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Hypocrisy they Name: “Colorado River flow Shrinks from Climate Crisis, Risking Severe water Shortages” -- A Note

Dr. S. Jeevananda Reddy*

Formerly Chief Technical Advisor – WMO/UN & Expert – FAO/UN Fellow, Telangana Academy of Sciences [Founder Member] Convenor, Forum for a Sustainable Environment Hyderabad, TS, India

***Corresponding Author:** S. Jeevananda Reddy, Formerly Chief Technical Advisor – WMO/UN & Expert – FAO/UN Fellow, Telangana Academy of Sciences [Founder Member] Convenor, Forum for a Sustainable Environment Hyderabad, TS, India

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Abstract

National and International Media has been ritualistically presenting hundreds and thousands of reports daily with the word such as “climate crisis” to create sensation-panic among people of all walks of life without understanding the basics of the subject “the science of climate” and “the science of climate change”. One such recent report in The Guardian the writer observed that the Colorado River flow shrinks from “climate crisis”, risking severe water shortages. Unfortunately the author used ‘climate crisis’ as an adjective without looking at factual ground realities to sensationalize “global warming”. The fact is that climate change is not global warming. The ground realities showed that the water flows in the Colorado River follow the natural rainfall patterns in the Colorado River basin but not temperature in the Colorado River basin. In this context cases of reports of model based dust-bowl and food security issues are also discussed with the help of Australian and Indian rainfall patterns.

Key words: *Colorado River; Water flows; Climate crisis; Rainfall; Temperature*

Background

Figure 1: *Colorado River.*

The Guardian published a report by Oliver Milman titled “Colorado River flow shrinks from climate crisis, risking severe water shortages”. The report observed that the Colorado rises in the Rocky Mountains and slices through ranch lands and canyons, including the Grand Canyon, as it winds through the American West. It previously emptied into the Gulf of California in Mexico but now ends several miles of this due to the amount of water extraction for US agriculture and cities ranging from Denver to Tijuana. The river’s upper basin supplies water to about 40 million people and supports 16 million jobs. It feeds the two largest water reserves in the US, Lake Powell and Lake Mead, with the latter supplying Las Vegas with almost all of its water. Millions of people rely on the

1,450-mile waterway as increasing periods of drought and rising temperatures reduce flow of river. The flow of the Colorado River [Figure 1] is dwindling due to the impacts of global heating, risking “severe water shortages” for the millions of people who rely upon one of America’s most storied waterways, researchers have found. Increasing periods of drought and rising temperatures have been shrinking the flow of the Colorado in recent years and scientists have now developed a model to better understand how the climate crisis is fundamentally changing the 1,450-mile waterway.

The loss of snow in the Colorado River basin due to human-induced global heating has resulted in the river absorbing more of sun’s energy, thereby increasing the amount of water lost in evaporation, the US Geological Survey scientists found. This is because snow and ice reflect sunlight back away from the Earth’s surface, a phenomenon known as the albedo effect. The loss of albedo as snow and ice melt away is reducing the flow of the Colorado by 9.5% for each 1.0oC of warming, according to the research published in Science. The world has heated up by about 1.0oC since the pre-industrial era and is on course for an increase of more than 3.0oC by the end of the century unless planet-warming emissions are drastically cut. For the Colorado this scenario means an “increasing risk of severe water shortages”, the study states, with any increase in rainfall not likely to offset the loss in reflective snow. The magnitude of the Colorado’s decline as outlined in the Science paper is “eye popping”, according to Brad Udall, a senior scientist at Colorado State University and an expert on water supplies in the west who was not involved in the research. “This has important implications for water users and managers alike,” Udall said. “More broadly, we’ve wasted nearly 30 years bickering over the science. The science is crystal clear – we must reduce greenhouse gas emissions immediately.”

Snow packs that last into late spring have historically fed streams that have nourished the Colorado River, as well as reducing the likelihood of major fires. As the climate heats up, the river is evaporating away and the risk of damaging wildfires is increasing. The climate crisis is compounding existing threats to the river, which include intensive water-pumping for agriculture, water use by urban areas and the threat of pollution from uranium mining. Lake Mead, the vast reservoir formed by the Hoover dam, has dropped to levels not seen since the 1960s. A 19-year drought that racked stretches of the river almost provoked the US government to impose mandatory cuts in water use from the river last year, only for seven western states to agree to voluntary reductions. The problems are set to become more severe, however, as the climate becomes hotter and drier at a time when demand for water from expanding cities in the American west increases.

An observation/comment on this article was posted as “On investigation...In 1922 seven US states and interested parties sat down to agree usage of the water in the Colorado River... Measurement of the flow was agreed and how much each could remove was also agreed, protecting the river... However, places like Las Vegas expanded to over 3 times its expected levels, using more water. Greater agriculture need took more water from the river... Other states and interests and water extractions have also exceeded their quota... leaving little or nothing to flow down the stream. Also, the river now has 15 dams along its length.

Results

Factual Information

Figures 2a, b & c respectively presents the natural Colorado River water flows at Lees Ferry, AZ, during 1906-2006, annual precipitation in Colorado River basin above Lees Ferry during 1895-2005 and annual average temperature in Colorado River basin for the period 1895-2005.

The annual water flows in Colorado River present a natural rhythmic pattern. The lower annual water flows were recorded around 1930 to 1970; and before around 1930 and after around 1970 recorded higher annual water flows [Figure 2a] in Colorado River. During 1906 to 2006, the difference between the lowest and the highest is around 20 million acre feet with a mean of around 15 million acre feet. Around 50% of the years each were below and above the average with 14 years each presented below 10 and above 20 million acre feet. This clearly shows the high variability in water flows that needs proper planning for utilization. This is also true with all Indian Rivers. To infer the water availability under high water requirements can be attributed to “climate crisis”. Annual rainfall time series [Figure 2b] also showed similar to water flow time series [Figure 2a] more particularly in the last 19 years. That means the water flows in the Colorado River followed the rainfall pattern of the region only. It is clear from the Figure 2b that the rainfall following the natural cyclic variation with floods and droughts. Water year precipitation in inches showed the lowest 9-10” and the highest 20-21”. Temperature annual march showed lower and higher values respectively prior to 1930 and after 1970 [Figure 2c] with higher water flows in Colorado River [Figure 2a].

