Imprint

Issue 3

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Chandrima Home

A Gold Rush in the Mountains

Imagine a fungus that sells for more than its weight in gold! Colloquially termed as Keera jari (in Hindi) and Yartsagunbu (in Tibetan), the caterpillar fungus (*Ophiocordyceps sinensis*) is perhaps one of the most expensive biological commodities in the world. Being such a sought after commodity also makes this species and its surrounding ecosystem highly vulnerable. A recent study in the Indian Himalayas investigates how this resource contributes to local livelihoods and the possible consequences of harvest and trade over time.

The caterpillar fungus parasitises the larvae of ghost moths (Family Hepialidae). It germinates inside the caterpillar, kills and mummifies it, and a stalk-like fruiting body emerges out of the zombie caterpillar. Both the ghost moths and the parasitising fungus are found at an altitude of 3000 – 5000m in the alpine meadows of the Tibetan plateau and the Himalayas.

So what makes this fungus so coveted? Often referred to as a "medicinal mushroom", this species has been used as an aphrodisiac in traditional Chinese and Tibetan medicine.

The high demand for its medicinal properties along with a restricted area of occurrence increases the prospect for overexploitation of this fungus.

In the current study, scientists led by Pramod Yadav from Centre for Integration of Conservation and Developmental Accountability in collaboration with the Himalayan Exploration Conservation and Livelihood Program, Babasaheb Bhimrao Ambedkar University, Global Tiger Forum, Forest Research Institute, HNB Garhwal University and University of Southern Queensland, examined the harvest and trade of caterpillar fungus in Nanda Devi Biosphere Reserve, Uttarakhand.

The authors interviewed 312 households across 32 villages in the Dhauliganga Valley within the Biosphere Reserve who were involved in the harvest and trade of the fungus. In addition to reporting the economics of the trade, the authors also gathered information on whether harvesters perceived any changes over these years of extraction. Overall, from 2006 to 2015, there was more than a threefold increase in the price of the fungus. Earnings from the fungus trade contributed a significant amount to the cash income for a majority of the households surveyed.

However, when natural resources are harvested unsustainably, there are cascading effects on both the ecological and the socio-economic fabric of the system. Local harvesters not only felt that there was a decline in the fungus availability but also reported a per capita reduction in the number of units harvested from the meadows.

More importantly, the increasing demand for this fungus for its medicinal properties

The caterpillar fungus *(Ophiocordyceps sinensis)*, commonly known as Keera jari (in Hindi) and Yartsagunbu (in Tibetan) is famous for its use in traditional Asian medicine, sometimes selling at prices higher than its weight in gold. A recent study in the Indian Himalayas investigates how this fungus influences the livelihoods and economics of local communities and the possible ecological consequences of overharvesting and exploitation of this natural resource.

along with the absence of a clear policy for harvest has created a black market. "Existing government-based guidelines regarding harvest and trade are inadequate for sustainability of the trade," says Yadav. "Promoting sustainable harvest, equitable trade, and conservation of caterpillar fungus requires sufficient knowledge on trade dynamics and the legal status in caterpillar fungus range states," he adds.

Absence of a legal status of this trade along with diminishing production of the fungus have also led to community disputes over areas of collection. "The trade of the caterpillar fungus is a relatively new source of livelihood for the people living in this valley," says Yadav.

While income generated from harvest and trade is high, there are several risks that harvesters are exposed to while collecting this fungus. "Harsh climatic conditions on a

Left: A female caterpillar fungus' harvester in the alpine meadows (Photo: Subhajit Saha) ; Right: Tents and cattle of caterpillar fungus' harvesters in the meadows (Photo: Pramod K Yadav)

treacherous terrain, snow-blindness, painful joints, respiratory issues and increased human animal interactions are some of the risks that they face," says Yadav.

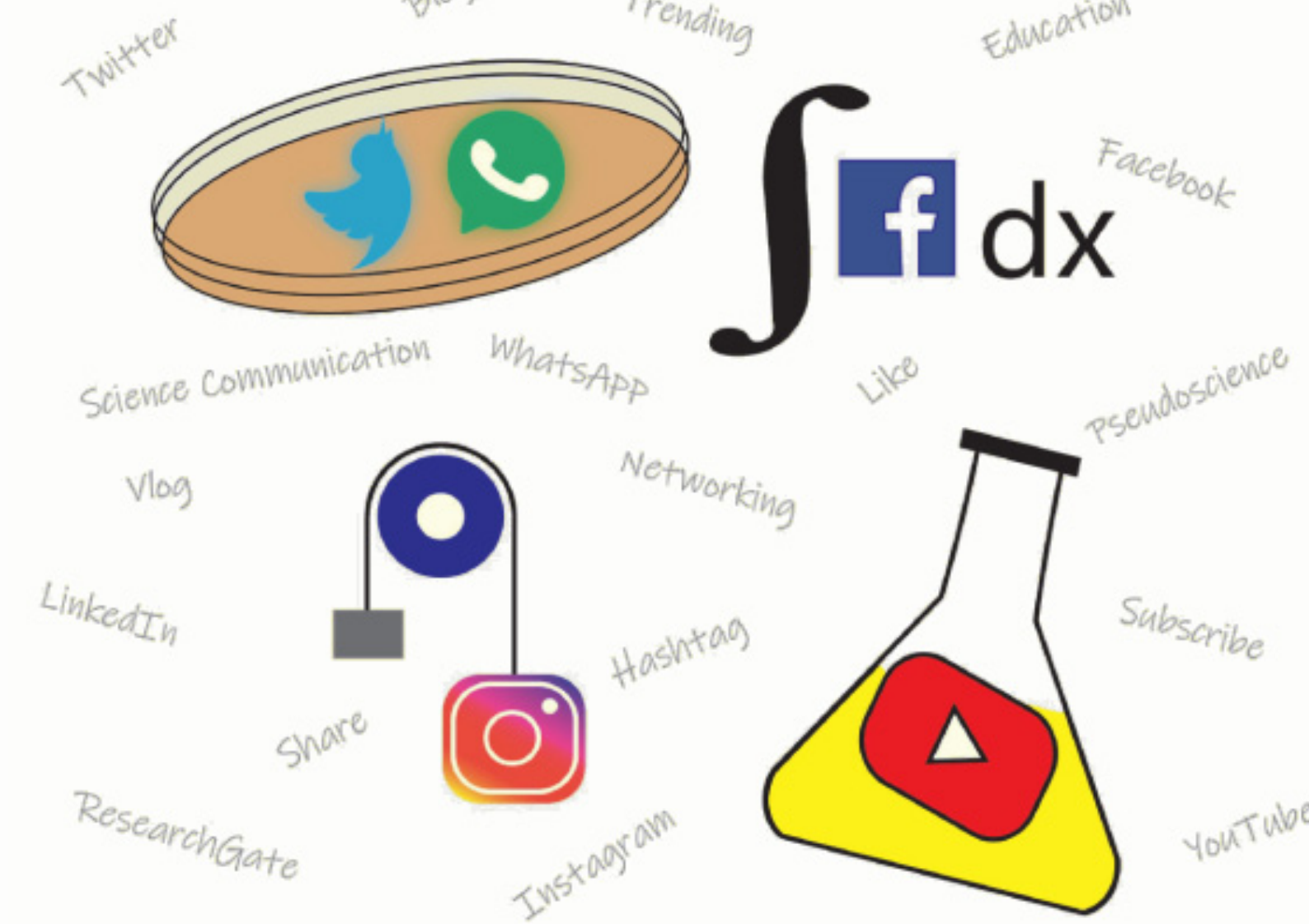
The ecological impacts of overharvesting can be manifold. The caterpillar fungus is harvested for a very small window in spring (May-July) each year during which large numbers of people camp in these meadows exposing them to trampling, soil compaction and deposition of garbage "Overharvesting of caterpillar fungus also triggers the exploitation of several highly medicinal and aromatic plants, ultimately affecting these fragile habitats," says Amit Kumar, scientist at the Wildlife Institute of India. "The study not only provides a detailed account of the economic and social aspects of the trade but also raises a concern for the decline of keera jari," he adds.

But can overharvesting be the only reason for the decline of the caterpillar fungus? A recent study shows that harvesting may not be the sole threat. A warming climate has also been contributing to its decline thereby being a 'double whammy' for the species.

The study provides important evidence on the various socio-economic aspects of trade of the caterpillar fungus. A nexus of black economy and an impending decline in the availability of the fungus necessitates the need for sustainable management policies. "Biodiversity conservation depends on local support," says Yadav. Therefore formulating these policies require adequate dialogue between government authorities and local communities along with awareness so that both conservation and livelihood securities are reconciled.

Reference: Yadav, P., Saha, S., Mishra, A., Kapoor, M., Kaneria, M., Kaneria, M.,Dasgupta S., Shrestha, U. (2019). Yartsagunbu: Transforming people's livelihoods in the Western Himalaya. Oryx, 53(2), 247-255.

Photo: Pramod K Yadav



Tweet, Post, Share, Like

How is social media shaping Indian science?

Snehal Kadam & Karishma Kaushik

The advent of social media has greatly increased the ease and speed of sharing information, and the Indian scientific community has not lagged behind. In this first article in our new series on scientific networking, Karishma Kaushik and Snehal Kadam from The Institute of Bioinformatics and Biotechnology (IBB), University of Pune, discuss the various ways in which researchers and science professionals can leverage the use of social media for influencing scientific discourse and policy.

From Aristotle's wandering lectures on the entire world of living things to Antoni van Leeuwenhoek's remarkable illustrations of bacteria under a microscope, science communication and cross-talk in the scientific community has undergone dramatic changes in scale and scope.

Over the years, treatises have given way to journal publications, discourses have been replaced by interactive webinars, and scientific letters have been superseded by almost instantaneous emails. One of the more recent changes is the use of social media platforms to reach the masses at large.

Social media, in general, has enabled a faster and larger reach of news, information, and opinions – whether it is through the sharing of articles on Facebook and Twitter, or via images on Instagram. In fact, the growth, speed and accessibility of these platforms have given each individual a voice, that can be heard louder and faster by people across the globe. Social media has, as clichéd as it sounds, brought the world closer. Tweets have become our new press releases, and everyone is trying to capture that perfect 'Instagrammable' moment.

The scientific community is not far behind when it comes to using social media for science communication, networking, and influencing policy and public opinion. In fact, scientists are increasingly embracing social media in their professional lives. So much so, that several popular science publications are helping scientists navigate social media, use social media effectively, and even survive this new-age platform.

> "The growth, speed and accessibility of social media platforms have given each individual a voice, that can be heard louder and faster by people across the globe."

There is a range of different social media platforms available for researchers, such as Facebook, Twitter, Instagram to connect, share and promote their work, ResearchGate and Academia.edu to discuss practical science issues and find collaborators, and professional platforms such as LinkedIn to build and leverage networks. In addition, popular science blogs/vlogs have made use of the reach and accessibility of social media to communicate scientific information in ways that are easily understandable to the student and citizen science community.

Popular YouTube channels like AsapSCIENCE, which makes videos using attractive drawings explaining the basics of different scientific topics, and Khan Academy, which designs online lectures on various topics, have millions of subscribers. And while text-based blogs provide a lot of in-depth information, in an age of Snapchat and Instagram, pictures have become a powerful tool in attracting and connecting with a larger audience.

Numerous schools and institutes like Harvard Medical School or the Wyss Institute, as well as individual scientists, run their own Instagram pages, sharing colourful microscopy images, complex robots, beautiful bacterial biofilms and highlights from the everyday life of a researcher. This is very valuable, as an attractive image is more likely to strike curiosity in the minds of viewers, who can then turn to various blogs/articles to learn more.

Social media and Indian science

In recent years, the scientific community in India has been seen to have a recognizable presence and engagement with social media platforms. From the scientists' point of view, benefits range from tangible ones such as finding collaborators and publishing opportunities, to the simple feel-good factor of belonging to a larger community.

We posted the question 'Has social media impacted or assisted your scientific career or opportunities in any way?' and received these responses.

> *"Not any…but many. Not always tangible gains. Could be a simple feel-good factor. Knowing that struggles & bad days are part of science and (being a) scientist & you aren't alone. Inspirational stories about how others cope with them and do great. Latest sci papers & opportunities as well".*
> *From @anups_11 (Anup Padmanabhan, Ashoka University, New Delhi, India)*

> *"It's a great way to keep up with science and stories behind it throughout the world. I got an opportunity to contribute an article and a collaboration request through Twitter. So it has worked great for me.*
> *From @poonam_thakur6 (Poonam Thakur, Goethe-Universität Frankfurt am Main, Germany)*

However, beyond this, as both interactors and observers will find, social media discussions and opinions are playing a key role in Indian science. This is evident on multiple fronts, from increasing accessibility to administrators and enforcing policy changes to determining the way the Indian science community wants to be represented and viewed, and even breaking down silos between scientists and citizens.

Here are a few thoughts we put together on how social media platforms are shaping and transforming science in India.

The Twitter 'morcha' — Shaping policy through social media

A highly powerful tool, social media allows a single hashtag to become trending overnight, reaching the twitter feed of thousands in a day. Given this immense reach, it can act as a platform for many individuals to come together, allowing users to stage 'virtual' protests, that would be difficult to achieve physically.

The 2018–2019 protest for a hike in research fellowship in India is one such example. A similar protest had occurred in 2014 as well, but this time, social media allowed a larger number of people to participate and show their support. The easy access of Twitter and the ability to tweet directly to the concerned authorities allowed researchers to voice their opinions on the need for a stipend increase. As the #hikeresearchfellowship movement gain 0ed traction on Twitter and Facebook, researchers submitted a petition to concerned authorities, to revise the fellowship amount.

While a hike in the stipend was recently granted, the decision itself created quite a buzz on social media, with researchers feeling that fraction of the hike was negligible considering the rise in tuition fees over the last few years. However, the reach and feasibility of social media allowed this protest to gain attention and authorities were able to hear the voices of individuals directly.

Social media to #savescience — Breaking down pseudoscientific myths

Pseudoscience in India is no 'new kid on the block'. Ever so often, Indian science faces the onslaught of cringeworthy claims that have no scientific evidence, from the existence of in vitro fertilization technology in ancient Vedic times to our ancestors being the first to invent planes. When these outrageous claims of Vedic science were made at the recent Indian Science Congress, the Principal Scientific Advisor, Government of India responded in a detailed blog, which among other things, stated that the large scientific community in India must hold the government and individual scientists responsible for untenable scientific claims made at the conference.

