

distress and agrarian crisis. The growing disparity in per capita income between farm and non-farm sectors is multifactorial and requires immediate attention. Realizing the need to pay special attention to the plight of farmers, the Government of India proposes to double farmers' income by 2022–2023, thus reducing agrarian distress and bringing income parity with the non-farm sector. Livestock contributes significantly to food and nutritional security, and stability and sustainability of the household income. In HP, an agriculture-based economy, livestock farming is an integral activity but long-term trends over last two decades reflect a gradual decline in livestock population, notably due to decline in pastoral farming. The broader areas of livestock farming which need attention include increasing productivity and production levels, clean milk production for export, proper utilization of

feed and fodder resources for sustainable animal production, reducing production cost and remunerative marketing and value-added products. Focus should also be given to institutional spending on research in animal husbandry with emphasis on skill upgradation and dissemination of production technologies and management practices for immediate productivity enhancement along with breed improvement programmes. Different models for different agro-climatic zones of the state incorporating dairying, goat-rearing and backyard poultry farming can be considered for incorporation in the farming system.

Thus the conference addressed basic issues of the farming community with a possible outcome for finding solutions to the problems being faced in doubling farmers' income by 2022. In order to double farmers' income, emphasis should be given to high-tech agriculture,

crop diversification, natural farming and sustainable animal husbandry for increasing livelihood security of mountain farmers by 2022.

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MEETING REPORT

Impact of Young Investigators' Meetings on life sciences research in India*

IndiaBioscience (IBS), a non-profit initiative, occupies a unique niche in the ecosystem of life sciences in India, serving as an excellent platform for exchange of ideas on different matters related to life sciences research and education¹. The IBS community includes scientists, educators and students at varying stages of their careers. IBS not only disseminates the scientific achievements of our researchers, but also highlights their efforts at public outreach and involvement in science education. Resources at IBS include a booklet on career opportunities, a space for science communicators to share their experiences, and opportunities for networking amongst young investigators (YIs) and postdoctoral fellows (PDFs). By engaging with academia and government along with the large network of people including educators and industry professionals that IBS has engaged with over a decade, it has now reached a stage where it can be used

as an ideal forum for discussions on matters related to science policy.

Starting with the first edition in 2009, the Young Investigators' Meetings (YIMs) organized by IBS have brought together early-career principal investigators, postdoctoral researchers, and senior scientists for wide-ranging discussions on science and careers in biology, and have helped to create a large network of biologists across India. The YIMs serve as a forum for lively interaction on a diverse set of topics including scientific ideas, building collaborations, securing funding and developing mentorship skills. Participants are able to network with potential collaborators, senior faculty, government leaders and representatives of granting agencies. In this way, the YIMs have acted as a launching pad for young scientists as they plan their independent careers in the life sciences in India.

The tenth edition of YIM (YIM-2018) brought together about 110 participants from all the previous YIMs under one roof for the entire duration of the meeting. The purpose of this YIM was to look

in the mirror – to understand the impact of our ten-year long journey on the landscape of Indian life sciences. Did our efforts help recruit bright young minds to the country? How well are these YIs doing, and is there a sense of community, collaboration and togetherness fostered by the YIMs? Are the YIs being good mentors, and are they able to attract and enthuse the next generation of scientists? Looking beyond the YIM, what is the future? Ten years from now, where are we going to be?

Since these questions address the pulse of life sciences research in India, it was anticipated that they would spur a spectrum of responses, concerns and suggestions. In order to have a structured self-evaluation, four discussion sessions were held around the following themes:

- (1) Best practices for recruitment and mentoring of YIs.
- (2) Sharing of resources and collaborations.
- (3) Ph D and postdoctoral training.
- (4) Future of biological sciences research in India.

*A report on discussion sessions during the Young Investigators' Meeting that was held in Thiruvananthapuram from 5 to 8 March 2018.

The participants were divided into four groups, and each group was further divided into subgroups. Each subgroup of about 5–7 members held parallel discussions on a given theme for approximately 90 min. The discussions were enthusiastic and intense. Observations from all the groups have been compiled to prepare this report. What did we hope to achieve by organizing brainstorming sessions of ~100 YIs representing a diversity of research areas, geographical locations and institutional structures (public/private, university/research centre)? To our surprise, much common ground was found. We came up with specific long-term and short-term ‘implementables’ that can be taken up at the individual, institutional and national levels. There was general optimism about what can be achieved, and willingness for honest self-evaluation. These discussions are summarized below under the four themes. We hope that this report will help lay down some new guidelines to improve and incentivization of life sciences research in India.