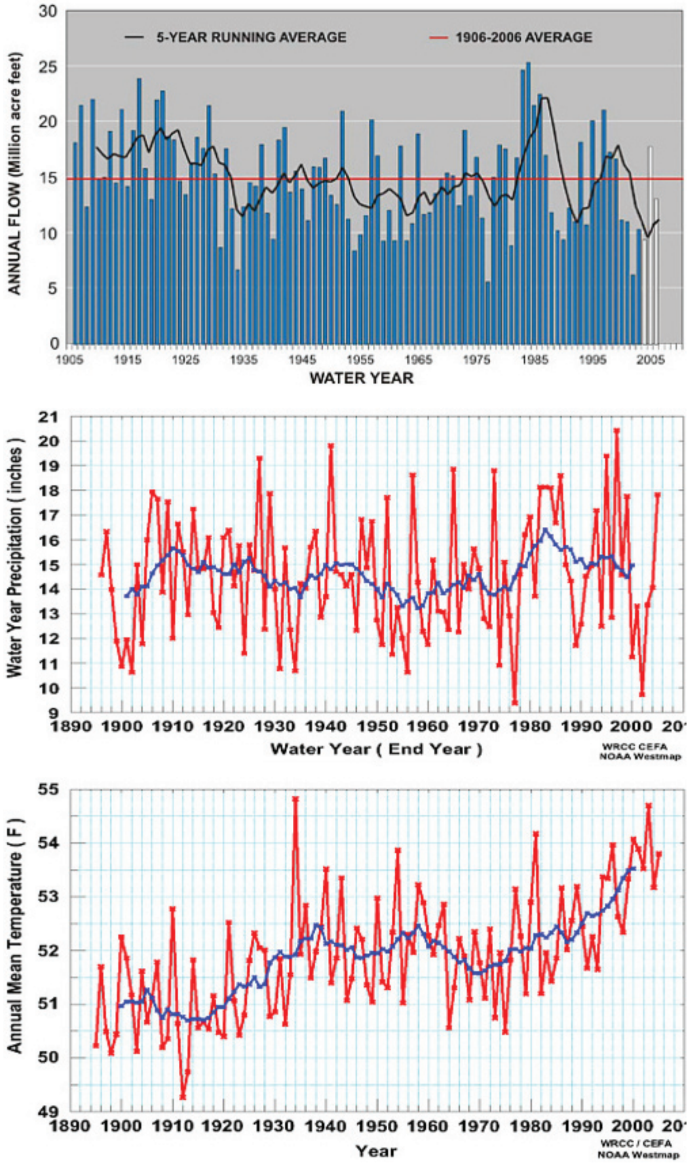

Figure 2: *Annual march of (a) water flows, (b) rainfall and (c) temperature.*

(a) Colorado River Water Flows at Lees Ferry, AZ, 1906-2006 --- Black line is 5-year running average and is plotted at the end of 5-year interval; Water years are denoted by the ending year; White bars for 2004-2006 represent preliminary estimates

(b) Annual Precipitation for the Colorado River Basin above Lees Ferry, 1895-2005 --- Red: annual values, Blue: 11-year running means; Source: Western Regional Climate Centre

(c) Annual Average Surface Temperature for the entire Colorado River Basin --- Red: annual values, Blue: 11-year moving means; Source: Western Regional Climate Centre

That means, temperature was not the driving force for water flow and rainfall in this basin as presented in Guardian [presented above]. However, in all the three parameters year to year variations are very high over the natural variability. The temperature time series [Figure 2c] were adjusted similar to global annual average temperature time series. This can be seen from the USA temperature pattern [Figure 3]. The raw data [observed data] was lowered to show an increasing trend due to global warming after 1950 [starting year of global warming as fixed by IPCC is 1951]. The raw data series showed natural variability. The start and end of the data series presented below the average pattern. Global average temperature time series of 1880 to 2010 showed 60-year cycle with -0.3 to +0.3°C of Sine Curve pattern. The human induced trend showed 0.6°C per century. Of this, half is global warming component -- 0.3°C per century or 0.45°C for 1951 to 2100 (Reddy, 2008).

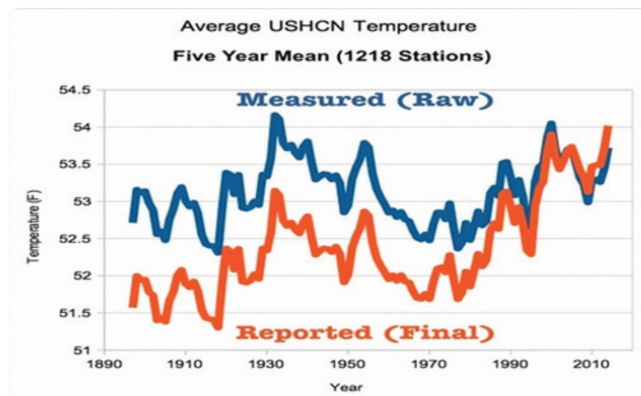

Figure 3: *Average annual temperature series of USA [measured & reported].*

However, according to IPCC reports the climate sensitivity factor showed a decreasing tendency and thus global warming component for 1951 to 2100 must be far far less than 0.45°C, which is far less than annual and seasonal temperature variations over stations, regions and countries. In Figure 3, the raw data showed no trend; scientists from IMD presented a report on state-wise temperature trend study. This showed no trend in central parts, some parts around Punjab showed decreasing trend with cold-island effect; and some areas showed increasing trend with heat-island effect. Recent NASA map showed no trend in Indian temperature; Sydney's [in Australia] hottest daily maximum temperature annual march during 1896 to 2016 showed practically no trend. All these suggest that the global warming is practically zero or for that matter insignificant. However, one must be careful while interpreting truncated data sets, which may lead to biased inferences [Reddy (2019a, b, c, d, e, f) & Reddy (2020)].

Discussion

The realistic conditions prevailing in Colorado River basin in USA are discussed above in terms of water, rainfall and temperature. But unfortunately, the modern media has been publishing sensational reports that lack scientific spirit and reality around the world by fixing one point goal of linking everything to "global warming". Some such reports on US dustbowl and thus food security are presented below with my observations at appropriate places. With the availability of sophisticated computers people [I don't call them scientists] are running hypothetical models similar to those used in global warming wherein at lower extreme one model predicted 2.0°C and at higher extreme another model predicted 8.0°C by 2100 for doubling of CO2. 28th April 2020, a report in The Guardian says that "Meteorologists say 2020 on course to be hottest year since record began – there is 50 to 75% chance with no El Nino [& with huge Arctic ozone-hole under severe colder temperatures regime]. This way they are wasting electricity and pumping more carbon dioxide (CO_2) in to the atmosphere. Such poor quality studies become handy to UN, World Bank, IMF, etc. The foundation "Gospel" for such reports is the "Climate Crisis" propaganda basically rhetoric is given as:

The fundamental science of climate change suggests that continued global warming will increase with frequency or intensity (or both) of a great variety of events that could disrupt societies', including heat waves, extreme precipitation events, floods, droughts, sea level rise, wildfires, and the spread of infectious diseases. Underpinning many of these extreme events is an acceleration of global hydrological cycle. For each 1.0°C increase in the global mean surface temperature, there is a corresponding 7% increase in atmospheric water vapour. Because warm air holds more water vapour than cool air, this leads more intense precipitation. Essentially, warm air increases evaporation from the ocean and dries out the land surface, providing more moisture to the atmosphere that will rain out downwind. Water vapours also a powerful naturally-occurring greenhouse gases. As such it is the source of a very positive feedback to the coupled climate system that amplifies any external forcing by a factor of approximately 1.6---. Let us see how realistic the rhetoric is. First-off all with continued drought, temperature goes up but vice-versa is not true.

