Climate Change and Global warming

Scientific research progresses through interactions and debates. Varied opinions surface and continue to bring out limitations of a theory or a model. These diverse opinions/arguments and counter arguments become at times so complicated that none can categorically support one over the other. In the October, 2014 editorial two sub sections were ear marked for Monsoon Aberrations and Agrometeorology. After going through the contents Dr.S.Jeevananda Reddy, Formerly Chief Technical Advisor – WMO/UN and a well-known Climate Expert has sent a mail to the editor, expressing his opinion about some details given in the two sub sections of the editorial. As it is our responsibility to give due importance to such opinions and clarify the basic objective behind the editorial, the observations made by Dr.S.J.Reddy and Editor`s views are given below. Hope, the details would of use in clarifying some aspects of climate change, global warming and monsoon aberrations. They, however, are not meant to provide answers to many aspects of climate change.

Dr.S.J.Reddy`s letter:

"Namaskar,
Congratulations for bringing out such Journal to cater Indian scientific community.

However, I disagree on some of the points mentioned under monsoon aberrations and agro meteorology sections. I published first practical application book on agrometeorology in 1993. This is being used as a reference book for post-graduate level students. The main issue which disagree is on global warming, El Nino issues mentioned in the Editorial. In fact we [around 129 scientists -- three from India] fought with UN. After the December 2009 Copenhagen Summit IPCC & Al Gore with drew some of their conclusions -- though after receiving the Noble Prize --. In AR 5 of 2013 report IPCC has changed drastically from AR 4 of 2007. Here they said around 50% of the increase in global temperature is not associated with increased levels of anthropogenic greenhouse gases. From this the global warming is 0.25 deg C since 1951 [starting year of global warming used by IPCC] to date. In the averaging of temperature, more emphasis was given to urban heat island effect as dense met network are located in urban areas. In the averaging of temperature, less emphasis was given to rural cold island effect as sparse met network are located in rural areas. This fact is clearly evident from the satellite data where the temperature raise is hardly 0.20 deg C. And thus global warming component is less than 0.1 deg C. About extremes in weather and climate, if we look at climate normal book, it gives us ample information. What we are experiencing a natural part of climate change. Even IPCC in AR 5 stated that in the coming decades the natural variability plays the vital role. All India Southwest Monsoon Precipitation follows 60-year cycle. Already two cycles are completed and the third cycle started in 1987, coinciding our calendar. In the case of AP [undivided] the SWM and NEM present 56 year cycles but in opposite direction. The cyclonic activity presents NEM pattern. When we look at it, the trend shows an increasing pattern but this is not so as annual rainfall presents a 132 year cycle. The first 66 years below the average and next 66 is above the average. Now we are in the new cycle since 2001."

Editor`s Views:

While respecting the valued opinion of Dr.Jeevananda Reddy I only reiterate that our concern, as scientists, is about how to find apt solutions to face the monsoon aberrations and thereby help the farmer. Our economy is agriculture based and proper advisories at regular intervals are needed to guide the farmer. Such a development is yet to be achieved, due to various factors. Australian Met experts gave a report in June stating El Nino would commence from July and extend for months affecting SW monsoon of India. This was in principle agreed to by IMD experts, with some reservations. In general even after revival of monsoon in the second half of July experts opined the revival would be temporary, confusing the farming community. After a lull for more than 20 days, from 3rd week of August monsoon picked up .Those who lost crops due to inadequate monsoon rains in June-mid August phase were mostly hesitant to go for fresh agriculture activity, as they have already incurred heavy losses. Those who could afford second time sowing operations received varied results, depending on area specific precipitation. Some gained where rains helped the cultivation practices and others, especially those from parts of northern, northeastern and eastern India lost due to floods. The editorial has reflected mainly our concern about these setbacks that are affecting our common man in general and agriculture activity in particular. Our objective was to draw the attention of concerned authorities in addressing the problems faced by the farming community. We urged the concerned to release on a regular basis area specific met advisories to help the farmer. The section on Agrometeorology was prepared mainly to bring in to

