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Mini Review

Fallacies' in Studies of Global Warming vs Agriculture

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Abstract

International agencies every now and then are warning developing countries with their short-sighted conclusions in their reports on the so called impacts of global warming on agriculture. It is well known in the basic science that in tropical countries, where most of the developing countries are located, moisture is the limiting factor and energy with the temperature as proxy are the limiting factors in extra tropical countries. The international agencies are adopting models developed in extra tropical countries and they are predicting misleading conclusions on food production. On this they are emphasizing the need to implement chemical inputs technologies and genetically modified crops to achieve food security in developing countries. These are flawed theories. The study by FAO showed globally produced food is wasted through losses and wastage by around 30% and to that extent all the inputs are also wasted in producing that much food. In India it is 40 - 50%. Unfortunately they are using global warming and food security path to achieve their sole goal of business interests. Here, it is essential to know two things: that in fact Indian farmers have shown tremendous yields under organic farming and thus India needs traditional organic farming under cooperative farming structure that includes animal husbandry; and in climate change the natural systematic variations play vital role in agriculture that define variability in moisture availability for choosing farming system.

Keywords: Global Warming; Agriculture; Moisture; Climate Change

Introduction

International agencies every now and then are warning developing countries with the short-sighted conclusions in their reports on the so called impacts of global warming on agriculture and thus on food security. This is done to serve the vested interests of Multinational Companies [MNCs] relating to seed and chemical fertilizers, etc. This resulted, in fact, the MNCs and their agents in India producing unapproved seed and selling in the market as the governments became simple spectators of such malicious acts affecting agriculture in India. Very recently market was flooded with BG-II and BG-III cotton seed without any approval from the government. This technology is like scratching the head with fire [1]. The state government, though stated that it will clean the adulterated seed and illegally produced seed from the market, says it will allow them in mix (90%:10% of BG-II:BG-III).

Though progressive farmers in India achieved remarkably in yields under traditional system of organic farming, they have not been encouraged and incentivised. Global seed is controlled by four MNCs and genetically modified seed by one. These MNCs lobbied at Paris meet in 2005 not to mention relating to pollution aspects and were successful. At the start of green revolution technology, India used to have excellent seed production and distribution system with excellent extension services [2]. With the entry of MNCs along with profit driven private sector players in seed market this system collapsed similar to IDPL a government based drug manufacturing company in India/Hyderabad. The former employees started their own drug manufacturing companies running in to crores of rupees market in India and abroad with disastrous consequences [polluting] in and around Hyderabad.

In this connection it is pertinent to mention that "I brought to the notice of central government of India that around 50% of what is pro-

duced is going as waste. I said this even in my talk on All-India Radio telecasted from Delhi. Union Finance Minister in his budget speech states that this as 40% on 28th February 2011. Even the Supreme Court of India noted this fact." Also pertinent to see a report by FAO in its 2011 wherein presented global food losses and wastages. They are:

- One third of food produced for human consumption is lost or wasted globally, which amounts to about 1.3 billion tons per year;
- Food is lost or wasted throughout the supply chain, from initial agricultural production, transport, storage down to final house hold consumption;
- Food losses represent a waste of resources used in production such as land, water, energy, and inputs.

Instead of helping the developing nations in reducing this waste in foods and natural resources, international agencies like World Bank goes on harping on global warming versus food security. This attitude is diverting developing nations' priorities in improving the agriculture and thereby the economy of the farmers.

Though both state and central governments repeatedly saying that they make agriculture economically viable by doubling the farmers' income. So far they haven't put forward the modalities, how they are going to achieve this goal. The politicians have been looking at agriculture as vote-bank; and thus instead of formulating agricultural policies that improves the production and thus economy of the farmers, coming up with financial incentive schemes such as loan waiver, cash help in addition to traditional input subsidies given by central governments. Such fallacious actions only helped markets flooding with spurious seeds with the tacit support from government agencies and finally leading to farmers' suicides and migration to urban rural areas to live as labourers - hut dwellers. Middlemen continued exploiting farmers by playing games on minimum support price for the produce with the tacit support from the ruling junta. However, farmer groups in some villages showed the path of achieving economic stability on their own but government never cared to learn from such achievements.

Climate Change - Global Warming

Deccan Chronicle (DC) a daily newspaper from Hyderabad dated 20th June 2013 presented a report "World Bank releases report, paints grim picture: Global warming to dry up rivers, inundate cities". World Bank released the report in New Delhi titled "Turn Down the Heat: Climate Extremes, Regional Impacts and Case for Resilience" in which in it warns that by the 2040s India will see a significant reduction in crop yields because of extreme heat.

The report says that "An extreme wet monsoon that currently has a chance in 100 years is projected to occur every 10 years by the end of the century". They claim that this report was prepared by the Potsdam Institute for Climate Impact Research and Climate Analytics and peer reviewed 25 scientists worldwide.

