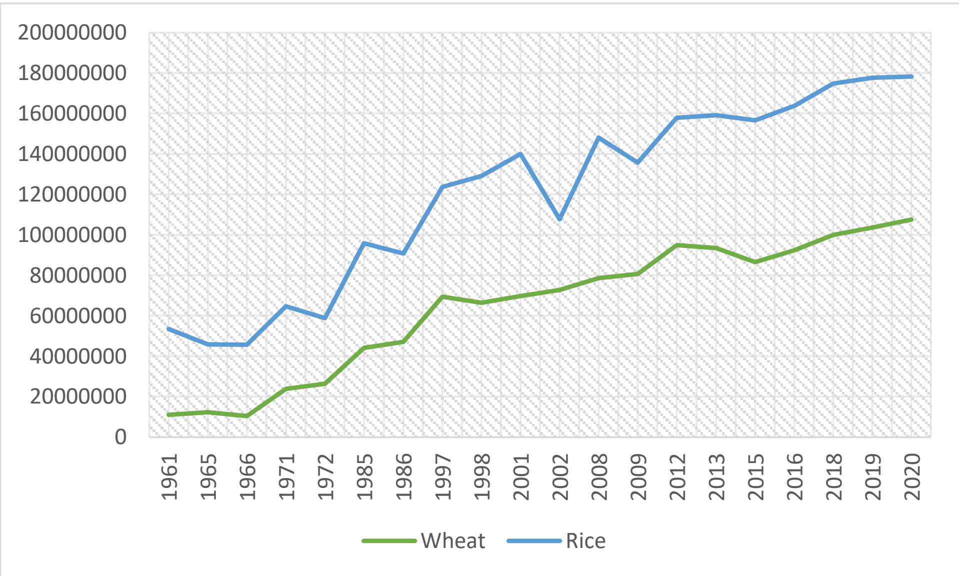


Chart: Crop Production, Wheat and Rice, in tonnes, Source: Created by author based on FAO statistics. https://www.fao.org/faostat/en/#data/QCL
Drought years show lower rice production compared to preceding year: 1966, 1972, 1986, 2002, 2015
Drought years show lower wheat production compared to preceding year: 1966,1998, 2009, 2015

India's agricultural growth has been dependent on the expansion of surface irrigation. In recent decades though criticism has been rising over the efficiency, equity and environmental implications of large surface irrigation projects. Both civil society and International agencies have observed the poor outcomes of such projects. From the perspective of national politics and farmers groups, the demand for public investment in irrigation has been consistent and risen over time to mitigate against weather risks and market shocks. Post-liberalisation, public investment in largescale irrigation projects have reduced leading to farmers in rain-fed areas becoming more dependent on private investment in ground water irrigation. Irrigation sources are also subject to risks especially from hydrological and meteorological droughts.

Emphasis on how competition over water advantages some sectors or groups over others, and regulation over water withdrawals, may add newer political and populist dimension to drought policy such as how excessive irrigation leads to destruction and pollution of aquifers and surface water bodies. International agencies and private sectors have long been invested in promoting fees and pricing that if successful lead to even greater commoditisation of usable water resources. The distributional argument that is provided is that poorer people (especially in urban but increasingly also rural communities) are being compelled to purchase water from private suppliers round the year, a situation that is worsened during delayed onset of monsoon and sometimes because local water sources have been irretrievable polluted. The policy focus on watershed and traditional-irrigation revival (popular in the late twentieth and early this century) have diminished in importance and 'water-pricing', data based monitoring and forecasting and 'trading' has emerged as a stronger contender in the present century.

Twenty-First Century Droughts in Peninsular India: Declining Public Support and Water Extraction

Food availability became an important concern in the twentieth century when recurrent droughts devastated rural communities in the global South, through the spectre of hunger, starvation and famines. Physical stocks of food in specific locations that could be distributed in times of crisis due to localized or widespread crop failure emerged as an important policy instrument that shaped the agricultural policies of many countries that adopted 'Green Revolution' technologies' to intensify cultivation and increase yields of mono-crop staples. Higher productivity and yields, it was believed would create surplus stock of food grains for a large and growing population and by supporting farmers, ensure rural on-farm work. Since then, stock maintenance have fallen out of favour because of the high cost to governments and effects on economic growth. International financial institutions, at present, discourage the maintaining of large domestic food reserves. See for instance, the following excerpt from a 2014 WB review report on the subject:

> 'Buffer stocks are expensive. They are a recurrent expenditure for national budgets. The cost of holding grain stocks can be as high as 15-20 percent of the value of the stock per year (Action aid 2011). Rising producer prices above market levels 'and lowering consumer prices below market levels adds to fiscal costs, especially in poorer countries. These costs can crowd out spending on public goods, thus impairing the long term growth of the economy. The high fiscal cost of buffer stocks have opportunity costs in terms of growth that may offset the benefits of stable prices (The World Bank 2012:39).[64]'

