biggest challenge with the Union Health Minister being made aware of this. SARS guidelines are soon to be released. The Directorate General of Health Services (DGHS), the Ministry of Health and Family Welfare has been keeping the media updated on SARS with daily press-briefings.

On 28 April 2003 the Director General of the Indian Council of Medical Research (ICMR), Nirmal Kumar Ganguly who had just returned from a visit to NIV, Pune spoke to *Current Science*. He said that although at present SARS is 'not notifiable', no case is being missed. There is a recent directive to open Ports for testing of SARS cases in their testing laboratories. This would aid the NIV, Pune and NICD, Delhi, two of the main centres for testing of SARS. Standardized protocols have now also been put in place in testing laboratories. India had obtained its PCR primers for SARS testing initially from a commercial source, which had been developed by the Bernhard Nocht Institute for Tropical Medicine, Hamburg, Germany and then also from the Center for Disease Control and Prevention, USA. Now, India has begun to make its own primers for testing SARS cases. The process from sample to microbial detection and sequence analysis takes just under twelve hours.

ICMR is also preparing to use an animal model such as monkey, infected with the SARS virus, develop the symptoms and then isolate the virus from the animal model for further studies to understand the nature of the virus. The method of infecting cell cultures for growing and detecting live virus in specimens from SARS patients would also be taken up by ICMR, said Ganguly. Since there is high rate of transmission, i.e. one patient can infect a large number of people, the key was to isolate index SARS cases. His advice for a person with SARS, if he is not suffering from any major infection, is to quarantine himself from any outside contact and if fever rises, to visit the Infectious Diseases Hospital.

When posed with the question as to how India was coping with SARS, Ganguly said 'at the moment we have been able to cope with SARS, we have done marvelously. Till date cases have come from contact with SARS-infected persons through travel to SARS-infected countries and we have been able to isolate these cases'. He added 'we are also looking at the long-term research strategy for accurate diagnostic tests and antiviral drugs'. When asked about the IR heat sensors that produce heat sensitive images, being used in countries such as Singapore, for detecting SARS cases at the airports, he replied that 'we are aware of these heat sensors and something is being done about this in India'. The World Health Organization would be holding an international conference in Geneva between 17 and 18 June 2003 to 'review epidemiological, clinical management and laboratory findings on SARS and to discuss global control strategies'.

Nirupa Sen

New forecast models for Indian south-west monsoon season rainfall

The 2002 forecast for the Indian south-west monsoon by the India Meteorological Department (IMD), New Delhi went awry. This prompted severe criticism over the validity of the existing 16-Parameter Power Regression Statistical Model for Long Range Forecast (LRF). As a backlash, the IMD seems to have attempted to save its face by developing a new set of LRF models, unveiled to the media by R. R. Kelkar, Director General, IMD on 16 April 2003. Kelkar has, however, denied that criticism had anything to do with making new models. He said the character of the monsoon season of July 2002 had been 'unique' and the nature of the anomaly by either hindsight or retrofitting could not yet be pinpointed. Figure 1 shows the performance of operational forecasts between 1988 and 2002.

The long-range forecast for the 2003 south-west monsoon (June–September) rainfall is that the rainfall for the country as a whole is likely to be 96% of the Long Period Average (LPA) with a model error of $\pm 5\%$. A newly adopted 8-parameter power regression model was used for this forecast.

The probability of monsoon season rainfall for the country as a whole in five broad rainfall categories is as follows:

- 21% probability of drought (rainfall less than 90% of LPA),
- 39% probability of below normal rainfall (90–97% of LPA),
- 14% probability of near normal rainfall (98–102% of LPA),