Historical Mega-droughts

Alan Boyle presented a report in GeekWire of 17th April 2020 titled "Climate experts say the past 19 years qualify as a mega-drought for western U.S.". According to this report, the study was made based on tree-ring data from nine Western states [Figure 4]. This figure showed dozens of droughts across the region over the centuries with four periods of extreme aridity. The current 19 years starting from 2000 was as dry as the worst 19-year period of the 1575-1603 mega-drought based on soil moisture readings. They noted that the four historical mega-droughts were part of natural variation in climate but the current one was attributed to global warming is pulling moisture out of the ground, intensifying the soil-drying effect.

Joseph Romm [Nature, 478:450-451, 2011] observed in the article "The next dust bowl" that "Drought is the most pressing problem caused by climate change. It receives too little attention". Which impact of anthropogenic global warming will harm the most people in the coming decades? I believe that the answer is extended or permanent drought over large parts of currently habitable or arable land — a drastic change in climate that will threaten food security and may be irreversible over centuries. A basic prediction of climate science is that many parts of the world will experience longer and deeper droughts, thanks to the synergistic effects of drying, warming and the melting of snow and ice. I first heard of the risks in a 2005 talk by climatologist Jonathan Overpeck of the University of Arizona in Tucson. He pointed to emerging evidence that temperature and annual precipitation were heading in opposite directions over many regions and raised the question of whether we are at the "dawn of the super-interglacial drought". A 2007 analysis of 19 climate projections estimated that levels of aridity comparable to those in the Dust Bowl could stretch from Kansas to California by mid-century.

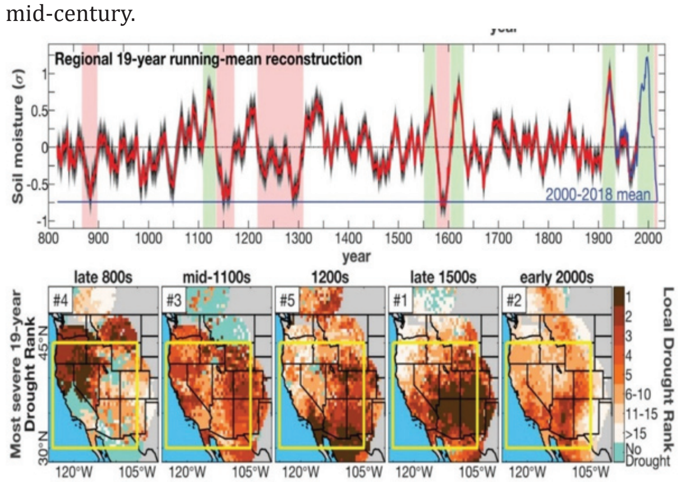

Figure 4: *Mega-drought comparison.*

- These are highly hypothetical as rainfall over different parts present different natural patterns – all areas may not get droughts or floods at the same time [Reddy, 1984, 1986, 1993 & 2008; Reddy & Mersha, 1990].
- Australian rainfall and temperature [Figure 7] – presented below -- do not support this presumption but it appears it is only a hypothetical presumption – bad science. It appears the primary objective of the report appears is to push for global warming.

The regions at risk of reduced water supply, such as Nevada, have seen a massive population boom in the past decade. Overuse of water in these areas has long been rife, depleting groundwater stores. Of course, the United States is not alone in facing such problems. Recent studies have projected 'extreme drought' conditions by mid-century over some of the most populated areas on the Earth — southern Europe, south-east Asia, Brazil, the US Southwest, and large parts of Australia and Africa. These dust-bowl conditions are projected to worsen for many decades and be "largely irreversible for 1,000 years after emissions stopped". Precipitation patterns are expected to shift, expanding the dry subtropics. What precipitation there is will probably come in extreme deluges, resulting in runoff rather than drought alleviation. Warming causes greater evaporation and, once the ground is dry; the Sun's energy goes into baking the soil, leading to a further increase in air temperature. That is why, for instance, so many temperature records were set for the United States in the 1930s Dust Bowl; and why, in 2011, drought-stricken Texas saw the hottest summer ever recorded for a US state. Finally, many regions are expected to see earlier snowmelt, so less water will be stored on mountain tops for the summer dry season. Added to natural climatic variation, such as the El Niño–La Niña cycle, these factors will intensify seasonal or decade-long droughts. Although the models don't all agree on the specifics, the overall drying trends are clear. "Aridity comparable to the 1930s Dust Bowl could stretch from Kansas to California by mid-century."

- During drought with less rainfall, temperature and thus evaporation goes up and vice-versa is not the case. The interpretation of current 19 years to increased temperature due to global warming is "brain in knee" concept only [see Figure 3].
- All these are hypothetical theories. So far the natural variability in rainfall over different parts of the globe have not shown any trend or changes in cycles which I presented above.
- These are hypothetical inferences and are not based on the factual data in those countries (see, for example Reddy, 1993, 2002, 2008, 2019a, b &c).

Figure 5: *Urban Flood Risk Scenario.*

In contrast to dustbowl, The Guardian published a report by Emily Holden in Washington on 23rd April 2020 titled "Flooding will affect double the number of people worldwide by 2030" [Figure 5]. The World Resources Institute [WRI] found that 147 million people will be hit by floods from rivers and coasts annually by the end of the decade, compared with 72 million people just 10 years ago. Damages to urban property will soar from $174bn to $712bn per year. By 2050, "the numbers will be catastrophic," according to the report. A total of 221 million people will be at risk, with the toll in cities costing $1.7tn yearly. Floods are getting worse because of the climate crisis, decisions to populate high-risk areas and land sinkage from the overuse of groundwater. The worst flooding will come in south and south-east Asia, including in Bangladesh, Vietnam, India, Indonesia and China, where large populations are vulnerable. The effects will be less dire but still increasingly serious in the US, where the risk is highest for coastal flooding. What are now once in a lifetime floods could become daily occurrences for most of the US coastline, according to a separate study? That's because hurricanes are stronger, seas are higher and rain patterns are changing, all because of global heating caused by humans. River floods will get worse in the US, but those damages will stay about the same, as large investments will be made in flood protection.

- Urban & coastal floods are caused by human greed and political apathy (Reddy, 2016b). Mumbai the business capital of India encountered a severe flooding disaster in July 2018 with more than 60% of Mithi River mouth before it enters the Arabian Sea has been filled with rubbles & waste and converted in to concrete jungle; and also several waterbodies, nalas were encroached (Reddy, 2018a).

- Gulf Coast give an impression of sea level rise but the reality was land subsidence from human activity such as pumping water, oil and gas from underground reservoirs, etc. (Reddy, 2018b). Major land falling hurricanes in Florida since 1900 showed no upward trend in frequency or intensity; Niagara waterfalls freeze of 1911 is worse than that of January 2018; inundation of the state capital city Sacramento in 2018 January has not reached to that level of 1862 (Reddy, 2018b).