After a recent uproar to such claims, the hashtag #savescience, representing all critical issues facing science, health, and medicine, started trending on Twitter, this time spearheaded by the Indian scientific community. Scientists across India tweeted that such pseudoscientific claims not only propagate irrational thought, but they also bring disrepute to the high-quality, cutting-edge science being pursued in India.

Web warriors — Communicating science to citizens

We have all received WhatsApp 'forwards' with more than one ludicrous way of curing cancer. While the scientific community balks at these messages that peddle supernatural cures, these very platforms can also be leveraged to breakdown implausible claims, and also communicate evidence-based scientific research being done in India and worldwide.

For example, Whatsapp lends itself well for large-scale communication of science snippets that are easy for public consumption. Recently, scientists at the Centre for Cellular & Molecular Biology (CCMB), Hyderabad, discovered a new enzyme that helps regulates cell wall formation in bacteria and thereby offers a potential new drug target. While this work was very eloquently explained in newspaper articles and gained widespread attention, sharing such discoveries on web-based social media platforms would significantly enhance the dissemination and consumption of original scientific research by the public.

In this context, it would also be important to highlight the careers of accomplished Indian scientists, thereby enabling researchers to be more visible and relatable. For example, an India-focused blog, The Life of Science (TLoS), is a unique project that focuses on Indian women as role models in science and highlights the work of women scientists in India. Further, TLoS also has a strong Twitter presence, which they leverage for discussion related to gender and equality issues in Indian science. In this manner, social media can be employed as a tool to educate the community on current science developments in India and features on Indian scientists, thereby developing a rational-thinking, curiosity-driven citizen scientist community.

The Social (Media) Scientist

Another very evident trend in Indian science is the increased presence of prominent scientists and scientific institutes on social media platforms. This includes the very active Twitter handle of the Principal Scientific Advisor, Govt. of India, to that of organization heads such as the Director-General, CSIR, Secretary, Department of Biotechnology, as well as institutes such as Indian Council of Medical Research and BIRAC.

Further, an overwhelmingly large number of institutes maintain updated and interactive

websites. What this means is that the scientific community has recognized and embraced the need to leverage social media as a tool. It would have been unheard of a decade ago, but for a young scientist today, 'tagging' or having a direct online interaction with a senior administrator in Indian science is possible at the click of a button. The next step could be to popularize these handles (and possibly websites) with the public at large, whereby they could interact with science policy makers and scientists. Given recent findings that of all social media users in India, only 20% followed a science-related account, this is a gap that needs to be filled.

Leveraging social media for Indian science

There are several opportunities to continue to leverage social media to impact, influence, and shape science in India. For starters, it would be critical that individual scientists adopt social media communication as a valuable part of their research communication and outreach process, by sharing their ongoing work, published articles, and professional developments. This survey surprisingly showed that more than 80% of scientists and researchers in India claimed to have never posted updates of their ongoing research on social networking sites; which can be easily addressed.

From the technology end, a key area would be to enable platforms in native Indian languages, which would significantly enhance the reach of Indian science. For example, certain India-centric science blogs, like Science India and Science Bloggers Association, publish content in both English and Hindi. IndiaBioscience has also been pushing the envelope on developing scientific material in regional Indian languages, through their recent science communication series in Indian languages, with features on The Language Project, which offers free videos on synthetic biology in 26 different languages, and Bigyan, a science outreach platform in Bengali.

So, tweet, post, share and like, let's make Indian science trending.

Photo: Snehal Kadam

Scientific Networking in India

Networking for navigating the landscape of science careers

Siddharth Kankaria

Building and maintaining a strong professional network can aid the career development of scientists and science professionals both in and out of academia.

Tweet, Post, Share, Like: How is social media shaping Indian science?

Snehal Kadam & Karishma Kaushik

Researchers and science professionals are increasingly leveraging the use of social media for influencing scientific discourse and policy.

An Introvert's Guide to Networking

Vanshika Singh

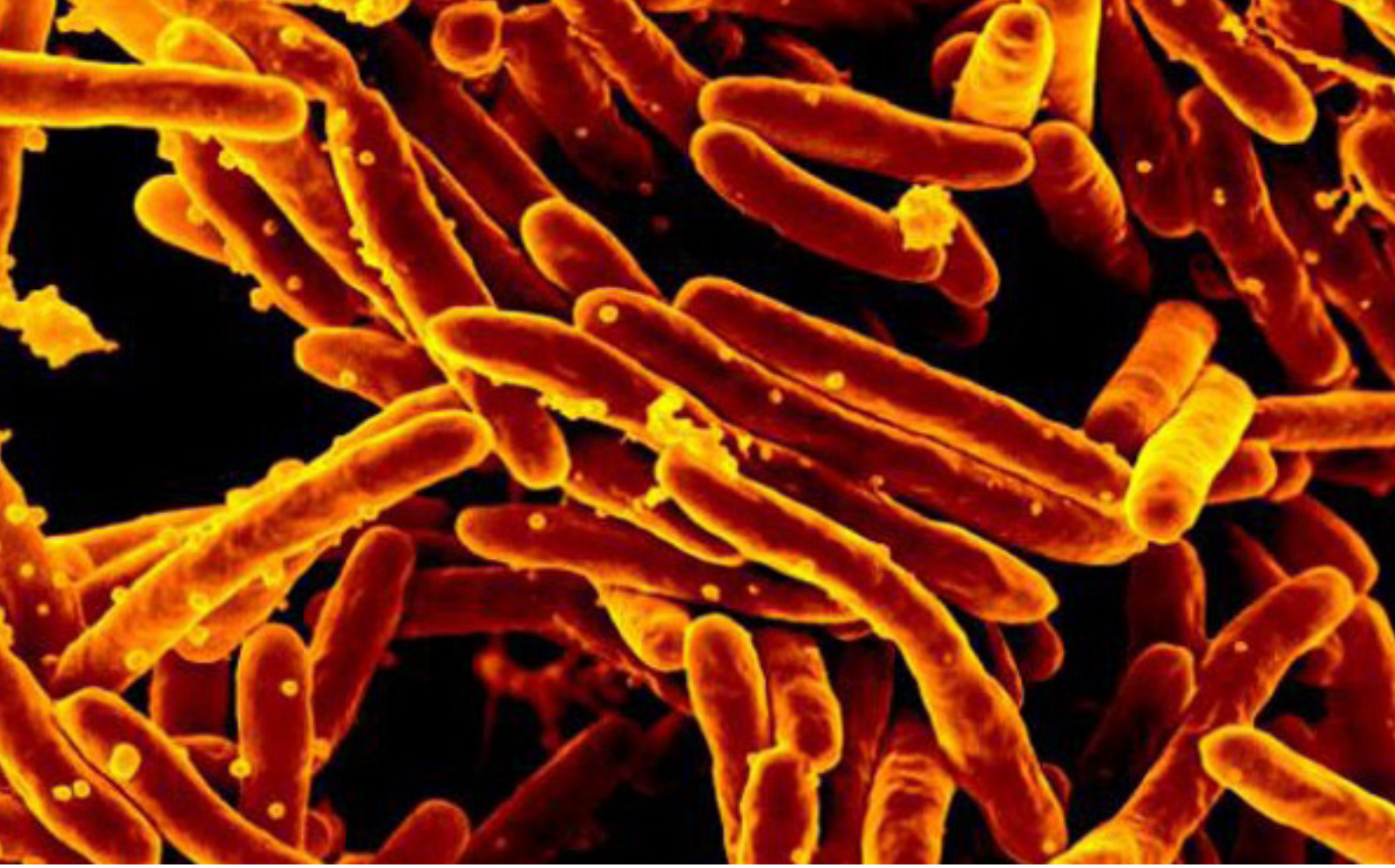
Networking can be challenging for an introverted graduate student. This article explores strategies that one can employ to derive the benefits of networking while remaining true to their personality.

Teachers connect

Anusha Krishnan

Do we need more educator-focused conferences in India? Encouraging teachers to attend or organise such meetings might elevate the quality of undergraduate education in our country.

Free exchange of ideas, knowledge, and expertise is crucial to the success of any scientific enterprise. Collaboration and networking are, therefore, skills that today's scientists need to learn and nurture in order to make progress on answering some of the most pressing questions of the day. In this series, we explored various facets of scientific networking and collaboration. Read more here - http://bit.ly/SciNetworking



A Low-Cost Paper-and-Plastic Device to Detect Tuberculosis

Joel P. Joseph

The lack of inexpensive and rapid diagnostic methods has been a hurdle in effective TB treatment. Now, scientists led by Bhushan J. Toley from the Department of Chemical Engineering, Indian Institute of Science (IISc), Bengaluru have developed a low-cost, portable device to detect tuberculosis.

Tuberculosis (TB), caused by the bacteria *Mycobacterium tuberculosis,* kills more people every year than any other infectious disease. India has the highest TB burden in the world with about 2.2 lakh reported deaths each year. Despite being curable, detecting TB cases has been difficult as current diagnostic tests are expensive and time-consuming and difficult to access. There are only about 3000 GeneXpert machines across India, which makes it difficult for a population as large as India's to access the test.

"The WHO-endorsed rapid molecular

Tuberculosis is an infectious disease that kills lakhs of Indians every year. Early detection of the disease is key to administering treatment; however, this has been hampered by the fact that current diagnostic techniques are often costly and time-consuming. Now, researchers from the Indian Institute of Science, Bengaluru, have come up with an inexpensive paper-based diagnostic device for tuberculosis detection.

diagnostic test called GeneXpert is prohibitively expensive for many and there are too few of them available in the country, given the massive disease load," Toley says. Using his past experience in developing technologies that enable sophisticated chemical reactions to be carried out on paper strips (paper-based microfluidics), Toley decided to address the TB diagnosis problem.

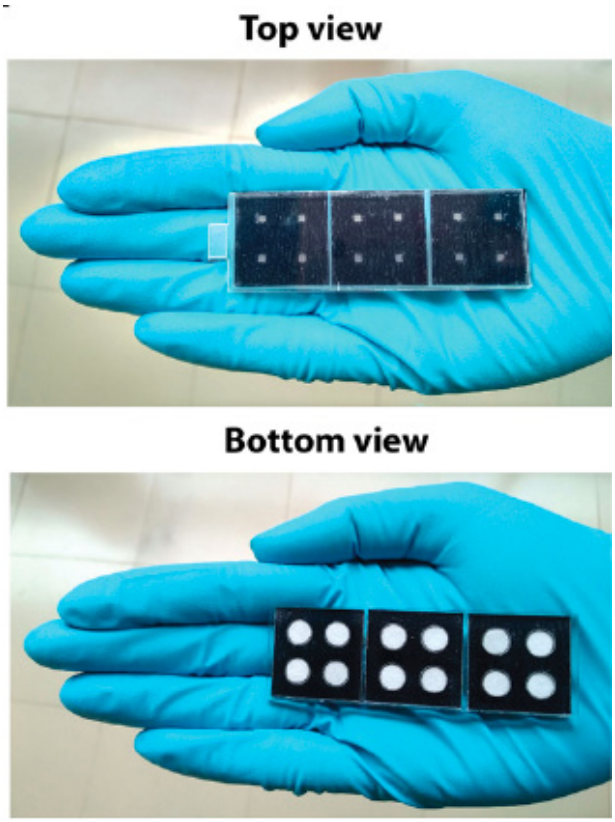
The paper-and-plastic device developed by the team enables rapid detection of tuberculosis at the point-of-care. It selectively amplifies (increases the number of copies of) the DNA of *Mycobacterium tuberculosis (Mtb)* from the DNA isolated from patient sputum. The presence of this DNA indicates TB.

The test consists of a few simple steps. First, one must add the DNA of the patient into a spot on the device (test-zone) and seal the device with an adhesive strip that comes with the kit. This set up must be kept at a temperature of 63°C for an hour. After this, one must add a fluorescent dye that binds to MtbDNA, flash ultraviolet light with a UV torch, and take a picture using a cell phone. Green fluorescence in the test zone indicates the presence of MtbDNA, hence a positive diagnosis for TB. The technology is called Fluorescent Isothermal Paper-and-Plastic Nucleic Acid Amplification Test (FLIPP-NAAT).

"With FLIPP-NAAT, we have tried to address the challenges of affordability, accessibility and user-friendliness," says Navjot Kaur, first author of the paper. While the GeneXpert test costs about Rs. 1800, a FLIPP-NAAT test has the potential to bring down the cost substantially – the team is aiming at bringing the cost down to less than Rs. 300 per test. "It is quite an important study," says Debjani Paul, Associate Professor, Indian Institute of Technology, Bombay (IIT-B), who was not involved in the study, "The World Health Organisation (WHO) has been pushing for a molecular test for TB that is suitable for primary healthcare centres. This certainly takes one step towards that goal."

Coming this far was not easy. Speaking of the challenges she faced in the process, Kaur says, "The DNA amplification technique that we use in FLIPP-NAAT is a difficult technique to handle and standardize." If the protocols were not followed religiously and the reagents not handled with utmost care, it would cost the researchers a lot of time and resources to figure out what was going wrong and to fix them. It took them almost a year to learn how to handle the technique and to understand the factors that affected the results. But once they had understood the factors that controlled the test performance, the technique was robust and reproducible.

Although this is a significant step forward in the rapid diagnosis of TB, some challenges remain – overcoming false positives and developing a rapid DNA extraction technique. Of the 30 patient samples that



The FLIPP-NAAT device ((Image: Kaur et al, Scientific Reports, 2019, CC BY 4.0)

were tested using FLIP-NAAT and compared with the GeneXpert test, there were five false positives. But the group is working on these aspects. "These are very initial results and there is a long way to go for it to be comparable with the existing molecular tests," Debjani Paul says. The device also lacks an integrated DNA extraction step, which is a crucial step for this test for TB.