focus the importance of Arometeorology, as we believe it`s apt application can meet important needs of agriculture fraternity. Editorial was not prepared to bring out various facets of Agrometeorology. Interested can refer books and scientific articles. It is good to learn that Dr.S.J.Reddy has brought out a book on Agrometeorology, way back in 1993. The editorial was prepared in third week of August, to meet publication target. Till third week of August every one believed El Nino effect would considerably hamper our agriculture operations. But, what surfaced subsequently went against the prediction. We witnessed, in place of El Nino (??),unexpected aberration in monsoon pattern. Such an aberration has even surprised experts. While, technical experts understand the limitations of weather forecasting (especially abrupt changes in the monsoon pattern)general public including farmers believe the weather bulletins (prepared using sophisticated data acquisition gadgets, including satellite imageries) are error free. To narrow down errors in our prediction it is essential to strengthen weather monitoring network. The weather monitoring network, as correctly pointed out by Dr.S.J.Reddy, is dense in the urban sector and sparse in the rural sector leading to unequal data coverage and resultant limitations in properly reflecting the rural cold island effect. This anomaly needs to be addressed by the concerned, at local and global level. What we need is a better prediction mechanism that can identify well in advance monsoon aberrations at local level. It is important to learn from the mail from Dr.S.J.Reddy that Andhra Pradesh and Telangana are having a varied weather pattern, since few years, albeit in the negative trend. Probably this trend is extending to Vidarbha and parts of Maharashtra and Madhya Pradesh. However, the weather experts may find it difficult to strictly consider this aspect (extracted from statistical data) in predicting monsoon aberrations, as monsoon pattern is dynamic and follows no specific trend and direction, year after year.However, we appreciate the information provided by Dr.S.J.Reddy that Andhra Pradesh and Telangana cyclonic activity presently follows NEM pattern (we have been witnessing significant cyclonic activity in the last 3 to 4 years during October and November; after ending of conventional SW monsoon).If this pattern is going to continue, it may be essential that agricultural operations be shifted to late July or early August and continued beyond November, instead of starting from June. This information further emphasizes the need to bring out area specific meteorological bulletins on a regular basis, for an extended period starting from May till February. To make these bulletins effective and informative It may be essential to bring out Met Advisory Maps depicting area specific segregation orsegmentation of our country in to number of weather zones and micro-zones, in a detailed way after collecting sufficient data through strengthened data acquisition network.

Global issues should be given due weightage, especially by the experts as global and regional factors do affect local factors. However, while releasing bulletins these issues should not be given more emphasis leading to masking of the importance of local factors. They are not paramount for sustenance of our agriculture sector.

About varied opinions on Global warming and Climate Change:

IPCC reports are periodically updated. There are varied opinions about the applicability of these reports. It is difficult for us to categorically support or disagree with the contents. The objections raised by Dr.S.J.Reddy are worth taking note of, including his comments about agriculture in his rejoinder to IPCC report…."*Food production, food security & nutrition security are not affected by global warming. Floods and droughts are part of rhythms in precipitation, however, their impacts are modified by agriculture technology and ecological changes. Food includes not only agricultural products but also include several others such as Dairy products, Poultry products, Sea & Water products [fish & prawns], Animal products [meat], etc. These are affected by agriculture technology and pollution components and not by global warming as crops adapt to temperature regimes which is evident from extremes in temperature given under climate normal data. These, along with ecological changes are the major contributors of destruction of biodiversity – on land, in water including oceans. Pollution, more particularly from new agriculture technology, is the major source of health hazards globally and not associated with Global Warming. Global Warming is in fact a brain-child to counter the Environmental Movement against pollution, more particularly agriculture pollution, initiated in late 60s and early 70s*"((**Source**:IPCC's Report on Climate Change: Myths & Realities**;** Guest Blogger / December 7, 2013*A World Meteorological Organization insider's view of the IPCC report.*Guest essay by Dr. S. Jeevananda Reddy…. http:// watts up with that. Com/2013/12/07/ ipccs-report-on-climate-change-myths-realities/)

It is evident from excerpts, cited above, pollution is creating number of problems to our environment. This reality needs to be taken in to consideration when we talk of deteriorating health of our environment. We are not attributing pollution related issues are basically contributing to global warming. We, however, emphasize that pollutions are affecting the health of our environment.