Rainfall of Andhra Pradesh in India versus Australian rainfall

Indian annual and southwest monsoon rainfall presents a natural variability of 60-year cycle similar to Indian 60-year Astrological Calendar [this is lagging by three years to Chinese 60-year Astrological cycle]. Water flows in NW Indian Rivers and Godavari River followed this cyclic pattern. 78% of annual rainfall falls on an average in the Southwest Monsoon Season [June to September]. But in the state of Andhra Pradesh in the southeast along the Bay of Bengal receives rainfall during Southwest Monsoon [summer monsoon – June to September] and during the Northeast Monsoon [winter monsoon – October to December]. Andhra Pradesh consists of three met sub-divisions, namely Coastal Andhra, Rayalaseema and Telangana. The three met sub-divisions received 52, 60 & 80% during the Southwest Monsoon Season and 39, 29 & 12% during the Northeast Monsoon Season of annual rainfall. Both the monsoons presented 56 year cycles but in opposite direction (Reddy, 2000 & 2002). The cyclones in Bay of Bengal followed the 56 year cycle of Southwest Monsoon. In the case of Australia, north wet season [summer - October to April] presented increasing trend while the south wet season [winter – April to October] presented decreasing trend. That is in opposite pattern [Figure 6], similar to AP summer and winter rainfalls.

However, the annual rainfall of Andhra Pradesh on the contrary showed 132 year cycle. The water flows in Krishna River followed this pattern (Reddy, 2016a & b). If we fit the annual rainfall data of AP to a linear curve, it shows an increasing trend as the rainfall prior to around 1935 presented below the average and after around 1934 presented above the average with each has 66 years. The Australian Annual Rainfall of 1900 to 2019 present the similar increasing trend with 1900-1919 presenting the low average and 2000-2019 high average [Figure 6]. AP annual rainfall showed the starting of second cycle in 2001 – below the average 66 years starting year --. However, similar to AP annual rainfall, shows a cyclic pattern – even the sediments data near to Canberra showed a 66-year cycle similar to Durban rainfall in South Africa. The following 10 figures present the Australian rainfall patterns over different parts along with annual temperature pattern [Figure 6]. More detailed work has to be done to fix the cyclic pattern.

Food Security

Historically, the primary adaptation to dust-bowlification has been abandonment. During the relatively short-lived US Dust-Bowl era, hundreds of thousands of families fled the region. We need to plan how the world will deal with drought-spurred migrations and steadily growing areas of non-arable land in the heart of densely populated countries and global bread-baskets. Feeding some 9 billion people by mid-century in the face of a rapidly worsening climate may well be the greatest challenge the human race has ever faced. These predictions are not worst-case scenarios: they assume business-as-usual greenhouse-gas emissions. We can hope that the models are too pessimistic, but some changes, such as the expansion of the subtropics, already seem to be occurring faster than models have projected. We clearly need to pursue the most aggressive greenhouse-gas mitigation policies promptly, and put dust-bowlification atop the world agenda.

- Harappa's civilization is classical example how they faced the drought (Reddy, 2019b&c).
- FAO report concluded that around the world around 30% of food produced is going as waste. In India this is around 40-50%. This year while people are suffering from Covid-19, the unseasonal rains affected the harvested grains. This is the major issue that is being faced in India under the modern agriculture technology. This is nothing to do with carbon emissions or global warming but is part of natural climate existing over different parts of the globe. Simply harping on carbon emission serve very little to farming community or solving the problems faced by farmers around the world.

A report by Nafeez Ahmed [January 6, 2020] titled "West's 'Dust Bowl' Future now 'Locked In', as World Risks Imminent Food Crisis" observed that "Research sponsored by global credit ratings agency Moody's concludes that by the end of century, parts of the US and Europe are now bound to experience severe reductions in rainfall equivalent to the American 'dustbowl' of the 1930s, which devastated Midwest farming for a decade. These consequences are now 'locked in' as a consequence of carbon emissions which we have already accumulated into the atmosphere. But that's not all.