According to Saharwardi et al. (2022), severe drought was experienced in almost all the regions of India in 1966, 1972, 1986 and 2002. 1972-74 was also a period of severe drought in West Africa, including the area that is known as Sahel (the northern most zone of the savanna – rainfed agriculture and nomadic herding) that became the centre of massive drought emergency relief.[65] Some observers of these interconnected drought, worried about the farming and herding communities argued that: 'storing food reserves as near as possible to the area in need is all the more necessary in the current world food situation. The world food stocks ran dangerously low in 1972-73…and farmers could be deliberately encouraged to grow for such reserves (Derrick 1977:586).' Indian development economists had been advocating for creating surplus since the mid-sixties droughts. Post liberalization, the focus has been shifting towards more individualised strategies, from provisioning of private irrigation to protecting crops and yields through financial instruments like crop insurance. Government subsidy to farmers in different forms, remain at the centre of farmer demand as protection against the uncertainties of weather and market.[66] Academic scholarship increasingly criticise 'agrarian productivism' dependence of farmers on state subsidies, describe contemporary agricultural sector as 'carbon emitting.' Such narratives tend to produce nostalgic visions of loss of traditional farming practices and engage in discourse about agrarian 'futures' while sidestepping the present crisis (see for instance Kumar 2019).[67]' Drought history shows that tropical agrarian regimes, no matter how diversely cropped or organically manured, was never secure and stocks of water and food and redistributive policies, that protect entitlements of vulnerable groups, have been critical for preventing the transformation of droughts into famines (Sen 1986).

Emphasis on improving productivity, per hectare yields, producing more surplus for the urban- industrial sector, reducing dependence on imports, was required they argued, especially in the context of the drought crisis of 1965-66 (Bardhan 1968).[68] Increasing agricultural yields required 'huge expansion of chemical fertilisers production and utilisation (ibid)'. India's synthetic fertiliser utilisation was 'miserably low' as compared to China and Japan, argued Bardhan in this important paper, and yields in Indian farms were low because most used organic manure. India also need to expand irrigation potential to support new farming technologies. Dependence on imported grains (especially Wheat) for distribution to drought-distressed rural population, rather than building an adequate buffer stock or creating rural works through small infrastructure to create employment in drought years, added to the problem (ibid). Such arguments as we know today, were precursors to greater focus and higher public investment in agriculture and also shaped the drought areas programme (see previous section). At present, the implications of some of these policy initiatives for drought as well as proposed reversals in such programmes based on varied readings of drought causality and consequences, is producing a new generation of concerns, especially in the states located in peninsular India, where agrarian expansion would have to face the challenge of irregular rains, dryland conditions and limited irrigation. Agrarian distress has taken different shape depending on underlying conditions. The next section focusses on the three states of peninsular India where groundwater irrigation has played a critical role in sustaining agriculture and water scarcity through depletion of groundwater would exacerbate the stress of recurrent droughts.

KARNATAKA, MAHARASHTRA, ANDHRA-PRADESH[69]

Karnataka had fourteen drought years in three decades including 1972-73 and 1984-85 (Deshpande1984).[70] The appearance of destitute migrants in urban areas was viewed in this period as an indicator of acute rural distress. 'Though relief works has started in quite a few places, the sight of migrants (Deshpande 1984) is not uncommon even in Bangalore.' In the described drought years, 1972-73 and 1984-85, deficient rainfall during the kharif and rabi sowing season led to loss of food grain production (Deshpande 1984:1860). Relief provided to the districts were in the form of food, fodder and temporary employment (ibid). By 2001, drought affected areas in Karnataka (unlike in 1984-85) included irrigated paddy and sugarcane.[71] Observers described largescale migration of agricultural labour to Goa. Small scale water shed development (NGO led) and dryland farming were the models of drought proofing that emerged during this period through the growing influence of green and alternative ideas, that were often removed from (or parallel to) the agricultural growth pattern. Agrarian distress, even in non-drought years, emerged in the next decade, with growing incidence of farmer suicides, that reflected the increasing cost and risk of farming, borne now by individual farming households.

