Preface……

It is prudent to recall couple of significant developments that happened in 2018 as they pointed to the future of CSIR Fourth Paradigm Institute (CSIR-4PI). The first development was setting up Advisory Committee (AC) under the Chairmanship of Shri Narayana Murthy and the second was the meeting of the newly formed AC in December 2018. The AC was of firm belief that with the advent of Data Science, the Institute has a much larger role to play and assume a central position in the CSIR system. In view of this, AC also recommended infusing 19 new positions. It also gave a call for developing AI/ML based technologies in Agriculture and Healthcare.

Since then, much effort has been made to steer the Institute in the new direction. A multi-institutional precision agriculture project for small and marginal farmers was discussed and deliberated with involvement from IIT Dharwad, IIIT Bengaluru, IARI Delhi, UAS Dharwad, IIT Jodhpur and a few CSIR laboratories including NAL and CEERI. CSIR Head Quarters also supported this with seed funding which resulted in data collection at UAS Dharwad using NAL drone and setting up an AI/Data platform for further development. However, Covid-19 eventually put a stop and it is hoped that this will unfold as a true Data based project in the future.

While Covid-19 effects became real as early as February 2020, it also provided us with an opportunity to develop AI based prediction models which has yielded wonderful results.

Following up on this direction, 4PI also organized a major meeting on Big Data, AI and ML at Infosys on 3rd and 4th June 2019 at Mysore. The whole meeting was fully supported by Infosys and was Chaired by Shri Narayana Murthy. More than 50 participated in this meeting representing diverse set of organizations such as IIT Dharwad, IIIT Bengaluru, IIT Jodhpur, Chennai Mathematical Institute, IITM Pune, NASSCOM, NIPFP, IGIDR, CNRS, CSIR Laboratories (IGIB, NEIST, IHBT, NAL, NGRI, IICT), and Industries (ThougthWorks, Pune; NEC India; nVidia; NewSpace Res & Tech; Infosys). Over a day and a half, discussions took place on seven focused areas, viz., Healthcare, Chemical Biology, Aerospace, Water, Agri Tech., Data and Natural Hazards. Six Grand Challenge problems were identified following this important meeting.

The fact that so many organization spanning different fields of expertise deliberated on one platform on diverse topics is an indication of things to come. It is clear that Data Science powered by AI and ML will take center stage in all walks of life and would be particularly of critical importance for CSIR. It is also clear that 4PI will and should have a central role to play in the country. However, this vision has to be strengthened with relevant and competent young researchers. That is something yet to be realized.
Meanwhile, the Institute continues to make significant contributions in the Earth Sciences research, High Performance Computing/Cyber Security. These are summarized below.

Under the project titled “Carbon and Nitrogen Cycling in Earth Systems” funded by CSIR, modeling and data collection efforts were continued. GHG data collected at Hanle, Pondicherry, Port Blair and Hoskote over the past few years were assimilated into a 4-D variational assimilation scheme employing the LMDZ model. It is established from this data that India is a major land sink. Numerical simulations of marine biogeochemical model were also carried out for climatological and interannual variations for the period 1949 to 2018. Databases generated from these simulations provide an excellent opportunity to apply AI models for possibly drawing new inferences apart from speeding up the tedious processing tasks.

In the area of weather and climate modeling, work continued on impact of weather on diseases and hydro-meteorological disasters. Monsoon prediction forms one of the key activities.

Under the continuing National Monsoon Mission project, the new rain-based all-India summer monsoon rainfall index was made operational by MoES which funded the project. A dynamical downscaling platform set up for climate change projections was deployed for local level impact studies. Efforts are on for developing an integrated System Dynamical Model for sustainable resource management in the Indian Himalayan region – an effort being funded by MoEFCC under the National Mission on Himalayan Studies programme. Work is also continuing on impact of weather on diseases and hydro-meteorological disasters.

Seismic hazard work in North-West Himalayas resulted in database on ground acceleration. Such data is crucial for better understanding of the phenomena and can aid new ways of using AI techniques in the future. High resolution microtremor noise survey at 429 locations was carried out with reference to Srinagar city in Kashmir.

This would help identify areas prone to seismic amplification which in turns helps assess the hazard. Probabilistic seismic hazard map for J&K region was compute using a logic-tree approach. Modification to the algorithm for robust estimation of Unified Scaling Law of earthquake parameters was carried out. Our efforts continue to provide significant inputs GNSS research resulting in high impact publications.

Providing state-of-the-art access to High Performance Computing (HPC) is an important activity of the Institute. The present 360 TeraFlops (peak) system has been a major support to Institutional projects and other major projects across CSIR. The machine has served well since its commissioning in 2013. The issue of complete refresh of this system has been placed before the HPC Policy Committee under the Chairmanship of Prof Sourav Pal, Director, IISER Kolkata. A concrete proposal is being made and being vetted by the committee. The committee has come is strong support for refresh and also for moving towards new cloud-based technologies in order to keep pace with rest of the world.

Cybersecurity and Cryptography related work forms another important cornerstone for the Institutional activities. Keeping in mind the future of the Institute moving towards data-sciences, AI/ML, it is clear that data security aspects become as important as any other core activities in CSIR. The Institute has taken forward a few initiatives in this area by taking part in CSIR AI mission and other DST and MeitY projects.

The Institute was very active in scientific activities resulting in 21 SCI publications and 6 non-SCI publications. One international patent was also filed. Seven new projects were initiated while three CSIR funded projects concluded. There are in all 18 projects in progress. The Institute signed three MoUs. Seven staff members were promoted to next higher grade.

It is hoped that 2021 will see a new beginning for the Institute. The urgent need to infuse fresh talent will hopefully be fulfilled and will fuel new growth.

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