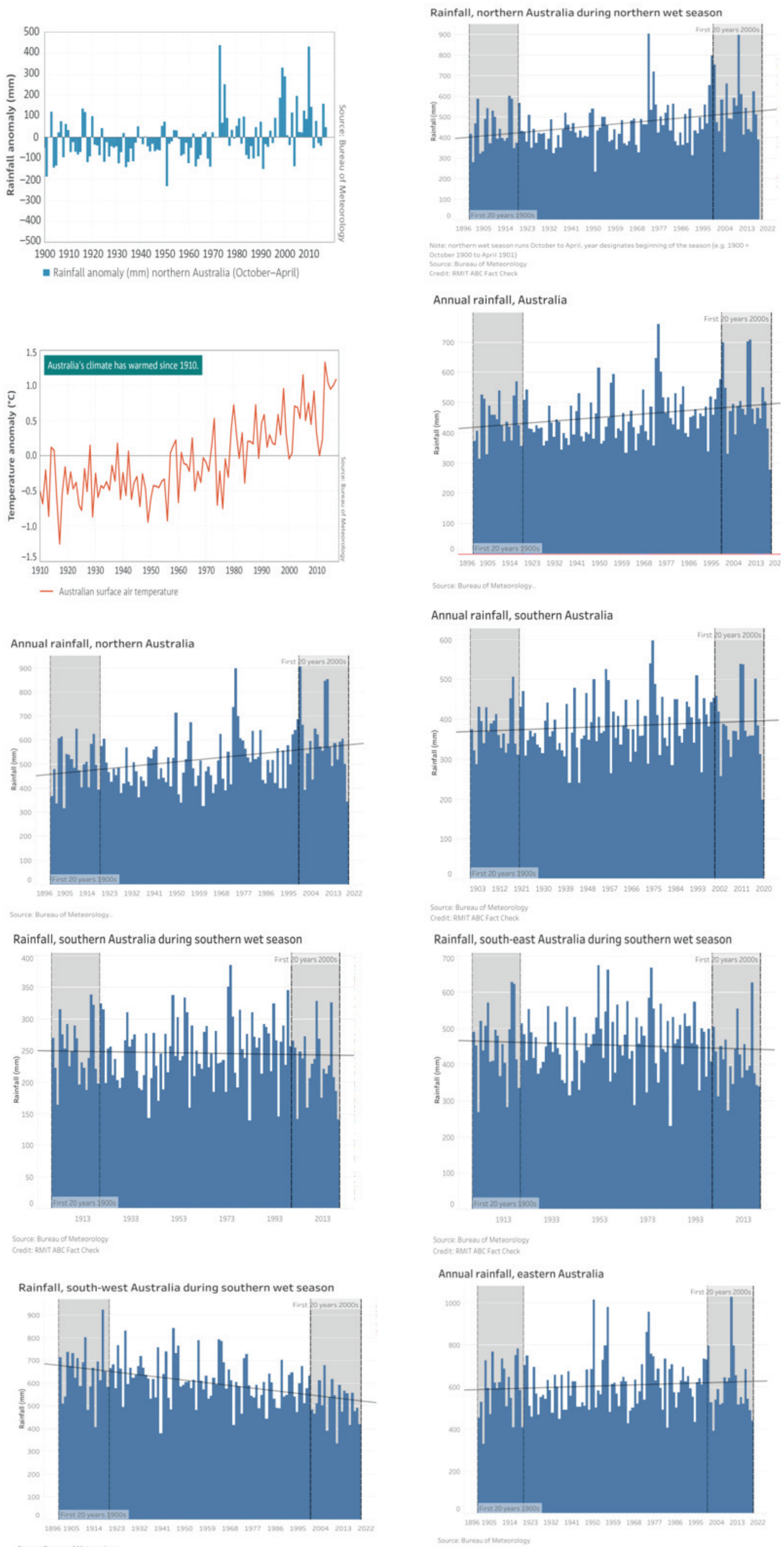

Figure 6: *Rainfall [over different regions] and temperature over Australia*

A spate of new scientific research released through 2019 has thrown light on nearer-term risks of a global food crisis in coming decades, such as a multi-breadbasket failure — due not just to climate change, but a combination of factors including population growth, industrial soil degradation, rising energy costs, groundwater depletion, among other trends. Over 1,700 published climate models examined by the University of Leeds point to the risk of a global food crisis after 2030; and 12 models point to this risk emerging and amplifying in just three years. The 'locked in' impacts of climate change are bound to produce "severe" impacts on societies over the next decades, according to new research sponsored by one of the world's biggest financial agencies. Among those impacts, the degradation of global freshwater supplies in particular threatens to destabilise the global food system. Historic carbon emissions appear to have made it inevitable that by the end of this century, some of the world's most important agricultural producers will experience conditions similar to the 'dust bowl', the worst human-induced ecological disaster in American history. Among the physical impacts identified, the most alarming includes increasing of water scarcity in areas of southern Europe, the Mediterranean, southwest United States and southern Africa. By the end of century those regions are now bound to experience "10 to 20 percent reductions in dry season rainfall, reductions equivalent to the two decades surrounding the American 'dust bowl.'" Nik Steinberg, Director of Analytics of Four Twenty Seven and author of the firm's new climate risk report, told me that these conditions are now inevitable. They will occur as "an effect of committed warming" that is "effectively locked in and expected to occur by 2100, regardless of any mitigation outcomes before then." Such heightened water stress has "dire implications for food security, water availability, and wildfire risk," adds his report, titled Demystifying Climate Scenario Analysis for Financial Stakeholders. These consequences are among many which are now "locked in" as a direct result of carbon emissions already in the atmosphere.

- All these are hypothetical statements and have no scientific basis. At ICRISAT Hyderabad, Arkin's SORGF model developed at A&M Texas in US was tested for the estimation of grain and biomass production but it failed even with several types of energy factor modifications as moisture accounting was more important than temperature. Later abandoned (Reddy, 1983, 1993, 2019a).
- It is basically because: moisture is the limiting factor in tropical warm regions. If moisture is available [through irrigation or rain/snow] one can grow three crops in a year as the temperature is not the limiting factor. One can select crop and seed variety to fit in to that temperature regime in that season. In extra-tropical regions it is the growing season availability for crop growth defined by cessation and onset of winter [yield suffers with shorter the period or with availability of degree days] (Reddy, 2019b). With irrigation, Telangana State in India growing three crops in a year.

The American 'dust bowl' was a period of severe dust storms and heatwaves that produce the worst drought in North America in a thousand years, destroying mid-west crops. From 1933 to 1939, wheat yields declined by double-digit percentages, with vast economic and societal consequences, eroding land value throughout the Great Plains states and displacing millions of people. An earlier study in Nature found that a drought on the scale of the American 'dust bowl' today would have similarly destructive effects on US agriculture despite modern technological advances. The Four Twenty Seven report finds that even if we immediately ceased all emissions today, the 'dust bowl' scenario is now unavoidable for parts of the West by the end of this century. To evade this outcome, we would need to not just halt global fossil fuels pollution right now, but somehow suck the carbon we've already emitted out of the oceans and atmosphere, and store it safely. Along the way, within the next few decades, areas of higher altitude in northern Canada, Russia, the Himalayas, Andes, and Alps will experience temperatures up to 25 percent hotter, the report finds. Ann Rowan's study on Himalayan glaciers was published in The Coversation (3rd August 2020) with the title "Two-thirds of Glacier ice in the Himalayas will be lost by 2100 if climate targets aren't met".

The record-breaking disruptive heat waves seen across the United States, Japan and Europe in 2019 are also a taste of things to come according to the Four Twenty Seven report, which warns of "significantly more [such] severe events" by mid-century, also locked in due to past emissions. The Four Twenty Seven report bases some of its analysis of water stress on data from a new tool released in November, Aqueduct Food, created by the World Resources Institute. Data from the new tool — which was funded by Cargill, the world's largest food producer by revenues — reveals that by 2040 as much as 40 percent of all irrigated crops will face acute water stress. This could impact a number of major crops. Sara Walker, who leads WRI's global water quality programme, told me that rice, wheat and maize will be significantly affected.

- In 2020 reports state that large ozone hole was developed in Arctic zone. Also reports state that Arctic ice will be zero in summer. The former relates to extreme colder conditions and the later relate to warmer conditions at Arctic. Both can't coexist.
- Indian temperatures have no global warming but have localized/regionalized changes (Reddy, 2020).
- Water Resources Minister of India in the month of May in 2020 said that the snow this year on "Himalayan Peaks" is the highest in 50 years, and reservoirs in downstream will receive very high water inflows from snowmelt during summer and southwest monsoon. In fact the situation is similar to massive floods in last year, but on a bigger scale. Bakra's catchment area at present received 480 mm (19 BCM) as compared to 230 mm last year. In the Sutlej and Beas Rivers catchment area received 540 mm (22 BCM) and 245 mm last year. Last year the government unable to utilize the flood waters. Under this scenario, more energy from the Sun is reflected back and thus the chances of higher temperatures are not possible.

Some 70% of rice production and one third of wheat are irrigated. "By 2040, we predict 72% of wheat production will face extremely high water stress," said Walker. In China, some three quarters of maize production are irrigated, and by 2040, as much as 80% of irrigated maize is expected to face "extremely high water stress." This in turn could dramatically impact food availability around the world, as an estimated 90% of the global population lives in countries which import over four-fifths of their staple food crops from regions that irrigate crops by depleting groundwater.

As a result, long before they reach 'dustbowl' conditions by end of century, around just two to three decades from now the breadbaskets of Mexico, South Africa and southern Europe are among the major agricultural regions "that will be grappling to grow food due to more regular water shortages", according to Nik Steinberg. As with the longer-term rainfall reduction projections, these nearer-term consequences are also "definitely locked in," he said.

Already some 80% of the world's population suffers serious threats to water security, Steinberg told me. Climate change will exacerbate this by decreasing the availability of reliable sources of water, leading to changes in water vapour in the atmosphere, patterns of rainfall, intensifying extreme weather events, reducing snow cover and changing soil moisture. One of the most worrying impacts could be on groundwater resources, the primary source of agriculture for many breadbaskets such as South Asia. Steinberg explained that there is currently nothing in place to "ensure farmers don't suck the aquifers completely dry."