Agricultural expansion and growth in Karnataka has taken place predominantly in drought prone areas that mainly grows commercial crops like corn, cotton, sugarcane and groundnuts.[72] In the above article published in 2004, sugarcane is described as a protected crop, being irrigated and supported by government procurement – making this crop the least vulnerable to weather based adversities (ibid). The article also shows the increase in area under two crops, maize (corn) and sugarcane in Karnataka from 1970-71-1999-2000 (p.5593). The authors argue that 'organisation and political clout' enable sugarcane producers to bargain effectively with the government and the sugar industry…'they can count on government help and support.' (ibid:5596). The crisis crop during this decade was identified as cotton. Based on the understanding that the growers of rice and sugarcane are relatively protected, the authors focussed on six rain-fed crops grown in Karnataka to examine farmer distress due to drought and adverse weather. Recommendations were 'ground level monitoring of drought effects' and 'crop insurance (ibid).' Drought effects are not only experienced in a fragmented way, they are increasingly viewed as specific to types of crops, nature of farms and the capacity of farmers. The insight from Karnataka is relevant for other dryland areas where farmers have shifted towards the best protected crops. In the context of declining or selective protection, crop selection by farmers logically cluster around the ones that are best protected. Since Sugarcane is viewed as the most unsuitable crop to grow under dry land conditions at present, sugarcane farmers who are at the forefront of drought related crisis, find unsympathetic reception from academics and policy makers. In 2022, farmers were protesting against declining support price for sugarcane. 35 percent of the sugarcane in the state grown in the drought prone district of Belgaum.[73] Reduced payments by sugar factories is attributed to a 2012 policy that recommended decontrol of sugar and bifurcation of support price by sugar factories to farmers to include a revenue share (market linked support). Farmers are demanding an upfront support price based on rising input cost and declining revenue share (Firstpost article 2019).[74]

Led by the Karnataka State Sugarcane Cultivators Association, farmers are demanding the reinstatement of 'state advised price' a fixed amount of procurement price to meet the escalating cost of inputs rather than the 'revenue-sharing' market linked policy that is in place.[75] According to a First post article: 'Once prosperous thanks to fertile soil, plenty of water and a reasonable price for their produce, sugarcane farmers today are reeling under declining yield due to drought conditions for the past three years and deteriorating soil quality.'[76] The state government in Karnataka, the third largest grower of sugarcane in India, owes cane-farmers Rs.3990 crore as of 2018-2019 (almost Rs 900 crore more than it did four years earlier). The central government has not revised the FRP (fair and remunerative price) for three years.[77] Drought crisis in this case must be understood through the changes in farm protective policies and the push towards financial instruments and market linked products, against environmental and climatic risks (variously defined, measured), that farmers are being advised to adopt. India is not only the third largest exporter of sugar in the world (after Brazil) but sugarcane is also required for the production of ethanol. A recent NITI Aayog Report recommends that the area under water-intensive crops like sugarcane should be reduced in 'low yield areas.'[78] While arid zone farmers are enmeshed in a similar productive logic (as government policy makers or market players), they have limited resources and higher exposure to risk in the context of liberalised economy and reduced state support for agriculture.

Analysing twenty first century droughts in Andhra Pradesh[79] the author discusses how agriculture in arid areas have become enmeshed in widespread debt and farmer suicides, in the twenty first century, (Taylor 2013). Observers documented more than twenty thousand deaths by suicides from 2003-2011. While related to 'drought cycles' that are part of the local 'agrarian environment', the suicides are viewed as a more recent phenomenon related to 'severe cost pressures from liberalised agriculture' as farmers acquired more debt to drill bore wells for irrigation (ibid). AP farmers installed '50,000 bore wells every year for a decade' (ibid). Pump-driven bore wells based on the availability of subsidized electricity and pump and drill technology has led to the spread of private bore-well and pump based ground water in India that has replaced canals as the principal source of irrigated agriculture. India has also attained the status of the largest groundwater user globally during this period (ibid). 20 million wells irrigated 60 percent of all irrigated land (ibid). For some policy makers, as Taylor argues, use of ground water irrigation to extend the adoption of Green revolution technology was viewed as 'democratisation of irrigation' and 'tool for poverty alleviation' and a 'short-cut for agrarian modernisation' (ibid:695).'

Governments extending free electricity to farmers to pump water for seven hours a day in AP, is described as a strategy of 'agrarian populism (ibid).' Droughts lead to increasing stress on ground water especially in particular geo-hydrological contexts such as interior AP. During droughts, as farmers increase their extraction of groundwater, drought depletes the shallower and rain-recharge dependent hard-rock aquifers of this region – leading to 'over-exploitation, well failure and withering of crops' (ibid). Well irrigation has displaced the more collectively managed, traditional tank systems of the arid region (ibid). Capital intensive small holder agriculture according to the author was unsustainable because it rested on debt relations and extractive practices, and would be pushed back by counter currents such as biodiverse farm systems. The author also argues that urban India has 'limited potential to absorb continual waves of migrants (ibid).' News reports show increase in groundwater use since the above article was published. In a decade since the article was written, another 10 million wells have been added by farmers in AP.

