

## Indian Monsoon and the Spectre of Droughts

Monsoon is a season looked forward with great anticipation all over India. In the picturesque words of C.V. Raman, a great lover of meteorological studies — ‘the opening and the shutting of the sluice gates in the sky are the most important events in the calendar of the man who tills the earth in these areas’. Since 2004 is declared as the Year of Scientific Awareness, there is need for the fruits of research to percolate and enrich the knowledge base of our people. We know so little on what causes monsoon and why it breaks on the Indian scene regularly at a particular time in the year. Cool winds begin to blow from the southwest often with gale-like intensity, followed soon after by welcome showers of copious rain. Skies remain cloudy for nearly three months, the whole scene of India gets transformed and tremendous activity is witnessed all over the country. Sometimes, the starting of the southwesterly winds may get delayed, the quantum of water received may get reduced and there may be long breaks in the monsoon current causing anxiety among the people wholly dependent on this heaven-born resource. Monsoon, therefore, is of vital concern to all of us.

The word monsoon itself is not of Indian origin but comes from Arabic (*mausam*) meaning a season marked by winds blowing with strict regularity over a part of the year. It is obvious that in common with other seasons like summer and winter, windy season also owes its origin to orbital causes, the position of the sun and its effect on different parts of the globe. The Sanskrit word coined by our ancients is *varṣa*, which persists in Hindi garb as *bāris* or *barsāth*, and the rainy season named *varṣa kāla* or *varṣa ritu*. In almost all our regional languages, the onset of the rains with accompanying wind, rain and thunder have been welcomed in song of incomparable beauty. We also learn that *varṣa māna*, the measurement of rain in gauges specially designed for the purpose, was in practice as far back as 4th Century BC and probably even earlier. Our knowledge as to how the information was used however, is poor.

### *Indian Summer Monsoon*

During the summer months (June-September) cool winds charged with moisture blow from the SW. Due to the existence of the high *Sahyādri* barrier across their flow path, the low-lying moisture-rich currents are forced to rise, become cooled, condense and precipitate in the form of rain on the windward slopes of the *Sahyādri*. Similarly, the winds blowing northward over the Bay of Bengal are obstructed and diverted westwards by the *Himālaya* causing copious amounts of rainfall all along the foothill region and the Gangetic valley in front of the mountains. These features point to the important role played by oceans,

and the major mountain ranges of India – the *Sahyādrī* and the *Himālaya* – in the distribution of rainfall which is characteristically Indian and termed therefore the Indian summer monsoon.

### *India's Contribution to Research on Monsoon Rainfall*

The ancient Indians were great astronomers and with their continuous observations seem to have been able to predict, with a fair degree of accuracy, various celestial phenomenon. *Varāhamihira*, a great astronomer, in his *Brihat Samhita* appears to have explained the distribution of rainfall in terms of lunar asterisms (*nakṣtra*). The early astronomers of India appear to have believed more in the position of stars and planets for predicting the course of rainfall. It is possible that the old *Jātaka* tales, the many texts of the *Jaina purānās* and old Tamil sangam literature have similar references to rainfall prediction as practiced by the Indian astronomers. Kalidāsa in his immortal poem *Meghaduta* (Cloud Messenger) speaks of the appearance of dark clouds (*āṣādasya prathama divase megamāslīṣṭha sānum*) hovering on the hill on the first day of *Aṣādha* (15th of June). Since the poet lived in Ujjain in Madhya Pradesh, the first arrival of monsoon clouds as observed by him coincides with the break of monsoon over central India at about the same time at present. This makes it clear that for the last 1500 years at least there has not been much of a change in the advance of monsoon. Western scholarship, apparently, has dismissed the findings and predictions of the Indian astronomers as not worth any recognition. Ever since Macaulay declared in his famous minute on Education that a single shelf of a good European library was worth the whole native literature of India, the attention of the intelligentsia of our country has come to lean more on western methods, greatly impressed by the spectacular advances made in science. All that is stated in the older texts may not have much significance but painstaking research by scientists who are also well versed in Sanskrit is sure to yield information of value.

In general, we know monsoon is the result of interaction between atmospheric movement of air over oceans and continents at various levels. There is as yet no clear perception at local level of the factors which affect regional distribution. Predictions that are frequently made and publicized in the media that rainfall during the ensuing season would be normal or 80% of the normal are too general in nature to be of any practical value. Statistical analyses of data, where available over a number of years, may in all likelihood prove to be better in forecasting these regional imbalances more accurately and in forewarning people in advance.