Citing an IPCC estimate that as many people as live in Africa would need to migrate due to water shortages, Steinberg painted a bleak picture: "The implications reach far beyond food security… Farmers turned climate refugees will need to vacate, find new work, and support families and households that suddenly find themselves uprooted and with little means to start over." Such risks could play out in different ways, in some cases sparking conflict or civil unrest. According to Steinberg, global food systems could experience food shortages and price increases as a direct consequence of climate change. These might "first affect farmers and later give rise to the level of unemployment and insecurity recently witnessed in Somalia and Syria."

A number of recent scientific studies have attempted to model the mounting pressures on the global food system in coming decades. One model whose results were published in April 2019 in the journal Science of the Total Environment looked deeply at one of the key issues studied in the Four Twenty Seven report — the implications of groundwater depletion for irrigated agriculture: "Many of the world's major freshwater aquifers are being exploited unsustainably, with some projected to approach environmentally unsafe drawdown limits within the 21st century. Given that aquifer depletion tends to occur in important crop producing regions, the prospect of running dry poses a significant threat to global food security."

The research, funded by the US Department of Energy's Office of Science, concluded that several breadbasket regions would probably experience major crop-failures between now and 2100, due purely to the declining availability of groundwater. But groundwater sources would not necessarily become completely depleted due to withdrawals becoming more costly with time. The study's most intriguing conclusion is that global groundwater withdrawals are set to peak between 2050 and 2060, and after that enter a decline-phase. "The largest absolute impacts in crop production are experienced by northwest Mexico, western United States (California and the Missouri basins), the Middle East, Central Asia, South Asia (particularly the Indus basin and in northwest India), and northern China (Yellow River basin)," forecasts the study lead authored by Professor Sean Turner of the Pacific Northwest National Laboratory, in relation to the model's realistic scenario for constrained water supplies.

In some of these regions, agriculture would simply collapse: "… the Arabian Peninsula (where groundwater becomes costly) and California (where groundwater reaches its environmental limit) experience almost total loss of rice and miscellaneous cropland, respectively." In other regions, the collapse of irrigated agriculture would drive expansion of rainfed crop land. As a result, the global agricultural system would be forced to transform, with crops shifting to new regions where they can be sustained. "Rice shifts out of Pakistan and India and into China and Southeast Asia," write the study authors. "Wheat shifts out of Pakistan and China, and into nearly every other region." Those areas losing production to climate impacts "will likely suffer significant economic losses." Meanwhile, the impacts of gained production elsewhere will be so "spread out" that no single region will experience a significant economic benefit. According to the study's lead author Professor Turner the model did not look at climate change and how it might affect other water stress issues, including extreme drought. The main drivers of groundwater depletion examined are "population growth, which drives up global food demands and therefore irrigation water demand", Turner told me. These factors drive water demand across other sectors such as electricity production and resource extraction. The simulations show global population increasing toward end of century when it begins to level off; crop yields and crop water-use are projected to increase gradually overall, despite some major local and regional reductions. "So the simulated peak groundwater withdrawal isn't necessarily caused by running out of groundwater. It could just reflect global peak water demand," said Turner. However, he added: "When we realistically constrain groundwater we do, however, start to observe the effects of scarcity. Some regions do run out of resource, and in other regions withdrawals cease because over-extraction renders the resource uneconomical. This is what causes the peak to occur earlier in the constrained scenario."

The Pacific Northwest National Laboratory study does say that in its constrained scenario, if rainfed crops and other regions take-up the slack as other groundwater-dependent regions face agricultural collapse, it would still be possible to sustain global agricultural production through trade: agriculture would end up shifting to areas where renewable freshwater supplies remain abundant. The bulk of crop production losses can then be "replaced by modest expansion of rainfed and irrigated agriculture in other regions where water is cheaper or more plentiful", write the scientists, though with the following caveat simply because the post-2100 period is not simulated: "… it remains unclear how long this trend can continue beyond the current century." In other words, it may be possible to adapt to these constrained conditions, but to do so the food system will need to change. In all scenarios, the model shows that global groundwater withdrawals peak around or shortly after mid-century and thereafter begins to decline, slower or faster depending on assumptions.

But perhaps most worrying is that the model focuses exclusively on groundwater depletion. Not only is the impact of climate change excluded, how climate could intensify the occurrence of extreme droughts around the world is not part of the model. Turner cautioned that "climate change effects on water are highly uncertain" and "can diverge significantly across model projections." In many regions, climate impacts might decrease stress on groundwater resources by increasing rainfall. Turner told me that one broadly accepted climate change impact is that, irrespective of extreme incidents like droughts in particular regions, overall we are likely to see an additional 2–3% increase in total rainfall globally overall for every degree of warming. The other complication, he added, is that "extreme hydrological events are not well captured and projected" in global climate models.

In September, a science team led by the University of Arkansas analysed 27 climate models, each of which had three different scenarios. They found that on a worst-case business as usual scenario, up to 60% of current wheat-growing areas worldwide could see simultaneous, severe and prolonged droughts after mid-century due to climate change. This is especially alarming given that wheat is the largest rainfed crop by harvested area, supplying some 20% of all calories consumed by humans. The scientists, who published their research in Science Advances, further concluded that even if we succeeded in reducing carbon emissions according to the Paris Agreement targets, up to 30% of global wheat production areas could see simultaneous drought between 2041 and 2070. "If only one country or region sees a drought there is less impact," said Song Feng, associate professor of geosciences at the University of Arkansas. "But if multiple regions are affected simultaneously, it can affect global production and food prices, and lead to food insecurity."

Western countries will not be exempt from the consequences, but may experience them quite directly. A Cornell University study released in May found that climate-induced heat stress could play an even larger role than drought in wiping out US crop yields. The Cornell team drew on over three decades of crop yield records from the US Department of Agriculture, as well as weather data from the PRISM Climate Group at Oregon State University, and hourly snapshots of soil moisture content at nine-mile intervals across the whole of North America from NASA and the National Oceanic and Atmospheric Administration. The conclusions were shocking. Even under the mildest climate scenario, yields for the six main crops in the US — maize, cotton, sorghum, soybeans, spring wheat and winter wheat — are predicted to decrease 8–19% due to climate change between 2050 and 2100. Under the worst-case scenario, crop yield reductions range from 20 to 48% over this period. Because these impacts are principally related to heat-stress, not water scarcity, the implication is that many food-producing regions in the US could end up being drier due to summer heat even with increases in rainfall. When combined with water scarcity impacts, the potential picture looks catastrophic. While many of these climate projections are for after mid-century, with some impacts beginning to kick in after 2030, compelling evidence points to significant near-term risks that could even erupt within a few years. In 2012, a study by IPCC lead author Professor Piers Forster of the University of Leeds's School of Earth and Environment, among other scientists, warned that large parts of Asia responsible for producing much of the world's wheat and maize would experience severe droughts within 10 years. We are now just a few years away from this timeline. Yet some of these are the same regions to which the Pacific Northwest National Laboratory study hoped groundwater-dependent agriculture would be able to migrate.