Groundwater use has steadily increased in India since the 1980s and the pressure on the governments to regulate extraction is considerable. 'India is the largest pumper of groundwater in the world, pumping twice that of the USA and 6 times that of Western Europe, pumps around 75 acre inches per well from around 30 million irrigation wells. Around 70% of irrigation in India is from groundwater. It is crucial to appreciate the role of natural recharge of groundwater and how it influences pumping from an irrigation borewell. Thus recharge of groundwater is crucial for sustainable extraction. Hard rock areas of India form 65% of its geographical area where recharge from rainfall is hardly 10%. Therefore if farmer receives a rainfall of around 750 mm in a year, only 75 mm is the natural recharge and the rest drains away (Chandrakanth 2022, TOI).'[80] Ground water regulatory authority had notified critical areas where extraction is not permitted. Based on a recent report by the Comptroller and Auditor General (CAG 2021, Report No.9, p.5), the Central Ground water Authority notified 162 critical or over-exploited areas from 2012-15 under the

Environment Protection Act, 1986. [81] Some of these provisions have been revised since 2019. Since 2019, state governments have been empowered to make appropriate laws to manage ground water (ibid). According to some accounts ground water extraction in AP had reached a saturation point by 2000-01 (see Taylor 2013). However in 2022, the state government addressed agrarian distress by subsidizing the digging of bore wells in the farms of small holders who applied for the same under the government scheme. This emerged from the new state government's election promise made in 2019. A part of this project the state government sought applications from farmers and progress on which was posted on the state website as follows:

'According to the officials, out of the total 2.08 lakh applications received from farmers in both online and offline modes, the government approved 1.72 lakh so far. Out of the total surveyed 34,726 applications, the government was able to sink 11,000 borewells and is preparing to increase the number in the days to come.'[82]'Reddy has also announced that free motors to pump water will be provided for the small and marginal farmers, a scheme that would cost Rs 1,600 crore.'[83]

Observers see the disproportionate use of ground water and sugarcane cultivation as responsible for water scarcity in other states like Maharashtra. Unlike Andhra Pradesh and Karnataka, Maharashtra has a wider network of reservoirs and canal networks. [84] However dam water is also directed to urban municipalities and industries at a higher rate in this state, leading to less availability for irrigation. Water conflicts are likely to occur in the Godavari, Krishna and Tapi basins (ibid). Droughts in Maharashtra are viewed as political mismanagement and policy failure. 'Water has been diverted to industries while starving agriculture and delays in completing irrigation projects.[85] 'The latest survey of the Groundwater Survey and Development Agency found that of **Maharashtra's 353 talukas, 279 have experienced depletion in ground water levels.** Parts of Marathwada and North Maharashtra are badly affected. In 2,642 villages across the state, groundwater levels were found to be more than 3 metres lower than the five-year average that suggested unsustainable extraction. GSDA officials blamed non-implementation of the Maharashtra Groundwater (Development and Management) Act, which was enacted to regulate extraction. With food production in rain-shadow belts dependent on groundwater use, depleting water levels are putting the state's harvest at risk.'[86]

While small holders struggle to make a living from agriculture in the context of recurrent droughts, high input costs, declining state support and competitive demands on water, policy makers suggest increasing the coverage of welfare and social protection for small holders and rural households. The point here is not always to protect the farming households but to expand the growth potential of the agrarian sector. Climate arguments are mobilised to suggest that shifting earlier generation farmers from agriculture, would open possibilities for land restoration and 'low carbon sustainable agricultural practices'.[87] Dramatic shift in agrarian policy may lead to adverse consequences for agrarian livelihoods and food security as the recent crisis in Sri Lanka's shift to 'organic' farming suggests.[88]

In 2009 the failure of South West monsoon led to droughts in many parts of India. The focus was 'monsoon dependence and vulnerability of agriculture in India. In addition there were news of farmer suicides in AP, water disputes in MP and migration from Bihar and Bundelkhand.[89] Bundelkhand emerged as an area of interest during this period – see J.S Samra Committee report. The region experienced erratic rainfall from 2004-07.[90] 2008 was the only good monsoon season in Bundelkhand since 2004. The article also points towards devastating migration to urban construction sites and brick kilns as a sign of collapsed rural economy. Since 2009, Bundelkhand has reappeared in public discourse repeatedly as an area of concern. Water stress has been repeatedly highlighted in Bundelkhand. In news media stories, solutions that are presented are voluntaristic small scale and individualistic models based on nostalgic revivalism about past communities. Women especially emerge as the problem solvers, highlighting the intra-community and household competitive use of water for household use versus irrigation.

'Erratic rainfall patterns and extreme heat have been linked to climate change in Bundelkhand, which has suffered several long dry spells since a drought was declared at the turn of the century. Social activist Sanjay Singh helped train women in Agrotha to harvest and store rainwater after the surrounding land was desiccated by drought. By doing so he helped the village rediscover knowledge that was lost decades earlier, when water went from being a community-managed resource to one administered by central government. "But government has failed to ensure water to every citizen, particularly in rural areas, pushing villagers to go back to the old practice," he told AFP.'[91]