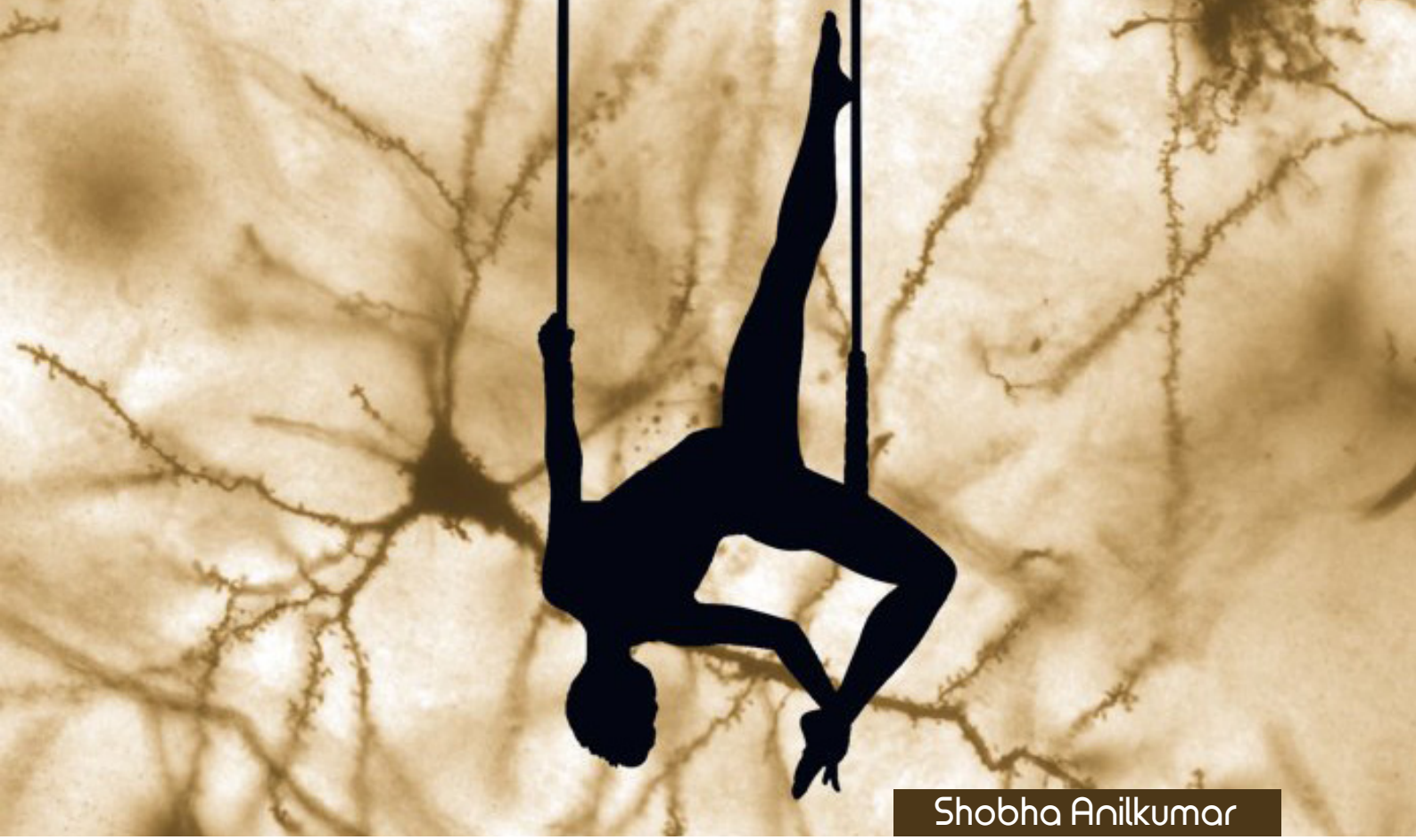
"The main focus of future work would be to reduce the false positives generated by the test. We currently have multiple approaches in mind to tackle this issue. Our lab is also working on methods to make TBDNA extraction portable and low-cost," Toley says.

Once these hurdles are crossed, FLIPP-NAAT could be a game-changer in the rapid diagnosis of TB in India. Besides its application for the diagnosis of TB in this device, it could be modified to detect other diseases as well.

Toley is careful in his claims, however. "One must be cautious about making these predictions too soon," he says, "because technology is just one link in the chain of delivering quality healthcare. For this technology to reach the masses, many other pieces need to fall in place, e.g. a commercial partner to manufacture the prototype and market it, large-scale clinical trials, and inclusion of the test in the diagnostic algorithm of the national tuberculosis control program. We are trying to take one step at a time towards this ultimate goal."

Reference: Kaur, N., Michael, J.S. & Toley, B.J. (2019) A modular paper-and-plastic device for tuberculosis nucleic acid amplification testing in limited-resource settings. Sci Rep 9, 15367

Photo: Mycobacterium tuberculosis by NIAID on Flickr [Public domain])



Shobha Anilkumar

Juggling Science and Life

The trapeze that kept me swinging

Starting her career as a nursery school teacher, Shobha Anilkumar went on to earn first an MSc and then a PhD degree while working full time and bringing up two young children. In this next article in our PhD Café series, Shobha writes about her journey and the highs and lows along the way.

Love for being around kids led me to accept a job as a nursery teacher when a friend's colleague went on maternity leave. I loved the job and even if I missed a single day, I used to get calls from parents mentioning that the kids are missing me. My family noticed this engrossment and asked me to take a serious call on my career choice.

That's when the Human Brain Bank at National Institute of Mental Health & Neurosciences (NIMHANS) advertised for the post of a Junior Scientific Assistant. The notion of getting a prestigious central government job was the driving force for me to apply. I got through the application process and accepted the job.

NIMHANS was a different world altogether and I felt like a little fish in a big pond. Human Brain Bank was part of the pathology department and S.K. Shankar was the principal investigator. He was a perfectionist and though many people were scared of him, I felt lucky working with him. Some phrases he hated were 'may be', 'could be', 'I don't know'. This taught me to think deeply and to be prepared from all perspectives before having a discussion with him.

On the Road to a Master's Degree

I only had a Bachelor's degree to my credit when I joined the department. I was exploring options for a Master's degree when my family got me married. I thought that my Master's options were gone and I would have to focus on the family as I was the eldest daughter-in-law in a very orthodox family. Days passed by. Then one day during a casual discussion, I mentioned to my husband that I was planning to pursue a Master's degree when our marriage took place and now it was a distant dream.

After a few months, he told me that Annamalai University is an esteemed university and asked me to register for a Master's degree there. The next day I spoke to my boss and he agreed and asked me to apply. I applied and had to attend 60 days of crash course and practical classes in the University campus, which is in Tamil Nadu. This was challenging because I had to convince my in-laws and also get leave from work. After some back and forth discussions at home as well as at the office, I got approval and packed my bags for the University.

During this period, I was 8 months pregnant and my family was disinclined to let me stay in a hostel. That's when a close friend's parents came to the rescue. They said "Why will she stay in the hostel when we are here?" and took care of me for those 60 days.

Then I had to appear for my theory exams, and my delivery date was close. So, every day while going for the exam, all of my medical reports and a delivery-related bag would go with me, just in case I went into labour during the exam and needed to be admitted to a hospital. My sister would sit outside the examination hall, waiting for me.

But my baby was waiting for me to complete the exam. I completed my exam on Monday and my daughter was born that same Wednesday. So that's how my first year of Master's ended. When I finished my second year, my daughter was not in the womb, but on my lap.

With an MSc in hand, the next step was a PhD. But since the pathology department at NIMHANS focused on clinical research, there was not much chance for someone from a basic science background to pursue a PhD here. Hence, settling to being satisfied with a Master's degree, I continued my work in the brain bank.

A New Innings

One Saturday afternoon in 2004, the telephone rang. I picked up the call and I hear someone saying "Hello" in an American accent. "I am Sumantra Chattarji (Shona) from the National Center for Biological Sciences (NCBS)," said the voice, "And I got to know about you from your old colleague and I am offering you a job," My reflexive reply was, "But I am not looking for a job." "That's fine, but we should chat," said Shona and asked me to come over to NCBS.

My visit and discussion with Shona changed my entire mindset. At the time I was pregnant with my second child. When I told Shona this, he said, "It is all the more reason

that you should consider the job as there is a beautiful Child Care Facility here".

I think you can guess what my decision was. I did join NCBS, but not immediately, as I had responsibilities back at the brain bank. I completed my tasks and handed over the job to my successor before going into maternity leave. I joined NCBS in June 2005, when my son was five months old. When I joined the lab, there were a number of projects with morphology as a major focus. As soon I joined I learned the Golgi-Cox technique. Initially, I had to travel back to NIMHANS regularly to use their microtome for sectioning, but then I found an old microtome at NCBS. I was told that the machine was not working, but I fixed that antique piece and moved our sectioning work to NCBS.

The Golgi technique that was used in the lab was tedious and both money and time-consuming. I spent almost six months standardising and modifying the technique to be more efficient in terms of time, money and quality. Now, there are six publications from the lab using this technique.

Those first few years were like a marathon. At home, I was equally busy, handling the responsibilities of weddings of siblings on both sides of the family. My day used to start at 3.45AM with cooking and packing lunch for my husband who had to leave by 6 AM and then getting the kids ready to leave home by 8.30AM. At some corner of my brain, the three letters 'P' 'H' 'D' lingered, but I never had time to think about it much.

On 23 February 2013, Shona called me and told me that Apoorva Sarin (Director, InStem) had suggested that given my hard work, I should register for a PhD. I cannot forget that moment. I registered at Manipal University and though I already had some data, I started my projects fresh. I used to plan major behavioural experiments during my kid's vacation so that I could come to the campus by 7 AM. And for analysis, I used to go back in the evening. With wonderful support from all directions, I finally completed my project and defended my thesis on the 27th of May, 2019. With this fulfillment of my long-time dream, I am now exploring my next journey.

Lessons learned

Here are some things that I want to share with my young colleagues.

Plan your day and don't get disappointed by negative results. They may, in fact, contribute strongly to your project. Don't be too stubborn or emotional about your hypothesis. Build a strong background in the area of the project that you join and see whether you can take forward some projects based on your seniors' findings. In parallel, work on your own ideas and by the end of your 3rd year, try to have a story ready for a publication. This will help in deciding what other experiments you need to perform to complete the project within the given time period.

My humble request is, "Please come out of the lab and spend at least a good 30 minutes every day playing on the lawn". This is an amazing way to rejuvenate. Do not compromise on your playtime. Don't say, "Where is the time?" You have the time, you just need to prioritize what's important!

I conclude with this nursery rhyme, which all of us could bear to keep in mind in our adult lives:

Work while you work, play while you play.
This is the way, to be happy and gay!

Photo: Background modified from Golgi stained pyramidal neurons by MethoxyRoxy [CC BY-SA 2.5]

"A PhD really is about solving many small scientific problems. One breaks down a broad idea into many small questions that may be linked to one another and tries to answer them one at a time."

— Debdutta Paul in
Busting a few PhD myths

"Just as science has constants and variables, so will your PhD journey."

— Jacinth Rajendra in
Welcome to the PhD Clan: perspective from a just-graduated survivor

"I used to plan major behavioural experiments during my kid's vacation so that I could come to the campus by 7 AM. And for analysis, I used to go back in the evening."

— Shobha Anilkumar in
Juggling science and life: The trapeze that kept me swinging

"In retrospect, it was not so much what I did on the day of, that made the talk a success. It was what I did in the month before, that did the trick."

— Pushp Bajaj in
From group meetings to international conferences: how to hone your presentation skills

At any point, if one is forced to leave something they have invested time and effort into, it is important to understand that it is not the end of the world or the death-knell to our degree."

— Zill E Anam in
From Challenges to Lessons

"'Are you a Doctor now, Amma?' my 6-year-old asked after sitting through my 50-minute-long thesis defense."

— Chandrima Home in
The Doc Mom

PHD CAFE

"'Research students spend a lot of their time in their labs (sometimes >12 hours a day). It is therefore essential that students invest and put consistent efforts in maintaining an environment that is apt for their mental fitness and growth."

— Parul Anup in
Do's and Don'ts for a healthy student-advisor relationship

PhD students contribute the bulk of the scientific output in the country, yet remain largely unseen and unheard in the popular narrative. Through this series which is written *by* PhD students *for* PhD students, we hope to provide graduate students with a platform to share their stories, experience, and advice with each other as well as the rest of the scientific community. Read more here:

http://bit.ly/PhDCafeIBS

The Right Time to Vaccinate against Measles

Navodita Jain

In the first year of an infant's life, maternal antibodies offer protection against most viral infections. This shield of maternal immunity is conferred through the transfer of antibodies across the placenta before birth and through breast milk once the child is born. Generally, maternal antibodies wane over a period of 6–12 months, by which time the infant's own immune system kicks in, bolstered by standard vaccination procedures.

Now, a new study funded by GSK Biologicals and carried out by researchers led

by Vidya Arankalle at the Bharati Vidyapeeth Deemed University, Pune, suggests that anti-measles maternal antibodies disappear much earlier than hitherto assumed, possibly leaving infants vulnerable to infection.

Vaccination against measles is a core component of the National Immunization Schedule for infants and children. Childhood vaccinations are timed to coordinate with the disappearance of passive maternal antibodies, as the latter interferes with the activation of the child's own immune response. Currently, the Indian measles immunization régime requires the first dose to be administered at 9 months and the second at 16–24 months.

Arankalle and colleagues found that maternal antibodies disappear earlier than 9 months. Based on this, they suggest that the timeline for administration of the first dose be revised to 5–6 months and the second to 12 months.

The researchers studied 600 children in total, 150 from each of the following age groups—6, 9, 12 and 15 months old. The researchers found that at 6 months of age, only 4.7% of the tested infants had maternal antibodies against measles, and by 9 months, this proportion decreased to 2.7%. A 2003 study carried out at Bombay Hospital with a smaller sample size of 23 infants had found 17.39% of the tested children positive for anti-measles antibodies at 9 months of age. Compared to the Bombay Hospital study, the current study suggests that antibody disappearance begins much earlier.