Based on 12 different 'state of the art' climate models, the research found that after the early 2020s, on an average drought across Asia lasting longer than three months would be more than twice as severe in terms of their soil moisture deficit compared to the 1990–2005 period. This could pose a serious and imminent risk to global food supplies, the research revealed. As early as 2022, the report found, "… droughts will, on average, become months longer and markedly more severe (132% and 154% on average for wheat and maize) across Asia… The increased drought risk is an imminent threat to food security on a global scale." The countries most affected would be China, India, Pakistan and Turkey according to the report, titled Food Security: Near future projections of the impact of drought in Asia, and published by the UK-based Centre for Low Carbon Futures. "Our work surprised us when we saw that the threat to food security was so imminent; the increased risk of severe droughts is only 10 years away for China and India," said report co-author Dr Lawrence Jackson eight years ago. "These are the world's largest populations and food producers; and, as such, this poses a real threat to food security." If the University of Leeds analysis is accurate, the risk of climate-induced droughts in parts of Asia triggering a global food crisis could start to become acute as early as 2022. That's two years from now. Much of Southeast Asia is already beginning to experience drought as a norm rather than an exception. In 2019, Australia was forced to import wheat for the first time in 12 years due to drought across the country's eastern states.

- Both surface and groundwater availability in space and time, primarily relate to rainfall/snowfall which presents natural variability (Reddy, 1993, 2008, 2019a) but they vary with space and time in terms of starting and ending years of droughts and floods. All the regions getting drought conditions will be very rare scenario. Around 18% of world population live in India & 18% in China. Also, food wastage is more than 40% and global average is around 30% (Reddy, 2019b). Thus, year to year variations in food production is common. However, there are large differences in yield per hectare around the world due to several local factors. Researchers are working on to improve the yield per hectare and thus it might compensate the losses with weather conditions.
- Reddy (2019c) presented the pollution impact on both surface and groundwater related issues. With this nutrition security is at great risk.
- Telangana State Government claimed during 2019-2020 crop year the growth rate in area under paddy was 43.5% and production growth rate was 48% over 29018-19 – these are estimates. The government claimed this due to increased area under irrigation. Governments' policies will change the crop production positively or negatively based on funds availability and thus water availability in realistic terms.
- In Ethiopia, the main staple food is "tef", a locally grown crop. In dry south they grow millets and in the wet north grow wheat, barley and tef.

Note: Even in India several organizations with the financial supports from international and national organizations dumping such reports, particularly using IPCC models. For example, IRADe report "Socio Economic Vulnerability of Himachal Pradesh to Climate Change" with the financial support from Department of Science & Technology, Government of India. In fact, on such assessments I questioned them as back as 1995 (Reddy, 1995a&b).

Tropical Cyclones versus Global Warming

Truncated data series or short period data series based studies lead to misleading inferences or conclusions. "Tropical cyclones have become more destructive over past 40 years" is one such report by Graham Readfeam, published by The Guardian [as usual] on 20th May 2020. The report says that -- Tropical cyclones have become more intense around the globe in the past four decades, with more destructive storms forming more often. The theory behind it is that warming oceans would drive more dangerous cyclones. To support this argument presented several studies.

- Analysis of satellite records from 1979 to 2017 found a clear rise in the most destructive cyclones – also known as hurricanes or typhoons – that deliver sustained winds in excess of about 185km/h. Australia sits across two ocean basins where cyclones form – the southern Indian Ocean and southern Pacific Ocean – where the study also identified rising trends of the more destructive storms. Experts told Guardian Australia the finding was in line with climate model predictions and the knowledge that increasing ocean temperatures gave tropical storms more energy. Dr Hamish Ramsay, a senior research scientist at CSIRO who studies cyclones, said: "This study confirms what the climate models have been predicting for some time – that the proportion of the most intense storms will increase as the climate warms."
- While climate scientists have long-predicted that global heating would deliver stronger cyclones, a trend that was statistically significant has been challenging to identify in part due to the natural swings in the world's climate masking changes.
- Published in the leading journal the Proceedings of the National Academy of Sciences, the study was carried out by scientists at the US government's National Oceanic and Atmospheric Administration. The scientists did not try to find a cause for the increase in more dangerous cyclones, but said the trends were consistent with understanding of physics and modelling, and the finding "increases confidence that [tropical cyclones] have become substantially stronger, and that there is a likely human fingerprint on this increase". As well as looking at the number of cyclones forming globally, the study also looked at changes in cyclone intensity by region. The southern Indian Ocean and the southern Pacific Ocean both showed an increase in the number of the more intense storms, although the trends in each individual region were not as robust due to the smaller number of cyclones.
- Australia's 2018's State of the Climate Report said since 1982 there had been a downward trend in the number of all tropical cyclones in the Australian region but it was not possible to see any trend in the intensity of cyclones. Previous research has found that when cyclones form, they are tending to move more slowly, while delivering more rain.
- Dr Greg Holland, a senior scientist emeritus at the National Centre for Atmospheric Research in Colorado, has studied cyclones for about 40 years. The Melbourne-based scientist said while there were legitimate arguments over the finer details of trends and intensity in relation to tropical cyclones: "The work all points in the same direction – the proportion of the most intense cyclones is going up." He said: "There is nobody saying the trend will go the other way. The physics has been well set out for 30 or 40 years. If you get a warmer ocean then the intensities of cyclones goes up. That's a 5% or 10% increase in maximum winds for every 1.0oC of warming in the ocean. The world is warming and it is because we have put more greenhouse gases into the atmosphere.
- "For the Australian region – which is the eastern Indian and southern west Pacific – it means we now have the potential for there to be more intense tropical cyclones coming ashore and doing more damage. "The chances of us getting an intense cyclone have gone up already and they will go up in the future." Holland said there was also evidence that the ocean regime of Australia where intense cyclones could strike was also expanding. The observed movement was only about 150km, he said, but this would soon put Brisbane "in the cyclone zone".
- Prof Steven Sherwood, of the UNSW Climate Change Research Centre, said the study was important "because it shows that the upward trends first reported about a decade ago in cyclone activity have been sustained, and have now gone on long enough that it is no longer possible for them to be a random natural variation." He said the study found that averaged globally, 30% of cyclones in the 1980s were "major" compared with 40% of cyclones now. "There is of course nothing surprising about this — we've just reached the point of 'non-deniability'," he said. "The implication for Australia is that our risk exposure to strong cyclones will almost certainly continue to increase as long as global temperatures increase. "It also appears that storms are encroaching farther away from the equator, although this is harder to confirm observationally. If this is true, it means that the Queensland southern coast in particular may be at growing risk."