Theme 1 – Best practices for recruitment and mentoring of YIs

An important aspect of building up the scientific enterprise is the hiring of faculty members who show promise, and then ensuring that their careers progress in a manner that brings about original and significant contributions to research and teaching. It was unanimously felt that institutions should be more receptive and responsible while evaluating faculty applications. Applications should receive a prompt response and a clearly stated timeline for processing, with mention of specific contacts at the host institution for follow-ups. If hiring is sought in focused areas, then such information should be made available to applicants. It must be clarified whether the offered position at the institution constitutes a tenure track, especially with respect to offers made for INSPIRE, Ramalingaswami and Ramanujan fellowships. Career breaks for women or any non-traditional track could be considered sympathetically in terms of age cut-offs. In addition, assistance in identifying career opportunities for spouses could be offered. It was also suggested that online application portals for science-related jobs should incorporate a transgender category.

Faculty applications should be evaluated by a committee that is comprised of members from both within and outside of the host institution, displays gender balance, and has a sufficiently wide range of expertise. In the interest of moving to a self-sustaining scientific ecosystem, host institutions should proactively hire faculty with postdoctoral experience within the country. Once a position is offered, it should be possible for the candidate to discuss terms of employment with a departmental committee. Matters such as availability of start-up funds, hiring of personnel, laboratory space, etc. should be open to honest discussion. Mentorship (formal or informal) and leadership courses could be offered to the young faculty to navigate scientific and administrative matters.

A committee comprising members from within the candidate’s field of research and outside of the field could conduct a review for tenure and promotion. In addition, such review committees could provide detailed and constructive feedback on the scientific accomplishments and trajectory to be taken in the future. Furthermore, mechanism(s) of quantifying contributions to teaching, administration and outreach could be developed for promotion evaluation. Participants also felt that lateral movement of faculty within India should be acceptable, and if needed, the involved institutions should liaison with funding agencies to facilitate such movement.

Actionable goal: Transparent institutional policies for recruitment and mentoring of young faculty.

Theme 2 – Sharing of resources and collaborations for better science

Collaborations, particularly across disciplines, can significantly improve the impact and volume of our research. There is an urgent need to recognize, incentivize and promote collaborations. In general, it is expected that collaborations bring in a new dimension and add value to the project. However, it was felt during the discussions that evaluation committees are reluctant to give credit to individual scientists in a collaborative project. This discourages young PIs from entering into collaborations. It is therefore important that transparent mechanisms be set up for evaluating collaborative projects. During presentations to committees, collaborators could clearly spell

out the scientific contributions of each team member. On the same lines, there can be ‘teamwork’ sessions during meetings where collaborative projects are presented jointly by the involved PIs.

To promote collaborations it is important that researchers have easy access to each other’s science. To do this, we should adopt methods to freely share our published work. This can be achieved by hosting details about our research projects on our websites, publishing in open access journals when possible, archiving our publications in institutional repositories (e.g. Science Central, a repository for DST- and DBT-funded institutions; <http://sciencecentral.in/index.php/index>), and opting to submit our work to preprint servers such as bioRxiv. Granting agencies could display the title/abstract of sanctioned grants on their website. This information should be searchable using keywords, so that researchers can easily find potential collaborators. Similarly, repositories could be set up for model organisms, cell lines, plasmids, cohort data, etc. and information about these resources should be searchable online. Upon retirement, researchers could choose to distribute their reagents and resources to other scientists via a searchable web portal. IBS could partner with an information technology consultant to develop appropriate search engines/portals to execute and manage such projects. Login-based forums for posing questions/seeking collaborators could also be used for this purpose – the IBS portal (<https://discuss.indiabio-science.org/>) allows for such discussions. In addition, as an outcome of YIM-2018, IBS is compiling a database of past YIM attendees, which will facilitate peer-to-peer contact and foster collaborations.

Much of modern biological research relies on access to sophisticated and expensive equipment operated by highly trained technical staff. Institutions that have such infrastructure should devise ways to share these resources with other scientists in the same city/region. Such facilities should be run in a well-planned manner to increase their productivity and impact. Due recognition and salary for staff at these facilities would keep them motivated. Usage monitoring systems are needed to evaluate accessibility and usefulness of these facilities. Research institutions could allocate a fixed time for usage of their equipment by researchers from nearby universities/colleges. Staff

or students from the research institution can run the instruments during these hours, with suitable compensation being given for such efforts. MoUs between the participating institutions would facilitate such usage. These regional infrastructure hubs would also serve to catalyse collaborative projects. For the ecological sciences, there should be concerted efforts for increased collaboration among institutions to establish and maintain field stations. The recent DST policy initiative on Scientific Research Infrastructure for Maintenance and Networks (SRIMAN) is an excellent step towards promoting and ensuring sharing of expensive research infrastructure within a region. The Regional YIMs, an idea born during discussions at YIM-2018, promise to facilitate collaborations and encourage the formation of stronger local networks of life sciences researchers, educators and industry professionals.

