# KNOWLEDGE SUMMIT

INDIA-FRANCE • HIGHER EDUCATION • RESEARCH • INNOVATION


## 24-26 November 2021

## Proceedings and Recommendations

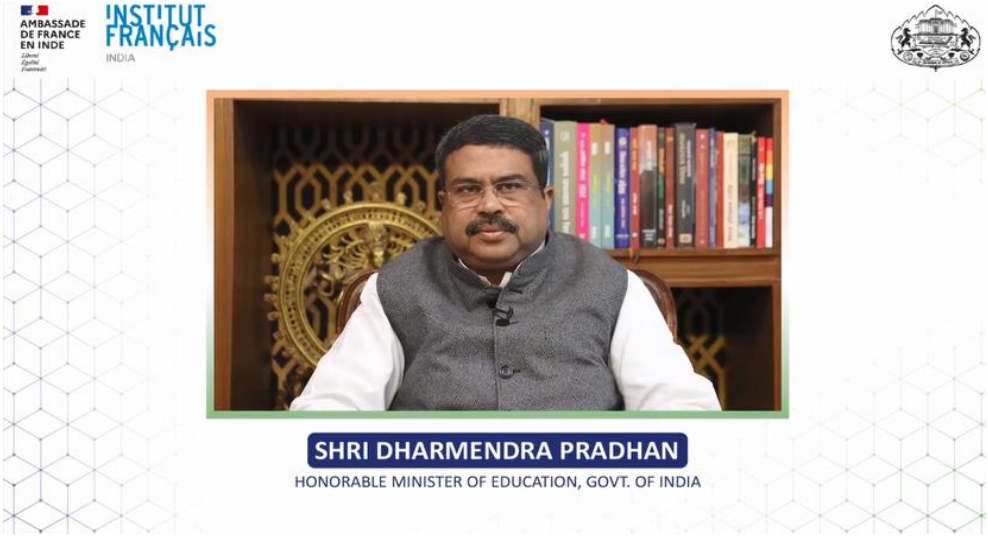
AMBASSADE DE FRANCE EN INDE
*Liberté*
*Égalité*
*Fraternité*

INSTITUT FRANÇAIS
INDE

# FOREWORD

*The words below have been taken form the address of the Ministers during the opening ceremony.*

## ➢ *Shri Dharmendra Pradhan, Honorable Minister of Education, Govt. of India*



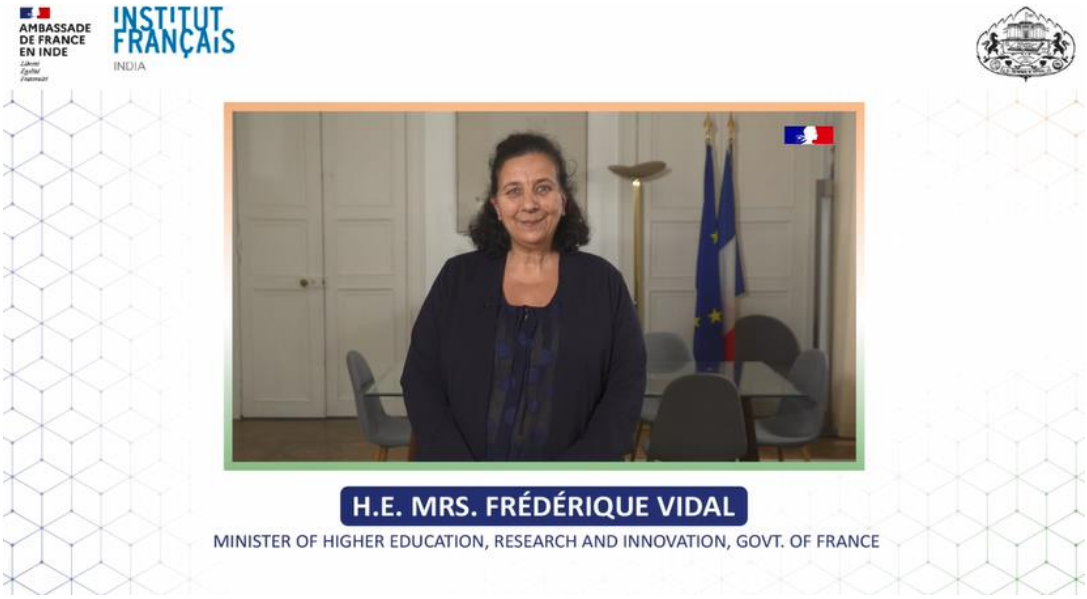

"The 3rd edition of India France Knowledge Summit 2021 will denote a significant milestone, given the fact that educational landscape in India is undergoing transformative reforms with announcement of National Education Policy (NEP) in 2020. NEP 2020 aims at bringing new methods at teaching, learning and student assessment with an overall aim to enhance the learning outcomes."

"I would like to highlight that the internationalization remains the core of our new National Education Policy. The policy has made recommendations for permitting branch campus of top international universities in India and for Indian institutes to set up campus abroad. Further collaborative arrangements like twinning, joint and dual degrees between Indian and foreign institutions will be put in place. India is committed to balance mobility of students and to enhance two-way mobility of international students and faculty."

"The past few years, academic and research cooperation between India and France has been progressing well. Mobility of students, faculty and researchers has been facilitated by various schemes launched by the Government of India. I hope that the 3rd edition of India France Knowledge Summit 2021 will further reinforce academic collaboration between our countries. The summit will discuss ways and means to promote research and scientific collaboration for better structuring our cooperation, taking into the account the priorities set and the strategies envisaged in NEP 2020 and in Science, Technology, and Innovation Policy (STIP) 2020. NEP and STIP seeks to develop an ecosystem for research and innovation in India for inclusive and sustainable development with required focus on traditional knowledge systems and indigenous technologies."

"I am hopeful that India France Knowledge Summit 2021 would meet its defined objective in underlining the success of our scientific collaboration and to draw some new leads to joint research work.

## ➢ *H.E. Mrs. Frédérique Vidal, Minister of Higher Education, Research and Innovation, Govt. of France*




"I am glad to have the opportunity to express my commitment to strengthening bilateral exchanges in higher education, research and innovation with India, a strategic partner of France in the Indo-Pacific region."

"Since 2017, France has made student and researcher mobility a top priority ensuring that those who planned to come to France to study or research could meet their needs and realize their ambitions. We have made sure that our border remained open for researchers and students despite the pandemic. France continues to welcome international researchers and students with specific support for their mobility as well as a solid offer of distance learning tools."

"In 2019, France welcomed 10,000 Indian students and our goal is to double this number by 2025. Today, only 11% of the total student mobility from India is taking place through student exchange agreements between universities. We hope to increase this percentage in the future, based on the 700 cooperation agreements between French and Indian higher education institutions. We also hope to broaden the range of curricula hosting Indian students, especially to fields such as science and engineering."

"Beyond higher education and student mobility the development of research cooperation is a priority for France. In December 2020, I presented a new research programming law for France for the 2021 to 2030 period. This law will translate to an investment of more than 25 billion euros in research over the next ten-years and will create more opportunities for international researchers to come to France to carry out their research in addition to the opportunities offered through the Horizon Europe Programme."

"You have my full support and commitment to the development of the academic and scientific collaboration between our countries, and I look forward to seeing the conclusions of this summit."

# INTRODUCTION
# BY THE AMBASSADOR OF FRANCE

**H.E. Mr. Emmanuel Lenain**
**Ambassador of France to India**

One of the major axis of the bilateral strategic partnership between India and France is to strengthen our academic and scientific cooperation. In the context of the development of "knowledge economies", research and higher education are achieving a strong internationalization of activities. In a fast changing world, facing global challenges and offering news opportunities for improving the societal welfare, the priorities of our collaboration in Research and Innovation need to be regularly updated. That is also why our scientific cooperation requires to be continuously fueled with new collaborations. Moreover, collaborations in research are the cornerstone of academic exchanges, since they accentuate the emergence of lasting, in-depth and structured relationships.

To this end, the Knowledge Summit is a dedicated forum where brainstorming, networking and analysis contribute to feed our joint scientific strategy.

The first edition of Knowledge Summit was organized in New Delhi in March 2018, during the visit of President Emmanuel Macron. Knowledge Summit 2 took place in Lyon on October 2019. Knowledge Summit 3 has been co-organized jointly with Savitribai Phule Pune University, in an online format due to the health crisis.

In the present "Proceedings and recommendations" document, Knowledge Summit 3 displays the outreach of our scientific cooperation and the new leads of joint research in many domains such as health, mathematics and Artificial Intelligence, marine sciences, sustainable energy, biotechnologies for natural resources and green chemistry. Importantly, Knowledge Summit 3 also highlighted open science and multidisciplinarity, in agreement with our vision of an integrated science promoted by mobility, core funding and networking tools. The 140 scientific lectures and related discussions with the more than 350 persons engaged on the platform gave rise to better shape our scientific cooperation, for instance with the identification of priority topics, constitution of informal thematic groups, and the proposal of various transverse actions.

The successful outcome of Knowledge Summit 3 reveals the strong involvement of our scientific communities from both India and France in this cooperation. I extend my warmest wishes to all those working tirelessly for the continued success of Indo-French relations.

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# EXECUTIVE SUMMARY

The Knowledge Summit is a bilateral forum dedicated to scientific and academic cooperation between France and India. The first edition was held in New Delhi in March 2018, and the second Knowledge Summit took place in Lyon on October 17 and 18, 2019.

Knowledge Summit 3 has been **co-organized on-line with the Savitribai Phule Pune University**, with a focus on research. The main objective was to promote the tools and methods for better structuring of our cooperation and its alignment to the current reforms such as the "*National Education Policy NEP 2020*" and "*Science Technology and Innovation* Policy STIP 2020". These two major reforms clearly encourage internationalization and the close association of Higher Education and Research Institutions with the private sector, both in education and research.

The three half-days program was launched by **Ms. Frédérique Vidal, French Minister of Higher Education, Research and Innovation**, **M. Dharmendra Pradhan, Minister of Education**, and **M. Ravichandran, Secretary of Department of Science and Technology, govt. of India**.

More than **350 participants** engaged on the platform to attend the **140 speakers** who presented their work and discuss the challenges and outcomes of the indo-french scientific cooperation.

The first part of the program was proposed in **plenary sessions**, on topics related to the presentation of the **Indo-french scientific cooperation in 2021**, then two panel discussions on "**Open Science**" and "**Health and Society**" respectively, followed by two **Keynote Lectures (Artificial Intelligence; Marine Biology)**.

The second part offered **seven parallel scientific workshops** on the topics of **One Health, Marine sciences, Artificial Intelligence for Sustainable Agriculture, Artificial Intelligence for Healthcare, Mathematical Foundations for Machine Learning, Sustainable energy, and Green chemistry, biotechnology and natural resources**. The open-mind dialog carried out by the researchers during these meetings allowed the researchers to formulate some new collaboration topics, transverse actions and recommendations.

The participants of various workshops widely shared and highlighted the need of some **data exchange action between France and India** in the topic of **access to data**, including the aspects related to collection, sharing, policy, ethics, **open data sharing platform** and standardization. Moreover, **Open Science** should be encouraged, and "open access" record could be incentivised in the CEFIPRA calls for projects. Preparing a **roadmap for One Health** has been proposed, as well as the creation of mailing groups or steering committees for specific topics. An other class of recommendations deals with **biodiversity assessments and natural resources protection**.

**Interdisciplinary approaches** help in addressing **societal and global challenges**, whose outputs facilitate communication. Therefore, projects crossing boundaries of disciplines **should be specifically supported**, while **they are generally sub-evaluated by the funding agencies**.

Some teams stressed the **difficulty to grant full joint PhD (and not only mobility)**.