While giving due weightage to the opinions expressed by Dr.S.J.Reddy we need to look in to studies/ statements by others, while dealing with the complicated nature of Climate change studies. In this respect a statement made by Paul A.T.Higgins (How to deal with climate

changehttp://scitation.aip.org/content/aip/magazine/physicstoday/article/67/10/10.1063/PT.3.2548?utm_medium=email&utm_source=Physics+Today&utm_campaign=4778436_October+2014+Table+of+Contents&dm_i=1Y69,2UF2C,HPHZCG,ABGWF,1)is worth reading…."*Even leading experts often reach very different conclusions about the seriousness of the risks we face. Some experts conclude that the consequences of climate change over the next several decades will most likely be small—perhaps a few percent of GDP. That conclusion might make sense if feedbacks in the climate system tend to stabilize climate rather than exacerbate changes. Or we might get lucky and find that physical systems , biological resources, and social institutions prove insensitive to climate change. Alternatively, rapid scientific and technological advances might give us the capacity to overcome the effects of climate change. Even setting aside disagreement among experts over the likely consequences—and the inescapable uncertainty that disagreement reveals—climate change represents a difficult risk-management challenge. Policy responses necessarily integrate both scientific information and subjective value judgments. Science can inform us about the climate system and our relationship with it. But it can't tell us whether to care more about our children and their children or about ourselves. Science can't decide what is fair for different nations and peoples. It can't resolve differences of opinion on the value of cultural heritage or nonhuman species. There is no clear path to agreement on any of those issues, and that lack of clarity sets up a complex and contentious policy debate. Policies relating to climate change fall into the four broad categories. We could reduce our greenhouse gas emissions, an approach that is typically called mitigation. We could increase society's capacity to cope with changes in climate, which is called adaptation. We could deliberately manipulate the Earth system in ways that might counteract at least some of the effects of increasing greenhouse gas concentrations. That kind of intervention is typically called geoengineering or climate engineering. We could also expand our knowledge base in ways that help us better understand the climate system, our sensitivity to climate change, and the other three risk-management strategies, which are more proactive".*

We only urge the experts to find ways and means to assess the situation at local level and help the common man, as local effects have significant impact on our society. Irrespective of the magnitude of global warming, there is a percentage of impact due to Man's interventions, in the form of pollution. We do agree that Nature's role, which is considerable, cannot be ignored, while developing any model. I have not reflected these points in the editorial, for obvious reasons. I mainly propagated the idea that our increased consumption of natural resources is affecting the environment and it is time to safe guard our environment and natural resources to lessen problems to future generations. My focus was on impact on our agriculture due to monsoon aberrations.

We thank Dr.S.J.Reddy for bringing out the importance of natural causes, in shaping up various climate related issues. Regarding Man`s role on monsoon aberrations we need to study in detail various aspects.

Details of a recent study:

Fall in monsoon rains driven by rise in air pollution:

Emissions produced by human activity have caused annual monsoon rainfall to decline over the past 50 years, a study suggests. In the second half of the 20th century, the levels of rain recorded during the Northern Hemisphere's summer monsoon fell by as much as 10 per cent, researchers say. Changes to global rainfall patterns can have serious consequences for human health and agriculture. Scientists found that emissions of tiny air particles from human-made sources -- known as anthropogenic aerosols -- were the cause. High levels of aerosols in the atmosphere cause heat from the sun to be reflected back into space, lowering temperatures on Earth's surface and reducing rainfall. Levels of aerosol emissions have soared since the 1950s, with the most common sources being power stations and cars. Researchers at the University of Edinburgh say their work provides clear evidence of human-induced rainfall change. Alterations to summer monsoon rainfall affect the lives of billions of people, mostly those living in India, South East Asia and parts of Africa. The team calculated the average summer monsoon rainfall in the Northern Hemisphere between 1951 and 2005. They used computer-based climate models to quantify the impact of increasing aerosol emissions and greenhouse gases over the same period. They also took account of natural factors such as volcanic eruptions and climate variability to gauge the impact of human activity on the amount of monsoon rainfall.

