

## Biotechnology in modern India

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There is no doubt that India is likely to become an economically prosperous nation among the different countries in the world. To realize such a vision, Indians are aware that science could be one of the main strategies for the uplift of national development. As India is well known for its natural resources and biodiversity, there is much scope for such development. There are various organizations, sectors, institutions and universities in and around India that look after the demands and challenges in various fields that benefits nation's economy as well as its progress.

Among different biological sciences, modern biology or biotechnology is one of the emerging fields in life sciences and is used extensively in agriculture, medicine and food sciences. Biotechnology is aptly described as the "technology of hope" for its promise of food, health and environmental sustainability<sup>1</sup>. According to the Biotech NOW profile, the Indian biotechnology sector is one of the fastest growing knowledge-based sectors in India and is expected to play a key role in shaping India's rapidly growing economy. The Indian biotech sector's

introduced many science related courses like molecular biology and biotechnology at school, undergraduate and postgraduate levels to inculcate an interest among the young minds that pave the way for the new inventions and the development of novel products<sup>3</sup>. Subsequently in 2000, biotechnology was introduced in many engineering undergraduate level programmes, with the intention of encouraging biotech business development through entrepreneurship or industrial activities<sup>4</sup>. In the case of higher studies, specifically at research level, fellowship has increased almost 10-fold in less than 2 decades. One of the main reasons for increasing the number of fellowships in India is to enlighten the students who face problems such as reduced teaching staff. There are only 200,000 full-time researchers out of a population of 1.22 billion<sup>5</sup>. To encourage young emerging researchers, the average 300 INR per month for researchers with a junior research fellowship has been increased to 25 000 INR per month over the 1980 to 2014 period. The budget allocation of the year 2014-2015 is 19,000 INR in crores.

There are various government and non-government organizations and institutions in India such as the Department of Biotechnology (DBT), Department of Science and Technology (DST), Indian Council of Medical Research (ICMR), Indian Institute of Sciences (IISc), Indian Council of Agriculture Research (ICAR), Indian Council of Forest Research Education (ICFRE), etc. that are involved in the development and economy of India by providing research opportunities for the young scientists in different fields especially in medicine, agriculture and environmental science, among other specialties.

To encourage applied biochemistry and molecular biology related research, the government of India has started several organisations. One of the leading and oldest organisations is the Indian Research Fund Association which was established in 1911 and was renamed as the ICMR in 1949. ICMR is mainly focusing on the medical aspects of biochemistry and allied research activities through its 33 autonomous institutes. The Board of Scientific and Industrial Research (BSIR) was established in 1940 and reoriented as the Council of Scientific and Industrial Research (CSIR) in 1942 among 38 autonomous institutions, 11 institutes are premier institutes and the main focus is about modern biology and its related



overall revenue in 2009-2010 was US\$3 billion. Bio-pharma contributed US\$ 1.9 billion; bio-agri US\$420.4 million, bio-industrial segment US\$122.5 million and bio-informatics US\$50.2 million<sup>2</sup>. The current trends indicate that the industry will reach its peak by 2020.

Moreover, to facilitate foreign investment, capital and government policies are being revised. Since 1980 the Indian government has gradually

One Crore is equivalent to 10 000 000 Indian Rupees (INR)

The Department of Biotechnology is responsible for administrating development and commercialization in the field of modern biology and biotechnology. It serves to fulfil the following role:

- Provides support of commercial development in this field by providing grants, creating technology parks and related institutions.
- Support research & development (R&D) and manufacturing in the biopharmaceutical industry
- Set up Centres of Excellence for R&D
- Nodal Point for specific international collaborations
- Serve as nodal point for the collection and dissemination of information relating to biotechnology

applications. The CSIR is considered as top among various research institutes and files more international patents. CSIR has 38 national laboratories and 4600 active scientists around the country. Among CSIR institutions, the Centre for Cellular and Molecular Biology (CCMB) is an important premier research organization to conduct high quality research in modern biology.

Since 1971, the DST has run various programmes and projects to promote the study of life sciences and almost half of the budget is spent to promote the applied aspects. DST has introduced various schemes to encourage young female researchers, as women make up only 14% of full time researchers in India. The prestigious Women Scientist award is one such a fellowship offered to women for pursuing Ph.D, as well as post-doctoral level studies. The main criteria for awarding this fellowship is having a career break due for unavoidable non-academic reasons.

The DBT, Government of India has sponsored various research centres in different universities and institutions across the country thereby encouraging the research students with financial support. The main vision of DBT is to use biotechnology as a tool for the welfare of society.

Dr Krishnaswamy VijayRaghavan is a famous fly geneticist and senior scientific administrator who helped to build the National Centre for Biological Sciences (NCBS) in Bangalore. Today the NCBS is one of India's most prestigious institutions. In January 2013, he left his job as NCBS director and moved to New Delhi to lead the DBT. The scientific community is expecting a drastic change in the scientific field under his supervision<sup>6</sup>.

Other organisations like the ICAR, Ministry of Environment, Forest and climate change (MoEFCC), ICFRE and the Board of Research in Nuclear sciences (BRNS) also have several autonomous institutions which are involved in funding research projects in academic research institutions and universities thereby boosting the research in the field of various sciences including modern biotechnology.

The IISc, NCBS, Tata Institute of Fundamental Research (TIFR) and the Birla Institute of Scientific Research are a few institutions whose main objectives are intensive investigations and exploring the molecular mechanisms of many biomolecules. IISc is the main institute in India that contributes major publications with high impact factor and citations. While TIFR is publishing interdisciplinary and multi institute publications, it has been reported that 55% of its publications are internationally co-authored. In addition, there are 16 Indian Institute of Technology (IITs) in India which admits only the best students, thereby contributing quality research in different areas of science.

Over the past twenty years, we have observed various schemes and fellowships offered by the aforementioned institutions. Also, the research graduates (D. Phil/ Ph.D) have various options available to continue their research carrier independently for three years with any of the academic, research institutions/universities across the country. These options for them can be in the form of Research Associateship (RA), Pool Scientist, Pool Officer or Senior Research Associate at CSIR or Young Scientist/ Fast Track Scientist at SERB (Science and Engineering Research Board) DST. To remember the silver jubilee year of DST, the Swarnajayanti Fellowship was introduced to help motivate young researchers. This fellowship allows researchers to set up their own lab and DST will support them for five years. Similarly various Post-doctoral fellowships are available from DBT. One impressive and prestigious fellowship is Ramalingaswami Fellowship. The idea behind this fellowship is to bring the modern Indian biology researchers who are settled in foreign countries back to India.

With its vast population and rapidly expanding economy, India is growing fast at an impressive rate. We believe that it will flourish soon with notable contributions in the field of modern biology. ■

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