Knowledge Summit 3 was organized in **partnership** of the French National Centre for Scientific Research (**CNRS**) and the Indo-French Centre for the Promotion of Advanced Research (**CEFIPRA**). It was also supported by 25 important stakeholders, either research organizations, ministries and regulatory authorities (MESRI, MoES, DST) or academic institutions.

# AGENDA

## Day 1 – 24 November – Plenary Sessions

9:30 - 10:00 (FR)
14:00 - 14:30 (IN)

**Opening ceremony**

*Prof Nitin R Karmalkar, Honorable Vice Chancellor Savitribai Phule Pune University*

*M. Shri Dharmendra Pradhan, Honorable Minister of Education, Govt. of India*

*H.E. Mrs. Frédérique Vidal, Minister of Higher Education, Research and Innovation, Govt. of France*

*Dr. M. Ravichandran, Secretary, Ministry of Earth Sciences and Department of Science & Technology, Govt. of India*

10:00 - 10:45 (FR)
14:30 - 15:15 (IN)

**Plenary session "Indo- French scientific cooperation in 2021"**

*Prof. K. Vijayaraghavan, Principal Scientific Advisor, Govt. of India*

*Dr Nicolas Gherardi, Deputy Counsellor for Education, Science and Culture, Embassy of France in India*

*Dr Purnima Rupal, Director of the Indo-French Centre for the Promotion of Advanced Research (CEFIPRA)*

10:45 - 11:45 (FR)
15:15 - 16:15 (IN)

**Panel discussion for "Open Science"**

11:45 – 12:45 FR)
16:15 – 17:15 (IN)

**Panel Discussion "Health and Society"**

12:45 -13:15 (FR)
17:15 - 17:45 (IN)

**Strengthening the Mathematical foundations for enabling field deployable AI models: An Indo-French collaborative effort**
*Conference by Prof. Chiranjib Bhattacharyya*

## Day 2 – 25 November

9:30 - 10:00 (FR)
14:00-14:30 (IN)

**Tara Oceans: Eco-Systems Biology at Planetary Scale**
*Conference by Chris Bowler*

| | **Scientific Workshops (parallel sessions)** | | | | |
|---|---|---|---|---|---|
| 10:00- 13:00 (FR)<br>14:30 - 17:30 (IN) | *One Health (infectious diseases)* | *Marine Sciences* | *Artificial Intelligence* | *Sustainable energy* | *Green chemistry, biotechnology* |

| | | | | | |
|---|---|---|---|---|---|
| | | | | *(Storage & EV)* | *and natural resources* |

**Day 3 – 26 November**

| | | | | | |
|---|---|---|---|---|---|
| 9:30 - 12:30 (FR)<br>14:00 - 17:00 (IN) | **Scientific Workshops (parallel sessions)** | | | | |
| | *One Health* | *Marine Sciences* | *Artificial Intelligence* | *Sustainable energy* | *Green chemistry, biotechnology and natural resources* |

## TAKEAWAY FROM THE PLENARY SESSIONS

### ➢ Plenary session "Indo-french scientific cooperation in 2021"


***The Indian scientific and Innovation framework***

***by Prof. K. Vijayaraghavan, Principal Scientific Advisor, Govt. of India***

There has been a very huge impact of collaboration with France over several decades. For example, in initial days of Tata Institute of Fundamental Research (TIFR), the collaboration between France and India was really important. It resulted in many areas of specialization being developed at TIFR towards the collaboration with France. Today, India has expanded its footprint in Science & Technology in the world, leading to the creation of several opportunities for similar collaboration where Indian students, faculties, researchers and scientists could go to France and *vice-versa*.

The long standing collaboration between France and India has for instance led to the creation of Indo-French Centre for Applied Mathematics (*IFCAM*) that was established in 2012 at Indian Institute of Science (IISc), Bangalore. Also, collaboration to develop better water technologies is underway through a variety of joint projects in the form of 'Indo-French Cell on Water Sciences' at Bangalore. The most impressive tool for Indo-French collaboration is the Indo-French Centre for the Promotion of Advanced Research (IFCPAR) or Centre Franco-Indien Pour la Promotion de la Recherche Avancée (CEFIPRA), which has seeded various programmes in advanced areas of science and technology. It is quite well-known amongst Indian scientific community. This is an opportune time for CEFIPRA to amplified on a much larger scale by getting

in substantial resources, both from industry and philanthropy, along with government resources on both sides, to take on big missions together and solves problems in a functional manner.

India has also put in place several major scientific missions such as Supercomputing mission including exo-scale computing, Artificial Intelligence and Quantum Computing mission as well as National *Mission* on Interdisciplinary *Cyber-Physical* Systems.

In 2015, in the presence of the Honorable Prime Minister of India, Sri Narendra Modi, and then French president, Mr. François Hollande, a memorandum of understanding was signed between India and French institutions for collaboration in Marine science and technology. A Marine Technology Center in India was set up and collaboration with France in Marine laboratories was decided, both in India and in France, in places such as Réunion Island. With the launch of Deep Ocean Mission by Ministry of Earth Sciences, the collaboration in the area of marine science could be taken forward with France. Another part of the program also included a training program in data science, for students in both countries.

The partnership between Indian and France in science and technology has been very significant over the past several decades and there is a great opportunity for that to scale several fold in the near future.

### *The French scientific and Innovation framework presented*

### *by Dr Nicolas Gherardi, Deputy Counsellor for Education, Science and Culture, Embassy of France in India*

India is a major partner of France. The strengthening of our academic and scientific cooperation is an important axis of the bilateral strategic partnership.

France **is a country of research and innovation**, and has always been (Figure 1). France scientists have been rewarded by the most prestigious prizes and France ranks very high in terms of publications, patents and unicorns. Means devoted for Research and Development are very impressive. Research and Innovation are funded by various initiatives, with 2 majors: National Research Agency and Horizon Europe.

***France Scientific and Innovation Dynamism***

- 71 Nobel prizes (#4 in the world)
- 12 Fields Medals (#2 in the world)
- Ranks #8 in the world for publication impact
- Ranks #6 in the world for patent filing (#2 in EU)
- 25 French unicorns end 2021 (startup >1 billion $)
- Ranks #7th for GDP revoted to R&D (2.5%, 60 billions €)
- 3000,000 full time researchers (4,000 / million inhabitant)

***The Indo-french Ecosystem in a nutshell***

- 28 private R&D Centers from French companies
- 2 French Institutes of Research (CSH and IFP)
- 4 International Research Laboratories
- 14 International joint structural projects
- 600 active agreements between French and Indian High education Institute

Figure 1 - France **is a country of research and innovation**

The French Research and Innovation sector is also open to **the society and to the word:**

- The well-known Joint Research Units (*Unité Mixte de Recherche*, *UMR*) that often gather more than one academic unit and can include non-academic stakeholders permit an integrated and ambitious fruitful scientific impact
- French Research and Innovation is closely linked to international, with 56% international co-publication share and 42 % of PhD coming from aboard

***The indo-French scientific ecosystem***

France and India have a long and fruitful Research and Innovation cooperation background. France devotes nearly € 5 million each year to scientific and technological cooperation with India. France is also India's 5th scientific partner (7.8% of the Indian international co-publications).


**Figure 2 – Main french public research organizations with activities in India**

***The indo-French scientific cooperation tools***

The French Embassy in India and its partners (DST, Europe…) provide many tools that promote *(i)* mobility of students or scientist, *(ii)* bilateral ambitious projects funding and *(iii)* networking (science and industry) in order to strength bilateral Research and Innovation cooperation.

| | | |
|---|---|---|
| Mobility | 1- Master | - **Charpak Lab** Fellowship *(IFI)*<br>- **Raman-Charpak** Fellowship *(CEFIPRA)*<br>- **Eiffel** Fellowship *(Campus France)*<br>- Make Our Planet Great Again - **MOPGA** |
| | 2- PhD | - **Charpak Lab** Fellowship *(IFI)*<br>- **Raman-Charpak** Fellowship *(CEFIPRA)*<br>- **Marie Curie** Fellowship *(EU)* |
| | 3- Post-Doc | - **Women Post-doc** Fellowship *(CEFIPRA)*<br>- **Marie Curie** Fellowship *(EU)* |
| | 4- Staff | - **Staff IFI** Fellowship *(IFI)*<br>- **Marie Curie** Fellowship *(EU)* |

| | | |
|---|---|---|
| Research and staff funding | 5- **Scientific Collaborative Research Programme (CSRP)** | - Bilateral Collaboration between 2 academic partners *(CEFIPRA)* |
| | 6- **Industry Academia Research & Development Programme (IARDP)** | - Bilateral Collaboration between 2 academic and 2 industrial partners *(CEFIPRA)* |
| | 7 & 8 - EU programs | - Marie Curie Fellowship (salary funded) *(EU)*<br>- Horizon Europe … *(EU)* |
| Networking | 9 - **Workshops** | - Bridging academic/industrial partners for new opportunities *(CEFIPRA)* |
| | 10- **IFIN** | - IndoFrench Industrial Network (R&D and academia) *(IFI)* |

**Table 1 - Ten tools for Indo-French Scientific and Innovation cooperation**
Details are available at https://www.ifindia.in/indo-french-university-cooperation
*In italic are the institutions supporting the call (to be contacted). IFI : French Institute in India*

### *The Indo-French Center for the Promotion of Advanced Research (CEFIPRA-IFCPAR)*

***By Dr Purnima Rupal, Director***

Indo-French Centre for the Promotion of Advanced Research (IFCPAR/CEFIPRA), a bilateral organisation set up by Government of India and Government of France is a model for international collaborative research in advanced areas of Science & Technology. The Centre was established in 1987 by the two governments to promote scientific cooperation between the two countries. It acts as a catalyst in strengthening collaboration and industrial research in cutting edge areas of Science and Technology across the knowledge innovation chain and for human resource development.

CEFIPRA, since its inception, has completed over 580 collaborative scientific research projects, 40 industrial projects and around 200 seminars and workshops have been supported. That has resulted in joint publications with an average impact factor of 4.5, and with more than 70,000 citations received. The human resource trained is over 3,400, which includes 1,100 PhDs and postdocs as well. CEFIPRA impacted in strengthening the institutes for linkages where over 165 Indian research institutes have been connected to more than 80 French research institutes under these programmes.

CEFIPRA is actively involved in supporting Indo-French Science, Technology & Innovation (ST&I) system through various activities. **Scientific Collaborative Research Programme** (CSRP) focuses on academia-to-academia collaborations between Indian and French academic collaborators in various domains. **Industry Academia Research & Development Programme** (IARDP) emphasizes to develop the linkage between Industry and Academia from France and India. The two deadlines for these programme is 1st February and 1st July of each year.

Targeted Programmes of CEFIPRA provide platform for Indian and French National Funding Agencies to implement a programmes for specific areas. Dedicated mobility support programmes such as **Raman**

**Charpak** PhD Fellowship and soon to be launched **Women Post-Doctoral Fellowship** program provide exposure to young researchers of the working, social and cultural environment of the partnering country. **Raman Charpak Fellowship (RCF)** is devoted to Indian and French students under a phD programme. At the same time, some French Masters students are eligible to study in India. Raman – Charpak Fellowship is indicated for short period of 3 to 6 months in France or in India.
**DST-CEFIPRA Women Post-Doctoral Fellowship Programme** is dedicated to French and Indian young women scientists under the age of 45 years. This fellowship will provide an excellent opportunity to Indian/French women scientists and technologists from various S&T disciplines to work with the French/Indian scientific communities.