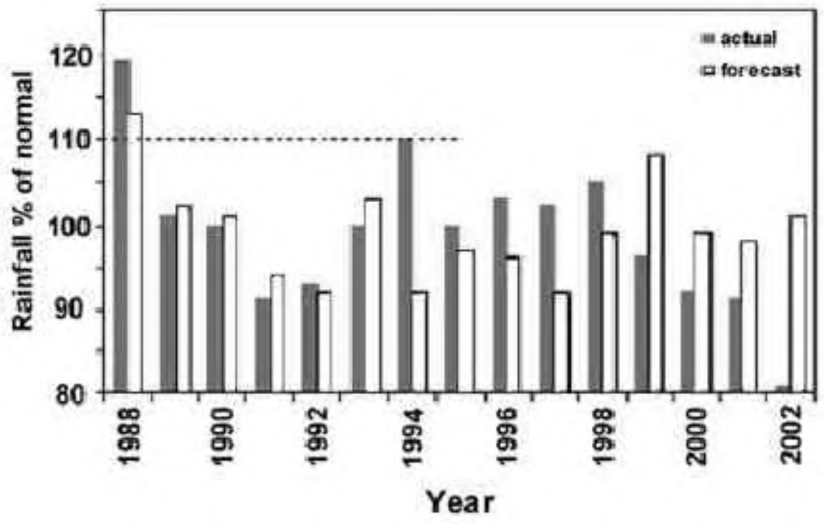

Figure 1. IMD's forecast performance between 1988 and 2002. (Source: IMD, New Delhi).

Table 1. Comparison of 16-parameter model for the year 1988 and the changes for the year 2000 model (parameters are not in any particular order)

1988 Model (original 16-parameters)	2000 Model (revised 16-parameters) (only changes are denoted)
50 hPa East-west wind (January–February)	
10 hPa Zonal wind (January)	Arabian sea surface temperature (January–February)
East coast India temperature (March)	
Central India temperature (May)	
Northern hemisphere temperature (January–February)	
North India minimum temperature (March)	Northern hemisphere temperature (January–February)
Northern hemisphere pressure (January–April)	
Darwin pressure (spring)	Darwin pressure tendency (January–April)
Argentina pressure (April)	
500 hPa Ridge (April)	South Indian ocean SST (February–March)
Equatorial Indian ocean pressure (January–May)	
Southern oscillation index (March–May)	
El Nino (same year)	
El Nino (previous year)	
Himalayan snow cover (January–March)	
Eurasian snow cover (December)	

Source: IMD, New Delhi.

Table 2. The model parameters for the 8-parameter and the 10-parameter power regression model

New 8-parameter power regression model	New 10-parameter power regression model
Model parameters (Month for data)	Model parameters (Month for data)
El Nino (previous year) (July + August + September)	El Nino (previous year) (July + August + September)
Eurasian snow cover (December)	Eurasian snow cover (December)
North west Europe temperature (January)	North west Europe temperature (January)
Europe pressure gradient (January)	Europe pressure gradient (January)
50 hPa Wind pattern (January + February)	50 hPa Wind pattern (January + February)
Arabian sea SST (January + February)	Arabian sea SST (January + February)
East Asia pressure (February + March)	East Asia pressure (February + March)
South Indian ocean temperature (March)	South Indian ocean temperature (March)
	El Nino 3 + 4 temperature (AMJ-JFM)
	South Indian ocean 850 hPa Z Wind (June)

Source: IMD, New Delhi.

- 23% probability of above normal rainfall (103–110 % of LPA),
- 3% probability of excess rainfall (more than 110% of LPA).

The country is therefore most likely to see a below-normal rainfall for the 2003 south-west monsoon season. For this, IMD has used a new 8-parameter probabilistic model for arriving at the qualitative forecast.

The prediction for the July rainfall, critical for agricultural operations would be made based on an 8-parameter model using power regression technique and requiring data up to June. IMD would give a forecast of July rainfall for the country as a whole along with the long-range forecast update to be issued in July.

IMD has issued forecasts for monsoon rainfall since 1999 over three broad homogenous regions of India (North West India, North East India and Peninsula). These forecasts would be issued in July along with the forecast update.

With the introduction of the new 8-parameter model, it has now become possible for IMD to issue the long-range forecast for the monsoon rainfall for the country as a whole on 16 April. Previously, the forecast was being issued on 25 May. So far, IMD did not have any model that could enable modification of the long-range forecast once it was issued on 25 May. With the new 10-parameter model, which uses data up to June, it would be possible to generate a quantitative forecast update by mid-July.

Monsoon prediction models are statistical and rely on strong correlations of monsoon rainfall including parameters such as atmospheric, ocean and land parameters. As is the problem with statistical models, the correlations change over time, and this was seen as well during the re-evaluation of the 16-parameter model in 2002, which showed that ten parameters had lost their significance.

About five groups of scientists in India are engaged in active research in atmospheric sciences including climate, monsoon studies, etc. When it comes to monsoon forecasts for our country, IMD, which prides itself as a service organization is solely responsible. Since 1988, predicting monsoons was based on a 16-parameter model (see Table 1). IMD's forecasts used to be made available at the end of May each year. In the year 2000, four parameters of the original 16-parameters were changed. These four new parameters replacing the old are described in Table 1.