Researchers say levels of human-made aerosols are expected to decline during the 21st century as countries begin adopting cleaner methods of power generation.

Lead author Debbie Polson, of the University of Edinburgh's School of Geosciences, said: "This study shows for the first time that the drying of the monsoon over the past 50 years cannot be explained by natural climate variability and that human activity has played a significant role in altering the seasonal monsoon rainfall on which billions of people depend."(**Source**: D. Polson, M. Bollasina, G. C. Hegerl, L. J. Wilcox. Decreased monsoon precipitation in the Northern Hemisphere due to anthropogenic aerosols. *Geophysical Research Letters*, 2014; 41 (16): 6023 DOI: 10.1002/2014GL060811).

This is a good study. But, with ever changing scenario no model/ result / opinion can be declared as final. With enhanced data coverage and improved technical capabilities

new models are bound to emerge. As such our aim should be to focus on facts and take viable measures to overcome the problems. Dr.Jeevananda Reddy in his excellent analysis of IPCC report has pointed out…."*In all around 50% of raise shown under global warming is influencing the local and regional aspects but not national and global aspects like sea level raise, ice melt, etc. Southern hemisphere with less number of urban areas, with less ecological changes and with more area under ocean waters showed lower temperature raise over the average pattern. In the case of Northern Hemisphere with more urban areas, more ecological changes and with less area under ocean waters showed higher temperature rise over the average pattern".* (http:// watts up with that. Com/2013/12/07/ ipccs-report-on-climate-change-myths-realities/).

Recently another article was published to impress upon both the researchers and the common man the complicated nature of climate change. This supports the view that we cannot come to any specific conclusion regarding the role of Man and the Nature in destabilizing climate dynamics. The details are included below.

Last interglacial period experiencedhighly variable climate

The climate of our planet is naturally variable and experiences cycles spanning decadal to multi-millennial timescales. Understanding these natural variations is key for assessing how humans affect natural climate variability and how climate might change in the coming centuries. In this context, many scientists are extensively studying the current interglacial period. To get baseline information, however, investigations of past interglacial climates are needed and require data that may be difficult to retrieve. Pol et al. provide a new look at a previous interglacial period, which occurred about 124,000−119,000 years ago, by analyzing a nice core from East Antarctica that preserved very detailed climate information. A highly resolved analysis of the ice core revealed that the Antarctic climate was highly variable during the previous interglacial period, when polar temperatures were warmer than they are today, leading to partial de-glaciation of Greenland and Antarctic ice sheets. The exact reason for this enhanced variabilityis not yet known. However, if the same processes that were at play during the last time Antarctica was several degrees warmer than today occur in the future, they will certainly be added to the expected disruptions caused by anthropogenic effects, thus making more pressing the questions about the stability of the Antarctic ice sheet. The authors note that other highly resolved records from other latitudes are needed to broaden the scope of these new findings. (Geophysical Research Letters, doi: 10.1002/ 2014GL059561, 2014).

On 1st November,2014 IPCC released IPCC synthesis Report [AR 5] .This received mixed reactions from the experts and governments, even though accepted by UN.In response to this Dr.S.J.Reddy has expressed his opinion. Some excerpts from the IPCC report (AR 5) and Dr.S.J.Reddy`s rejoinder are listed below, basically to clear some ambiguities.

Effects of climate change on Agriculture:

The IPCC report observed that "**Climate change will especially affect the livelihoods of people, agriculture the mainstay of the Indian economy, will see dramatic changes in yields, affecting people's right to food security"**.