In addition, CEFIPRA is mandated to implement various other scientific initiatives such as **High Impact Scientific Research Network (HISRN)** to allow researchers networking for 2-3 years and **CEFIPRA Annual Lecture Series** to increase the interactions between the best S&T minds and young students and researchers from both countries. **CEFIPRA outstanding Project Award** recognizes and encourages advanced Indian and French Principal Investigators (PIs) of most successful collaborative projects funded by CEFIPRA. Last, the **Indo-French Centre for Applied Mathematics (IFCAM)** enables Franco-Indian collaborations in applied mathematics, physics, computer science and engineering**.**

Apart from its own funding programs, IFCPAR has been entrusted since 2012 with an increased role as a catalyst for French-Indian cooperation, by promoting the involvement of French and Indian, public and private organizations, companies, foundations and institutions (example: **DST-ANR, DST-Inria-CNRS, DST-INRA**) willing to develop *ad hoc* bilateral R&D cooperation programs. CEFIPRA also supports Indian doctoral students to participate in **the European School on Nanosciences and Nanotechnologies (ESONN)** session in Grenoble, France. ESONN is a three-week course aimed at providing training for graduate students, postdoctoral and junior scientists from universities and laboratories in the field of nano-sciences and nano-technologies in Physics, Biology and Chemistry.

CEFIPRA has been contributing to the Knowledge Summit and had participated in first edition in New-Delhi, India as well as the second edition in Lyon, France. During Knowledge Summit 3, CEFIPRA partnered with French Embassy & Institut Francais in India (IFI) and organized workshops on Artificial Intelligence (AI) for Sustainable Agriculture and Healthcare for two days.

## ➢ Panel Discussion "Open science"

### *Moderators*

*Dr Kasturi Mandal*

*National Institute of Science Communication and Policy Research, Council of Scientific and Industrial Research (CSIR), New Delhi*

*Dr Srini Kaveri*

*Director, Centre National de la Recherche Scientifique Office in India, (CNRS), New-Delhi*

### *Experts*

*Dr Geetha Vani Rayasam, Head of Science Communication and Dissemination Directorate, Council of Scientific and Industrial Research (CSIR), Delhi*

*Mr Sanjeev Kumar Varshney, Head of International Bilateral Cooperation Division, Department of Science & Technology (DST), Govt. of India, Delhi*

*Dr Rene Von Schomberg, Team Leader - Policy officer - Open Science policy coordination and development, Directorate-General for Research and Innovation, European Commission, Brussels, Belgium*

*Dr Sylvie Rousset, Director of the Scientific and Technical Information Department, French National Centre for Scientific Research (CNRS), Paris*

*Dr Benoît Pier, CNRS Research Director, Fluid Mechanics and Acoustics Laboratory, CNRS,*

*Dr Akhilesh Gupta, Senior Adviser & Head, Policy Coordination & Programme Management (PCPM) Division, Department of Science & Technology, Delhi*

As the Royal Society of London states, open science arguably began in the 1600s with the practice of publishing scientific observations and reproducing the experiments that are published in the scholarly reports. However, over the last few decades, the concept has witnessed a major international movement as the internet has made it possible for publications to reach a global scale with reasonable costs. The open science movement broadly declares that scientific studies must be carried out in an open and reproducible manner where all components of research are accessible.

Open Science now occupies an important place in national scientific strategies. In India, it is strongly highlighted in the new Indian Science Technology and Innovation Policy STIP2020, on a model similar to that of the European Union. In France, the French "National Plan for Open Science" attempts to ensure

that “the results of scientific research are open to all, researchers, companies and citizens, without hindrance, without delay, without payment”.

With regard to the respective strategies of the two countries, the objective of this panel discussion was to offer recent information about Open Science versus Open Access and discuss on the current state and latest developments in Open Science. It was also an attempt to identify a first possible axis of collaboration, including how to develop OA and OS policies that take into account the economic and social inequalities among countries and institutions.

## Recommendations

- Cooperation and collaboration in research should be incentivised – **for example, CEFIPRA should consider not only the scientific merit but also the applicants “open access” record.**
- **CEFIPRA should insist that research publications coming out of its support should be in open access journals.**
- **Incentive collaborative research more rewarding research behaviour rather than research output**, such as a pure quantitative approach.
- **Plan S is still evolving even in EU: Green route and Diamond route are acceptable, Gold route is not acceptable**. France will not accept that the publishers charge ‘twice’, first from the institutions and then from the researchers. India has not signed Plan S.**
- There is an urgent need to work on issue of the Article Processing Charges. Article processing charges actually have become a kind of Article Prestige Charges, and are charged much above the real processing costs.
- **India is initiating strong steps to carry forward open science with efforts like building a national STI observatory consisting of all kinds of data from STI ecosystem, through a *one nation one subscription* plan, and is looking forward to learn from initiatives taken by other countries practising open science.**
- **Need for awareness of peer group in respective field, an open repositories/Archives for that which can lead towards more open science.**
- To foster collaboration on open access, the data or results of the Indo-French collaboration may be made open and then deliberate on other mechanisms.
- Possibility of building **open science cloud** where respective nation contributes by sharing their scientific materials, data etc.

** Green OA (no publishing charges, authors can self-archive the article in an institutional/central repository for free access), Gold OA (articles are freely accessible on the journal's website immediately after publication, usually authors pay the cost of publication), and Hybrid (a mix of green and gold where some articles are free to access and some are behind a paywall).

## ➢ Panel Discussion "Health and Society"

### *Moderator*

*Mr Siddharth Kankaria, Communications & Program Coordinator at Simons Centre, NCBS Bangalore*

### *Experts*

*Dr Gagandeep Kang, Professor Department of Gastrointestinal Sciences, Christian Medical College, Vellore*

*Dr Srinath Reddy, President, Public health foundation of India (PHFI), New - Delhi*

*Mrs Charlotte Marchandise-Franquet, International expert in public health policy, Rennes*

*Dr Olivier Telle, urban health geographer at CNRS, CSH, Paris-New-Delhi*

We have lived through a series of unprecedented circumstances in the last few months that has taken away a lot from us but, in turn, has also left us with a series of learnings and reflections. Our discussion on health and society today hopes to collate some of these learnings and reflections on how we can move towards more robust, realistic and receptive public health interventions.

How critical is the active participation of leaders and experts in engaging different communities with the latest developments in medical science, health policy, and public health interventions? How can we gain a better understanding of both disease burden as well as the impact of public health interventions? How can the engagement of communities go beyond just dissemination of scientific, health and risk information and also additionally focus on active listening, mutual learning and consultative processes?

This session on Health and Society explored many of these nuances of bridging health and society, by building on the rich shared experiences of our esteemed panellists. The session will touched upon many themes like science communication and public engagement, evidence-based policymaking, medical innovations, health literacy, and community-centric public health interventions.

### Recommendations

- The engagement between the different sectors based on policymaking, medical innovations, health literacy, and community-centric public health interventions is crucial for developing good health practices that is beneficial at multiple levels to the society. This includes inclusive training opportunities and skill development platform set-ups.

- Early engagement of students and training with multi-disciplinary approaches and exposure to reality checks towards solutions of multidisciplinary nature.
- More transparency on the part of the Government for data accessibility and status of reality
- Long term solutions for health care practices including improving living conditions.
- Curiosity and intend to learn and share data is the way to move forward.

## ➢ Conference by Prof Chiranjib Bhattacharyya

### Strengthening the Mathematical foundations for enabling field deployable Artificial Intelligence models: An Indo-French collaborative effort

*Prof Chiranjib Bhattacharyya, Dean of Computer Science and Automation Department, Indian Institute of Science (IISc), Bangalore, India*

*His research activities focus on the foundations of Machine Learning, optimization and their industrial applications. He regularly collaborates with several French researchers.*

Harnessing the transformational power of Artificial Intelligence (AI) for betterment of society is now a well-recognized global goal. Achieving this goal will crucially depend on developing efficient algorithms which can aid in learning models from diverse and large collections of data. Over the years Chiranjib has been involved in an Indo-French collaborative effort which sheds new light on a few classic problems in Machine Learning. Lasso is an well known algorithm for feature selection. However, it is well known that Lasso fails to recover the true model when the relevant features are sparse. We take a sub-modular perspective to this problem and develop a smoothed version of ordered weighted L_1 norm(SOWL), which when used as a regularizer significantly outperforms Lasso in model selection in the presence of correlated features. Both theoretically and practically these results constitute significant advance of the state of the art. Apart from regularization, developing First order methods for large scale

Optimization problems remains a key focus of the current Indo-French collaboration. Developments include primal dual methods which not only advances the state of the art in large scale learning but also contributes new methods to the problem of minimizing a convex function over an intersection of convex sets. In this talk some of these results will be presented. Also, several applications of related research which has led to field deployable models in Social Robotics, and Diagnosing X-ray images, now launched all over India as X-raySetu, will also be presented.

## ➢ Conference by Chris Bowler

### Tara Oceans: Eco-Systems Biology at Planetary Scale

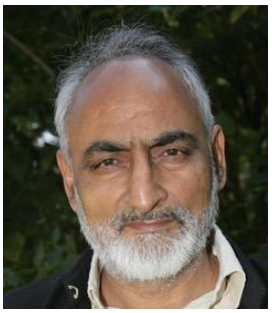

*Dr Chris Bowler, Ecology and Evolutionary Biology Section, Institut de Biologie de l'Ecole normale supérieure (IBENS), Paris, France*

*Dr Chris Bowler is research director at CNRS, director of the plant and algae genomics laboratory at the Biology Institute of the École normale supérieure (ENS-CNRS-INSERM). He currently holds the chair "Biodiversity and Ecosystems" at Collège de France. His main research interest is to understand the response of plants to environmental signals thanks to genomics. He is one of the scientific coordinators of the Tara Ocean project aimed at exploring the biodiversity, ecology and evolution of plankton in the world's oceans.*

The ocean is the largest ecosystem on Earth and yet we know very little about it. This is particularly true for the plankton that drift within, even though they form the base of marine food webs and are key players in Earth's biogeochemical cycles. Ocean plankton are at least as important for the Earth system as the forests on land, but most of them are invisible to the naked eye and thus are largely uncharacterized. To increase our understanding of this underexplored world, a multidisciplinary consortium, Tara Oceans, was formed around the 36m research schooner Tara, which sampled plankton at more than 210 sites and multiple depth layers in all the major oceanic regions during expeditions from 2009-2013. The talk summarized the foundational resources from the project, which collectively represent the largest DNA sequencing effort for the oceans, and analyses that illustrate several aspects of the Tara Oceans' eco-systems biology approach to address microbial contributions to ecological and evolutionary processes. The project provides unique resources for several scientific disciplines that are foundational for mapping ocean biodiversity of a wide range of organisms that are rarely studied together, exploring their interactions, and integrating biology into our physico-chemical understanding of the ocean, as well as for identifying new organisms and genes of biotechnological interest. These resources, and the scientific innovations emerging to understand them, are furthermore critical towards developing baseline ecological context and predictive power needed to track the impact of climate change on the ocean.

## SCIENTIFIC WORKSHOPS

## ➢ One Health



*PICTURE*

(3,5 cm large)

*Dr Rakesh Mishra, Director*
*Tata Institute for Genetics and Society (TIGS), Bangalore*

*Dr Vinay Nandicoori, Director*
*Centre For Cellular And Molecular Biology (CSIR-CCMB), Hyderabad*

*Dr Srini Kaveri*
*Director, Centre National de la Recherche Scientifique Office in India, (CNRS), New-Delhi*

With the main goal of improving policies that affect science and policies that can benefit from the accurate understanding of science, the workshop on One Health highlights on the attempts of researchers by providing information on controlled experiments to the public. The objectives will enable to increase the credibility of scientific advances and will encourage the society to make use of the scientific knowledge and understanding. Especially in the current pandemic situation, this idea and objective are reinforced. Hence it is important for the researchers engaged in the field of health sciences in particular with infectious diseases like COVID and vaccine development to engage with the public to not only create awareness but also use the available ecosystem to integrate into the scientific domain which in turn can help researchers define and resolve such life threatening problems.

One Health' is an approach to designing and implementing programmes, policies, legislation and research in which multiple sectors communicate and work together to achieve better public health outcomes. Building sustainable and effective public health interventions requires expertise and experience of a variety of actors ranging from scientists, doctors, healthcare workers, and policymakers to name just a few. But even more importantly, it also requires the participation, engagement and trust of all the different communities on the ground to whom these public health interventions are directed towards.