After the forecast debacle that actually saw drought-like conditions in 2002,

IMD searched for a new model whose parameters were both physically well related and statistically stable. IMD has now brought out the following new models:

- 8-Parameter power regression model: This requires data only up to March. This replaces the existing 16-parameter power regression model that required data up to May. The model error is ± 5%.
- 8-Parameter probabilistic model: This requires data only up to March. This replaces the existing 16-parameter parametric model that was used for giving a qualitative forecast.
- 10-Parameter power regression model: This requires data up to June and has been developed for purposes of a long-range forecast update to be issued by 15 July. The model error is ± 4%.
- 8-Parameter power regression model for forecast of July rainfall: This requires data up to June. The model error is ± 9%.
- The existing power regression models for long-range forecasts of monsoon rainfall over three broad homogenous regions of the country have been refined and these forecasts would be issued by 15 July.

The model parameters for both the 8-parameter and 10-parameter power regression models are shown in Table 2. According to IMD, both these new models and the 8-parameter power regression model for July rainfall has used 38 years data (1958–1995) and an independent verification conducted for 7 years (1996–2002). The probabilistic model uses a 'statistical discriminant analysis' for a qualitative forecast. IMD has claimed a better performance for the new 8-parameter and 10-parameter models over the old 16-parameter model during the period of independent evaluation between 1996 and 2002 (see Table 3).

IMD has thus adopted a two-stage forecast process, the first forecast on 16 April and the second, an update to be made available in mid-July. IMD has not got the forecasting models peer-reviewed, although this is strictly not applicable, IMD being a service organization. However, data subjected to a peer-review process is definitely in line with any scientific pursuit. Kelkar said a move was on for ensuring requisite input parameters needed for the statistical models from space satellite data of the Indian Space Research Organization's (ISRO) satellites such as 'Metsat', 'Oceansat' and 'Climatesat' for further improved forecasting of the Indian monsoon now and in the future.

Table 3. Comparative chart for the better performance of the new 8- and 10-parameter models as compared to the 16-parameter model

Year	16-Parameter	8-Parameter	10-Parameter
1996	+7	+3	+3
1997	+10	−1	+1
1998	+6	−4	−2
1999	−12	−5	−6
2000	−7	+3	+3
2001	−7	+1	+3
2002	−20	−17	−14

Source: IMD, New Delhi.
Note: Actual minus forecast (%).

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MEETING REPORTS

Eco-friendly approaches for sustainable insect pest management*

Agricultural production in India is limited by many factors like soil, water, genetic potential of the crop and the organisms that feed on or compete with food plants. Food crops the world over are damaged by more than 10,000 species of insects and the overall estimated yield losses from different pests are reported to be US$ 500 billion globally and Rs 45,000 crores in India alone. About 42.1% of attainable production is lost due to pest attack; however, if no control measures are adopted, the figure would be 69.8%. To realize the impact of chemical pesticides, sustainable pest management strategies have become vital to systematically review the recent advancements in insect control and to develop better crop protection programmes. Sustainable Insect Pest Management (IPM) was discussed at a national symposium.

Participants from all over India discussed the sustainability of various pest management strategies available for controlling insect pests of different crops. Pest-tolerant cultivars, seed treatment with imidachloprid, *Trichoderma*, etc., judicious use of fertilizers and clean cultivation, okra or marigold as trap crop, monitoring through pheromone traps, *Trichogramma* release, ovicidal insecticides, NSKE 5%, *Ha*NPV, limited use of pyrethroids, hand collection of grown-up larvae, ETL-based application, etc. were the core components of an IPM module which was successful in repeated large-scale trials to give satisfactory control of cotton pests. Growing maize, sunflower, cowpea and green gram leads to more natural enemies.

Prospects of using transgenic crops in India have been looked into and crops like cotton, rice, sugarcane and brinjal containing *Bt* genes have been indicated recently. All these crops are also attacked by several other insect, mite and nematode pests, which are not susceptible to the *Bt* toxins. Hence IPM for transgenic crops becomes important. Insecticides have been found to affect the post-embryonic development, behaviour, haemogram, biochemical, and structural

*Based on the National Symposium on Sustainable Insect Pest Management conducted at Entomology Research Institute, Loyola College, Chennai, 6–7 February 2003.