GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
LOK SABHA
UNSTARRED QUESTION NO. 1389
TO BE ANSWERED ON 4th March, 2015

RESEARCH IN ARCTIC & ANTARCTICA.

1389 ADV. JOICE GEORGE:
SHRI HARISHCHANDRA CHAVAN:
SHRI KAPIL MORESHWAR PATIL:
SHRIMATI SANTOSH AHLAWAT:

Will the Minister of EARTH SCIENCES be pleased to state:

(a) Whether the Government is conducting research & development in Arctic and Antarctic region;
(b) If so, the details and the findings thereof so far along with the expenditure incurred during the last three years and the current year in this regard;
(c) Whether the Government proposes to increase research stations/centres in Arctic and Antarctic and if so, the details thereof along with the number of scientists/technicians likely to be deputed to the above centre;
(d) Whether the Government has made agreement with foreign countries for research & development in the region and if so, the details thereof along with the works proposes to be conducted in this regard;
(e) Whether the Government has Ice- breakers for exploration and research in the above places; and
(f) If so, the details thereof and if not, the reasons thereof along with the steps taken / being taken by the Government for construction of indigenous ice-breakers?

ANSWER
MINISTER FOR MINISTRY OF SCIENCE AND TECHNOLOGY AND
MINISTRY OF EARTH SCIENCES
(DR. HARSH VARDHAN)

(a) Yes, Madam.
(b) The details and the findings so far has been furnished at Annexure-I. The expenditure incurred during 2011-12, 2012-13, 2013-14 and current year i.e 2014-15 (as on 31-1-2015) are Rs.249.79 crores, Rs. 190 crores, Rs.196 crores and Rs. 169 crores respectively. The enhanced expenditure during 2011-12 was due to the construction of the new Research Station at "Bharti" in Antarctica.
(c) No, Madam.
(d) Yes, Madam. The Ministry of Earth Sciences through its autonomous institute, National Centre for Antarctic and Ocean Research (NCAOR) has entered into a MoU with the Norwegian Polar Institute for scientific and logistic co-operation in the Arctic. India has a station "Himadri" at Ny-Ålesund, Svalbard, Norway.
(e & f) No, Madam. However, India has the capability to build ice class vessel. Indian ship building industry has yet to build a Research Vessel cum ice breaker.

Annexure-I

Research and Development in Arctic and Antarctic region.

ANTARCTICA:

Government of India under the aegis of the Ministry of Earth Sciences/erstwhile Department of Ocean Development has been undertaking multi-institutional annual scientific expeditions to Antarctica since 1981. Research and investigations by Indian Scientists in disciplines such as atmospheric sciences & meteorology, earth sciences and glaciology, biology and environmental sciences in Antarctica have significantly contributed directly to global experiments mounted by International Scientific community of various countries. India presently has two year-round research bases in Antarctica- "Maitri" commissioned in 1989 and "Bharati" commissioned in 2012. Some of the significant contributions by Indian scientists to Antarctic research are:

(i) **Measurements of atmospheric ozone concentrations made from the Indian Antarctic research station "Maitri" reveal that the recovery of ozone depletion does not take place as fast in Antarctica as in the Arctic.**

(ii) **India is among the first countries to take up magnetometer triangulation experiments in Antarctica to determine the presence and movement of small scale, auroral current systems.**

(iii) **Magnetic field has been reported to decrease rapidly during last century in and around Maitri. Continuous magnetic measurements at Maitri however, indicate that the rate of decline has reduced considerably during last few years. Magnetic field data from Indian Antarctica stations and near conjugate stations in Arctic have been analysed to understand storm time pulsation and substorm phenomena.**

(iv) **India also tapped the opportunity of observing Shadow Bands during the unique total Solar Eclipse on 23rd November 2003 studied by Indian scientists from the icy continent. The observations have been analysed for the study of shadow bands and their relation with Total Solar Eclipse, Antarctic lower Atmosphere Boundary Layer, Solar Corona and the other features of solar activity during declining phase of the sunspot cycle.**

(v) **Biological Research by India in Antarctica has been focused primarily towards enumeration of the microbial biodiversity of Antarctica and also to understand the molecular basis of cold adaptation. Research on the molecular basis of cold adaptation demonstrates that cold loving bacteria adapt to low temperatures by their ability to modulate membrane fluidity by regulating the synthesis of fatty acids and carotenoids. The study of the biodiversity of cyanobacteria and algae in fresh water and terrestrial ecosystems and chemical environment of the Schirmacher Oasis has revealed that various ecosystems differ significantly.**

(vi) **30 out of 240 new bacterial species discovered so far in Antarctica have been made by Indian scientists. Two genes namely t-RNA modification GTPase and aspratate aminotransferase have been identified as genes required for survival of bacteria at low temperature; a number of lipases and proteases active at low temperatures and useful for the biotechnology industry have also been identified.**

(vii) **Sustained effort till date has enabled scientists from the Geological Survey of India to complete systematic geological mapping on 1:50,000 scale, in areas of exposed outcrops covering the Wohlthat, Orvin and Muhlig-Hofmann ranges off the Princess Astrid coast in central Dronning Maud Land of east Antarctica.**

(viii) **Geophysical studies have yielded gross features of the sub-glacial topography and thickness of the ice in the region south of the Schirmacher Oasis.**

(ix) **Maitri is one of the Global Positioning System (GPS) stations contributing to the International database.**