Droughts were common in the twentieth century and led to widespread crop failures and distress among the agriculturally dependent communities. The question that emerged towards the end of the century was why these droughts not led to famines, as witnessed in the nineteenth century or what prevented the occurrence of mass starvation. For development policy makers, governments needed to shift their focus from food availability to relative food entitlements and the capacity and willingness of governments to implement the correct distribution of food surplus. In addition, they should control the rise in price of food, raise productivity of agriculture, provide some forms of social protection (income support) and enable the diversification of the livelihoods of the rural poor. See for instance, Dreze argues that: 'stabilizing food prices reduced the correlation between production and consumption."…Almost every year large and heavily populated parts of India suffer from devastating droughts, through "the entitlement failures" they threaten to precipitate, remain quite capable of causing large scale starvation' (Dreze 1988).[92] Food crisis had assumed unusual proportions in 1966-67, 1972-73 and 1985-87 (Dreze 1988) and rural population in India remain exposed to famines in the absence of welfare. Nineteenth century famines, argues Dreze resulted from 'massive crop failures following droughts' (ibid).' Crop failures reduced food availability and shattered the rural economy, landless rural workers lost employment in agriculture and the pool (supply) of casual workers expanded. No drought proofing policies can work without keeping this fundamental connection between production and protection in the context of the Indian agrarian sector stressed by climate and competitive demands of the agricultural commodity trade. Sustainable, accessible, and affordable stocks of food and water and protective policies that enable the vulnerable from erratic weather and market prices, would be even more essential to preserve in the context of widespread disruption.

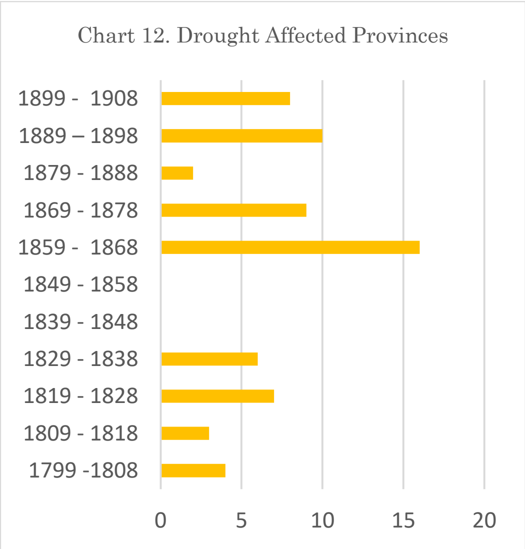
COLONIAL DROUGHT-FAMINES

Crop loss and harvest failures are documented in the context of eighteenth and nineteenth century famines, the immediate cause was rise in food prices and reduction in real wages caused starvation, epidemics and malnutrition for agricultural labour. Agriculture under tropical monsoon conditions, 'seasons of unusual drought' and dependence on dryland and rainfed cultivation. Colonial famine enquiry and irrigation commissions made the case for emergency response or relief system for farmers and agricultural labour and provided justification for building systems of irrigation canal by providing an 'ecological account of famines' (Roy 2016:7). To some extent India's drought management policy follows this understanding. Improved transportation network and 'free-trade' allowed the movement of grains, preventing famine causation even after harvest failures, from 1900-1943 (McAlpin). In Sen's now well-known thesis, mapping of entitlements of different occupational groups and how these may get undermined, should inform the analysis of 'prices, wages and outputs,' if famine has to be anticipated in advance (1986:20).93 Determination of relative vulnerability of groups based on their existing and shifting food entitlement, then would provide the most accurate indication of crisis. Distributing either cash or food then would offer significant protection to groups that are most exposed to shocks of crop failure or price rise, irrespective of whether this was caused by droughts resulting from climatic variations or normal seasonal cycles. He further argues that, growth in food production should lead not simply to increase in expanding output but increasing 'enhancing, securing and guaranteeing' entitlements, including to the producers/growers of food (Sen 1986:30).[94]

An important essay published in 1914, discusses multiple climatic and other causes for famine causation, of which agricultural droughts constituted a major factor. During the late nineteenth century (1898) famines affected provinces witnessed declining real wages for labour and rising cost of living (Loveday 1914:125).[95] Areas that produced large grain surpluses, were less affected by drought: '..districts which export the greatest quantities of raw produce and grain are on the whole the least subject to drought (ibid).' The author argued that droughts, whether in the nineteenth or the sixteenth century, were caused by meteorological conditions that resulted in '**unusually long period of inadequate water supply'** (Loveday 1914:16). Famine relief was based on the distribution from royal grain stores in the pre-colonial period. '*It was to the supplies of stored grain that the rulers and the people chiefly looked for protection against drought. The Muhammadan Emperors maintained these stores in their capitals as war chests, and the cultivators kept what surplus they could from their years of bounty as an insurance against those of dearth. How often such provision proved successful cannot be estimated;* ***for only of the droughts which proved disastrous does record exist.*** *According to the* *benevolence of the rulers and the severity of the famine the corn was either sold or given away* (Loveday 1914: 20).' To a great extent, contemporary buffer stocks are based on the same principles. Discussions about whether precolonial droughts were as frequent or if they led to famines, is limited by the dearth of information beyond the most calamitous events. Much more information is available for the nineteenth century, marking it as a particularly famine prone period.