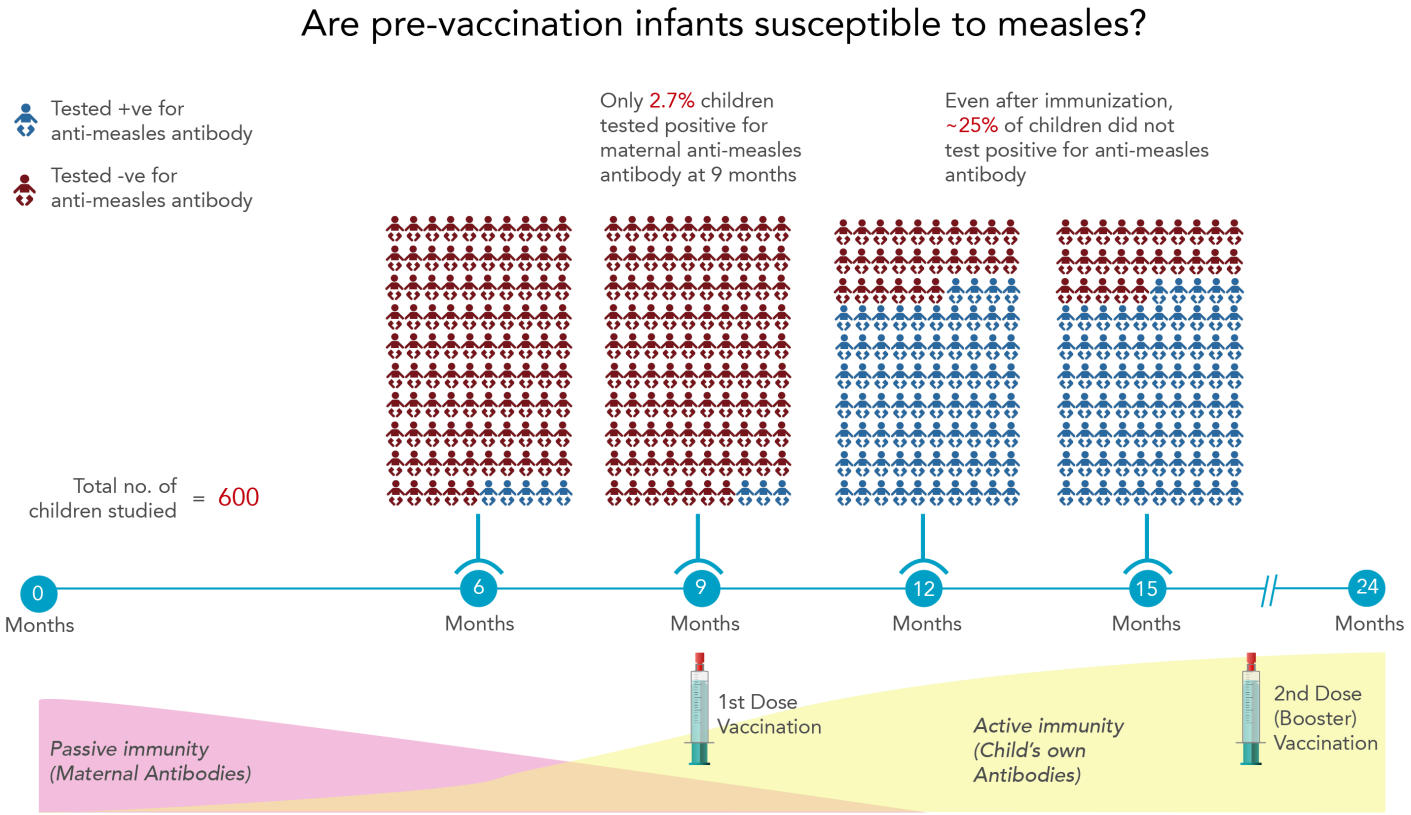
Arankalle calls this an early investigational study. "We shall follow up with a cohort of younger, <6-month-olds," she adds. The study also finds support in another clinical study at a Trivandrum hospital that reported half the number of children presenting measles to be less than 9 months old.

In India, children are vaccinated against measles starting at ~9 months of age. This time is chosen to correspond with the loss of maternal immunity conferred through the placenta or breastfeeding, which protects the infants till then. Now, a new study suggests that maternal immunity may disappear much earlier than predicted, potentially leaving infants vulnerable to infection.

Another finding of the study was that 25% of children in the 12-month and 15-month groups were not positive for anti-measles antibody, despite being immunized earlier at 9 months of age, suggesting susceptibility to the virus. This provides further support for the need to administer a second booster dose of measles vaccine, particularly in a wake of a recent report demonstrating significantly reduced measles mortality in India as a result of the second dose vaccination drive.

Sutapa B Neogi, Additional Professor at Public Health Foundation of India (PHFI) (not associated with the study) found the study interesting and speculated that the early disappearance of maternal antibodies in infants could be due to the fact that the mothers nowadays gain immunity not by getting directly infected, but through passive immunization. Such antibodies may have lower placental transfer efficacy.

However, she also added, "The population tested in one hospital is not representative of the entire country. For the results to have a potential impact at a policy level, a larger cohort should be included to increase the



Expected Trajectory of Immunity against Measles in Infants

Ref: Malshe et al, 2019

confidence interval."

A recent rise in measles cases worldwide can be attributed to the western anti-vaxxer movement (resistance against child vaccination). Anti-vaxxers arm themselves by assuming that all industry funded studies on vaccination are biased. To gain a better perspective of the current study, we asked Arankalle to elaborate on the involvement of GSK Biologicals. However, she declined to comment, stating that this was already disclosed in the paper.

Neogi does not mind the involvement of industry. However, she suggests a few actionable steps for insulating public health research from the vested interests of funding bodies (if any). "The institutional ethics committee should be aware of the funding, and ensure that there are no conflicts of interest," she says. She also advises researchers to "freeze results in the presence of a technical advisory group, declare the frozen results to the funders, and not make any changes to the results, if requested, except for any technical errors."

Reference: Malshe N, Palkar S, Kulkarni R, Lalwani S, Mishra AC, Arankalle V (2019 Early disappearance of maternal anti-measles, mumps, rubella, and varicella antibodies in Indian infants, Vaccine (37-11), 1443-1448

Photo: DFID - UK Department for International Development [CC BY-SA 2.0]

Speaking Up

Ending the culture of silence

Zill-e-Anam

Do you remember calling in sick to work one day because you didn't have the energy to wake up and go to the lab, or because you were feeling anxious, depressed or restless, and then coming up with a different 'reason' for it afterwards? This is not uncommon and almost all of us have done something similar at one point or another.

It's a common observation that a person suffering from mental health-related issues often prefers to suppress these issues instead of seeking help. A whole community of people looking calm and composed on the surface but paddling furiously beneath to stay afloat is what defines 'the culture of silence'. Being silent about mental illness in academia (and in general) is one of the leading causes of us not faithfully addressing the issue. Hence, it is important

to understand the origins of this culture and why it is so pervasive.

Why does the culture of silence exist?

Multiple concerns, both societal and personal, keep us from acknowledging and speaking about our mental health. The whole idea that mental health disorders are not similar to regular physical ailments and suffering from them is not okay, or that they are a sign of weakness, allows us to brush the conversation under the carpet. Our limited understanding of mental health issues, for e.g. the boundaries between regular sadness and clinical depression, or between day-to-day worrying and generalized anxiety, leads to decisions made in ignorance. If someone luckily does recognize that they are facing difficulties related to their mental health, they are stumped by the questions of where to go and whom to trust. The stigma and embarrassment associated overpower the suffering.

Academia serves as a breeding ground for the culture of silence despite the fact that people here are likely more susceptible to be suffering from mental ailments as compared to society in general. A large part of this non-acceptance comes from the fact that the immediate surroundings, in most cases, do not give equal importance to mental and physical illnesses. Suffering from regular panic attacks, breakdowns, and severe impostor syndrome is often considered normal and a standard part of a research career. Hence, one is asked to "just deal with it" or "get over it".

Because of the pervasive idea that "everybody goes through it" and "the nature of the work demands it", people in academia tend not to discuss their mental health struggles with the people around them. Setting extraordinarily high, rigid and narrow expectations from oneself and others lets most people believe that until certain very clear lines are crossed, one should not seek support. The constant struggle to maintain the image of a dedicated, satisfied and happy researcher leads many of us to suffer in silence.

Another factor that promotes silence in academic environments is the possibility of negative repercussions upon opening up. Many fear that their work would not be taken seriously, or that peers would not understand, or that they would be accused of ingratitude, or that others would feel uncomfortable to be around them.

What does this silence lead to?

Being silent about mental health disorders leads to a lack of visibility and false perceptions about one being alone in experiencing mental health problems. A dearth of honest communication heightens feelings of isolation, worsening the illness and amplifying the internal crisis. The illness is further exacerbated due to the patient's reluctance to seek help.

We also need to understand that the cost of silent suffering extends far beyond the sufferer. The persons' capacity to contribute positively to their environment deteriorates, relationships with family, friends and colleagues are negatively affected, and the upshot of this is an overall unhealthy atmosphere surrounding the sufferer.

What can be done to combat silence?

In order to break the culture of science, building an environment that is open to honest dialogue is the first step. The effort has to be made at an individual, peer, institutional, and policy level.

At an individual level, talking about mental health issues can help us figure out the next step forward and take action on improving the situation. Depending upon the severity of the condition, simple breathing

techniques, exercise or yoga may help some, while others may need extensive therapy or medication. But one can only figure out which end of the spectrum they are on if they actively open up about what they are feeling.

An important question here is who to speak to? Family members and good friends can often be the first choice. However, many times this may not be possible due to circumstances or a lack of knowledge/ understanding on the part of one's loved ones. It is, therefore, a good idea to identify people at your workplace whom you can talk to freely. Talking to peers at an individual level does two things – (1) makes one feel better and lighter, (2) many times the listener might also end up sharing their own experiences making one realize and accept that they are not alone in this. This has a much more profound effect than simply saying that mental health issues are very common these days. Also, one might also end up learning about some practical solutions to common problems.

Immediate surroundings, especially peers and workplace, play an important role in encouraging one to open up. Listening without judging and treating sufferers normally afterwards breaks down many such barriers. Making it clear that self-disclosure will not lead to persecution but admiration can help in normalizing the discussion. Talks, where faculty members open up about their experiences with mental health, can also help in building a more receptive environment promoting students to look into similar signs and seek help if they are suffering. Such discussions can also raise awareness among people who have never suffered from any mental illnesses. This can help them understand that if someone complains, there might be some underlying issue that needs attention.

Zill-e-Anam discusses the culture of silence that prevents many researchers and students from discussing their mental health issues, thus compounding the problem and delaying treatment for those who need it the most.

Principal Investigators (PIs) should take mental health seriously and be trained to identify academic and personal crises appropriately so that in cases where students are not opening up, they can initiate the discussion. Initiatives like Time to Talk can also help us break the culture of silence.

Another major roadblock in opening up about mental health issues and seeking help is the lack of affordable and approachable therapists. For addressing counselling needs, fast-responding medical systems need to be developed. Academic organizations need to bridge the gap between the mere existence of resources and their proactive usage.

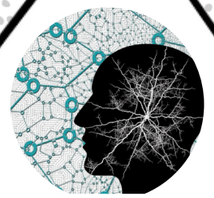
At a wider public level, discussions and debates to put physical and mental first aid on equal footing are necessary. This does not mean that stress or depression can be eradicated completely from academia. It is normal for us as human beings. But we need to learn to address and handle it. By ensuring that the discourse on mental health is free and open, discussions leading to policy changes can be promoted, ultimately leading to acknowledgement and protection for those suffering.

Lastly, this article was born out of the fact that someone had the courage to break the silence and said, *"I suffered from it, I know how it feels, and there is help available."*

Mental Health & Indian Academia

Speaking up: Ending the culture of silence

Zill-e-Anam



Wake up academia, it's a brand new mental health patient

Debdutta Paul

Sowing the seeds of a long-term mental health study in an Indian population

Shantala Hari Dass

You don't have to be 'crazy' to be doing a PhD!

Hina Lateef Nizami

Mental Health Fiesta at New Delhi

Hina Lateef Nizami

Lessons from a mental health workshop in an undergraduate college

Charu D. Rawat & Sagnik Das

We are progressively seeing the signs of a burgeoning mental health crisis in academia. In this ongoing series, we have been examining the status of mental health awareness and research in the Indian context, and discuss possible strategies and interventions to counter the issue.

Read more:
http://bit.ly/MentalhealthIBS

From Students with Love

New bacteria named after an Indian microbiologist

Lekha Bandopadhyay

Led by Ranadhir Chakraborty, Professor, North Bengal University, Siliguri, a group of researchers have identified a new genus of bacteria capable of degrading a fatal neurotoxin, 3-nitropropionic acid (3-NPA), produced by many plants and fungi. The scientists named the new bacteria *Pradoshia eiseniae,* to honor their beloved mentor late Pradosh Roy, an eminent Indian microbiologist.

"Pradoshda is omnipresent in our mindscape. He pops up every now and then in our daily discourse," reflect Chakraborty and Wriddhiman Ghosh, Associate Professor at Bose Institute, Kolkata. Chakraborty and Ghosh, who collaborated for this study, were incidentally the first and last PhD scholars to finish their thesis under Roy's supervision, respectively.