Covid-19 pandemic has drastically changed our life these last 20 months. It has demonstrated how our societies and systems were vulnerable. On day 2 the OneHealth workshop will focus on infectious diseases, Covid-19 being one amongst them.

On day 3, OneHealth workshop invites researchers with a wide range of expertise to share their latest perspectives arising from different sectors, such as public health, animal health, plant health and the environment. Different facets of one health will be touched upon ranging from molecular and biochemical aspects of one health to biodiversity to genetic issues and zoonotic diseases.

## Speakers Infectious Diseases

*Dr. Chandrakant Lahariya*
*Public Policy expert*

**One Health approach in India: Time to take a leap from the policy to implementation**

*Dr. Olivier Neyrolles*
*Institute of pharmacology and structural biology (IPBS), Université de Toulouse, CNRS, Toulouse, France*

**Exploiting cidal TA systems to induce "suicide" mechanisms in Mycobacterium tuberculosis**

The identification of bactericidal toxin-antitoxin systems in the human pathogen Mycobacterium tuberculosis has opened avenues for developing novel antimicrobials.

*Dr. Rakesh Mishra*
*Director, Tata Institute for Genetics and Society (TIGS), Bangalore, India*
*CSIR-Centre for Cellular and Molecular Biology (CCMB), Hyderabad, India*

**Environmental surveillance for infectious agent [Lessons learned from the pandemic]**

Currently pandemic has shown how vulnerable and fragile our economic structure and healthcare system can be in such situations. In the context that most of the infectious disease are either transmitted through originate from animals, understanding and livning in harmony with the environment is absolutely essential.

*Dr. Farah Ishtiaq*
*Tata Institute for Genetics and Society (TIGS), Bangalore, India*

**Disease Ecology and surveillance: One health approach**

Understanding the key drivers for the emergence of virulent infectious pathogens, and surveillance are important components of One health strategy. Currently, we lack an evidence-based approach to tackle serious evolving threats to human and wildlife health. We need to integrate One Health approach into governmental surveillance and response mechanisms.

*Dr. Pushkar Sharma*
*Senior Scientist  National Institute of Immunology*

**Dissection of a novel signaling pathway that regulates phospholipid biosynthesis in Apicomplexan parasites**

This Indo-French collaboration resulted in deciphering a novel signaling pathway, which is critical for the development of two human pathogens: Plasmodium falciparum and Toxoplasma gondii. It involves an enzyme protein kinase CDPK7, which regulates the synthesis of important phospholipids which are essential for these parasites.

*Dr. Sylviane Pied*
*Centre d'Infection et d'Immunité de Lille, CNRS 9017-INSERM 1019-Univ Lille-Institut Pasteur, Lille, France*

**The contribution of system immunology to the study of parasitic diseases**

The project is based on a multidisciplinary approach to identify immunologic and genetics factors implied in parasitic diseases pathology such as malaria in India. Data collected from epidemiological, clinical, cellular and molecular studies done together on the same

individual were analysed to identify signatures associated with protection or disease severity to define biomarkers of malaria sub phenotypes in India.

*Dr. Chetan E Chitnis*
*Institut Pasteur, Paris, France*

**Development of vaccines for malaria**

Malaria vaccine development requires both basic understanding of malaria parasite biology and translational research. The development of a recombinant vaccine for Plasmodium vivax malaria based on the Duffy binding protein, which mediates receptor-binding and host cell invasion will be described. Results from early stage clinical trials will be presented.

*Dr. Sarah Delliere*
*Scientist, Institut Pasteur*

**The role of soluble mediators in anti-Aspergillus immunity**

## Speakers

*Dr. Shiv Kumar Sarin*
*Director Institute of Liver and Biliary Diseases*

**Machine learning tools to measure Liver Pressure and fibrosis**

*Dr. Nathalie Gagey Eilsteina*
*INSERM UMR-S 1139, Université de Paris, FHU PREMA, Paris, France*
*Dr. Sarit Agasti*
*New Chemistry Unit, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bangalore, India*

**Chemical nose sensor strategies in health: Predicting cell states, drugs mechanism and identifying disease-specific amyloid assemblies**

Chemical nose sensing strategies, a method which relies on “differential” sensing rather than being “specific”, has recently emerged as an important concept for analytes discrimination. Here, we present chemical nose sensing strategies based on nanoparticle or macrocyclic receptor scaffolds for discriminating a range of analytes connected to human health.

*Dr. Abhay Bang*
*Centre for Ayurveda Biology and Holistic Nutrition, University of Trans-Disciplinary Health Sciences and Technology (TDU), Bengaluru, India*

**Reducing the use of alcohol and tobacco in population: a new integrated strategy – Mukti-path**

Tobacco and alcohol are among the top seven risk factors for the Global Burden of Disease. No single approach is very effective in reducing them in population. An approach integrating four strategies is piloted in the Gadchiroli district, India (2015-20). The problem, methods, results and scope for collaboration was presented.

*Dr. Sandhya S Visweswariah*
*Dept. of Molecular Reproduction, Development and Genetics, Indian Institute of Science, Bangalore, India*

**The role of cGMP in gut physiology: relevance to diarrheal disease**

The receptor guanyly cyclase C (GC-C) mediates the actions of bacterial heat-stable toxins that cause of infectious diarrhea. Mutations in the receptor contribute to congenital secretory diarrhea. A mouse model harboring an activating mutation in GC-C identifies multiple effects of elevated cGMP in the gut that contribute to disease.

*Dr. Uma Ramakrishnan*
*National Centre for Biological Sciences, TIFR, Bangalore*

**Biodiversity, Pathogens and One Health**

Zoonotic spillover is the result of interactions between humans and wildlife. India is a predicted hotspot for spillover. We are attempting to understand spillover in two biodiversity hotspots in India. Going forward, we are attempting to incorporate our learnings in a One Health framework, especially in the context of Bangalore city.

*Dr. Alok Srivastava*
*CMC Vellore*

**Prevention and control of the major haemoglobin disorders in India: Novel approaches to establishing a comprehensive model in Odisha**

*Dr. Patrick Ducoroy*
*CEO BIOMANEO, Dijon, France*

**NeoHemog: the solution to a public health need: high throughput screening for hemoglobin variants, Sickle cell disease and Thalassaemia by MALDI mass spectrometer**

The objective is the development of an innovative in vitro diagnostic medical device for largescale screening of haemoglobinopathies. The use of the latest innovation in the filed of mass spectrometry combined with automated data treatment and management for a reliable, fast and secure medical rendering.

*Dr. Karima Kissa*
*Multiscale analysis of blood stem cells production in vivo- UMR5235-CNRS, Montpellier, France*

**Zebrafish : an animal model for biomedical research**

The zebrafish, a small tropical fish, offers many advantages that have motivated its recent use in many laboratories to study human pathologies. Its strong genetic homology with humans and its transparency are two major assets adapted to real-time monitoring pathologies such as cancer or bacterial and viral infections. We have developed a first diabetic zebrafish model which, as in humans, suffers from a deficit in insulin secretion. A second model develops a human cancer in which we observe the progression of the cancer in real time. These two collaborative projects aim at developing new drugs.

*Dr. G.R. Chandak*
*Chief Scientist & Group Leader, CSIR-Centre for Cellular and Molecular Biology, Hyderabad, India*

**How Complex are Non-Communicable Diseases in Indians: A Translational Point of View?**

Through studies encompassing observational-, birth- and prospective cohorts, my group has established genetic heterogeneity for susceptibility to non-communicable diseases like type 2 diabetes. Further, we have demonstrated that the risk is established during intrauterine period and altered DNA methylation, especially of NCD-specific candidate

genes explains missing heritability and may present an avenue for prevention of NCDs like type 2 diabetes.

*Dr. Serge Morand*
*SEM Montpellier University Montpellier*

**Emerging zoonotic diseases: accelerating the One Health implementation**

The great majority of emerging infectious diseases involve animal reservoirs, both wild and domesticated. Globally, we face an increasing number of outbreaks of zoonotic diseases in link with the ongoing climate disruption, land use modification, growing urbanization, farming intensification and increasing trade. Studies show globally and locally how these ongoing changes are affecting the ecology of disease transmission and the likelihood of emergence and epidemics. Results of these studies call into action using the One Health approach promoted by the international organizations.

## Recommendations

Coordination, collaboration and communication to have good health practices in order to prevent an epidemic breakout which involves different sectors mentioned above under the umbrella of One health. Setting up of One health Institutes and concepts: Strategic research agenda on One health was not recommended in National Health Policy of 2017. Post COVID, there was dedicated allocation for One Health under the Union Budget of 2021. Department of Biotechnology has started National Institute of Animal Biotechnology and Centre for one Health in Hyderabad under this Umbrella. Institutional mechanisms and financial allocations have been done. The scientific community is to maintain the momentum of the One health concept and have a road map for the long term.

Sewage surveillance gives a qualitative and quantitative estimate of the number of people infacted and such measures need to be taken to prevent pandemics like COVID 19. Wildlife trade, wild life consumption and destruction should be stopped. Apart from this generation of spatial and temporal heat maps regarding the distribution of the viral biomarker in a community will also help prevent such pandemic and infectious diseases in the future.

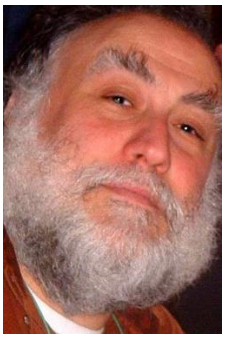
Need for industrial product development through clinical studies carried out in research institutes to develop multistage vaccines.

Institute of Liver and Biliary sciences is keen on collaborating with French researchers for treatment options related to sepsis in Cirrhosis and Liver Failure.

Bengaluru to be the headquarters of One health where integration of human health with disease ecology could take place. There already exists a partnership amongst government, NGOs, academia and Think Tanks.

Creation of the French company Biomaneo subsidiary in India to carry out clinical compound screening and to deal with economic, medical and societal challenges posted by haemoblobinopathy-related diseases.

## ➢ Marine Sciences



*Prof. Manell Zakharia*

*Ecole navale- French Naval Academy, France*

*Dr Kartik Shanker*

Centre for Ecological Sciences, Indian Institute of Science, Bengaluru, India

*Dr.Blandine Ripert*

*French Institute of Pondicherry, India/France*

The Indian government is promoting the blue economy as a strategic priority sector, including a marine science component and a deep seabed exploration program. This seminar aims to support Franco-Indian teams in their collaborative projects on major emblematic projects in areas such as marine biology and biodiversity, Climate, Deep Sea, Technology, Social Sciences, etc…

The workshop on Marine Sciences incorporated three different sessions, Marine Science and Technology with focus on deep sea, Marine Biology and Biodiversity, and on Socio-economic transformations of coastal areas.

### Speakers Science and Technology with focus on deep sea

*Dr. Ramadass*
*Director, National Institute of Ocean Technology, Chennai, India*

**Technology for the exploration and harvesting of Ocean Resources**

National Institute of Ocean Technology, under the aegis of the Ministry of Earth Sciences, Government of India has the mandate to develop and demonstrate technologies for the sustainable exploration and harvesting ocean resources such energy, fresh water, Polymetallic Nodules, PolymetallicSulphides and Gas Hydrates.

*Yann Hervé de Roeck*
*Director General, France Energies Marines*

**Technological and methodological advances in development of Offshore Renewable Energies**

India and France share interest in introducing Offshore Renewable Energies in their energetical mix. Steadily, new technologies are being developed, both for producing electricity on the grid, but also for empowering the deployment of the blue economy with

many applications. Strong attention is needed to track and assess this progress. The presentation stressed on the activities of the International Energy Agency (IEA-OES), so that new ideas of bilateral collaboration sprinkle in this spirit.