Dr.S.J.Reddy points out that *"the two natural resources that are vital for agriculture are the soil and the climate. Man has no control as yet on the climate and needs to adapt to it. The farmer is aware that crop production is limited by climate. He also knows that some crops do well in his region whereas others do not. In tropical regions like India, the production is limited by moisture while in extra-tropical regions it is limited by energy. When a model developed under extra-tropical conditions [SORGF of Texas A& M] was applied to semi-arid tropical conditions the model was found inadequate, with poor correlation coefficients both in terms of production of biomass and grain yields. This is so even after modifying several sub-models relating to energy factor. When the moisture sub-model was replaced with moisture model developed for the tropical semi-arid conditions the correlation coefficient gone up from 0.35 & 0.37 to 0.85 & 0.81 for biomass and grain yield. Crop development is related to several factors like temperature, photo-period, relative humidity, soil moisture, soil fertility, crop population, etc. Each crop and variety has a range of temperature, where its development needs are met. As a result temperature is not an important factor in India. The main factors for crop production are precipitation/irrigation and fertilizer. Under irrigated agriculture, yield is a function of several factors including soil type, fertilizer, water [quality & quantity], water logging/salinity factors, etc."*

Health:

Pollution-induced changes in air and water quality, as well as changes in weather pattern, are expected to have wide-reaching effects on the health of Indians, according to the IPCC report.

Dr.S.J.Reddy states that *"To avoid the criticism on the impact of global warming on health, they mixed this with pollution. In fact we are fighting the IPCC and UN on this issue for the long. Don't mix the pollution with global warming when we are talking of health hazards on*

life farms. It is entirely different issue and not related to global warming".

Dr.S.J.Reddy in his Concluding Remarks states:

"The presentations in Synthesis Report of AR5 are quite different from the previous two reports . This report is filled with ambiguous statements. To avoid the confusion particularly in relation to the impact aspects instead of using the generalized word climate change, use the specific part of climate change, namely global warming, ecological changes, natural variability, etc. This gives the clarity to public on the issue of global warming.

Separate the global warming component from ecological change component. Tell the public…What is global warming component since 1951 to date;is it 0.1°C or between 0.1 and 0.2°C? If this is clarified then one can get the real picture on what will be the global warming by 2100! At present everything is classified under a broad title "global warming"; not acceptable. The ecological changes do partly contribute to impacts at local and regional scales and not at global scale. As the surface data present an over estimate of ecological change component, it is essential to use the satellite data for the purpose of separating global warming component from ecological change component.

In the case of sea level change, separate the impact due to global warming from natural variation from land sinking from oil, gas & water extraction, destruction of coast line – particularly protective walls of nature, etc components.

In the case of changes in ice, separate the impact of global warming from the impacts of natural disasters such as earthquakes, volcanoes, nuclear tests, and sporting, etc components.

There is no impact of global warming on Indian weather systems, water resources availability and agriculture production. This will remain so even up to 2100. Natural variability impacts are not to be depicted as caused by global warming only. Extreme weather events are part of natural variability.

IPCC at last recognized the importance of pollution in health. It is also an important factor even for agriculture production. IPCC must not use ambiguous terminology and present where the data is quantitatively validated."

Concluding Remarks:

It is good to have such interactions. The subject under question is complicated. And as such it invariably generates varied opinions. While giving due importance to different opinions it is essential to keep in mind that no definite answer can be expected from scientific studies aimed at in developing global models, as interpretations are influenced by many factors that are subjective, at macro level.

It is essential to think globally but act locally(This has been advocated by experts including Dr.S.Jeevananda Reddy). However, in doing so it is essential to avoid global models (developed through averaging principle) in solving local issues, as the local problems are invariably at variance from global.

We have no intention of either supporting or criticizing IPCC reports. The debate will continue, as many other scientific issues. But, we do want apt information that can help our country, in particular. And as such, we thank Dr.S.Jeevananda Reddy for some vital inputs.

We are of the opinion that it is difficult to predict future scenario, as on 2100. However, we strongly believe if the present rate of pollution continues Indians will be having significant negative impact on their health and that of the environment. So, it is imperative that we pay attention to POLLUTION to save the present and future generations.