(x) **Analysis of snow/ ice cores data has provided valuable information on the spatial and temporal variability of snow accumulation in the Centra Droning Maud land (CDML) region. Near the erstwhile Indian Research Station 'Dakshin Gangotri', a net accumulation of 62.7cm was recorded during 1999-2001. Moving south towards the continental ice sheet, an average accumulation of 10cm/yr has been computed for the last 500 years from the ice core studies (core IND22/B4). Accumulation rates recently deduced from an ice core recovered from a continental ice sheet near the Humboldt Mountains indicate an average rate of ~70cm/yr for the past two decades.**

(xi) **NCAOR team successfully drilled 101.4 m ice core from the cDML during the summer of 2014- the longest by Indian scientists.**

(xii) **The major ion analysis of an ice core provides excellent marker horizons of many volcanic eruption events such as Krakatao (1883), Tambora (1815) and Huaynaputina (1600). Studies have also revealed that the tephra accreted during the Agung (1963) and Krakatao (1883) eruptions harboured microbial cells, suggesting that volcanic ash particles could provide a significant micro-niche for microbes and nanobes in the accreted ice.**

(xiii) **A high-resolution ice core record from coastal Antarctica reveals a doubling of dust and trace element fluxes over East Antarctica since 1980s, coinciding with the enhanced intensity of southern westerlies and polar easterlies.**

(xiv) **Molecular-level characterization of dissolved organic matter in Antarctic snow shows that many of the identified supraglacial organic matter formulae are consistent with material from microbial sources, and terrestrial inputs of vascular plant-derived materials are likely more important sources of organic carbon to Antarctica than previously thought.**

(xv) **A 54.5 MHz Moveable Atmospheric Radar (MARA) was installed at Maitri during the summer of 2014 as a collaborative venture between NCAOR and Swedish Institute of Space Physics to study (a) the vertical transport and mixing processes in the polar troposphere and lower stratosphere under different meteorological conditions, and (b) ice-cloud layers in the polar summer mesosphere to improve understanding of middle atmosphere dynamics and composition.**

(xvi) **The palaeoclimatic data so far generated from Zub & Long lakes in Antarctica going back to 8,000 years before present indicate alternating arid - warm and humid climatic conditions. Studies of the samples collected from marginal Antarctic lakes in the Vestfold Hills show the presence of types of foraminifera, reflective of marine influence in the past.**

(xvii) **Environmental magnetism studies carried out from one of the lakes of Schirmacher Oasis indicate that the glacial periods were characterized by high magnetic mineral concentrations. The Holocene period is characterized by alternating phase of relatively warm and cold events. This study also gives evidence of Schirmacher Oasis escaping full glaciations during the past 40,000 years.**

ARCTIC:

Considering the need for trans-hemispheric studies focusing on climate variability and change, in 2007 the Ministry of Earth Sciences decided to dovetail the country's scientific endeavour in the Antarctic region with some major long-term scientific initiatives in the Svalbard area of the Arctic. To facilitate the studies, a permanent station building christened "Himadri" was also taken on lease at the International Arctic Research facilities at Ny-Ålesund on the Spitsbergen Island of Svalbard, Norway. Over the years, many long-term scientific programmes in the frontier areas of climate change, glaciology, terrestrial and aquatic ecology and atmospheric sciences have been initiated by the Indian scientists which have been contributing substantially to the international programmes at Ny-Ålesund. To date, over 125 researchers from nearly two-dozen national research institutions and Universities have visited Ny-Ålesund for scientific data collection and the results have been published in over 60 peer-reviewed journals. Some of the accomplishments are as below:

(i) **Indian scientists have been continuously monitoring one of the fjords in Svalbard, the Kongsfjorden, since 2010 for understanding the possible response of this fjord to climate variability at different time scales. The temperature and salinity profiles of the fjord, water column nutrients and diversity of biota are being monitored at close spatio-temporal scales throughout the spring-summer-fall seasons. A major milestone in India's scientific endeavours in the Arctic region was achieved on the 23rd July, 2014 when a team of scientists successfully deployed IndARC, the country's first multi-sensor moored observatory in the Kongsfjorden. IndARC is programmed to collect sea truth data at close temporal scales even during the harsh Arctic winter.**

(ii) **Studies have shown that the Kongsfjorden and adjoining glaciers are colonised by bacteria hitherto know to the world and have unique properties that could be tapped for the welfare of mankind.**

(iii) **Establishment of a dedicated atmospheric observatory at Gruvebadet in Ny-Ålesund: Instruments such as nephelometer and aethalometer have been installed which have been collecting data at very high resolution. A Micro Rain Radar has also been installed to obtain precipitation characteristics at every one minute interval. The Gruvebadet Observatory also serves as an excellent platform for instruments like Quartz crystal microbalance, Photo acoustic soot spectrometer, Transmissometer, Micro aethalometer, High volume sampler, Optical particle counter etc.**

(iv) **The focus of glaciological studies in the Arctic is on monitoring the mass budget, snout and dynamics of Vestre Broggerbreen glacier at Ny-Ålesund. Another aspect of the measurements has been the measurement of glacier velocity and ice thickness thereby computing ice flux. Snout position is also being monitored by using differential GPS. Indian researchers have also recently embarked on a mission to target larger glaciers such as Feiringbreen in Svalbard facilitating comparative studies with the glaciers of the Himalayan region.**

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