*David Vincentelli et Guillaume Eudeline*
*iXblue, France*

**Hydrospatial data gathering: new perspectives offered by the introduction of a new generation of USV, unscrewed surface vehicle**

The introduction of a new generation of USVs offers new perspectives to take full benefit of our time at sea, providing unique endurant, efficient, low-carbon and low-noise environment. Merging the efficiency of these USVs with a new generation of sonar such as synthetic aperture sonars or environmental 3D multibeam, lead to reset concept of operation standards.

*Prof. Manell Zakharia*
*Ecole Navale, Brest, France*

**The GOAT Project, a GOA ATlantic Cooperation Programme in Marine S&T**

Presentation of the GOAT project (GOA-Atlantic) that gathers 10 partners including IIT Goa and 9 French partners (2 clusters, 1 company, 2 R&D centres and 4 academic institutions). The project covers a variety of Marine S&T topics and a wide range of actions (from student exchange to common research lab).

*Chritophe Maes* [a] *& Rene Garello* [b]
[a] *IRD-France, LOPS, Plouzané,*
[b] *IMT Atlantique, Plouzané, France*

**Observing and Monitoring Plastics in the Oceans: General assessment and a case study**

Plastics have gained infamy as one of the most pressing environmental issues of our present lives. In order to develop more and more detection and mitigation, one needs to develop an integrated approach, crossing through several disciplines and requiring collection of data from as many sources as possible.

*Stephan Jorry* [a] *& Pankaj Khanna* [b]
[a] *Ifremer, Unité de Géosciences Marines, Pointe du Diable, 29200, Plouzané, France*
[b] *Discipline of Earth Sciences, Indian Institute of Technology Gandhinagar, Gujarat-382355, India*

**Tracing Evolution of Tropical Highstand reefs in Indian Seas (TETHIS)**

The objective of the TETHIS project is to drill into Paleocene to Late Quaternary drowned tropical coral reefs located along the Lakshadweep Ridge (offshore India) and around the Eparses islands (offshore France), in order to analyse past sea-level and environmental changes in the West Indian Ocean.

*Mathieu. Lengaigne*[a]*, I. Suresh*[b]*, S. Neetu*[b]*, V.P. Akhil* [b]*, T. Izumo*[c]*, Jérôme Vialard*[d]
[a] *IRD, MARBEC, Sète, France*
[b] *CSIR, National Institute of Oceanography, Goa, India*
[c] *IRD, EIO, Tahiti, Polynésie Française*
[d] *IRD, LOCEAN/IPSL, Paris, France*

**An Indo-French collaboration in the field of Indian Ocean climate variability and change, and its impact on marine biogeochemistry**

In this talk, we will describe key results from the lasting collaboration on the effect of climate variability and change on the Indian Ocean circulation and biogeochemistry built by the Institut de Recherche pour le Développement (IRD) and National Institute of Oceanography (NIO) over the last 15 years

*Katell Guizien[a], D. K. Bharti[b,c*], M. T. Aswathi-Das[d,e], P. N. Vinayachandran[e], Kartik Shanker[b]*
*[a] CNRS-Sorbonne Université, Laboratoire d'Ecogéochimie des Environnements Benthiques, LECOB, Observatoire*
*Océanologique de Banyuls Sur Mer, 1 avenue Pierre Fabre, 66650 Banyuls sur Mer, France.*
*[b] Centre for Ecological Sciences, Indian Institute of Science, Bengaluru, India*
*[c] CSIR-Centre for Cellular and Molecular Biology, Hyderabad, India*
*[d] National Centre for Polar and Ocean Research, Ministry of Earth Sciences, Goa, India*
*[e] Centre for Atmospheric and Oceanic Sciences, Indian Institute of Science, Bengaluru, India*

**Marine connectivity networks and delineation of disconnected coastal provinces along the Indian coastline using large-scale Lagrangian transport simulations**

Understanding connectivity patterns at a large scale can help define the spatial extent of coordinated biodiversity management. In this study, we built marine connectivity networks from Lagrangian transport simulations over various dispersal durations in different years and monsoonal seasons along the Indian coastline. Four disconnected provinces were consistently identified.

*Punyasloke Bhadury[a, b]*
*[a] Integrative Taxonomy and Microbial Ecology Research Group, Department of Biological Sciences, Indian Institute of Science Education and Research Kolkata, Mohanpur-741246, Nadia, West Bengal, India.*
*[b] Centre for Climate and Environmental Studies, Indian Institute of Science Education and Research Kolkata, Mohanpur-741246, Nadia, West Bengal, India.*

**Biocomplexity in coastal Bay of Bengal- what we know now we did not know before**

The Sundarbans mangrove located in the north east coast of the Bay of Bengal is home to rich biodiversity, support livelihood and also shapes microbial complexity and linked functions. By disentangling some of the features of microbial complexity that influences carbon cycling, there is now a better understanding which can improve estimations of regional carbon budget in coastal Northern Indian Ocean.

## Speakers Marine Biology and Biodiversity

*Rohan Arthur[a,b], Teresa Alcoverro[b,a], Farai Patel[c], Wenzel Pinto[a], Mayukh Dey[a]*
*[a] Nature Conservation Foundation, India.*
*[b] Centre d'Estudis Avançats de Blanes (CSIC), Spain*
*[a] National Centre for Biological Science, India*

**Coral reef decline and the habitability of the Lakshadweep Islands**

As a densely populated group of low-lying coral atolls, the Lakshadweep Archipelago is among the world's most vulnerable locations to the impacts of climate change. Using two

decades of reef monitoring, we discuss the impacts of multiple climate-related coral mortality events on reef growth and island habitability.

*Soniya Sukumaran*, Heidy Q. Dias, S. Neetu, Hurmine Ridha*
*CSIR-National Institute of Oceanography, Regional Centre Andheri (W), Mumbai 400 053, India*

**Evaluating resilience of estuarine benthic communities via taxonomic and functional approaches**

This multi-species traits study provides novel insights into the tropical benthic functioning based on both taxonomic and functional facets of macrobenthos and their resilience against estuarine stress gradients in the backdrop of multifarious anthropic stressors.

*Baban Ingole*
*Visiting Scientist, National Centre for Polar & Ocean Research Vasco Goa 403804 India*
*(Formerly: Chief Scientist & Head, Biology Division CSIR-National Institute of Oceanography, Dona Paula, Goa)*

**Benthic biodiversity of the Indian Ocean: Implications of the deep-sea mining**

The deep Indian Ocean, especially the abyssal plains in the Central Indian Ocean Basin, the seamounts habitats, and the hydrothermally active ridge environment, are considered as biodiversity hotspots. The region is also biologically least explored compared to any other deep-sea area. However, the region has been the focal point of global discussions, primarily due to its potential for deep-sea mining. Moreover, the International Seabed Authority (ISA) has already issued 4 contracts for mineral exploration in the deep Indian Ocean. Based on the initial baseline studies, and deep-sea trials, many of the deep-sea regions recognized as the potential for seabed mining are already considered as vulnerable marine ecosystems.

*Kartik Shanker[a], Diya Das[a], Tejal Vijapure[a], Maria Thaker[a], Tanmay Wagh[b], Naveen Namboothri[b], Vardhan Patankar[c], Abhishek P.[d], Deepak Subramani[d], P. Sreedevi[e], PN Vinayachandran[e]*
*[a] Centre for Ecological Sciences, Indian Institute of Science, Bengaluru, India*
*[b] Dakshin Foundation, Bangalore*
*[c] Wildlife Conservation Society, Bengaluru, India*
*[d] Department of Computational and Data Sciences, Indian Institute of Science, Bengaluru, India*
*[e] Centre for Atmospheric and Oceanic Sciences, Indian Institute of Science, Bengaluru, India*

**ARMS, BRUVs and Response Curves: integrated approaches to exploring the impact of climate change on marine biodiversity in the Andaman and Nicobar Islands**

The Andamans and Nicobar Islands are a significant centre of marine biodiversity in the Indian Ocean. We are using an array of different methods to monitor reef ecosystems including conventional reef and reef fish survey methods, ARMS to study reef associated organisms, BRUVS to characterise predators, as well as ecological and oceanographic models to understand the potential impacts of climate change. We present some preliminary results from species distribution and oceanographic models and outline our plans for the future

*Xavier Carton, M Morvan, C De Marez, S Correard*
*LOPS/IUEM/UBO, Brest France*

**Edy dynamics in the Arabian Sea**

The surface and subsurface submesoscale dynamics in the Arabian Sea, in the Gulf of Aden and in the Gulf of Oman, modeled with primitive equations, show the interactions of mesoscale structures and fronts instabilities forming submesoscale eddies and filaments. Local upwelling systemsshed filaments, coastal current instabilities generate submesocale structures. In particular, the Ras al Hadd cape is a site of submesoscale eddy generation. We show the Ertel potential vorticity to illustrate these processes. Finally,subsurface submesoscale eddy production influence the diffusion of tracers.

## Speakers Socio-economic transformations of coastal areas

*Blandine Ripert*
*French Institute of Pondicherry, CNRS, India-France*

**Introduction to socio-economic transformations of coastal areas**

Coastal area is an ecosystem that is fast changing from physical, ecological, social and political points of view. It became important to observe these transformations taking into account the large spectrum of stakeholders and of practices of population, but also the consequences on this space. This workshop will identify various sets of issues and of approach, which will highlight the challenges in designing interdisciplinary programs, including various social sciences, remote sensing and biodiversity considerations.

*Nicolas Bautes[a] and Ajit Menon[b]*
*[a] University of Caen, France, and associated to the French Institute of Pondicherry.*
*[b] Madras Institute of Development Studies, India*

**Coastal transformation and fisher well-being in Cuddalore, Tamil Nadu**

The Fishercoast project examines how policies with regard to coastal development have transformed the physical, ecological and social character of coastal areas in India and select European countries and how this has impacted the wellbeing of fishing communities. It engages with processes of coastal transformation, mapping these changes geospatially as well as engaging with particular issues such as conflict within the fisheries, industrialization of the coast, migration and responses to alternative imaginations of future development. The research undertaken is multidisciplinary bringing together social and natural scientists so as to holistically map the process of coastal transformation.

*D.Partha Sarathi*
*Indian Institute of Technology Bombay, India*

**Industries, Infrastructures and Blue Economy: Coastal Transformation and Contested Development in the context of Climate Change**

The presentation will lay out the nature, extent, and character of coastal transformations in the Indian context and bring out the implications for emerging risks and vulnerabilities for coastal communities, infrastructure, livelihoods, and settlements. In the context of future risk scenarios from anthropogenic and climate change related impacts, the talks will also raise broader issues and research agendas for addressing problems related to governance, conflicts and contestations.

*Marine Al Dahdah*
*CNRS, French Institute of Pondicherry, India/France*

**Indian Digital Ocean: the global dynamics and anchorage points of a connected ocean**

At the crossroads of digital social research and Science & Technology Studies, this project explores how the Indian Ocean (IO), historically a fulcrum of global exchange, lies at the heart of many of the challenges of global digitalisation. Unpacking the infrastructural and environmental challenges of a connected ocean, it explores the major domains of the social impacted by this connectivity, through economic, political, and cultural dynamics and change.

Julien Andrieu[a] and Sadanand Sontakke[b]
[a] *French Institute of Pondicherry, India/France.*
[b] *National Environmental Engineering Research Institute, India*

**Indian mangrove ecosystem health, is the restoration process hiding emerging threats?**

Indian mangroves show a paradox between positive trend in mangrove extents and increasing pollution concerns. Therefore, the project envisages monitoring the anthropogenic impacts on mangrove by crosscutting contaminants (EDCs/heavy metals) impact on biodiversity with remote sensing, botany and interviews on local ecological knowledge. This would probably be the first comprehensive interdisciplinary study of its kind in India targeting a multiproxy statistical approach of mangrove health ecosystem, with an interdisciplinarity approach, original data collection and spatially explicit database.