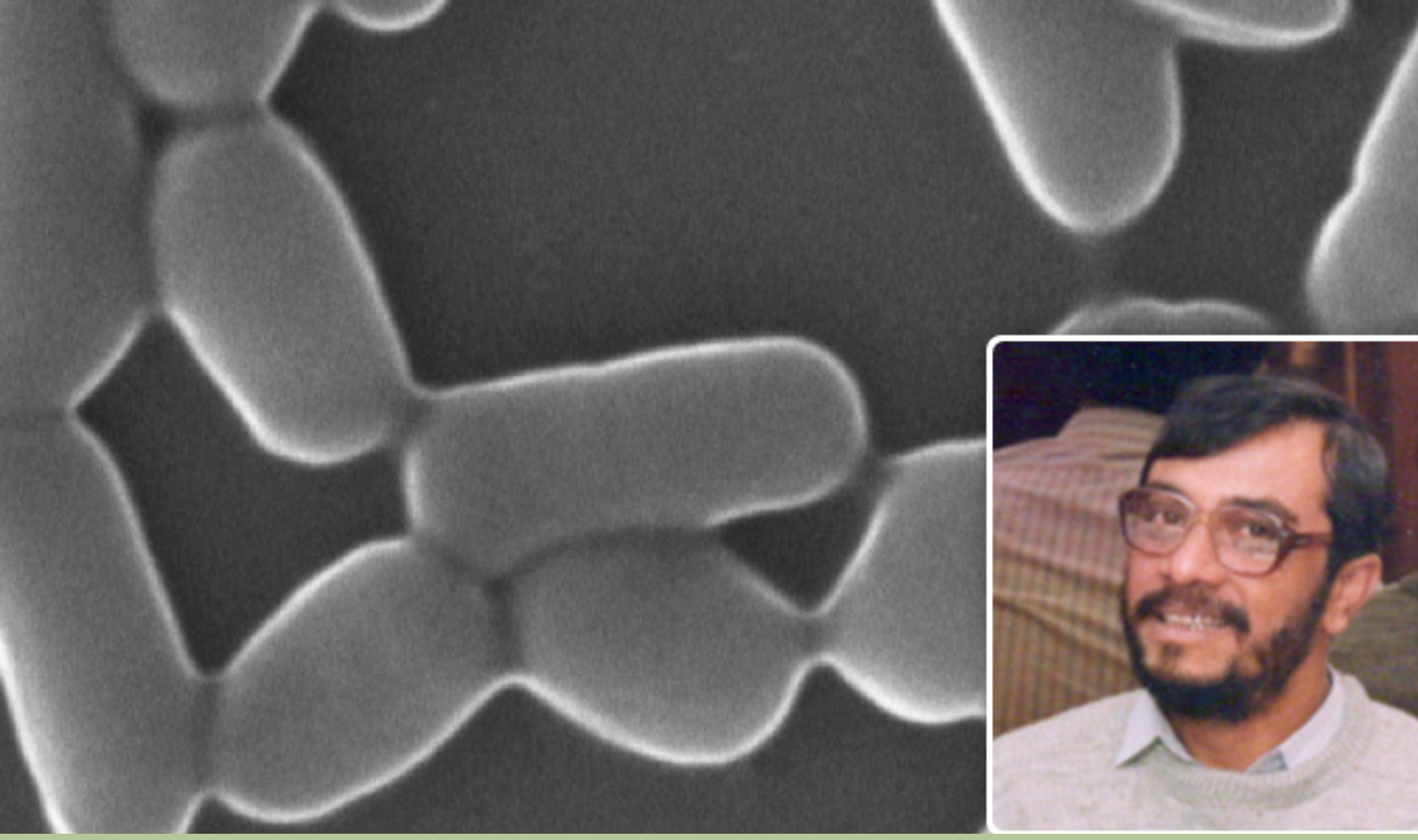
Roy worked at the Department of Microbiology of Bose Institute from 1990 till his untimely death from cancer in 2005. In his short lifespan, he made pioneering contributions in the discovery of genes and regulatory elements essential for microbial sulfur oxidation. His contemporary Arun Lahiri Majumder, presently an INSA Senior Scientist, describes Roy as "An extremely brilliant and innovative scientist, he interacted with his students like friends. They learned from each other. He was loved by his students and colleagues alike because of his remarkable unassuming nature."

The hunt in the worm gut

Capable of crossing the blood brain barrier, 3-NPA irreversibly inhibits mitochondrial respiration causing involuntary muscle contraction. There are several reports of food poisoning outbreaks caused by this neurotoxin. Interestingly, some cattle can convert it to nontoxic forms with a little help from their ruminal microbes. So what about earthworms, who are famous for being voracious dung eaters and consuming rotting vegetation on the ground, both being potential sources of 3-NPA?

"If you notice those worms, they rarely appear sickly, suggesting a very strong immune system," says Chakraborty. As these worms obviously have the guts to deal with toxic compounds like 3-NPA, researchers of the current study aimed to test whether any assistance was coming from the microbial community within the worm gut.

The researchers cultured the gut content of redworm *Eisenia fetida* on laboratory media containing 3-NPA. From this, they were able



Electron micrograph of Prodoshia eiseniae; Inset: Pradosh Roy (Photo: Ranadhir Chakraborty and Wriddhiman Ghosh)

to isolate 3-NPA consuming bacteria, even capable of surviving solely on a diet of this neurotoxin.

An all-round analysis of the isolate confirmed characteristics typical of spore forming members of the Bacillaceae family. However, there were enough differences from other known members of the family to demand that the new bacteria be classified into a separate genus and species. Decoding the bacterial genome sequence unveiled the presence of enzymes necessary to break 3-NPA. The genus of this new Bacillaceae has been named *Pradoshia* after Roy and the species eiseniae after the source organism E. fetida.

"P. eiseniae can be useful in several ways in the bioremediation of toxic 3-NPA," notes Chakraborty. Punyasloke Bhadury, who studies marine microbes, currently Head of the Department of Biological Sciences at Indian Institute of Science Education and Research, Kolkata, says, "This is a potentially novel discovery with far-reaching consequences for safeguarding human health. This bacterium can offer a new approach in the food industry towards breakdown of 3-NPA."

A LASTING IMPRINT

Ghosh says, "As our guide, Pradoshda was always thematic and philosophical, dealt with logic-building and seldom talked about the techniques, or for that matter the fashionable methods of contemporary science; and that's exactly why he hasn't lost, and shall never lose his relevance in our thought process and intellectual existence."

In this era of publishing madness, this inspiring mentor-mentee connection instead reminds us that there is more to the scientific enterprise. As Chakraborty recalls Roy often saying, "Think differently!"

Reference: Saha, T., Ranjan, V. K., Ganguli, S., Thakur, S., Chakraborty, B., Barman, P., … Chakraborty, R. (2019). International Journal of Systematic and Evolutionary Microbiology, 69(5), 1265–1273.

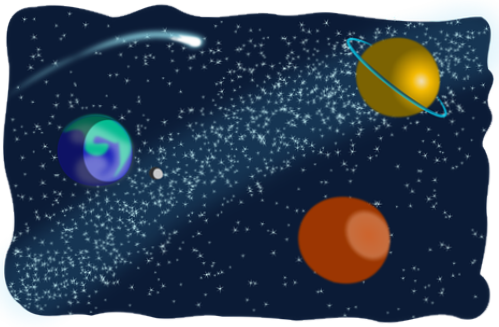
Why Does Science Communication Excite me?

Kollegala Sharma

If I think about how I became a science communicator, I find that it is a full circle. Popular science got me interested in science, and science pushed me to communicate with others. As a child, I had dreams of serving society as a touring doctor and building a new nation, but that was not to be. When I look back at my journey, sometimes I wonder how I managed to reach here despite the poverty at home and my resource starved hometown of Kollegal.

The answer probably is books. In school, because of my stunted stature, I was often a "play-thing" instead of a "play-mate" for my classmates. Bullied and frustrated, I took shelter in reading. Not that there were many books around – the school library was half an almirah! But one of those books, Nakshatra Loka, kindled my imagination. I still remember the first sentence: "Look at the sky. There are billions of twinkling stars, each billions of kilometres away from another. Now imagine how vast the Universe could be!"

Even though I was barely ten-years-old at the time, these sentences awakened my love for science. It was only as a grown-up, and as a science communicator, that I found



that the book was written by Sri R. L. Anantharamaiah, a pioneering science writer in Kannada, and father of the legendary aeronautics engineer-scientist Roddam Narasimha.

My imagination ran riot, even when watching movies. Those were the days of mythological movies in Kannada. Once, when I was in the third standard, I watched Dashavataram, a Telugu movie. That night I couldn't sleep. What will happen to us, I wondered, if the Earth, as shown in the movie, goes under the ocean? Would we all die? What would happen to the people on the other side of the Earth? I asked my parents, my teachers, even lost several nights of sleep. There was no answer. In fact, I wouldn't find one until several years had passed.

My next encounter with popular science took place while I was an undergraduate. Enrolled in a small college in a remote town where postings were seen as a punishment, we had no option but to study by ourselves. But whether it was taught in class or imbibed via self-study, taxonomy was equally boring.

It was then that I came across BGL Swamy's Sahitya Akademi award-winning book, "Hasiru Honnu". Humour, literature and science were judiciously mixed in the book, actually making taxonomy enjoyable. I think it may be one of the very few popular science books that have received a literary prize in India.

The book made me ask: why can't our teachers teach like Swamy? Why are our textbooks so boring? That was the beginning of my journey into reading popular science. I had a job as a part-time typist and spent all my earnings on buying more books and magazines. Incidentally, Kollegal used to get only one copy of Science Today every month, and that was reserved for me!

As a post-graduate student, I found it very difficult to find reading material in Kannada on evolution, genetics or molecular biology. It was a time when exciting things were

> "Bullied and frustrated, I took shelter in reading. Not that there were many books around – the school library was half an almirah!"

happening in the fields of immunology and molecular biology. Monoclonal antibodies were in the news. Oncogenes had just been discovered. Stem-cells were a new concept.

But journals took at least 3 to 4 weeks to arrive at the library and as a result, we were the last to hear about any exciting discovery. That is when I decided to write, and write in Kannada, on every new topic which excited me. My first few articles were published as a student. And then there was no going back.

I kept on writing while I was doing research, and then finally took the plunge into full-time science communication. I wrote a weekly column on science for a Kannada newspaper for 16 long years. The idea was to write about the latest discoveries, for which I

Kollegala Sharma has been a science communicator for over forty years. His most recent venture is Janasuddi, a weekly podcast about science in Kannada, which is circulated amongst thousands of people. In this invited article, he writes about how his early experiences and interests led him to science communication and what keeps him going.

> While things have changed now that the internet is pervasive, the language barrier remains.

relied on peer-reviewed papers.

It has been over four decades since I began my journey in science communication. And it still excites me when I can explain a discovery to someone, one which I had myself found difficult to understand.

Breaking the language barrier

I am very vocal about the need for communicating science in non-English languages. It has been my experience that students from rural areas lack resources to update their knowledge. While things have changed now that the internet is pervasive, the language barrier remains. Even on the internet, Kannada resources are scanty.

I began a science blog in Kannada in the days of the dot-com boom. It was difficult to keep going due to technical issues such as lack of compatibility with fonts and software. Today Unicode has solved many of these issues. Besides, dissemination of information through social media, especially on messenger services like WhatsApp is not only rapid but also has high impact. They also provide an opportunity to interact directly with the audience.

Lately, I have begun distributing an audio magazine titled Janasuddi. It is a digest of science news in Kannada. About 30 minutes in length, each edition is distributed to around 2000 people directly through WhatsApp. These listeners then share it with their friends and family. The podcast is free and hence community radios in Karnataka re-broadcast the digest, thus taking the news to remote corners of the state.

The most challenging aspect of science communication is getting the audience interested. The tag "science" itself puts off many readers who assume that scientific texts are difficult to read. Besides, many such texts sound unnatural due to translation. It is also a fact that a substantial percentage of high school students have poor reading and writing skills.

I ventured into podcasting with these thoughts. And the rewards have been very precious. I chose audio because the tools to produce good quality audio are easily available and distribution is easy. I don't have a studio, but can still get near studio-quality audio very easily. The low level of technical skill needed also means that the process can be inclusive. For example, listeners as far away as the US have provided audio for my podcasts. Listeners without any scientific background have volunteered to help in the production.

One of my listeners is an 80-year-old lady who sends voice messages (she can't send text messages) after every episode. She listens to the podcast because that is the only means for her to get information. After listening to a translation of the Voyage of the Beagle by Charles Darwin, she asked me if that was true and if scientists really suffer such hardships to find answers.

Time for a change

For those who wish to start a project on science outreach in Indian languages, it is important to understand that text as a medium of communication is not as relevant

any more. It can, at best, be a preparatory step. Blogs, newspapers, magazines etc. are not impactful as a well-made video or audio. My experience is that a science communicator cannot now remain just a writer. He/she has to be a multimedia person, able to use all three modes – text, video and audio in synergy, and if possible, even venture towards non-traditional modes such as performing arts and illustrations.

The nuances of translation of scientific texts also need to be different. The focus must be the reader rather than the source text. Unless we shift our emphasis to effective communication rather than fidelity to the original text, Indian language science texts will not gain popularity.

I chose to be a generalist, as there is a dearth of writers or communicators in Kannada. Almost all popular science communicators in Kannada have been generalists though they usually prefer one subject over others. I choose to write on those topics that excite me, those I feel others should know about, and those which are basic to our understanding of the world. If it is a difficult topic, I take my time to understand it and then explain the same to a new audience.

> “One of my listeners is an 80-year-old lady who sends voice messages (she can't send text messages) after every episode. She listens to the podcast because that is the only means for her to get information.”

Over the years, my presentation might have changed, but the conviction that communicating science in Indian languages is a necessity remains the same.

ಜಾಣಸುದ್ದಿ

The Journey of the Language Project

The Language Project offers free video courses in synthetic biology in 26 different languages (9 of which are Indian) and is the brainchild of a group of undergraduate students from the Indian Institute of Technology (IIT) Madras.

Mugdha Mohkhedkar, Roshni Shetty, Sahana Gangadharan, BP Kailash & Mousami Shinde

Bigyan: A science outreach platform by researchers in Bengali

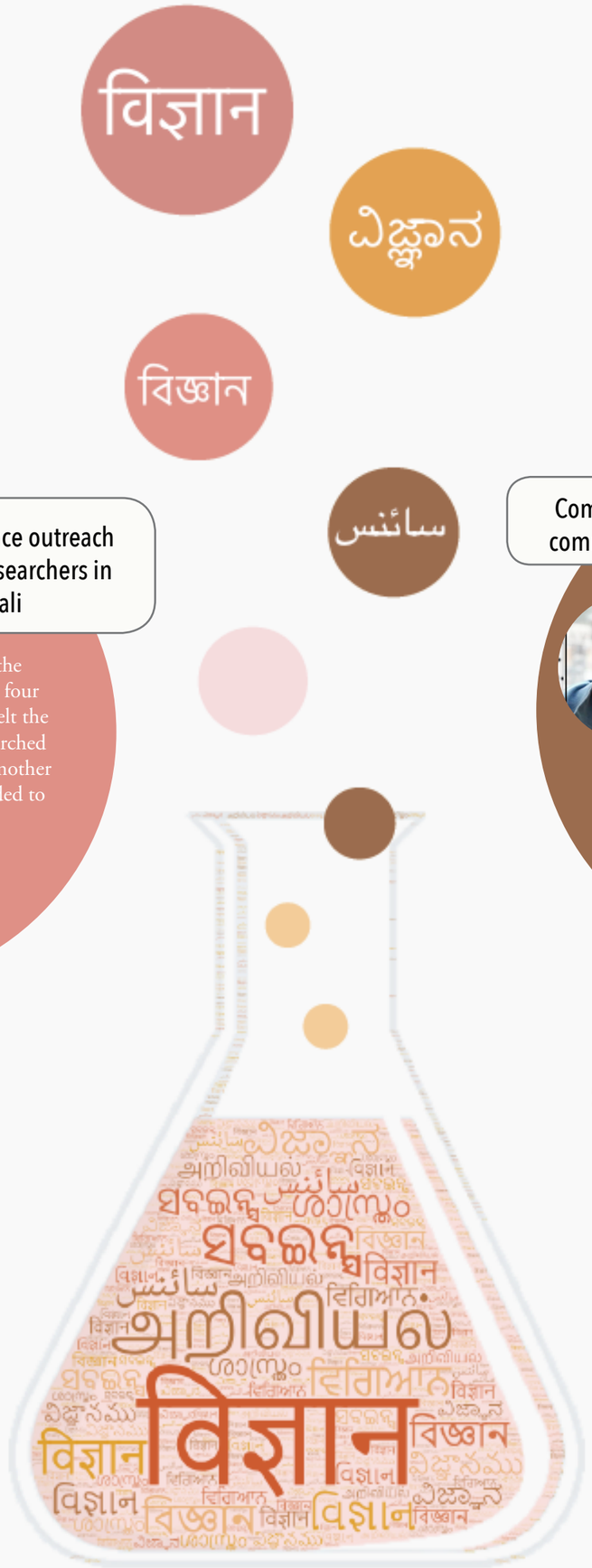
Located halfway across the world from each other, four dedicated researchers felt the acute lack of well-researched science stories in their mother tongue, Bengali, and decided to come together to fill this gap.