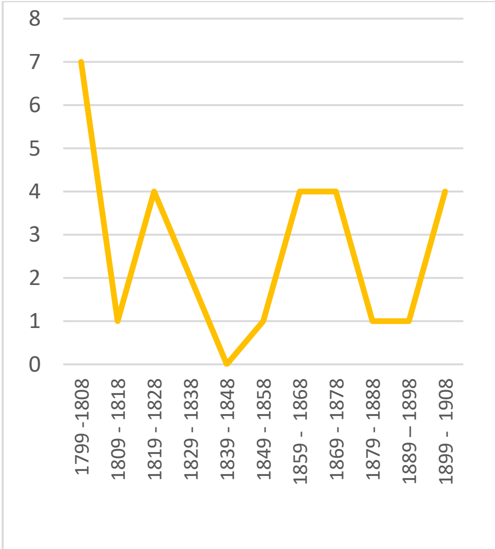
Twenty five famines listed in Loveday's article are described as caused by rain-failure leading to crop-droughts. War, locust attack, excessive rains are also mentioned as leading causes (Loveday 1914:137-38). From 1859-1868, widespread areas and provinces were recognized as. These include affected by drought including, Northwest Frontier province, Rajputana, Kutch, Deccan, Orissa, Behar, Ganjam, Bellary, Hyderabad, South Mysore, Punjab, Gujarat, parts of Central provinces, north Deccan and Rajputana. Famines could be averted despite widespread droughts through appropriate state policy. Loveday describes how the agricultural drought in 1906-07 did not result in famine due to 'the improved condition of cultivators' due to the spread of irrigation.

'Into the nature of the change that has passed over India in the last decade it is impossible to enter here ; but from the ***story of the drought of 1906-7*** *some conception of it can be gathered. Although the rains in June had been locally deficient, and those of September and December had completely failed in the provinces affected, (a) although the harvests had suffered in 1903 and 1904 from excessive wet and been generally deficient in 1905-6, still the increase of mortality was almost negligible, (b) and the calamity never bore the name of famine. The consequent rise in prices during this period had been met in some districts by an equivalent rise in the wages of labour. 13 But the* ***real causes of the success, with which the effects of the drought were resisted, lay rather in the improved condition of the cultivators, the existing irrigation systems, and the ready and extensive grants of tuccavee*** *(Loveday 1914:75).'*



Source. Based on information from Loveday 1914:137-38.

CHART 13. Colonial Drought-Famines



Source. Based on information from Loveday 1914:137-38.

Nineteenth century droughts and famines have a large literature. In recent times, the prominence of the climate variable, have not only collapsed centuries but also blurred the diversity of context, condition, political freedom and institutional structure. Mike Davis describes the famines that occurred in India, China and Brazil during the following periods: 1877-1878, 1888-1891, and 1896-1902, as being triggered by crop failures through El Nino droughts.xcvi In a review essay on famines, economic historian Tirthankar Roy (2016) argues that neither climate nor colonialism was sufficient to explain the outbreak of famines since 'if the cause of the famines was climate, we should expect that famines disappeared because climate changed after 1915. If the cause of famines was colonialism…colonialism ended around 1915….neither of these statements is true, which means that these terms do not really explain anything…they need to be seriously qualified.' State capacity in colonial India, according to Roy was limited not just by the 'beliefs, intentions and interests of politicians' but 'small fiscal capacity of the state in colonial India.'xcvii While famines serve as important reminders of the catastrophic consequences of climatic aberration and state policy failure, contextual, fine grained understanding of social context and environmental use and degradation, is necessary for understanding drought at present. This is one of the reasons why populist evocation of reviving past (precolonial) traditions of farming or irrigation, seem to suggest that neither climate science nor state policy is willing to invest public resources to engage with smallholder based agriculture's battle with frequent droughts.

INFLUENTIAL DISCOURSES OF ATTRIBUTION AND FRAGMENTED POLICY DIRECTION

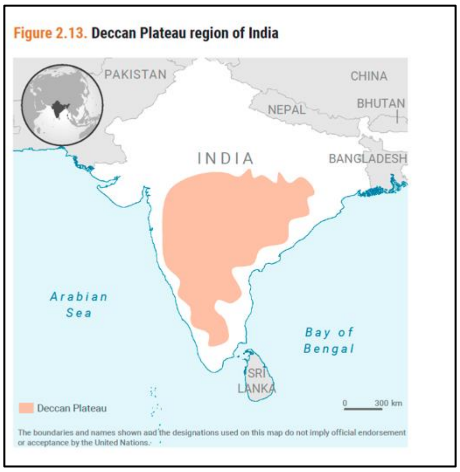
Influential policy documents predict increasing flows of migrants from drought affected areas that become resource constrained. Loss of agricultural productivity leading to migrations are moreover viewed as causal factors for the emergence of conflicts. Scarcity theorists tend to draw causal connections between climate induced droughts, conflicts over resource use and dwindling renewable resources leading to what they describe as 'intractable conflicts' between rival users such as farmers and herdsmen, as well as 'environmental scarcity driven' migrants and host populations in places like west Africa.[xcviii] As in other concerns around droughts discussed above, local, and regional studies, as well historical scholarship on famines, would present a more nuanced and complex connection between climatic risk, drought events and migration from affected region and competition over natural resources. From other perspectives, non-ecological factors, such as the politicization of identities around religion, ethnicity, and indigeneity, associated with access and use of resources, result in the frequent outbreak of conflicts.[xcix]