The report also predicts substantial reduction in the flow of the Indus and Brahmaputra in late spring and summer. It is estimated that by the 2050s, with a temperature increase of 2.0 to 2.5°C, water for agricultural production in the river basins of the Indus, Ganges and Brahmaputra will reduce further and may impact food adequacy for 63 million people.

On this report I presented my observations. They were included below the World Bank report in DC on the same day. I observed that "After the Intergovernmental Panel on Climate Change's (IPCC's) Assessment Report 4 (AR4), published in 2007, there were several sensational reports published by several international groups, including World Bank, Oxfam, CGIAR, etc. They based their arguments on the AR4 predictions on global warming and the consequent impacts on agriculture and weather - rainfall, cyclonic activity, etc.

However, some of these were exposed at Copenhagen Summit in December 2009. After this, IPCC withdrew its conclusions on melting of Himalayan Glaciers and Al Gore on Greenland ice-melt. This action came after they jointly received Nobel Prize!!! Later IPCC presented its summary of AR5 draft wherein it expressed natural variations in climate will play a vital role in the next two decades [3-5]. Also, it summarised that global warming has not shown any significant influence on hurricanes, global precipitation and extreme weather.

Reddy [3] observed that "The two natural resources that are vital for agriculture are soil and climate. Man has no control as yet over the latter and needs to adapt to it. The nature of climate is sometimes complicated because of the wide range of ecological and topographical diversities and hence requires in depth studies to develop adoptive measures and this is more so with modern agriculture wherein new varieties entering the scene." The duration of each growth phase determines the accumulation and partitioning of dry matter in different organs, the size of source (leaves) and sink (panicle components) and the response to environmental and external factors, resulting in the total biomass and grain yield [6].

Soil moisture budgets from rainfall and evaporation have been studied by several researchers as a first step in calculating the expected productivity of agricultural systems under a wide-range of climate conditions. They have also been used to develop alternative choices and decision strategies for use of the limited available water

[7]. Tropical countries like India, wherein most of the developing countries are located, energy is abundant for crop growth.

Earth's climate is dynamic and always changing through natural cycles. What we are experiencing now is part of this system. Water scarcity in southern Africa (Cape Town) and southern America (Sao Polo in Brazil and Buenos Aeries in Argentina) are part of it only [7]. That is, changes in climate are not new. At present people of all walks of life are looking at climate change as a monster created by anthropogenic greenhouse gases, a false alarm created by vested groups. That means, these inbuilt natural variations were there in the past and will be there in the future. Droughts and floods form part of natural variability in climate and form main part of the climate change. These are beyond human control. We need to adapt to them. Agriculture was adapted to such vagaries by our forefathers; and built location specific technologies in terms of farming systems. Some rivers changed their courses and built water storage facilities by ancient rulers and people. Migration helped to overcome water scarcity in some years.

The major weakness is lack of uniform data set in both space and time over oceans and over-land; and yet studies are made and drawn devastating conclusions. Several groups have made predictions of Global Warming for doubling of carbon dioxide in the atmosphere with variations. IPCC predicted its variation from 1.5 to 4.5^{o}C - some even gone up to 6 - 7^{o}C, which have no meaning in real terms.

The global (land and ocean) temperature anomaly data series of 1880 to 2010, the trend component presented an increase of 0.6oC per Century. Over this trend natural variability is superposed. Moving average analysis of global average temperature anomaly presented a 60-year cycle. Further the analysis showed its variation from -0.3 to +0.3^{o}C. According to IPCC from 1951 more than half of the global average temperature anomaly trend is associated with anthropogenic greenhouse gases effect. Global warming is part of this. Even if we assume global warming component as 50%, the trend associated with it is only 0.3^{o}C per Century. Even this is basically because of tampering the data sets. Also the data is corrupted by having met network concentrated in urban areas and thus overemphasizing urban-heat-island effect and by having sparse network in rural areas and thus under emphasizing rural cold-island effect. Satellite data series showed that the current 20 years a pause. Reddy [8] discussed the issue of global warming-climate change. Reddy [9] presented observations on IPCC's AR5 report on climate change.

Effective Available Growth Periods - moisture versus temperature

Figure 1 presents the projected impacts of climate change on water resources, agriculture and ecosystems as presented by IPCC. Here the global temperature change basically refers to global warming. It is important to note the fact that the global warming is a part of climate change only.

Figure 1: Projected impacts of climate change on Water Resources, Agriculture and Ecosystems: IPCC.