*Aarthi Sridhar*
*Dakshin Foundation, India*

**Democratizing Maritime Knowledge: Outline for practice-based coastal research programme**

The Indian Ocean is shaped by diverse historical inequalities which impact societal responses to phenomenon such as the COVID-19 pandemic, environmental degradation and injustice. Through examples from collaborative projects, I outline potential 'post-normal' research practices that could democratize knowledge production and widen our understanding of life on India's marine margins

## Recommendations

Researchers point out the difficulty of having very different timescales for science and technology in marine exploration, mainly due the necessity of prior programming of vessels. The scale of requirements to assume the cost of a campaign is also very specific, and additional (National) budgets are essential. For instance, the total budget of CEFIPRA could pay for about 1 month of sea trials. Common expeditions and experiments on shared interest areas have to be coordinated as much as possible.

**Access to data and multi-disciplinary data exchanges** on the same site are encouraged and requested by modelling scientists. A **data exchange action** between France and India would be helpful in that direction.

Some coordinated actions are proposed on the following topics:

- **Climate change in Indian Ocean** at large, ranging from anthropic pressure to plastic waste, including automated sensors and blue economy.
- **Carbon capture**

- **Geothermal energy**
- **Biodiversity assessments and monitoring programmes**
- **Oceanographic models**

As far as cooperation tools are considered:

- **shared financing of PhD** is proposed similar to IRD model (50% in FR 50% in I)
- travel support for PhD exchange
- particular efforts toward early career researchers is requested
- special efforts toward data collections and maintenance of them

Interdisciplinary approaches, including social sciences to other types of data collections, will help in addressing some of the society's expectations and result outputs would facilitate communication toward stakeholders. Therefore, projects crossing boundaries of disciplines should be specifically supported, as they help in taking into account broader views.

## ➢ Artificial Intelligence

This workshop has been divided in three seminars. The first one is relative to the foundations of artificial intelligence: Mathematical Foundations of Machine Learning, Explainability and Robustness. These questions refer to new and difficult issues in mathematics and computer science (statistics, logic, representation of knowledge, etc.).

The other two envision some specific fields of application of artificial intelligence, which yield a high interdisciplinary component:

- Artificial Intelligence for Healthcare, with a focus on diagnostic assistance for health workers in rural or peri-urban areas, and on the sensitive issue of collecting and protecting health data.

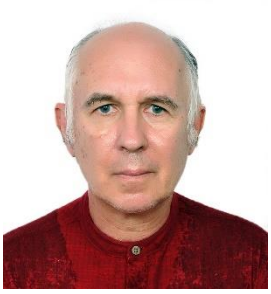
- Artificial Intelligence for Sustainable Agriculture, on the contributions of AI to sustainable and precision agriculture, in particular in terms of irrigation management and chemical inputs, and strategies of farmers for transport and the marketing of their productions.

*These two seminars were co-organized with the Indo-French Centre for the Promotion of Advanced Research (CEFIPRA)*

## Artificial Intelligence for Sustainable Agriculture

*Prof. Prof. Utpal Garain*

*ISI Kolkata*



*Dr. Pascal Weil*

*CNRS, IRL ReLaX, Chennai*

### Speakers Artificial Intelligence for Sustainable Agriculture

*Prof. Alka Arora*
*Principal Scientist, Division of Computer Applications*

**Applications of AI techniques in Image analysis for Agricultural Domain**

*Dr. Pierre Bonnet*
*UMR AMAP*

**Potential of deep learning for the development of a more sustainable agriculture. Analysis of case studies aiming at the automated characterization of plants and agricultural fields**

*Prof. Abhishek Mukherjee*
*Agricultural and Ecological Research Unit (AERU)*

**Machine learning for image-based identification of root knot nematode species**

*Jeremy Foisil*

**Software solutions based on computer vision and artificial intelligence for precision agriculture**

*Prof. Kavita Sutar-Deshpande*

**Corn yield estimation from drone images**

*Ayan Das*
*Space Applications Centre (SAC)*

**AI/ML for crop discrimination and yield modeling using multi-source remote sensing data**

*Dr. Hugo Gimbert*
*LaBRI*

**AI and Robotics for Sustainable Agriculture**

*Mukesh Kumar*
*Space Applications Centre (SAC)*

**ML based kharif crop discrimination and mapping using microwave remote sensing data**

*Dr. Pascal Neveu*
*UMR MISTEA*

**Overview of artificial intelligence methodologies and Big Data for agriculture**

*Kamlesh Narayan Singh Head*
*Division of Forecasting and Agricultural Systems Modelling*

**Application of machine learning techniques for crop yield forecasting using weather variables**

*Parag Gautam Ramteke*
*Product Manager*

**Developing data driven solutions to address problems faced in Agricultural Finance and Insurance**

*Prof. Delphine Thivet*
*Director of the Department of Social Sciences*

**Digitalization of Agriculture: Perspectives from the Social Sciences**

*Prof. P.C. Abhilash*
*Institute of Environment & Sustainable Development*

**Adaptive Agricultural Practices for Rural Food Security**

## Recommendations AI for Sustainable Agriculture

Speakers from different fields such as Agronomy, Plant Science, Computer Science, Mathematics, Statistics, and Social Science participated in this seminar, including two representatives of start-up companies (one from an Indian spin off and the other one from a French start-up). A wide range of topics has been covered, such as the use of machine learning and AI techniques for crop yield prediction, crop management, pathogen control, disease prediction, nematode identification, crop discrimination and mapping, soil modelling, farm robotics, agricultural finance, etc... The discussions also addressed the subjects of adaptive agricultural practices and the effects of technology on farmers' lives (cultural and social issues). Several on-field AI based systems were demonstrated.

The main outputs of the discussions are as follows:

### 1. Develop widely open data sharing platforms

Data, either raw or annotated, is the major resource required to develop AI-based solutions, and acquiring it is often long and labour-intensive. In this respect, it would be immensely helpful **to develop widely open data sharing platforms**, in the spirit of **open science and open data**. These platforms would act as repositories for raw and annotated data, but also for ontologies, and possibly for software tools. Among other benefits, such platforms allow the training of ML (machine learning) algorithms on larger data sets, making them more reliable, and the cross-validation and benchmarking of proposed solutions (which can

be tested against shared test cases). Beyond these benefits, these platforms and the data they host can be the substrate for new scientific projects and services, including data-curating services.

Rather than individual researchers, organisations such as CNRS, INRAe, Inria, CIRAD in France, and ICAR-IASRI, ISRO, ISI, CMI, IISc, IITs in India could take the lead towards this objective, preferably in a coordinated way. It is essential that, true to the tenets of open science, access to these repositories should be widely opened.

It is possible that, in some instances, IPR considerations would stand in the way, but the workshop showed that a number of scientists are already able and willing to participate in this sharing effort.

**2. Promote faculty and students exchanges**

In order to expand the number of French and Indian teams that could elaborate and carry out joint projects, one needs (relatively) small budget grants, centred around exchanges of visits (faculty, PhD students) and internships (end of Bachelor and Masters level).

**3. CEFIPRA call for AI**

The **CEFIPRA regularly gives a coloration to its calls for projects**, indicated that it is wishes particularly to support projects in a short list of topics. The topics on such a list must remain sufficiently coarse-grained to leave ample space for the creativity of researchers. However, AI should figure prominently and durably in this list, making it clear that this includes all aspects of that burgeoning field, from its foundations to its applications, notably to agriculture or health. Projects that include an effort to deploy AI-based solutions should not be overlooked. Such projects might well involve non-academic partners, whether industrial or NGOs.

**4. Within the scope of AI for agriculture, the following are important thrust areas:**

4.1. Solutions based on **image or remote sensing analysis** (e.g. plant, pest or crop identification, yield estimates, monitoring of the welfare of farm animals).

4.2. **Solutions based on heterogeneous data**, mixing e.g. image, video, weather patterns or forecast, water management data, market information.

4.3 Solutions based on **robotic intervention**, for **monitoring or for labour-intensive tasks** for which labour is hard to find.

4.4 **Interdisciplinary studies evaluating the accessibility** of proposed solutions for farmers (on different sorts of farms) and the impact of these solutions, both at the local level and at broader scales. The **involvement of social scientists** would be essential in such studies.

**5. constitution of a mailing group**

The workshop coordinators will form an email group consisting of the speakers and the participants to keep them updated on the future developments in this regard.

## Artificial Intelligence for Healthcare

*Prof. Yann Busnel*

*IMT Atlantique, IRISA, Nantes*

*Prof. Nikhil Pal*

*ISI Kolkata*

### Speakers Artificial Intelligence for Healthcare

*Prof. Tavpritesh Sethi*
*Computational Biology, Indraprastha Institute of Information Technology (IIIT), Delhi*

**Designing Real World Artificial Intelligence Solutions for Healthcare**

*Prof. Nicolas Farrugia*
*IMT Atlantique, Lab-STICC*

**Better Representations for Artificial Intelligence**

*Prof. Dipti Prasad Mukherjee*
*Computer and Communication Sciences Indian Statistical Institute (ISI), Kolkata*

**Exploring Non-invasive Tool for Monitoring Cancer Biology**

*Prof. Shandar Ahmad*
*School of Computational and Integrative Sciences Jawaharlal Nehru University (JNU), Delhi*

**Multi-scale and multi-dimensional modeling of biological and biomedical data using intelligent systems**

*Dr. Gael Varoquaux*
*INRIA, Neurospin research center*

**Machine learning and public health: the sciket-learn experience**

*Prof. Prathosh A P*
*Department of Electrical Communication Engineering, Indian Institute of Science (IISc), Bangalore*

**Information guided representation learning for healthcare analytics**

*Dr.Cedric Gangloff*
*LTSI Laboratory, INSERM U1099, Université de Rennes 1, Rennes, France*

**Machine learning improves the performances of chest-CT and RT-PCR for COVID-19 diagnosis: a proof of concept study**

*Prof. Yann Busnel*
*IMT Atlantique, IRISA*

**Using AI for phamacovigilence : the Inshare project**

*Prof. Mitali Mukerji*
*Head of Department of Bioscience & Bioengineering Indian Institute of Technology (IIT), Jodhpur*

**Transdisciplinary initiatives for ecosystem phenomics and precision integrative medicine with focus in the Thar eco-region**

*Prof. Yann Le Cunff*
*Université Rennes 1 / IRISA*

**Using AI for phamacovigilence**

*Prof. Debarka Sengupta*
*Computational Biology Indraprastha Institute of Information Technology (IIIT), Delhi*

**Gene expression-based inference of cancer drug resistance**

*Prof. Subasree Ramakrishnan*
*Dept. of Neurology National Institute of Mental health and Neurosciences (NIMHANS)*

**Brain Computer Interfaces in Neurorehabilitation**

*Akash Narayana*
*Senior Data Scientist, Niramai Health Analytix*

**Breast cancer screening with thermal imaging and AI**

*Prof. Stéphanie Allassonnière*
*PRAIRIE, University of Paris*

**Three example of decision support systems. Outputs of my PR[AI]RIE researches**

## Recommendations AI for Healthcare

The talks covered a wide spectrum of challenging and important problems along with some solutions. The following set of keywords illustrates the diversity and complementarity of the themes addressed during this workshop: biomedical data, multi-dimension, representation, non-invasive tools, federated learning, public health, analytics, covid-19 monitoring, pharmacovigilance, medical imaging, gene inference, neuro-rehabilitation, cancer curing (screening and drug monitoring), *etc.*

An original aspect of the workshop was to bring together medical doctors and scientists from startups companies along with researchers from various well-known universities and institutes.

The different kind of applications presented during the workshop were meant to **reduce the cost of diagnosis**, **reduce the hazards of invasive techniques** associated with diagnosis, or yet to achieve **better accuracy in diagnosis** and **comfort for the patients**.