Anirban Gangopadhyay & K. Rajibul Islam

Science Education in Marathi at HBCSE

For the last four decades, the Homi Bhabha Centre for Science Education (HBCSE) has been steadily pushing science education for primary and secondary school children in both rural and urban areas, through the medium of innovative activities and publications in multiple Indian languages, including Marathi, Hindi, Urdu and English.

Rohini Karandikar



In a country with 22 official languages and over 700 additional ones, English still remains the language of choice for most mainstream science communication. In this series, we asked some of those individuals who have not allowed language barriers come in the way of communicating science to share their experience and insights. Read more here - http://bit.ly/indianlanguages

Communicating science is communicating excitement

Narmadha Devi writes about mathematics for children in the Tamil student's daily – 'Pattam', a product of Dinamalar groups. She discusses the importance of presenting science to children in an accessible, attractive and rational manner in order to build scientific temper and enhance their interest in science as a whole.

Narmadha Devi

Why does science communication excite me?

Kollegala Sharma has been a science communicator for over forty years. His most recent venture is Janasuddi, a weekly podcast about science in Kannada, which is circulated amongst thousands of people. In this invited article, he writes about how his early experiences and interests led him to science communication and what keeps him going.

Kollegala Sharma

Sumeet Kulkarni

Evolution of Geckos Linked with Past Climatic Conditions

"You might not appreciate how pretty they are," says Aparna Lajmi of the geckos she studied over the course of her PhD at the Indian Institute of Science (IISc), Bengaluru. She is the lead author of a new study linking these little critters to changing past climates in the subcontinent. "Beyond the pale ones we see in our house, one can find many related species in the wild which have different body types and patterns, and they're all pretty," Lajmi says.

Lajmi and her colleagues found that the evolutionary timescales over which distinct body forms started appearing in different species of geckos correlate with changes in their habitat as a result of the evolving climate in the Indian peninsula millions of years ago.

Based on a technique known as the 'molecular clock', scientists believe that geckos belonging to the genus *Hemidactylus* first appeared on the Indian subcontinent about 36 million years ago. From their common ancestor, the geckos today have

evolved into many species which can be divided into 2 broad categories: the scansorial kind which has the ability to climb vertical walls and live in rocks, crevices, trees and urban households, and the terrestrial kind which lives mainly on flat ground. The former are generally longer and have enlarged toepads which help them climb.

How did these different lineages develop? Whenever a group of organisms first occupies an entirely new patch of land, they tend to quickly diversify. This leads to a burst in the formation of new species. This is because competition drives individuals to occupy different comfort zones in terms of the place they live, the food they eat and so on. Each comfort zone forms what is known as an 'ecological niche'. A group of individuals adapting to a particular niche will start accumulating characteristics unique to surviving in that niche and will eventually diverge to form a new species.

Many such niches give rise to many closely related but distinct species evolving from a common ancestor, like rays emanating from a common point. This phenomenon is called 'adaptive radiation'.

This is what Darwin observed in the famed finches of the tiny Galapagos islands. The tiny islands harboured as many as 15 different species of finches with slight variations in their features, most prominently in the size and shape of their beaks. Darwin realized that this resulted from the fact that each type of finch had uniquely adapted to eat a particular kind of food like seeds, insects and nectar—which formed the niche for that particular species.

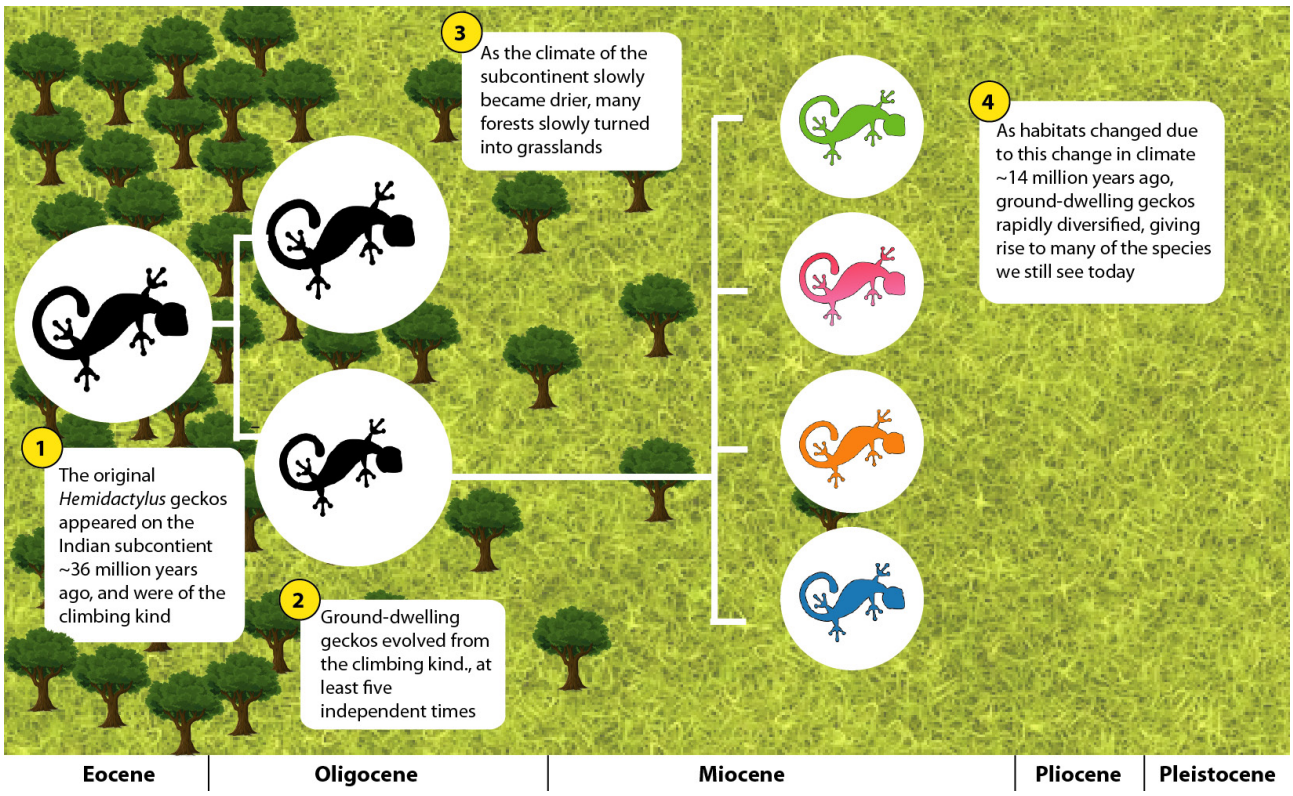
Lajmi and her colleagues came across this kind of differentiation while sampling for terrestrial geckos in the arid landscape of the Deccan plateau. They discovered a new species which showed features different

The Hemidactylus geckos have evolved into several distinct species in the Indian peninsula, some of which often show up as uninvited guests in our houses. Researchers at the Center for Ecological Sciences, Indian Institute of Science (CES-IISc) have shown that differences in morphology among species of ground-dwelling geckos can indicate changes in the past climate of peninsular India.

from anything seen before. Speaking over the phone with her advisor Praveen Karanth soon after, Lajmi recalls exulting "Wow, this looks like a case of adaptive radiation!".

Originally working on a different question, the researchers diverted their attention to closely studying the morphological differences between different species of ground-dwelling Hemidactylus geckos. Among these, they observed many different forms that seemed to correlate with different kinds of habitat.

When these geckos originated in India 36 million years ago, they were all of the climbing kind. Interestingly, the researchers found that geckos began to live on the ground and diversified into several different ground-dwelling species much later than this, around 14 million years ago. This is contrary to the expectation of the 'early-burst' model of adaptive radiation, which says that most of the species diversification occurs immediately after the first appearance of a population.
"It was expected that the ground-dwelling type of morphology evolved independently



Ground-dwelling (terrestrial) geckos underwent rapid diversification when a drier climate converted forests to grasslands on the Indian peninsula (Note: Geological epochs not drawn to scale) (Image: Shreya Ghosh)

from the more climbing variety of geckos, but the timing of when that happened is the most exciting thing here," says Aaron Bauer, a Professor of Biology at Villanova University, USA, and an expert on geckos who was not involved with this study.

What caused this delayed diversification? The period around 14 million years ago is referred to as the late Miocene era. The climate in the Indian subcontinent at that time morphed into much drier conditions which led to the conversion of forest habitats into dry grasslands. This created new niches for geckos to adapt, which in turn led to the development of distinct morphological features to facilitate their terrestrial life.

By linking the diversification of terrestrial geckos to the late Miocene era, the researchers have placed an important timestamp on when the climatic conditions governing their habitat changed. "The climate change seen during the Miocene era is a global phenomenon, and this is one of the first studies to show that the same is also true for India," Bauer notes.

Species diversification is a complex process that depends on a multitude of factors. While it is hard to definitively link the evolution of ground-dwelling gecko species to changing climates, there is a strong correlation. The case can be strengthened by observing the same patterns in the evolution of other organisms around the same period, which is an area of active research.

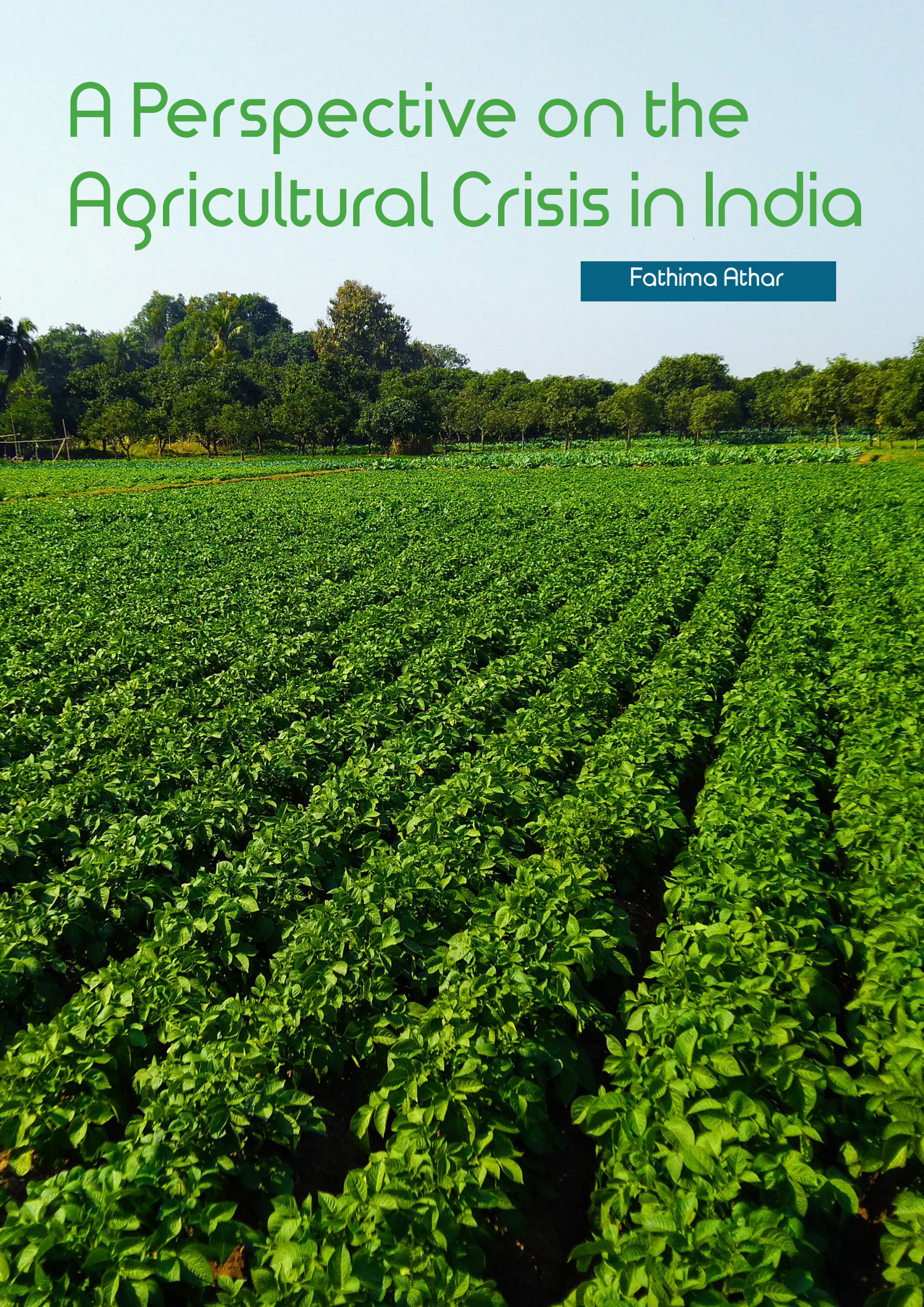
This study serves as an example of how investigating the glorious diversity of life on the planet we now call home can provide snapshots of how it looked like when it was our cradle.

Reference: Lajmi, A., Verma, A., & Karanth, K. P. (2020). Repeated evolution of terrestrial lineages in a continental lizard radiation. Journal of Evolutionary Biology, 33(1), 57–66.

Photo: Aparna Lajmi

A Perspective on the Agricultural Crisis in India

Fathima Athar



How did the agricultural crisis start in India?

If I go to a doctor and tell him that I have a headache, the doctor diagnoses the cause and treats it. But unfortunately, in the past, whenever farmers reported agricultural problems, the scientific community blamed the farmers for their illiteracy and not following the instructions they were given, rather than understanding the problems.

