GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
RAJYA SABHA
UNSTARRED QUESTION No. 2732
TO BE ANSWERED ON THURSDAY, AUGUST 13, 2015

RESEARCH IN CLOUD SEEDING

2732. SARDAR SUKHDEV SINGH DHINDSA:

Will the Minister of EARTH SCIENCES be pleased to State:

(a) whether Government has undertaken some research in the in the areas & Cloud seeding to improve rains in rain deficit Areas;
(b) whether Government has made an analysis of models currently being used by the IMD for predicting monsoons in India;
(c) the variation of rainfall during Monsoon for the last 20 years i.e. actual rain fall, versus, predicted rain fall as per IMD; and
(d) whether Government has taken any analysis related to rainfall prediction and actual rain fall at Micro level, say District, Blocks etc. and not a micro level extending India as one unit?

ANSWER
MINISTER OF STATE FOR MINISTRY OF SCIENCE AND TECHNOLOGY AND MINISTRY OF EARTH SCIENCES
(SHRI Y. S. CHOWDARY)

(a) Yes Sir. As things stand today, artificial rain making techniques involving cloud seeding cannot be used for bringing rain clouds to rainfall deficit/drought areas. These techniques can only induce potential preexisting clouds, already passing over a given place, to produce enhanced quantum of rain.

However Earth System Science Organisation – Indian Institute of Tropical Meteorology (ESSO-IITM) is putting its effort in understanding the rain formation in clouds through studying cloud microphysical characteristics through a research program Cloud Aerosol Interaction and Precipitation Enhancement Experiment (CAIPEEX).

(b-c) Yes Sir. For preparing the operational long range forecast (monsoon season rainfall), currently, indigenously developed state-of the-art statistical models are used. These models have shown useful skill. The operational forecast for the monsoon onset over Kerala, a 6-parameter principal component regression model is used. The forecast for monsoon onset over Kerala has been correct (within the forecast limits) during all the 10 years (2005-2014) since issuing of operational forecast for the event started in 2005.

The LRF for all India season rainfall was reintroduced in 1988 using 16 parameter power regression and parametric models. IMD introduced new state of art LRF models during 2003 & 2007 following review of old forecasting system in 2002 The success achieved in improving the accuracy of heavy rainfall warnings during the summer monsoon season is enumerated below:

1. **Probability of Detection (PoD) has been assessed at 0.71.**
2. **False Alarm Rate (FAR) has been dipped to 0.13.**
3. **Missing Rate (MR) has also been reduced to 0.29.**
4. **Percent correct (PC) of yes/no rainfall forecast for monsoon season 2014 is 91%.**

It may be mentioned that skill of Earth System Science Organisation – India Meteorological Department (ESSO-IMD)'s present seasonal forecasting system is better than other countries in the world. The Variation of all India rainfall during monsoon for the last 20 years are given in Annexure-I.

(d) Yes Sir. An analysis on this aspect have been made and it has been revealed that the models do not have any useful skill in the long range prediction at smaller spatial scales such state, district, block etc. Since 2003, ESSO-IMD is issuing Long Range Forecast (LRF) for four broad homogeneous regions namely, East & North East India, Northwest India, Central India and South Peninsula.

Variation of All India Rainfall during monsoon

Annexure-I

Year	Forecast		Actual (% of LPA)
1994	92% of LPA ± 4%		110
1995	97% of LPA ± 4%		100
1996	96% of LPA ± 4%		102
1997	92% of LPA ± 4%		102
1998	99% of LPA ± 4%		106
1999	108% of LPA ± 4%		96
2000	99% of LPA ± 4%		92
2001	98% of LPA ± 4%		92
2002	101 of LPA % ± 4%		81
	Issued in April	Issued in June	
2003	96% of LPA ± 5%	98% of LPA ± 4%	102
2004	100% of LPA ± 5%	100% of LPA ± 4%	87
2005	98% of LPA ± 5%	98% of LPA ± 4%	99
2006	93% of LPA ± 5%	92% of LPA ± 4%	99
2007	95% of LPA ± 5%	93% of LPA ± 4%	105
2008	99% of LPA ± 5	100% of LPA ± 4	98
2009	96% of LPA ± 5	93 % of LPA ± 4	78
2010	98 % of LPA ± 5	102 % of LPA ± 4	102
2011	98 % of LPA ± 5	95 % of LPA ± 4	102
2012	99 % of LPA ± 5	96 % of LPA ± 4	93
2013	98 % of LPA ± 5	98 % of LPA ± 4	106
2014	95 % of LPA ± 5	93 % of LPA ± 4	88