It is important that a collaborative spirit is inculcated early on in students/researchers. University/college educators could spend time in research labs where they appreciate the spirit of working together, and then impart this to their own students. Institutions such as Universities, IISERs and IITs, where education and research go hand-in-hand, such that students can 'learn' and 'do', are fertile ground for collaborative research. Training Ph D students and postdocs under joint supervision across institutions could be a way to practice the collaborative spirit. When PIs initiate collaborations, we could encourage postdocs in our respective labs to lead these collaborations. The upcoming Indian PDFs meeting, sponsored in part by IBS, would be useful in building such collaborations. We should also initiate mechanisms to incentivize collaborations amongst Ph D students/postdocs through targeted grants and awards.

Actionable goal: Setting up policies that encourage and allow critical evaluation of collaborative projects.

Theme 3 – Empowering Ph Ds and postdocs

Students in our schools/colleges are often taught to respect authority, and not to question their teachers. This tradition of veneration is detrimental to the scientific growth of young minds. It was strongly felt that group leaders must do more to empower the Ph D/postdoc community, so that they can break out on

their own. Giving students more freedom to think independently and appreciating their original ideas is the first step in this direction. This must go hand-in-hand with training in academic ethics, good lab practices, writing manuscript/proposals, regular lab meetings, etc. PIs should also explain budgeting and finance to their students, or involve them in the process. Students should be trained in handling high-end instruments, and allowed to use them and when needed. Students must be encouraged to attend national and international meetings so that they communicate with a wider audience. For Ph D students, a thesis committee should be constituted mandatorily, and should be available to discuss scientific progress. It is important that students have a wider peer group beyond their supervisor. In the same spirit, with a view to broaden their outlook, students must be sensitized to gender and caste biases prevalent in academia. Access to health care, including mental health, could go a long way in improving the work environment and general wellness of our students. Excelling at research is something we are trained for, but managing personnel and keeping them motivated requires a different set of skills. Therefore, as PIs, we may seek mentorship, advice and training to develop our skills in human management – the EMBO Lab Leadership Courses and professional development resources at iBiology were recommended.

As mentors, we should be aware that every Ph D degree does not necessarily and automatically lead to a postdoctoral fellowship. Completion of Ph D should be a milestone where other career options are also sought, and are made available. The time has come for us to encourage and guide our Ph D students to choose career paths based on their strengths and interests. It was viewed that empowering postdoctoral fellows (PDFs) needs an altogether different approach. They must be encouraged to obtain their own fellowship, which will boost their confidence. Such fellowships should provide them with funds to attend international scientific meetings. Occasionally these fellowships are given for a period of two years. However, for entry-level jobs three years of experience is mandatory, and thus it was emphasized that such fellowships should be extended for an additional year. In the same realm, several participants were of the view that

to strengthen the PDF culture in India, the fellowship of PDFs must be increased. A PDF must be treated as a future colleague. Institutions should encourage teaching programmes for PDFs to bolster their CVs. Another means to empower PDFs is to host 'Indian PDF meetings' across institutions. As the number of PDFs, INSPIRE fellows, India Alliance early career fellows (ECFs), etc. is growing, the question of their job security must be addressed seriously. Industry-academia and clinician-scientist collaborations leading to increased employment opportunities for young scientists are one way forward.

Actionable goal: Independence to Ph D students and postdocs in the lab – encourage career paths based on strengths and interests, even if they are outside academia.

Theme 4 – Future of Indian biological sciences

This was the last and arguably the most important discussion. Although the topic seemed abstract and intangible, clear ideas did emerge on how we can facilitate a brighter future for life sciences research in India. Participants felt that the teaching and research pyramid is currently 'top-heavy'. We have a handful of outstanding research centres and universities at the top. Strengthening the base of this pyramid, i.e. undergraduate-level science education and research, is the only way to ensure a healthy future for Indian science. To bring about this change, Central and State Governments need to channel funds towards building basic research infrastructure at undergraduate and postgraduate levels (city/town colleges and State Universities). The DBT Star College Scheme has had an impact in this direction; yet this is only the beginning, and more such programmes are required to strengthen exposure to research at the college level. A helping hand to improve college and postgraduate-level research could come from research institutions and Central Universities based in the same city. Undergraduate/postgraduate students and educators should be allowed access to research infrastructure at these well-funded institutions. Undergraduate-level research (at both Government-funded and private colleges) should be recognized and rewarded at the State and National level.