There is a great deal of research on the ocean-atmosphere system in the Indian ocean. Events in Tibet, Australia and even Antarctica seem to have an effect and El Nino and Southern Oscillations, (ENSO), are terms now commonly used. These events may have an impact on global climatic changes but are not likely to provide information of practical value to the Indian farmer in planning his agricultural operations.

### *Drought Incidence and Variability over the Past Thousand Years*

There is need to know the full range of past drought variability by piecing together climate data that is available, however fragmentary they may be. Have the droughts been caused by abrupt climatic changes? More importantly, are such droughts of longer duration likely to become more frequent? Geologists could play a significant part in these researches as valuable data is provided by lake sediments. There are in south India tanks which are more than 500 years old which are now mostly silted up. A study of the undisturbed cores of clays accumulated in these tanks may very likely yield valuable data regarding variations in past climate, especially recurrence of droughts and floods. These, supplemented with the study of sediments deposited in the deltas along the west coast, the study of tree rings and stalactites and stalagmites are sure to give a true picture of changes in climate during the last 1000 years. Analysing the isotopic composition of coral skeletons as a measure of the combined effects of changes in sea surface temperature and sea water isotopic composition which is strongly affected by rainfall and evaporation is another field of study which may prove useful. Monsoon studies are of an interdisciplinary nature and not confined to just physics and atmospheric sciences. Researchers should take note of the needs of the rural community whose economic prosperity is based on agriculture. Groups engaged in these studies should focus on new ideas, observations, analysis and on theories about droughts to improve our understanding of various factors involved and develop prediction capabilities.

### *Communicating Science*

A fundamental rethink also appears necessary in respect of our research on monsoons. Communicating the result of research to the beneficiary in a language understandable to him is of greater urgency today. In the words of C.V. Raman "It is the association and continuous control with such activity that can revive our centres of learning and serve to remind them that the aim of science is to advance our knowledge of Nature and by doing so to *serve the needs of humanity as well*" (italics mine). If this is kept in mind and researchers periodically come out with summaries of ongoing research in language understandable by a large section of the population, there will be a greater understanding and clearer perception of the vagaries of the Indian monsoon.

### *Drought Preparedness*

One thing however, is clear. Analysis of distribution pattern of rainfall over a period of 100 years has clearly indicated that regions receiving less than 400 mm rainfall are affected by drought more frequently than the rest of the country. A slight delay in the onset of monsoon, increase of dry period between spells of rain, even a ten percent decrease in the quantum of rainfall received can set in drought conditions. It is not difficult to demarcate

such regions and adopt a strategy for providing relief to these drought hit areas on a permanent basis. The present bureaucratic system of identifying drought prone regions, every year, notifying them in the gazette and making distress calls to Delhi seeking financial and food aid is too slow and tardy. Some type of aid dribbles down the line but never reaches the needy in time and these stereotype procedures adopted by governments do not bring credit to anybody. Instead, the State government should take steps to establish adequate storage facilities for food and fodder in areas which are known to be drought-prone and keep them well stocked and under effective local control.

The growing insensibility of the rulers, administrators, politicians and even scientists, to the wretched conditions of villages and the unsanitary conditions in which children grow is reprehensible. There is hardly any direct investment in agriculture compared to the crores of rupees being spent on cities. The instinct of self-help on the part of rural folk has got frozen and they have been accustomed to look to government as a *dharmshala* where they can get things gratis. Wrong policies of granting subsidies, waiver of electricity charges etc have made matters worse. Precious water gathered at great expense and supplied at highly subsidized rates have led to gross misuse of the resource.

Vision papers of almost all political parties have not made any direct reference to the relieving of distress in chronically drought-prone areas – a most disturbing omission. Presumably, unable or unwilling to recognise the growing water problem, it is believed that linking of rivers as a panacea to the problem is dangled before the public, little realising that it will be the exact opposite – a vast chimera, a fanciful (and vastly expensive) alternative.

I have in an earlier editorial pleaded for initiating a procedure for the preparation of blueprints for drought affected areas listing the works to be carried out: the number of tanks to be desilted, ponds to be excavated for the storage of rain water, check dams to be built, contour bunds to be erected, contour ditches to be excavated, areas to be demarcated for afforestation and for growing horticultural crops. With the detailed accurate maps becoming available through satellite photographs, it should not be difficult to draw time bound programmes to be undertaken and estimate the cost and manpower required. Funds earmarked for rural development should be utilised for these works in a well-planned manner and help of voluntary organisations utilised. Small mines and stone quarries could be started in suitable areas. The whole scheme should be so oriented as to reduce the percentage of people wholly dependent on agriculture and create alternative employment. Within a matter of two or three years the selected areas will be able to withstand drought and start functioning independent of external aid.