Some other challenges are the development of **light-weight and less data-hungry AI/ML algorithms** and also how to address the issues with real-life healthcare data.

Moreover, any successful AI system for healthcare **requires large volume of reliable and labeled (annotated) data**, which most often are not available. The abundance of **missing data or the unstructured and heterogeneous** characteristics of the data do challenge the development of useful AI/ML based healthcare applications. Health data research **needs some policy for the standardization for the collection**, organization, curation, and use of healthcare data, **ensuring the ethical, privacy and security** principles. It should also provide **guidelines about sharing data**, best practices, and promoting federated learning. Availability of digital health records in a standardized format can facilitate its management, mining for knowledge discovery, planning for healthcare infrastructure development and so on.

A major issue is the **very low degree of trust in AI shown by both the practitioners and patients**. One way to turn out these stakeholders to be confident in the decision support process via AI could be by bridging the gap between discipline and AI experts: we need to build AI solutions on *what and how we do* instead of blind methods applied to databases.

Suggestions/Demands/Actionable items:

1. Extension of the scope of such **workshops by including physical hands-on training** would be more useful to the participants.
2. Organizing **summer schools or workshops** for graduate students/researchers from both countries involving experts from different labs from both India and France. This should also include hands-on training (cf. item 1).
3. Some **start-up research grants** for healthcare.
4. Reduce the barrier from the **availability of Health Data** from only practicians to a larger public (health association, citizens, etc.)

Prospective thematic areas for the future:

1. **Less data hungry and light-weight AI/ML** algorithms and architecture
2. **Affordable rural healthcare support with AI/ML**
3. **Explainable AI/ML** for healthcare
4. **Interoperability** between health data warehouses, which works in silo only
5. **Making Health Data a Reality**: engineer point of view (stress feature selection, CNN architectures, deep and federated learning deployment, etc.)

## Mathematical Foundations for Machine Learning

*Dr. Nicholas Asher*

*IRIT CNRS, Toulouse*

*Prof. K.V. Subrahmanyam*

*CMI, IRL RELAX, Chennai*

### Speakers Mathematical Foundations for Machine Learning

*Prof. K.V Subrahmanyam*
*Chennai Mathematical Institute*

**Introduction session "Mathematical Foundations for Machine Learning"**

*Hariharan Narayanan*
*TIFR Mumbai*

**Fitting a manifold of large reach to noisy data**

*Purushottam Kar*
*IIT Kanpur*

**Using high-school geometry to defeat adversarial attacks on learning algorithms**

Can machine-learning algorithms operate with training data corrupted by a sentient adversary determined to defeat the learning process? This question has long occupied the areas of robust ML and robust statistics. We present the first results fortifying non-linear kernel models against attack by a fully adaptive adversary.

*Edouard Pauwels*

**Nonsmooth backpropagation for deep learning**

*Vianney Perchet*
*Crest, ENSAE*

**Online Matching and Stopping in Random Graphs**

Motivated by several sequential budgeted allocation problems, we investigate online matching problems in a two-side markets where connections between agents on the supply side and on the demand side are discovered on the fly. Pairing demand to supply must also be done in an online, and irrevocable fashion. The objectives are then to devise (online) algorithms that are good "approximations" of optimal (offline) algorithms, i.e., such that their performances are up to some multiplicative constant. The whole point is to provide guarantees on this constant.

*Aurelien Bellet*

*INRIA, France*

**Federated Learning: Advanced and Open Challenges**

Federated learning (FL) is a machine learning paradigm where many clients (e.g. mobile devices or whole organizations) collaboratively train a model while keeping their data decentralized. FL embodies the principles of focused data collection and minimization, and can mitigate many of the systemic privacy risks and costs resulting from traditional, centralized machine learning and data science approaches. In this talk, I will introduce various settings which fall under the umbrella of FL, review a few standard algorithms and discuss some recent work and open problems.

*L A Prashanth*
*Indian Institute of Technology Madras, India*

**Concentration bounds for temporal difference learning with linear function approximation: The case of batch data and uniform sampling**

We provide concentration bounds for temporal difference learning with linear function approximation in the case where inputs are from a batch dataset, and the samples are picked uniformly at random from this dataset.

*Dr. Nicholas Asher*

**Introduction session "Explainability and Robustness"**

*Vineeth Balasubramanian*
*IIT Hyderabad*

**On Exploring Connections between Explainability and Robustness in Neural Network Models**

*Joao Marques-Silva*
*IRIT, CNRS, Toulouse, France*

**Formal Explainable AI**

This talk offers a brief overview of the emerging field of formal explainable artificial intelligence (FXAI). FXAI addresses important limitations of existing XAI methods, but also exhibits a number of challenges. The talk overviews both the limitations of other XAI approaches, the progress observed in FXAI, and the remaining challenges.

*Marie-Christine Rousset*
*Univ. Grenoble Alpes, MIAI Institute, LIG, France*

**A query-based approach for analyzing and explaining privacy risks**

We are developing a declarative framework for a formal specification and verification of privacy and utility policies. In case of a detected privacy breach, it returns an explanation that can then be used to understand and correct it.

*Amit Deshpande*
*Microsoft Research India, Bangalore*

**Fairness and Robustness in Responsible AI**

A brief introduction to theoretical and practical challenges in developing, monitoring and deploying responsible AI systems, particularly in the context of fairness and robustness.

## ➢ Sustainable energy

*Prof. Sylvain Franger*
*Institute for Molecular Chemistry and Materials, Paris Saclay University*

*Prof. Ashok Jhunjhunwala, founder of IIT Madras Research Park, Department of Electrical Engineering, IIT Madras*

*Prof. Preeti Aghalayam, Department of Chemical Engineering, Indian Institute of Technology, Madras*

From production to use through storage, the theme of energy is inseparable from the industrial sector and is also addressed from the perspective of collaborations between academics and the private sector. The workshop highlights the projects of IIT Madras and its Research Park, which aims to convert all of its infrastructure to become an eco-campus producing renewable energy and reducing consumption. On the French side, the University of Paris Saclay has recognized expertise in the field of energy and contributes very actively to the establishment of a center of excellence in sustainable energy which brings together prestigious institutions and industries such as the 'Ecole Polytechnique, CEA, TOTAL, EDF, Air Liquide, PSA, Renault, Saint-Gobain, IFP-EN as well as a large number of start-ups.

### Speakers Energy Storage and EV

*Prof Ashok Jhunjhunwala*
*Founder and director IITMRP*

**Industry-Academia effort to accelerate India's move to net-zero**

*Prof. Christel LABERTY-ROBERT*
*Sorbonne Université*

**The RS2E competence cluster and its road map**

*Dr. Kaushal Jha /Mr. Anson Sando*
*CEO /Manager CEET/IITMRP*

**Towards 100% Renewable Energy : The Energy Storage Story**

*Ms Samantha HILLIARD*
*Energy storage and integration specialist, Total Energies*

**Addressing the technical challenges of hybridization and storage of decarbonisation at Totalenergies**

*Dr. Aravind Kumar Chandiran*
*IITM*

**Solar water splitting and Metal-Air batteries**

*Dr. Sylvain FRANGER*
*Paris Saclay*

**Electro-Thermo-Mechanical modelling of batteries**

*Ms.Sandhya Ravikumar*
*Centre of Battery Engineering and Electric Vehicles (C-BEEV) - IITMRP*

**EV Battery and Charger**

*Mr. Milind Kulkarni*
*Reliance New Energy Solar*

**Solar Value Chain and Strategic Decisions for India**

*Mr. Anuvrat Joshi*
*Head Business Development, Clean Tech solar*

**Sustainability Through Solar Energy**

## Speakers Sustainable Energy

*Prof. Satyanarayanan Seshadri*
*Energy and Emission Lab, IITM*

**Electrification of Industrial heating: High Temperature Heatpumps Systems**

*Dr. Johnny DESCHAMPS*
*ENSTA/ Institut Polytechnique de Paris*

**The Hydrogen Technology in France and at ENSTA IP Paris**

*Dr. Ramachandra Rao*
*Department of Physics, Material Science Research, IITM*

**Green Energy, power harvesting and sustainable coatings: Material and Technology Development at IIT Madras**

*Dr. Jean-François GUILLEMOLES*
*Head of IPVF joint research unit, Ecole Polytechnique*

**IPVF and recent progress in photovoltaics**

*Prof. Rajnish*
*IITM*

**Process development for CO2 capture and sequestration**

*Dr. Gilles POULAIN*
*PV Specialist, Total Energies*

**Totalenergies is transforming itself to meet society's needs – a look at society and our ambitons**

*Dr.Mux Narasimhan*
*Founder and CEO, PlaySolar*

**The New Energy Paradigm**

*Dr. Bruno PRESTAT*
*R & D Business development head, EDF grid*

**Fostering Decarbonized Microgrids**

*Prof. Ashish Garg*
*IIT Kanpur*

**Research Challenges and Directions in Si and Perovskite Photovoltaics**

*Dr. Hiranmayee Vedam*
*Sustainability Champion, IITM Alumnus*

**Commercialising Sustainable Energy Technologies – Opportunities and Gaps**

*Prof. Sagar Mitra*
*IIT Bombay*

**Sustainable Energy – a scenario from solar fuel and the storage angle**

## Recommendations

- The need for electricity in coming years is going to boom in India, France and elsewhere. The development of electromobility is one of the reasons. Sustainable energy must therefore be apprehended as a whole: production, storage, management, usage and be associated with carbon capture and sequestration to improve the global footprint and balance.

- Closer collaborations between academia and corporate sectors is absolutely needed to move one step forward as large companies can "nourish" themselves from fundamental research and academia researchers need to scale-up and industrialize their innovation

- Despite existing disparities between India and France in terms of energy landscape, environment and energy consumption habits, the 2 days-workshops have shown than Indian and French researchers as well as Indian and French companies have a lot to compare and exchange. Solution-innovation for one country can help the other and vice versa

## ➢ Green chemistry, biotechnologies and natural resources

*Prof. Catherine Bennetau-Pelissero*

*ARNA, U1212 Inserm 5320 CNRS, Université de Bordeaux*

*Dr. Shubhangi B. Umbarkar*

*Sr. Principal Scientist, Catalysis Division, CSIR-NCL Pune*

This workshop was split in two sessions. The first one had a focus towards Green Chemistry, and ended with a round table that aimed to identify possible technological exchanges between India and France.

The second session was devoted to Biotechnology and Natural resources, and included a final discussion on "Questions on the uses of plants in health and cosmetics as a topic for collaborations between France and India".

India has a rich tradition of using plants for medicinal and cosmetic purposes. From the plant to in vivo assimilation, via the cell, this theme is eminently transversal. In addition, the chemistry of natural substances is also present in the scientific cooperation between India and France, applied to fields such as CO2 capture, the functionalization of materials, the reduction of emissions and micro-structured polymers.

### Speakers Green chemistry

*Shubhangi B. Umbarkar*
*Sr. Principal Scientist, Catalysis Division, CSIR-NCL Pune, India*

**Introduction to the session**

*Prof. Avinash Kumbhar*
*Savatribai Phule Pune University SPPU, Pune, India*

**DNA condensation by Coordination Complexes**

*Prof. Christophe Michon*
*LIMA UMR7042 CNRS Unistra ECPM, Strasbourg, France*

**Towards sustainable catalysts for the hydrogenation and hydrosilylation of fine chemicals**

*Vinod Prabhakaran*
*Sr. Principal Scientist, Catalysis Division, CSIR-NCL Pune, India*

**Nanocatalysis through shape and surface modulations**

*Sumanlata Jain*
*Sr. Principal Scientist, CSIR-IIP Dehradun, India*

**Semiconductor-metal complex hybrids as efficient materials for photoelectrocatalytic (PEC) reduction of CO2 to chemicals**

*Prof. Andrei Khodakov*
*Unité de Catalyse et Chimie du Solide, Université de Lille, France*

**CO2 hydrogenation to light olefins over iron catalysts: efficient promoters and reaction paths**

*Ass. Prof. Vivek Polshettiwar*
*Department of Chemical Sciences, TIFR Mumbai, India*

**Nanotechnology to Combat Climate Change**

*G V M Sharma*
*Director, Yajushi Laboratories, Hyderabad, India*

**Synthetic Applications of Bis-botonates and metal mediated reactions**

## Speakers Biotechnology and Natural resources

*Prof. Sarada D. Tetali*
*Department of Plant Sciences, School of Life Sciences, Hyderabad, India*

**Phytochemistry and Pharmacological Targets of the Selected Medicinal Plants**

The presentation relates the effects of herbal medicine on inflammation and more specifically on atherosclerosis. The main pathway is the reduction of oxidative stress. Phytochemistry helps in the identification of the active substances and of their pharmacological target.