Science outreach is essential for the general public to appreciate what we do in our labs and the relevance of our work. The importance of research and its tangible outcomes need to be shared with the taxpayers who fund us. The onus is on every individual scientist and research organization to ensure that their scientific achievements are communicated to the public in a simple and factually correct manner without exaggeration. 'Open days' for the public to visit labs, sharing our research achievements and outcomes in the public domain, and freewheeling Q&A sessions open to the public are some practices we all must adopt. An even better approach (although not always possible) would be to include the public in our research. The Citizen Science programme in ecological sciences being conducted at the Nature Conservation Foundation in collaboration with NCBS, Bengaluru was mentioned in this context.

Indian research suffers from a lack of interdisciplinary science. At this time, our education system bears some blame for the paucity of scientists who bridge multiple disciplines, such as physics and biology, or engineering and life sciences, or clinical medicine and research. The practice of asking high-school students to choose between biology and mathematics has to stop. School and college curricula should be modified to enable students to opt for all science subjects in high school and cross-disciplinary courses in college. Many of our bright and talented students who take up undergraduate education in engineering or medicine are often 'lost' to science. To expose these students to research, engineering and medical colleges should be encouraged to partner with life sciences research organizations in their city, and to set up short-term training and dissertation projects. The ICMR fellowships given to medical post-graduates for a research thesis/dissertation during their MD/MS/MCh course are a great step in this direction. Research institutions and funding organizations should support and reward truly interdisciplinary research programmes, such as those framed on the lines of the Human Frontier Science Program research grants.

The questions that our young PIs choose to work on today will be the future of Indian science. Should this choice be driven by scientific curiosity, societal need or funding opportunities?

The YIs were unanimous that scientific curiosity is ultimately the primary driver of research and should continue to remain so. However, scientific curiosity and societal needs are not mutually exclusive – every researcher should find a way to bridge these two motivating factors. Most YIs were in agreement with the concept of 'directed basic research' in selected areas of national importance put forth by R. Chidambaram, erstwhile Principal Scientific Advisor to the Government of India. However, they also emphasized that taking the focus away from basic research will leave us without tools to deal with unknown future challenges. Indian research should strike a healthy balance between 'blue sky' and 'product/service-driven' research. One significant way to promote research that addresses India-specific issues is to fund and support subcontinent-specific repositories for our unique biodiversity and epidemiological data.

Our research can address societal needs if we let the spirit of entrepreneurship develop among scientists. Every one of us must ensure that our research is communicated widely and freely, so that others who can apply or translate our work can find us. Funding for biotech start-ups through BIRAC has made a tremendous contribution towards facilitating entrepreneurship based on outputs from basic research. Several universities and research centres have set up incubation centres where start-ups are provided access to infrastructure, and more such centres should be encouraged. Technology transfer expertise, either in-house or outsourced, should be available at every research institution and clearly defined policies on conflict of interest should be in place to encourage entrepreneurship by scientists.

Actionable Goal: Focus on strengthening undergraduate-level science education and research; formulate and implement policies to encourage entrepreneurship and technology transfer by biologists.

Thus, the 'theme discussions' at YIM-2018 were lively, fervent and optimistic, and have given us some tangible goals. However, it was felt that these discussions are only the beginning, and that we must work together to bring the ideas outlined above to fruition. YIM-2018 ended with the promise of a brighter future in life sciences research in India. However, the onus to make this happen

lies with us at the individual, institutional and national levels. We must recruit the best YIs, ensure that they find a vibrant and collaborative atmosphere within the country, and empower the students who will work with the YIs. A new resolve in Indian science must be visible – within ourselves, and to the public at large. We must engage with the public and inspire students and educators by sharing our research with them. We must strive to create gender-sensitive workspaces in which male, female and transgender scientists work together comfortably, to achieve their full potential². We must also participate in science advocacy by showcasing our 'lab to field' and 'bench to bedside' success stories to the Government and funding bodies. By doing so we hope for increased support to the Indian scientific community. The scientific community, in turn, must work tirelessly to bring the joys and benefits of science to every Indian citizen.

1. Tole, S. and Vale, R. D., *Science*, 2010, **329**(5998), 1441.
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