When water levels started getting depleted, pests developed resistance, fertiliser use efficiency decreased and factor productivity went down, mainstream agriculture never responded to the crisis. We became more technology and product-driven. We dismissed taking a scientific approach for problem diagnosis in agriculture creating the crisis.

I can give you several examples. Today, in Telangana, cotton is grown in more than 50% of the crop area, while not even 15% of the land is suitable for cotton. Crop failure is inevitable when a crop that usually grows in black soil with irrigation comes into rainfed areas with shallow red or chalka soils. As a result of farmers growing water-intensive crops, groundwater depleted.

Often, hybrids were turned to as solutions for falling yields or failing crops. But hybrids can only perform in specific growth conditions unlike local varieties, which can withstand the existing conditions and survive better. Glyphosate (herbicide) use in India is increasing significantly even though the World Health Organisation has declared Glyphosate as a known carcinogen. Though recommended only for few crops, it is sold and used all over the country all year round.

I believe mainstream agricultural institutions entered a monoculture of ideas and failed to innovate. They copied solutions from the West and never entered a dialogue to discuss the farmers' crises. The world has now recognised and moved on to agroecological approaches. But in India, not a single institution talks about it. We don't innovate; we don't learn from contemporary innovations.

How have government policies contributed to this crisis?

The government's functions can be understood from its two roles – (1) investing

G.V. Ramanjaneyulu is the executive director of the Centre for Sustainable Agriculture (CSA), Hyderabad. Following his PhD, he gave up a well-paying job to establish CSA, a non-profit organisation which aims to find solutions to the crisis that Indian agriculture is in today. He is recognised for his efforts in pioneering non-pesticidal management in agriculture. In this interview, Ramanjaneyulu explains the causes of the agricultural crisis, the need for sustainable agriculture in our country, CSA's history and the the various initiatives that it undertakes.

and incentivising activities or products required for the greater good; and (2) regulating activities which may have negative impacts. However, presently, it has failed in both.

There are no long-term policies on use of natural resources like land/water or biodiversity in our country (these three being primary resources for agriculture). Not many private companies or new technologies were in play when the 1966 Seed Act was passed. Since then, there have been no new regulations for seeds. Much later, the PVPFR (Plant Variety Protection and Farmers Rights Act), the Biodiversity Act etc., came into existence giving new rights to farmers and more responsibilities to the government, but these are not accommodated in the regulations. The new seed bill has been pending in the parliament for the last 14 years.

The current crisis in farming is also about farmers' incomes. 85% of farmers have low incomes (about 5000 Rs/month/family), which have not increased for many decades. There have been talks about moving people out of agriculture in the last 20 years but no sector has provided any gainful employment to people.

As a result of all of these factors — the collapse of public institutions and the failure of the government in meeting the changing needs of farmers and establishing necessary support systems — farmers are caught in crisis.

What changes are necessary within the scientific community and science policy in India to combat the agricultural crisis?

Fixing accountability at various levels and taking an integrated approach towards agriculture, livelihoods and environment is the key. Course curriculums and research priorities have to change. We looked at agriculture-focused projects taken up during the last 20 years, the crop varieties released, and the recommendations made. Among the top 100 projects in terms of financial investment in agricultural institutions, very few stand to succeed and meet the needs of the farmers.

Knowledge about the Intellectual Property law (IPR) and biosafety implications of their work is sorely lacking in the scientific community. Innovations have become technology-oriented rather than designed to solve existing problems of the farmer community. Regulatory failures, illegal cultivation of GM crops and unlawful sale of herbicides/agrochemicals is rampant. All of these have to be mended.

We need to plan and conserve natural resources for agriculture as a long-term plan. We need a land use policy in this country. We need efficiency in our ways of resource use, not just economic but also ecological efficiency.

Coming to economic policies, for a long time, we have been asking for income security for farmers. When I say income security, it's not guaranteed income or direct income support. It is about ensuring farmers get what is due to them. The government artificially lowers the prices in the market for consumers, to make food cheaper, but does not compensate the farmers. Costs of cultivation and costs of living are high. Regulatory failures further significantly increase tenancy costs and inputs costs for the farmers. To make matters worse farmers do not have access to productive resources and support services. Policy changes should address these issues.

To sum up, policy changes should ensure

that we adopt new parameters to assess agricultural productivity and build a new agro-ecological framework and farmer's income security framework. These two are critical.

What is sustainable agriculture and can you comment on the current scenario of organic farming in India?

Agriculture impacts the environment and the environment impacts agriculture. The more we damage the environment, the more environment damages agriculture. A balance is necessary to be able to sustain agriculture longer. Sustainable agriculture is about renewability of resources, be it water, land or nutrients. Gains of the green revolution were realised only because of the organic matter in the soil built over the preceding years. In 20 years, we exhausted that, and from the 1980s the yields declined and crop failures increased. But we continue to use the same old model of agriculture. It is now essential to restore the organic nutrients of the soil and adopt organic farming.

Organic farming encompasses various strategies like abolishing or reducing the use of synthetic chemicals, growing multiple crops, using cover crops for ground recovery, etc. The organic farming sector is multiplying rapidly in India, registering about 19% growth rate. A massive shift is happening towards organic farming, both in production and consumption.

Across the country now, more than ten states have an organic farming policy in place with clear programs for implementation. States like Sikkim have become entirely organic, and Nagaland is moving in a similar direction. Andhra Pradesh is on a mission to grow completely organic by 2027. Odissa has come up with a policy on organic farming.

> "When water levels started getting depleted, pests developed resistance, fertiliser use efficiency decreased and factor productivity went down, mainstream agriculture never responded to the crisis."

However, just like the growth rate of green revolution benefitted only a small section of people- many of who were not the producers, the same is happening with organic agriculture. The growth is not helping the producers, hence not solving the crisis.

So, first, we need to look at how farmers can engage with markets and get a better share of the consumers' price. Second, the regulatory systems for organic farming were terrible in this country until recently. While improvisations have started, more restrictions now exist for organic farming compared to conventional chemicals-based methods. With larger vested interests entering into the organic sector, problems are cropping up. We are looking at how to resolve these issues with a farmer-centric approach.

Nevertheless, I would say that in ten years, there will be a gradual shift to organic farming. But that shift can be sustained only if supported by proper research, extension and markets. If the public institutions do not wake up to the reality and continue to look at agriculture in the conventional yield and technology-centric way, the crisis will

continue. How the agricultural research system gears itself to meet these challenges and adopt an agroecological approach is an important issue.

A common misconception is that organic farming gives lesser yields compared to conventional agriculture. Can you comment on this?

Instead of crop yield as the only factor, we need to look at two parameters—long term sustainability of natural resources and the net income that farmers get. No production system in this world works at maximum production capacity. They are optimised so that the net incomes are met. We have proven, again and again, that just improving yields will not solve farmers' problems.

Even the calculations of yields are wrong; we don't add the resulting by-products or the externalities caused or factor-in agroecological effects in the yields. Today, productivity has increased, but it is not gainful. We always compare our yields with American yields, which are different because of their climatic conditions and their soil types. The Swaminathan commission has already concluded that agricultural growth should be measured based on the increase in the income of farmers rather than yields.

Do you have any message for the young research community?

First, India has great potential to become agroecological-approach centric. There is vast scope to expand research in this area rather simply copying something that has been tested and failed. Second, being accountable is essential. As consumers, we are all connected, and we need to connect with those who produce food for us. Like we care for our mother, we should care for our farmers.

What motivated you to set up the Centre for Sustainable Agriculture (CSA)?

I used to volunteer with farmers' organisations while working as a scientist in the Indian Council of Agricultural Research (ICAR), at Directorate of Oilseeds Research in Hyderabad. Here, I saw a deep contrast between what was happening in agricultural institutions and what was happening at the level of farmers. The technological developments, extension services or policy measures were often not directly related to the crises in farmer communities. Also, the innovations that farmers were making themselves never reached other farmers and remained as islands of successes.

Around the same time, farmer suicides were increasing. Debates on the ecological crisis due to the green revolution model of agriculture and climate change were beginning. That's when a few of us decided to build an institution which takes a scientific approach to alternative models of agriculture for ecological and economic sustainability. That is how the Centre for Sustainable Agriculture (CSA) was born in 2004.

Across the country, farmers were making

"As consumers, we are all connected, and we need to connect with those who produce food for us. Like we care for our mother, we should care for our farmers."

agricultural innovations. We tried to understand the usefulness of these methods in different contexts, looked at their scientific validity and rationality, tested them in various growing conditions and replicated them.

We started in 2004 in Andhra-Telangana region with 20 people in the organisation, and today we are a workforce of 150. We now work in six states- Telangana, AP, Maharashtra, Punjab, Sikkim and Tripura. We are also going to be in UP, Orissa and Bihar with whom we partner and implement government programs. We support more than 250 farmer co-operatives across the country. We have scaled up many successful models in partnership with various state governments.

What are farmers' field schools?

As an organisation, we looked at farmers' most and immediate pressing problems, as a strategy to gain their interest and trust. Pests and diseases were significant problems, and pesticide use was very high. Pesticide poisoning cases were on the rise with thousands of farmers being hospitalised every year.

CSA attempts to understand farmers' crises, design remedies and make agriculture productive and ecologically sustainable. Fifteen years since its establishment, CSA has rescued several crisis-stricken villages by introducing organic and sustainable farming, organising farmers into producer organisations and engaging with policy changes.

We found problem diagnosis to be the main issue. Farmers were unable to identify the pests, the stage of the pests' life cycle or whether it is a pest infestation or a disease. Therefore, we introduced farmer training programs adopting a farmer field school approach.

The idea was to transform farmers from passive learners to active participants in the learning process. In these schools, farmers are taught to understand their ecosystem. They learn to identify pests and intervene early during the pests' lifecycle so that they do not reach damaging levels. Most of the preventive measures are not chemical based. We devised and started the 'non-pesticidal management program' where we use locally available material like pheromone traps, neem, vitex-kind of local botanicals, etc., to treat infestations.

Learned and experienced farmers become resource people to train other farmers. By 2010 we had spread across the state and reached out to about 20% of the state's farmers. Pesticide use was brought down by 50% in Andhra Pradesh and pest incidences came down significantly. The only major incidence since 2010 was in 2018 when we observed a predominant pest incidence of Brown planthopper in rice, specifically in the areas where non-pesticide management was not followed.

Farmers speak in local languages and communicate in a particular way, whereas scientists understand and communicate differently. There is always a mismatch between the two, and never had an attempt been made to synchronise them. This program closed the gap between farmers and scientists and showed us that the confidence-building mechanisms for farmers are

essential.

A decade ago, agricultural universities were the only source of knowledge, but now farmers are also recognised as sources of knowledge and innovations. I see great potential in knowledge-based extension programs, where farmers are trained to understand their ecosystem, manage it and become resource people for other farmers.

Could you tell us about some other initiatives undertaken by CSA?

We are setting up an incubation centre in farmer cooperatives called Grameen Academy, where youth from villages can learn, innovate and become entrepreneurs themselves. They can also organise and participate in the marketing of their produce. We started a helpline for farmers called Kisan Mitra, which runs from 8 a.m. to 8 p.m. Along with the hotline, we also started farmer service centres in villages for addressing their problems and for accessing government support services. We partner with governments in implementing services. We work with district administrators to help farmers obtain credit, insurance and the right prices. We also take farmers' issues to the government.

We are also trying to bring consumers, farmers and the government on a single platform. At our consumer cooperatives, consumers come together, engage and directly buy from the farmers. We also educate consumers about making the right choices about their food by nutritional counselling. We help consumers grow their vegetables and manage their home wastes. We are also working to bring the consumers and farmers together on public policy issues. All these work falls under the Farmer Producer Organisation (FPO) called 'Sahaja Aharam'.

Another initiative we just began is to map the ecological footprint of food before it reaches the consumers' plate. Many a time as consumers, we only think about what food does to us but not what it does to our environment. We call this the 'ecological footprints' of food, in terms of carbon, water and energy and ecology. We are using action research to educate consumers. Each packet sold at Sahaja Aharam can be traced back to the farmer who produced it, its ecological footprint, and its economic footprint (which indicates the share of each player in the supply chain).

CSA, in partnership with various farmer breeders and farmer cooperatives, has built an open source seed network called 'ApnaBeej'. ApnaBeej is an institutional system for open access to seeds and attempts to establish a benefit-sharing model. This is in contrast to the current proprietary seed models, which have led to an extensive monoculture of crops and varieties and monopoly of the industry.

Finally, CSA is also working on a cloud-based IT platform 'eKrishi' which supports farmers and farmers' institutions from production to consumption across the supply chain.

10 Leaders 10 Questions

A large part of leadership is not just coming up with ideas by oneself, but collecting ideas from the community and figuring out ways of bringing them into action.

— *Ron Vale, Executive Director, Janelia Research Campus.*

I don't see anything as a failure. Everything is a challenge or a hurdle; it becomes a new learning for something better to be done next time.

— *Renu Swarup, Secretary, Department of Biotechnology, Govt. of India*

Mostly, very difficult situations get resolved just because you actually sat across the table and discussed it.

— *Renu Swarup, , Secretary, Department of Biotechnology, Govt. of India*

As a leader, everyone is not just working for you, you also have to be working for them… People have their own careers, their own aspirations, and they want to advance in their lives. I think a good leader has to understand that.