A recent study that looked at the 1976 devastating drought in South Dakota, United States, found that, 'droughts had a lag effect on population pattern.' In 1976, drought led to increase of in-migration (return-migration) to the region as members of the family returned to help with family farms. In the next decade the region saw indebtedness, farm failures and population decline (McLeman et al. 2022). Scholarship on the Syrian conflict have also refuted the 'drought-migration-conflict nexus', droughts led to agrarian collapse in the Syrian countryside, largescale rural migration to cities led to collapse of resources, leading to conflict.[c] Protests in Syria were concentrated in non-drought affected regions and migrants were not the principal participants in conflicts (ibid). Drought, migration, and conflict linkage require more nuanced, long term and region-specific assessment to avoid easy attribution for the purposes of forecasting and prediction as recommended by the burgeoning literature on 'earth-futures'.

In the context of Indian droughts, newspaper and media stories have highlighted climate induced drought leading to widespread migration, especially from 2016. These representations and discussions avoid drawing on the extensive literature on migration and seasonal migration. For instance, the Indian case study in the GAR 2021 report draws upon popular narratives from news reports about desertion and abandonment (Beed district) to generalise about conditions in 'peninsular India' as follows:

'Rain-fed agriculture in a low rainfall area is the dominant source of food production, and droughts are ingrained into society and the economy. In 2019, villages in the heart of the Deccan plateau in Maharashtra and Karnataka were deserted as families left due to acute water crisis. The village of Hatkarwadi, in the Beed district…was effectively abandoned…..'(GAR 2021, p.94)

The report recommends technical improvements and development of 'practical tools' in monitoring and early warning. The case-study describes over dependence on groundwater sources, drying cities and farmers growing mono-crops to present a context of acute distress. The description however is remarkably devoid of social context, political processes, economic policies and historical modes of drought management. Droughts according to the GAR analysts result in agrarian crisis, vulnerabilities and degradation of natural resources because institutional authorities tend to view it as 'discrete', 'episodic' and 'outlier' events.



Source: GAR 2021. India case study. p.94.

In 2016 and 2022, drought event reportage highlighted water crisis more than agrarian distress or migration. From 2016-2018, failure of the south eastern monsoon, is believed to have caused droughts leading to severe water scarcity in southern India. 'From 2016 to 2018, South India witnessed severe drought conditions, which significantly impacted agriculture and water availability in the region ('Chennai water crisis: City's reservoirs run dry,' BBC 2019). The densely populated states of Andhra Pradesh, Karnataka, and Tamil Nadu continuously declared drought in 2016, 2017, and 2018 related to the deficits in NEM precipitation (Mishra et al. 2021).' [ci]….During 2016–18, South India experienced the worst NEM drought over the last 150 years with a precipitation deficit of 45%, whereas the 1874–76 drought was the second-worst, with a deficit of 37% (ibid). Others have been cautious to attribute the water crisis in the Southern city of Chennai from 2016-2019 as resulting from climate change. Chennai's water problems, the authors argue comes not from 'insufficient rainfall but from the sub optimal harnessing of run off (Nigam et al. 2021).[cii]'

The above analysis compares the 2016-18 drought event with 1874-76, based on monsoon deficit. But the human impact of the drought events, that are not part of the evaluation, make the difference between a 'famine 'with millions of deaths, and multiple forms of distress that maybe addressed in the present context. It is important to ensure that the factors that transform droughts from a frequently occurring phenomena with highly variable contextual implications, are not conflated across centuries. Being connected to planetary scale weather information, devoid of human context, may result in some critical disaster risk and ethical consequences. Whether 2016 was a drought year globally (or not)…commodity prices and trading emerged as significant policy suggestions during this period. The shift is from drought forecasts and warning from public information to mediated communication linked to financial markets and speculations in food and crops. See for example the Reuters press report on the drought in South Africa.

'Breaking the **cycle of drought and hunger** in Southern Africa, where 39 million people are suffering a drought-induced **food crisis**, will need **better early warning systems, switching to new crops and hedging commodity prices**, food experts said on Friday.'[ciii]…**Keeping big food stocks is an old measure to prepare for drought, but it is also an expensive way to do it**, he said….Cheaper alternatives include buying options on commodity exchanges so, when the harvest fails, a country can buy food at a locked-in price, or keeping dollar reserves in an offshore account that can subsidize the cost of grain imports, he said…..Better forecasting can also play a role. Last year, meteorologists gave several months-notice of the drought and warned of severe drought within a month of the planting season (ibid).'