*Dr. Alexandre Maciuk*
*Laboratoire de Chimie des Substances Naturelles UMR CNRS 8076 BioCIS, Université Paris-Saclay, France*

**Mucuna pruriens in Parkinson disease, Kapikachu in Kampa Vata: exploring relevance of Ayurveda and beyond**

Seeds of Mucuna pruriens is a typical example of natural medicinal resources which has been selected on empirical grounds by Ayurveda to treat Parkinson's disease. Advanced research confirms the striking relevance of this usage by demonstrating the synergistical effect of its bioactive constituents.

*Dr. C. N. Vishnuprasad*
*Centre for Ayurveda Biology and Holistic Nutrition, University of Trans-Disciplinary Health Sciences and Technology (TDU), Bengaluru, India*

**Ayurveda Biology: A transdisciplinary approach for health science research**

Complex biological processes involved in health and disease require a more holistic and systemic understanding, as opposed to a restricted molecular understanding. Emerging concepts of transdisciplinary concepts of medical pluralism can offer novel strategies for managing complex life style diseases like diabetes, obesity etc. Ayurveda-Biology is an example of such a novel transdisciplinary framework for future health science research.

*Dr. Cyrille Santerre*
*Institut Supérieur International Parfum Cosmétique Arômes, Plateforme scientifique, ISIPCA, Versailles, France*

**SFE, SFC-MS and their hyphenation: from extraction to characterization of lipids**

This presentation focuses on supercritical fluids used as green solvents for extraction (SFE) and chemical characterization of lipids by chromatography (SFC). Our research works also lead us to focus on the hyphenation of these two technologies.

*Dr Varsha Kelkar Mane*
*Department of Biotechnology, University of Mumbai, India*

**Validation of cosmetic manufacturing- Microbial Analysis need and future**

Cosmetic Microbiology has witnessed a number of transformations, most of which have been consumer/market driven. With an established use of chemical preservatives to prevent the growth of unwanted microorganisms in various products, the personal care sector slowly changed into greener /natural alternatives replacing the chemical preservatives. With the advent of skin microbiome and the role that it plays in skin ageing and repair, cosmetic microbiology changed gears and now uses them to achieve multiple benefits for a healthier skin.

*Prof. Catherine Bennetau-Pelissero*
*ARNA, U1212 Inserm 5320 CNRS, Université de Bordeaux, France*

**Exposure to estrogenic isoflavones from legumes. New evaluation in France and potential health consequences**

Isoflavones from legumes include genistein, daidzein and glycitein three polyphenols with estrogenic properties, being beneficial or adverse depending to the human physiological status. The study reports an estimation of the French exposure based in soy-food and ultra-transformed foodstuffs.

## Recommendations

### a/ Session on Green chemistry

The panel discussion on “Possible technological exchanges between India and France in Green Chemistry, Catalysis and Materials” was mainly focused on addressing the three questions:

1. What are the research areas where India/France can develop joint technologies that are of interest to the respective countries?

2. What kind of mechanism or support will be needed for taking lab scale processes further to market in either countries?

3. At what stage would be desired the participation of industries?

During the discussion, the following opinion have been given by the experts:

- Some of the research areas of mutual interest will be **biomass valorization**, **conversion of CO2 and propane** into value added products, utilization and functionalization of **agriculture waste** like bagasse, wheat straw etc…

- Major concern was the support needed for **scaling up a process from the laboratory to the pilot**, which is very essential before industries can decide on plan for commercialization. More specifically, some mechanism is needed for scaling up a process from one country with better prospects in the other country. Authorities from both countries could promote some mechanism to support such activities.

- **Collaborations between chemists, chemical engineers and organic chemists** are needed for upscaling the bench scale reactions.

- In order to facilitate the participation of some industrial company in the scale-up development, it was suggested to settle **bilateral start-up companies by group of students from both the countries**.

### b/ Session on Biotechnology and Natural resources

The panel discussion on "Possible scientific and academic exchanges between India and France in Analytical Chemistry, Biotechnology and Biology of natural substances" yielded four axis:

1. The need of **increasing students and researchers exchanges** on **medicinal plant activities and validation, methodology improvement and analytical training**

2. Building a bridge and tools for **experience sharing between safety authorities from France, Europe and India** to build collaborations on **safety of food, medicinal plants** and ingredients for food supplements

3. Proposal for a **steering committee helping to draw research projects on natural ingredients** research. This committee, could be connected to Cefipra, and would help to coordinate Indian and French research efforts on natural products for health and other applications.

4. The need to take into account the **protection of natural resources** and the **owners of resources** and **traditional knowledge**.

During the discussion the following elements were shared by the experts:

- In the University of Mumbai, Prof. Kelkar will now focus her work on testing new antimicrobial plant extracts to reduce skin diseases and acne. Models and tools to assess the efficiency of plant extracts are available in Mumbai and the team is ready to test any sample in line with the need of large cosmetic companies. They are also interested in pre- and probiotics, to enhance the good

skin microbiome which protects the skin health, and in encapsulation process for plant compounds.

- In TDU, the transdisciplinary approach of Ayurveda requires collaborations in omic tools including metabolomics that can help assessing complex pathways. They are interested in the exploration of cross-talks and are keen on developing cell models able to show such integrative approaches. They can undertake clinical studies to check the hypothesis drawn in vitro or on animal models.
- The team in Paris Saclay is ready to train students at PhD levels on validated analytical methods for natural extracts. The interest is also around cannabis which should increasingly be used in therapy under medical supervision. Beyond the plant production there is a great need of fine characterization to ensure the quality and efficiency of the plant extract that could be produced in India at large scale and that could be used for therapeutic purposed in Europe for instance.
- In Versailles, the Analytical teams is ready to exchange with Indian laboratory and to welcome PhD students in co-supervising. They have a large network in the fields of cosmetics, aromas and pigments. They can open this network to Indian collaborators to set up new project. They are ready to share their experience and super critical facilities for new analytical works on natural substances.
- In Bordeaux the research activity is focused on plants with endocrine effects. The endocrine substances are increasingly consumed nowadays essentially with soybean which is modernly transformed. The team is ready to collaborate with any Indian partner who will be interested in assessing the exposure of the Indian population, the effect of such an exposure and finally who will be interested on developing a solution.

# CONCLUSION

The third edition of the Knowledge Summit **focused on scientific cooperation** and was a **great success**, despite being held entirely online. With more than **350 participants and 140 speakers, i**t was well received with the high level of **involvement of the scientific community of both countries**, which confirmed the relevance of this new configuration.

The commitment of the researchers was demonstrated by fruitful exchanges which made possible:

• to identify themes for future collaborations

• to set up thematic groups or informal steering committees

• to propose transversal activities/ actions for which the Embassy/ IFI could be a driving force

• to affirm the position of CEFIPRA in relation to the joint commission for scientific and technological cooperation (COMIX) between France and India

The first part of the program was proposed in **plenary sessions.** The **Indo-french scientific cooperation in 2021** was presented, by both the indian and French authorities perspective, as well as from the indo French funding agency point of view. The panel discussion on "**Open Science**" gave rise to interesting suggestions that can allow to strengthen a common "open science" agenda in our bilateral scientific cooperation, for example for incentiving collaborative research, valorize the open access record of projects, or face the article processing charge issue. The panel discussion "**Health and Society**" pointed out the necessity of a better integration of the different sectors based on policymaking, medical innovations, health literacy, and community-centric public health interventions. Two **Keynote Lectures,** on **Artificial Intelligence** and **Marine Biology** respectively were proposed to non-specialized public.

The second part offered **seven parallel scientific workshops** in the following fields:

- **One Health**, including a specific session on *infectious diseases*
- **Marine sciences**, in the fields of *Science and Technology with focus on deep sea, Marine Biology and Biodiversity, Socio-economic transformations of coastal areas*
- **Artificial Intelligence for Sustainable Agriculture**
- **Artificial Intelligence for Healthcare**
- **Mathematical Foundations for Machine Learning**
- **Sustainable energy**, including a specific session on *Energy Storage and Electrical Vehicles*
- **Green chemistry, biotechnology and natural resources**

The participants of various workshops widely shared and highlighted the need of some **data exchange action between France and India** in the topic of **access to data**, including the aspects related to collection, sharing, policy, ethics, **open data sharing platform** and standardization. Preparing a **roadmap for One Health** has been proposed, as well as the creation of mailing groups or steering committees for specific topics.
Some coordinated actions were proposed, such as **Climate change in Indian Ocean**, **Carbon capture, Geothermal energy**, **Biodiversity assessments, protection of natural resources, electro-mobility** or **biomass valorization**. Within the scope of **Artificial Intelligence**, many topics were suggested for research,

such as solutions based on **image or remote sensing** analysis or **robotics**, processing **heterogeneous data**, or use of **frugal data**.

**Interdisciplinary approaches** help in addressing **societal and global challenges**, whose outputs facilitate communication. Therefore, projects crossing boundaries of disciplines **should be specifically supported**, while **they are generally sub-evaluated by the funding agencies such as CEFIPRA**.

Some teams stressed the **difficulty to co-funding the full joint PhD (and not only mobility)**. The model of IRD mechanism was suggested as an example.

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### About IFI

The French Institute in India / IFI (Institut français India) is the Education, Science and Culture department of the Embassy of France in India. It facilitates academic and scientific exchanges between higher institutes of learning and research, enables student mobility, promotes the French language and artistic and cultural partnerships. Cooperation between India and France takes place through a number of sectors: Arts & Culture, Books & Ideas, French Language & Education, Study in France programme, Academic Partnerships, Science & Technology, as well as Innovation and Multimedia.

www.ifindia.in

### About Savitribai Phule Pune University

Savitribai Phule Pune University, one of the premier universities in India, is located in Pune. It was established in 1949 under the Poona University Act. The university houses 46 academic departments. It is popularly known as the 'Oxford of the East'. It has about 307 recognized research institutes and 612 affiliated colleges offering graduate and under-graduate courses.

http://www.unipune.ac.in

### About CNRS

The French National Centre for Scientific Research is among the world's leading research institutions. Its scientists explore the living world, matter, the Universe, and the functioning of human societies in order to meet the major challenges of today and tomorrow. Internationally recognised for the excellence of its scientific research, the CNRS is a reference in the world of research and development, as well as for the general public.

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### About CEFIPRA

Indo-French Centre for the Promotion of Advanced Research (IFCPAR/CEFIPRA) is a model for international collaborative research in advanced areas of Science & Technology. The Centre was established in 1987 and is supported by Department of Science & Technology, Government of India and the Ministry of Foreign Affairs, Government of France. CEFIPRA is actively involved in supporting Indo-French Science, Technology & Innovation (ST&I) system through various activities. The Scientific Collaborative Research Programme focuses on academia-to-academia collaborations between Indian and French academic collaborators in various domains. The Industry Academia Research & Development Programme works on developing the linkage between industry and cademia from France and India. Dedicated mobility support programmes of CEFIPRA provide exposure to young researchers of the working, social and cultural environment of the partnering country.

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