The success of mitigating the suffering of the people in drought prone areas is largely dependent on how successfully the people adopt rain water harvesting techniques and take all measures for water conservation. Shallow groundwater is a god-given gift which is to be wisely employed to provide supplementary irrigation to food grain crops which are rain fed requiring the least amount of water. Increased use should be made of modern technology by

conveying water through pipes rather than in open channels and by adopting drip and sprinkler irrigation systems. Sinking of borewells and tapping deep-seated groundwater should be prohibited forthwith, as it leads to resource depletion with no hope of replenishment in the near future. Growing of sugarcane in drought prone areas should be totally banned and any delay in adopting such measures will result in a much lowered water table, reduced stream flow, withering of trees whose roots are unable to reach water at deeper levels thus converting the whole area into a desert.

Government agencies, with too much bureaucratic control, cannot undertake the gigantic task of rebuilding rural India. Non-official organisations with an All India character manned by service oriented people, with full cooperation both from the public and government have to come forward. Investment of capital, planned utilisation of surface and groundwater aided by science and technology, more and more use of the excellent maps released by ISRO, provision of employment and clear-cut programmes — these and these alone have the potential to transform the face of rural India.

What an irony that while *Sahyādri* along the western margin of India receives one of the largest supply of fresh unpolluted water, a large part of India lying east of the range should be affected by drought. Surely science and technology can find ways and means for utilising the rainwater which flows away to the sea unutilized. Even the worst drought affected areas are not too badly off compared to a country like Israel. But that country has modernised its agriculture aided by science and technology and converted deserts into gardens while we who are better placed than them, instead of harvesting and making the best use of rainwater are remaining idle, lacking in all initiative. While Israelis consider water as a most precious resource, supplied in pipes in measured quantities, we are recklessly wasting water conveying it in open channels and flooding fields without exercising any care.

Years ago M.A. Srinivasan, a first class administrator of the Mysore Civil Service and later Chairman of the Indian Coffee Board pointed out that India ranked below 60 in the world in rice production, while under the same sky and the vagaries of monsoon, on the same good earth and same workers it ranked first in the world in tea and fourth in coffee. The reason was that the cultivation of tea and coffee was treated as an industry with financial investment and scientific backing. If rainfall is delayed in the month of April, the planters have now the resources and equipment to create rainfall with the aid of sprinklers. Similar transformation can be made to take place in the case of food-grain cultivation. Large areas of land remaining fallow can be made productive with scientific skill, adequate financial input and wise utilisation of both surface and groundwater.

#### *Mega Project of Interlinking of Rivers*

The interlinking of rivers is being talked about so casually that one begins to wonder how projects costing no less than Rs. 560,000 crores are pushed through without carrying out a proper scientific scrutiny of all the factors involved. River valleys form a negligible

part of India. Major dams can at best store 40% of rainfall and most of them cannot withstand one year of drought. How can river valley projects be expected to solve the water requirement of India as a whole? Large parts of India are not served by any rivers, yet these semi-arid lands have a better record of agricultural development by adopting time honoured practices like rainwater harvesting, water conservation, growing food grains requiring least quantity of water and adopting life styles suited to a water scarce environment. It is only in recent years, through bad water management, indiscriminate utilization of groundwater, encouraging growing of sugarcane and paddy, surface as well as groundwater resources have been ruined. This has created man-made drought, depressing water table and leading to a situation which is so serious that one becomes apprehensive of the future scenario.

Our rulers should give up their megalomaniac and overambitious thinking and direct their attention to measures which will utilise resources judiciously aimed at bringing peace and prosperity to the nation as a whole and not particularly those who live in river valleys. They are so bent upon getting rich quickly by misuse of both surface and groundwater that they forget the long term consequences of such ill-conceived policies, which will ultimately convert fertile land into deserts and make us bankrupt and chronic beggars.

Rural India has to be saved if India is to survive. In an overpopulated country like India any major work undertaken should cause minimum disruption, minimum excavation and adopt environmentally sound subsurface technologies. This is inevitable. The sooner we give attention to this aspect the better for us. As in other spheres, science has to play an increasing and important role. Our scientists doing serious research in institutions of learning should remind themselves that the 'aim of science is to advance our knowledge of Nature and by doing so to serve the needs of humanity as well'.

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