Drought forecast and predictions are used by agricultural commodities trade, that take place both physically as well as through forward buying or 'futures (Henn 2011).' Farmers or companies use 'futures' as insurance against market fluctuation. Requirements of this sector has created a new industry of influential private weather communication.[civ] Drought declaration in large producer regions affect highly-traded food grain such as corn, soya bean and wheat. Traders in 2012 were: 'bullish for a 15th consecutive week on speculation that the drought spreading across fields in the US will spur the government to make more cuts to its production forecasts…..CME Group Inc., the world's largest futures market, said trading of agricultural commodities jumped 46 per cent in July from a year earlier.[cv] In recent years observers have remarked on whether food price volatility is driven by drought or market speculation. While climatic disruptions causing droughts and floods would reduce harvests and hence increase the price of food in global markets, 2007-08 price spike, 'might have been driven by financial speculation in commodity markets.'[cvi] Indian agriculture is not insulated from these trends, despite precarious base. News report shows how the conflict in Ukraine, led to hurried selling by Indian wheat farmers and traders. [cvii] Government initially claimed tradeable surplus between 10-15 million tonnes in 2022-23, but banned exports when Rabi season yields fell due to exceptional heat during harvest season and food inflation increased. Eventually the government was compelled to reduce wheat procurement for the food security programme. India is one of the largest producers of wheat but has rarely produces surplus for export (see FAO stats in the previous section).

Influential discourse about crisis models, scenarios and predictions are pervasive in the public sphere as climate change increases temperatures, disrupts rainfall patterns and the world become warmer by 2 degrees Celsius. A report by the UN office for disaster risk reduction suggests 'urgent action' to manage drought risks that would devastate human lives and livelihoods. [cviii] Climate change science though rarely informs or is informed by the nuances of social, historical and ecological knowledge base of agricultural systems and populations. A more visible effort is toward communication that appears to market climate services and products directed towards public resources in countries like India, a push towards modelling, forecasts, surveillance and prediction and individual management of risk by planning in advance.[cix] While climate change may cause more frequent droughts in India, affecting survival and livelihoods, it is not clear how current use and application of climate science, distanced, top-down and ahistorical, would enable context appropriate action. Ending the report with an excerpt from a recent communication drive by the WMO:

'In 2014 and 2015, WMO invited some 60 weather presenters to imagine a 'weather report from the year 2050.' Four series of reports were launched to promote the Paris climate change conference (COP 21), the Third World Conference on Disaster risk Reduction held in Sendai, the Lima climate change conference (COP 20) and the UN Climate Summit in New York. None of the worst-case futures presented in these video reports need to happen. What the weather presenters have created are only possible scenarios, and not true forecasts. Nevertheless, they are based on the most up-to-date climate science, and they paint a compelling picture of what life could be like on a warmer planet.'[cx]…..Climate variability and climate change present many risks to people and communities everywhere. Fortunately, rapid advances in climate science and climate services make it increasingly possible to provide decision-makers and the general public with climate predictions and information that they can use to address the climate challenge (ibid).

ANNEX I

DROUGHT MANUALS –GUIDELINES FOR MITIGATION

Drought Manual 2016	Drought Manual 2008
pp.93-120	pp.109-146
National Rainfed Area Programme	National Rainfed Area Authority
Mahatma Gandhi National Rural Employment Guarantee programme (MGNREGA)	Drought Prone Areas Programme (DPAP) and Desert Development Programme (DDP)
Water saving technologies – Drip and Sprinkler irrigation	Integrated Watershed development programme
Improved water saving farm practices	Water harvesting and Conservation
Long term irrigation management	Water saving technologies – Drip and Sprinkler irrigation
Afforestation	Long term irrigation Management
Crop insurance	Afforestation
Community participation in Drought Mitigation	Crop insurance
Climate variability and adaptation	Community participation in Drought Mitigation
Power supply in vulnerable areas, public distribution system	Climate variability and adaptation
Crop management practices – Indigenous knowledge	
Documentation of best practices, awareness, and capacity building	
Monitoring of drought mitigation, drought vulnerability and risk mapping	
Decision support system for drought management	
Impact assessment and evaluation	

Promote education and awareness of drought mitigation	
Encourage community level plans for drought mitigation	

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[cvi] Henn, M. (2011), The speculator's bread: what is behind rising food prices?. EMBO reports, 12: 296-301. https://doi.org/10.1038/embor.2011.38

[cvii] https://www.aljazeera.com/economy/2022/5/24/inside-indias-policy-flip-flop-on-wheat-exports
[cviii] https://reliefweb.int/report/world/drought-report-calls-new-management-approach
[cix] https://www.agrifutures.com.au/wp-content/uploads/publications/99-014.pdf

[cx] https://public.wmo.int/en/resources/weather-reports-from-future