Figure 2 presents the inputs and outputs of Indian agriculture. The total food grains production increase with years shows association with seed, chemical fertilizer and irrigation. Figure 3 presents crop-wise yields with chemical inputs in Andhra Pradesh state with years; in figure 4 impact of chemical inputs technology on area of crops in Andhra Pradesh. Figures 3 and 4 are taken from Reddy [10].

Here we can see the role of high yielding seeds, irrigation and chemical fertilizer use on yield/production and area cultivated. Reddy [2] presented a chapter in a book "Current Environmental Issues" on request from the editors. In this paper I presented effect of different components of technology on rice yields and progressive agriculture development at all India level. Let me quote a paragraph from this article: "(1) yields of rice that constituted around 75 - 80% of total food grain production of the state [of Andhra Pradesh, known as rice bowl of India]; (2) more than 90% of the rice area is under irrigation; (3) high yielding rice varieties have gone up from 14.5% to 67.9% in around four years with little change in chemical fertilizer use but increased the yield level only by about 245 kg/ha [1359 to 1604 kg/ha] - that is, increase under 100% area under high yielding seed the yield

increased by 500 kg/ha; (4) during 1974-75 to 1978-79 with no change in % of high yielding seed use but an increase in fertilizer use by about 3.258 lac tons showed an increase in yield by about 303 kg/ha (1604 to 1907 kg/ha); (5) by increasing the chemical fertilizer use by 20 lac tons will increase the yield by 2000 kg/ha.

Figure 2: Indian agriculture - inputs and outputs.

Figure 3: Role of Chemical Fertilizers on yield.

Figure 4: Impact of Chemical input Technology on Area of Crops.

With the traditional average yield of about 1300 kg/ha, the high yielding seed plus chemical fertilizers are expected to yield about 3800 kg/ha on an average under irrigation. This suggests that the only way to increase the production could be through bringing more area under irrigation.

The whole system here refers to crop growth as for the development temperature is not a limiting factor. The same is not the case with extra-tropical regions where the development is limited by energy/temperature factors.

Figure 5 presents the annual march of G [effective available rainy period] and S [starting time of G] for Kurnool in Andhra Pradesh. This shows a 56 year cyclic variation.

Figure 6 presents one such an example. When development is shortened due to winter late withdrawal or early onset of winter limits the energy required to reach the growth stages to meet the growth needs. Table 1 presents the severe drop in maximum and minimum temperatures in April 2018 for Buffalo, Chicago and Detroit in USA. This reduces the period available for normal development and thus yield is affected.

Figure 5: Variation of Agroclimatic Variables in Kurnool.

Figure 6: Crop progress and condition for corn in Indiana.

	Buffalo	Chicago	Detroit
Maximum [°F]			
Normal	55	59	59.1
Actual	45	47.3	49.7
Minimum [°F]			
Normal	36.8	38.8	39.4
Actual	30.2	31.5	32.4

Table 1: Likely coldest April [2018] since 1895 – US Farmers delay planting crops.

Based on such conditions, it is generalized that moisture is the limiting factor for defining crop growing period in tropics and temperature/energy is the limiting factor. The duration of each growth phase determines the accumulation and partitioning of dry matter in different organs, resulting in the total biomass and grain yield [11].

The intra-seasonal and diurnal variations are far higher than these with high variations in space, which play the critical role at local and regional level. With such variations literature is pumped with impacts on sea level rise, glaciers melts, floods and droughts, heat and cold waves, etc.

Let me give an example of Hyderabad temperature variation in °C from 1931 - 1960 normal book: May average 38.7 - December average 27.8 = 10.9; May extreme average 42.4 - May average 38.7 = 3.7; December extreme average 30.6 - December average = 2.8. That shows our agriculture system works under such a wide temperature variations. 2002 and 2009 were drought years at all-India level with 81% and 79% of average and temperature respectively gone up by 0.7 and 0.9°C at all India level. With increased irrigation activity, the temperatures during crop growing periods are less than these averages.

Agriculture

Crop growth and development: Each agricultural species has an area of geographical adaptation where its' climate requirements are best met. The limits vary according to individual species. Individually or in combination the environmental factors produce significant changes in a biological cycle which may be either detrimental or beneficial. The two biological processes that are influenced by weather parameters are crop development and crop growth; wherein development is the appearance of a phase or series of phases during a plant's life cycle; and growth refers to an increase in weight or volume of a certain organ of plant, or a plant as a whole, within the time interval of a certain phase or an entire life span of a plant.