“Global warming is causing hurricanes, around the world, to become stronger, say scientists” reported by FP Trending in Firstpost of 28th May 2020. It reports that “A new study has now found that hurricanes are getting stronger due to global warming. Over a period of 39 years, between 1979 and 2017, trends have shown that storms are getting stronger in general and major tropical cyclones have become more frequent. The results of this study have been published in the journal Proceedings of the National Academy of Sciences. According to the National Oceanic and Atmospheric Administration (NOAA), the 39-year period has shown a dramatic acceleration in climate change and includes eight of the 10 warmest temperatures ever recorded. As per a report in Daily Mail, researchers from the NOAA have found that the risk of a hurricane wind speed reaching above 115mph or category 3 had increased by 15% over the last 40 years. Study authors say that the change in intensity and speed is likely to continue increasing and become more substantial as the planet warms up further in the next few years. Climate scientist and study author James Kossin from the NOAA quoted as saying that their results highlight that the storms growing stronger on global and regional levels is consistent with what to expect with hurricanes responding to a warmer world. According to the report, researchers have suspected for a long time that there would be an increase in stronger hurricanes as warmer ocean temperatures add moisture to the atmosphere. This, in turn, energises the storms. Kossin, however, admitted that the results do not say precisely how much of the trends is caused by human activities and how much maybe just natural variability.”

All these inferences are hypothetical in nature as their mind set has been fixed towards global warming. Reddy (2008) presented information on cyclones in Bay of Bengal/India. The cyclones per year followed 56-year cycle of southwest monsoon rainfall in AP/India. More than ten cyclones per year were recorded prior to 1972 and less than 10 after 1972 to 2001; and there onwards more than 10 cyclones per year 28 year period are expected. During 1891 to 1990 in the month of May recorded 32 depressions, 15 cyclonic storms and 35 severe cyclonic storms. Next in November recorded 55 depressions, 42 cyclonic storms and 53 severe cyclonic storms. That means more severe cyclonic storms were recorded in summer [May] and winter [November]. So, global warming cannot be the driving force for severe cyclonic storms in Bay of Bengal during 1891 to 1990. The above researchers made heuristic attribution to global warming to severe cyclones occurrence in recent years. Here temperature gradient plays an important role rather than the magnitude of temperature. This is evident from the formation of sea breeze and land breeze concept/theory.

Summary and Conclusion

The water flows in the Colorado River Basin were not unusual or related to global warming, particularly of recent period as proposed by the media report. The water flows in the Colorado River have been following the rainfall pattern in the same basin areas. In the case of average annual temperature, at the starting period of the series lower temperatures correspond to high water flows and at the end period of the time series increasing trend [higher temperatures] also correspond to high water flows in Colorado River. That means temperature is not the driving force for water flows and as well rainfall in the Colorado River Basin. At all-India level India faced with drought conditions during 2002 & 2009 [0.81 & 0.79% of average rainfall] and in association with this the temperature showed a rise of 0.7 & 0.9°C. That means end period of the series with high water flows must show lower temperatures.

It has become common among research groups [academic and scientific institutions] with global warming bent coming up with very poor quality and faulty inferences with high tech models using sophisticated computers with poor knowledge on climate and climate change issues over different parts of the globe. Planning with such inferences is dangerous and creates disasters in several fields with huge economic losses. Such model simulations are creating huge greenhouse gases emissions as side effects.

International Agencies & Governments in specific and people in general instead of harping on “non-significant/non-existing” global warming and wasting public money, they must concentrate on how to bring down pollution [air, water, soil & food] and adulterated food that severely affecting the health of rich and poor and creating more pollution. We have seen the impact Covid-19 on humans and as well on global economy. Several cases are discussed in this connection covering wide areas.

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References

1. Reddy SJ. (1983). A simple method of estimating the soil water balance. Agric. Meteorol., 28: 1-17.
2. Reddy SJ. (1984). Climatic fluctuations and homogenization of northeast Brazil using precipitation data. Pesq. Agropec. Bras. (Brasilia). 19: 529-543.
3. Reddy SJ. (1986). Climatic fluctuations in the precipitation data of Mozambique during the period of meteorological record. Comm. No. 39, Series Terra e Agua, INIA, Maputo, Mozambique, pp.40.
4. Reddy SJ & Mersha E. (1990). Results: climatic fluctuations in the precipitation data of Ethiopia during the period of meteorological record. Agrocl. Series 4, ETH/86/021 – WMO/UNDP, NMSA, Addis Ababa, Ethiopia, pp.28.
5. Reddy SJ (1993) Agroclimatic/Agrometeorological Techniques: As applicable to Dry-land Agriculture in Developing Countries. www.scribd.com/Google Books, 205 [Book Review: Agricultural and Forest Meteorology, 67:325-27, 1994].
6. Reddy SJ (1995a). Discussion: Over-emphasis on energy in crop yield models. Agric. For. Meteorol., 77:113-120.
7. Reddy SJ. (1995b). Comment: Sensitivity of some potential evapotranspiration estimation methods to climate change. Agric. For. Meteorol., 77:121-125.
8. Reddy SJ. (2000). Andhra Pradesh Agriculture: Scenario of the last four decades. Hyderabad, India, 104.
9. Reddy SJ (2002). Dry-land Agriculture in India: An Agroclimatological and Agrometeorological Perspective. BS Publications, Hyderabad, 429.
10. Reddy SJ (2008) Climate Change: Myths & Realities. www.scribd.com/Google Books, 176.
11. Reddy SJ (2016a). Irrigation and Irrigation Projects in India: Tribunals, Disputes and water wars perspective. BS Publications, Hyderabad, 132.
12. Reddy SJ (2016b). Climate Change and its Impacts: Ground Realities. BS Publications, Hyderabad, 276.
13. Reddy SJ (2018a). Urban water Management for sustainable development: The role of "climate change and Human interference". Acta Scientific Agriculture, 2.10: 43-53.
14. Reddy SJ (2018b). Role of climate change on recent weather disasters. Acta Scientific Agriculture, 2.4:22-29.
15. Reddy SJ (2019a) Agroclimatic/Agrometeorological Techniques: As applicable to Dry-land Agriculture in Developing Countries [2nd Edition]. Brillion Publishing, New Delhi, 372p.
16. Reddy SJ (2019b) Workable Green Revolution: Agriculture in the perspective of Climate Change. Brillion Publishing, New Delhi, 221p.
17. Reddy SJ (2019c). Water Resources Availability over India. Brillion Publishing, New Delhi, 224p.
18. Reddy SJ (2019d). Comments on IPCC's 7th August 2019 Report on "Climate Change and Land". Acta Scientific Agriculture 3.9: 147-150.
19. Reddy SJ (2019e). Climate Change and its Impact on Water Availability in Rivers and Crop Productivity. Acta Scientific Agriculture 3.10: 155-163.
20. Reddy SJ (2019f). Comments on IPCC's 24th September 2019 Report on "The Ocean and Cryosphere in a changing climate: Summary for Policy makers". Acta Scientific Agriculture, 3.11: 16-19.
21. Reddy SJ (2020). Indian Temperature Scenario: "No Global Warming Trend", Op Acc J Bio Sci & Res 1(1) – 2020, 6pp.

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