— *Ron Vale, Executive Director, Janelia Research Campus*

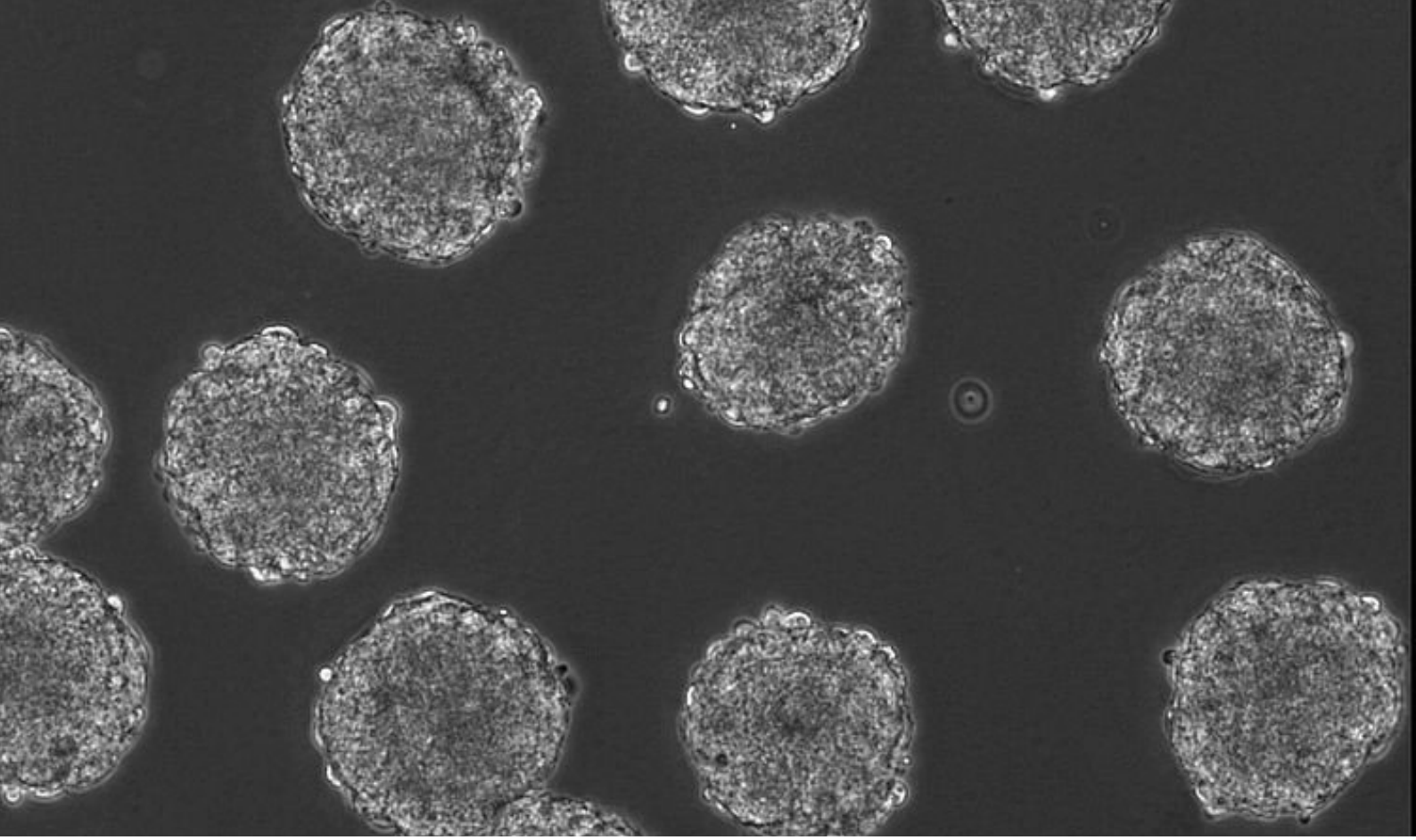
I think the most important quality of a leader is to not be afraid of taking decisions... Leaders have to look for a long-term vision and use intelligent arguments to drive towards that vision.

— *Shahid Jameel, CEO, Wellcome trust/DBT India Alliance*

There is nothing better than investing in good people. People are the most important part of any enterprise.

— *Shahid Jameel, CEO, Wellcome Trust/DBT India Alliance*

Through this interview series, we explore the importance of visionary scientific leadership and the attributes that set true leaders apart. In these articles, you will find insights on setting a clear vision, leading teams to success, embracing failure, and more. Read more here - http://bit.ly/10leadersIBS



How Stem Cells Retain their "Stem" ness

The science of staying uncommitted

Aditi Jain

Stem cells, with their ability to form almost all the cells in the body, have remained a subject of intense scientific interest. In a recent study, a group of Indian scientists led by Deepa Subramanyam from the National Centre for Cell Science (NCCS) show that endocytosis, a process by which cells internalizes substances such as proteins, polysaccharides etc., is essential for stem cells to retain their "stemness".

Embryonic stem cells are a group of cells which reside deep within the mass of cells that are formed soon after fertilization of the egg during development. These cells have the remarkable ability to give rise to ~200 different cell types, based on the signals they receive from the outside environment.

In the year 1981, Martin J Evans and Mathew Kaufmann from the University of Cambridge, UK, published a method to culture embryonic cell lines in the laboratory, which could then be artificially induced to differentiate into different cell types. This discovery brought the

Since their initial discovery several decades ago, stem cells have faced intensive study due to their potential medical applications and fascinating biology. A question that has long interested scientists is how do stem cells continue to remain in an undifferentiated or 'uncommitted' state, unlike every other cell type in the body? Now, a new study from researchers at the National Centre for Cell Science (NCCS) sheds light on this unique problem.

attention of the research community to the potential applications of embryonic stem cell technology, particularly in the fields of regenerative medicine and disease therapeutics. Since then the field has grown in leaps and bounds.

While scientists all over the world are working on methods to transform stem cells into specific cell types, our knowledge on the pathways and molecules that help these stem cells to sustain their state of "stemness" still remains scarce. In the present study, Subramanyam's team add one piece to this puzzle by showing how endocytosis helps in maintaining the undifferentiated state of embryonic stem cells.

"In order to achieve proper and complete differentiation, it is critical to understand how certain factors can regulate the fate of stem cells," says Subramanyam. The team knocked down the expression of Cltc, a protein required for endocytosis, in mouse embryonic cells and found that this reduces the ability of embryonic stem cells to stay in undifferentiated form.

Next, the scientists studied the effect of this loss of endocytosis on two molecules known to regulate the differentiation state of stem cells. They found that levels of E-CAD, a protein that promotes maintenance of an undifferentiated state, decrease with the loss of endocytosis. On the other hand, expression of TGFβR1, a protein which drives differentiation of stem cells to different cell types, increases with the loss of endocytosis. This data suggests a mechanism for the link between endocytosis and maintenance of undifferentiated state of stem cells .

"The report by Subramanyam's group reconfirms and builds on the importance of the cellular transport machinery in actively regulating the stem cell state," says Maneesha Inamdar, Professor at the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) who was not associated with the study. She added that the importance of studying transient interactions and the machinery that moves cargo into and within a cell has been becoming more and more evident over the years.

"Understanding how cellular processes such as endocytosis play a role in regulating the pluripotency of embryonic stem cells is important towards developing safer and more efficient cell-based therapies, " says Subramanyam.

Reference: Narayana, Y. V., Gadgil, C., Mote, R. D., Rajan, R., & Subramanyam, D. (2019). Clathrin-Mediated Endocytosis Regulates a Balance between Opposing Signals to Maintain the Pluripotent State of Embryonic Stem Cells. Stem Cell Reports, 12(1), 152–164.

Photo: Phase image of embryoid bodies (EBs) formed from mouse embryonic stem cells (Photo: Stemcellscientist [CC BY-SA 3.0] via Wikimedia Commons)

Slaying Hoaxes

Harnessing fake 'scientific' information to teach science

Anusha Krishnan

As a teacher/researcher, how many times have you cringed on hearing a piece of well-meant, but terrible advice?

Here's an example: *"Don't eat Kurkure, it's made of plastic!"*

For the record, this rumor was started because of a video clip that showed a piece of Kurkure 'burning and melting', which apparently meant that the popular snack contained plastic.

Fact: Most snacks that contain high levels of carbohydrates and oil will 'burn and melt' just like Kurkure.

A downright dangerous challenge: *"It's dengue season…for all those who want to avoid dengue, or cure dengue in a day, drink papaya leaf juice."*

Fact: papaya leaf extracts do not prevent or even cure dengue (in a day?). Dengue fever causes a decrease in platelets in your body. Papaya leaf extracts boost your body's ability to make platelets, and help mitigate the effects of dengue – if you get bitten by a dengue-carrying mosquito, even though you have drunk papaya leaf juice, you can still get dengue.

When well-meaning friends or relatives, who are usually sharp enough to spot fake notes in a wad of money, believe in and pass on such messages, what do you do? Taking my responsibility as a former scientist and current science communicator very seriously, I decided to try and explain that this 'information' was not true.

The most common response to my carefully collated research material (and rational thinking) was, "Yes, yes, but all of this is done by someone else! How do you know they're telling the truth?". This is in truth, a fair question. The only way to counter it is to test these so-called facts by carrying out and interpreting the results of experiments by yourself.

This is exactly what an Associate Professor, Evan Lampert, and a graduate student, Holly Munro, at the University of North Georgia made undergraduate students do. The students designed their own hypotheses and set up experiments to test the veracity of a well-known and widespread modern myth in the USA – that fast food does not decay.

In a study that they have published in The American Biology Teacher, Lampert and Munro made students inoculate hamburgers and other fast food items with the fungus Rhizopus stolonifer (black bread mold) as a part of an introductory biology class. R. stolonifer is usually harmless, easily obtainable, and easy to culture. Students used a 3 mm plug of R. stolonifer cultured on potato-dextrose agar to inoculate 60

mm disks of different foods such as burger patties, chicken nuggets, bread, burger buns, biscuits, and other baked products. Petri plates with the inoculated foods were sealed and incubated at 25 °C for four days, following which, the diameters of the fungal growths on the food were measured. During the incubation period, students were given worksheets where they had to list out the ingredients, including antimicrobials and preservatives, in the foods they were testing. Using this information, they were asked to formulate a hypothesis on whether a particular food item would support fungal growth or not, and explain their reasons for the hypothesis. Since most undergraduate students usually have difficulties in differentiating between a question, hypothesis, and prediction, the exercise was useful in helping them understand these concepts.

Through the experiments, the class observed that plain bread products, which contain the antifungal agent calcium propionate, seldom allowed fungal growth. Similarly, fungal growth was low in foods covered with condiments such as ketchup and mustard, which also contain high levels of preservatives. However, animal products like burger patties and chicken nuggets, and moist foods with sauces and glazes supported plentiful fungal growth. Overall, the experiments helped students understand that fungal growth depended on the moisture and preservative content of the food.

The entire exercise not only helped the class evaluate the reliability of online information, it also served as an introductory lesson on fungi. Using well-known foods boosted interest in the laboratory experiments, and promoted discussions of nutritional practices. The authors report that after the experiment, many students expressed interest in changing their eating habits for a healthier future.

How do you perceive a social media news of a common snack being made of plastic? Or that fast foods never decay? The new currency notes carrying nano-GPS chips? Test such news before dismissing it (or accepting it) - the experiments are surprisingly simple, rational and logical. An excellent opportunity to instil the practice of enquiry-based learning.

Lampert and Munro end their publication with thoughts on unlimited opportunities to examine online claims in lab courses. "We recommend that high school and college instructors seek out their own online stories and develop ways to test them or seek original information in peer-reviewed scientific literature. Such activities can be effective and engaging learning experiences," they add.

"Popular myths can be busted through simple hypotheses-driven experiments in colleges and schools. Students can be asked to identify and list prevailing online information — fpr example, certain rice brands made of wax or Maggi noodles being coated in wax," says Urmi Bajpai, an associate professor from the Acharya Narendra Dev college, New Delhi. "In testing such claims, students learn to prove/disprove a 'known fact' instead of doing cook book-style experiments. They learn to question the credibility of unverified facts and understand the concepts of enquiry-based learning, along with learning experimental skills," she adds.

Reference: Lampert, E., & Munro, H. (2019). Does Fast Food Last Forever? Exploring the Mold Myth. The American Biology Teacher, 81(5), 360–365.

Education

Talk with Teachers

"Contemporary teaching will have to rely on teacher networks"

– MM Chaturvedi, Department of Zoology, Delhi University (interviewed by Aditi Jain)

"Collaborating with a senior teacher can facilitate faculty mentoring"

– Manjari Jain, IISER Mohali (interviewed by Aditi Jain)

"Rewarding student research requires college teachers to be recognised as guides."

– Sandra Misquith, St. Joseph's College, Bangalore (interviewed by Urvashi Bhattacharyya

"I am glad that I was mentored, not 'supervised'"

– PK Burma, Department of Genetics, Delhi University (interviewed by Aditi Jain)

On Research-based Pedagogy

Teaching Scientific Writing to College Students
Lakshmi Supriya

Course-based undergraduate research experience: students become scientists
Yashika Kapoor

Bringing online citizen science to classrooms
Suchitra Sankaranarayan

The language of concepts in chemistry and biology textbooks
Anusha Krishnan

An ecologist and a game designer walk into a forest
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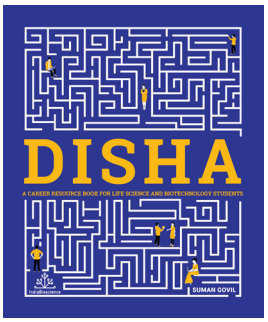
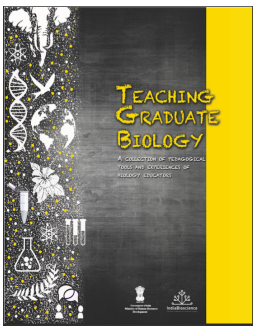
Spoorthi is an eBooklet featuring resources for women in science in India, in addition to articles born out of conversations with several such trailblazing women. You can download it at http://bit.ly/Spoorthi

Disha is a comprehensive resource meant to help life science and biotechnology students in India navigate their careers in science. In addition to providing information about various careeer paths, the book also provides tips on progessional development.





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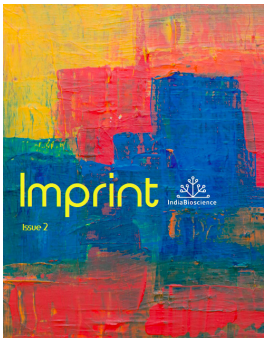

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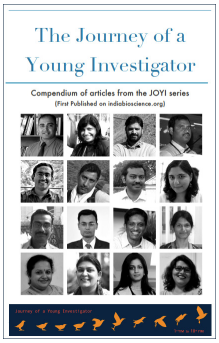
We asked young investigators attending YIM 2019 to share their scientific journeys with us. This collection celebrates those successes. Download it here - http://bit.ly/joyi2019

Alumni from the first ten years of YIM returned to discuss the future of Indian science during YIM 2018. Here are some of their stories - http://bit.ly/joyi2018



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IndiaBioscience is an organization that fills a unique niche in the ecosystem of the life sciences in India, by being a catalyst to promote changes that affect the culture and practice of the field, through engagement with academia, government and industry at various levels. IndiaBioscience aims to increase the visibility of science in society, by being a hub for policy discussions, science communication, and as an aggregator of information.

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IndiaBioscience

Department of BioTechnology, Government of India

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