It is clear from the above discussion, global warming is not of importance in agriculture but in Tropical countries moisture is the limiting factor for crop production. However in extra-tropical countries energy expressed in terms of temperature is the limiting factor. That means in tropical zone moisture defines the growing season for crop growth; and extra-tropical zone growing season is defined by temperature in terms of degree days for crop development wherein the onset and withdrawal date of winter season define this index

Reddy [3] observed that "Food production is largely determined by crop area, technology and growing season conditions. Climate fluctuations may cause wide variations in growing conditions and they in turn affect all components of food production ecosystems. The grow-

ing conditions, in terms of climate, are largely controlled thermally at higher latitudes and hydrologically at lower latitudes. Thus, the study of climate fluctuations in the rainfall, as this is the main input in the hydrological condition in tropics, and their impact on agriculture has become an important area of climatology." Because of this nature of climate, in tropics crops are gown in summer season, in monsoon season and in winter season with wide temperature regimes with rainfall and or conserved soil moisture. Here we must remember one factor that crops-cropping patterns/varieties are season specific.

Soil water balance: Soil water balance integrates climate with soil and crop. The term soil water balance relates to the moisture added through precipitation and/or irrigation to that lost through evapotranspiration, runoff and drainage and thereby it explains the changes in water content of the soil profile under given crop/cropping, soil management systems. Reddy [7] presented a method for daily soil water balance wherein, evapotranspiration is one of the most important components to be estimated in determining the soil water balance.

Actual evapotranspiration relates to the amount evaporated by the soil and transpired by the plants at the given crop growth stage under existing meteorological and soil moisture conditions. Potential evapotranspiration basically relates to meteorological conditions under pastures while actual evapotranspiration relates not only to meteorological conditions but also to soil moisture condition and crop and its growth stage. Through water balance models the actual evapotranspiration is computed using potential evapotranspiration. There are several models to estimate PE using meteorological data [3]. The reliability of actual evapotranspiration estimates relate to the accuracy with which potential evapotranspiration values are derived for use in water balance model.

Extra-tropical models rarely work under tropical conditions. Thornthwaite and Mather [12] model is a simple book keeping procedure uses monthly climatic data [rainfall and temperature only] inputs. Reddy [13] presented comments on, McKenny and Rosenberg (1994) article, wherein used several PET models to study in climate change impact on agriculture. They noted that Thornthwaite produces the lowest annual values at all locations and Penman the highest differences; between the two in excess of 100% at some sites. As the PET is model specific, if the estimates of a given model (like Thornthwaite, 750 mm) are lower than another (Penman, 1500), then for the same magnitude of increase or decrease (150 mm) as a consequence of supposed climate changes, expressed in percentage change of PET, naturally they present quite a different picture (20% and 10%). If the magnitude of change, which is important in the water budgeting study, had been used, then the conclusions drawn would have been quite different.

Thus, accuracy of growing period primarily relate on the reliable estimates of actual evapotranspiration and which in turn depends upon the accurate method of estimation of potential evapotranspiration. To achieve this goal extra-tropical models do not fit in to it. I used in my soil-water-balance model, open pan evaporation (observed data) calibrated with lysimeter data through crop/cropping pattern growth stage factor instead of potential evapotranspiration (estimated).

Reddy [6] presented that "ICRISAT Hyderabad to test SORGF model developed at A and M Texas, USA wherein Ritchie's 1972 water balance model was used. They tried to adapt the model to semi-arid conditions and tested this with the data collected. They presented the results at a collaborators meet, chaired by ICRISAT DG [Dr. Swindale, a Soil Scientists from Hawaii]. The model presented poor correlation even after making several adjustments energy term in the SORGF model for dry matter and grain yield (0.35 and 0.37, respectively). DG asked me in the meeting, change water balance model output by your model (Reddy, 1983) output and present the results at tomorrow meeting. I analyzed and presented the results that improved significantly the correlations (0.85 and 0.81, respectively). That is extra-tropical models rarely work for tropical climate conditions particularly models use only temperature in place of meteorological parameters".

Multinational institutions/organizations look at sharing green fund under the disguise of global warming. They are not interested to look such issues to help agriculture in developing countries. I made studies on moisture availability periods under natural variability in rainfall for several countries [14]. These are summarized for India, tropical Australia, Senegal-Upper Volta in West Africa, Mozambique and Ethiopia in southern-northern Africa by Reddy [3].

Summary and Conclusions

1. Global warming a component of climate change is not an important factor in agriculture both in crop development and crop growth in tropical regions.

2. To define the growing period, moisture is the limiting factor in tropics and temperature/energy is the limiting factor in extra-tropics. Because of this the models developed in extra-tropical countries rarely work under tropical condition.

3. To get successful agriculture in tropics characterization of moisture at location and regional level are of great importance in tropics; and characterization of temperature/energy at local and regional level are of importance in extra-tropics.

4. That means, in tropics even if temperature meets crop requirement agriculture will not be a successful proposition with limitation in moisture availability, more particularly where rainfall presents a cyclic variation; while in extra-tropics even if moisture meets the crop requirement agriculture will not be a successful proposition, more particularly in years when the winter is withdrawn late and or early onset of winter.

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