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5. India's biotechnology boom: A lesson for Africa

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INTRODUCTION

Biotechnology is a frontier of science which has served as a premium precision tool for commercial enrichment and socio-economic development in many developed economies. The advancement of biotechnology has been relatively rapid in the past two decades, leading to unprecedented transformations in medicine, agriculture, forensics and other production based industries.

India, at present, is one of the primary players in the international biotechnology field. Her many comparative advantages in terms of knowledge, skills, R & D facilities and costs benefits, in the sector, are the incentives for this. The institutional infrastructure in India provides the basic foundation for these strengths to translate into business opportunities. The biotechnology sector crossed the 2 billion USD mark during 2006 – 2007 and is still growing, showing 20 per cent growth in 2007-2008 [12].

Today there are about 300 biotech companies in India, with the top ten accounting for 50 per cent of the revenue generated, and R & D investment of the top five exceeding 300 million USD. India emerged as third in Asia-Pacific and is one of the top 12 biotech markets globally, with her key opportunity segments encompassing bio-pharmaceutical (vaccines, therapeutics, and diagnostics), bio-agriculture (transgenic products, bio-fertilisers, bio-pesticides), bio-industry, bio-informatics and bio-services (R & D, clinical trials and manufacturing on contract). The bio-agriculture segment registered the highest growth rate during the last year at 154 per cent, followed by bio-services (54.6 per cent), bio-industry (34.55 per cent), bio-pharma (30 per cent) and bio-informatics (25 per cent) [12].

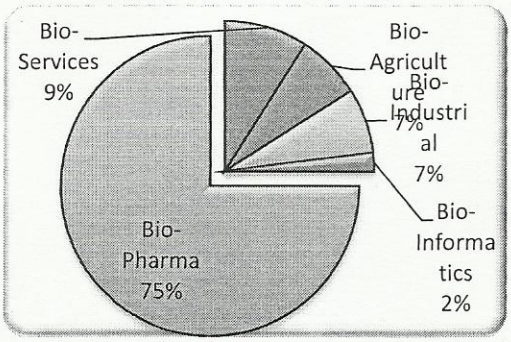


***Figure 1*: Biotechnology segments in India** [11]

The Biotechnology sector in India, although nascent at the present time and accounting for a mere 2% of the global Biotechnology market, is poised for exponential growth over the next 5 years with an expected global market share of 10%. It is predicted that with proper fiscal and consistent policy initiatives, this sector could easily scale the 25 billion USD by 2015 [2]. .

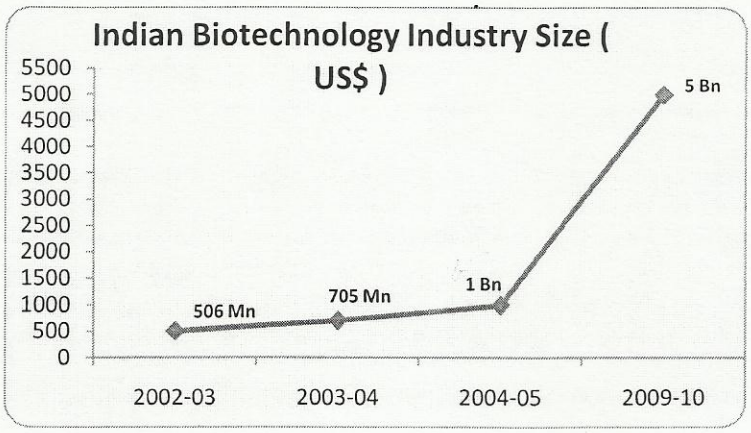


***Figure 2*: Growth of the Indian biotechnology industry** [11]

This momentum for the current progress of biotechnology in India was set in motion chiefly as a result of the government's initiative in the 1980s, by creating an institutional framework to strengthen biology and biotechnology research in the country. Scientific agencies supporting such research initiatives in modern biology were also set up. These include: the Council of Scientific and Industrial Research (CSIR), Indian Council of Agricultural Research (ICAR), Indian Council of Medical Research (ICMR), Department of Science and Technology (DST), and University Grants Commission (UGC). [8]

With the establishment of the National Biotechnology Board in 1982, biotechnology in India was given an important boost. Its priorities were human resource development, creation of infrastructure facilities, and supporting research and development (R&D) in specific areas.

The success and impact of the National Biotechnology Board prompted the Government to establish a separate Department of Biotechnology (DBT) in February 1986. These agencies have invested substantially in building the infrastructure to carry out R & D in life sciences in the country. It has created and supported new centres and institutions in different parts of India, in a wide spectrum of subjects. [14, 15]

Additionally, other research institutions were set up and were placed under the supervision of the DBT. These institutes include: The National Institute of Immunology (NII), New Delhi; National Centre for Cell Science (NCCS), Pune; National Brain Research Centre (NBRC); National Centre for Plant Genome Research (NCPGR), New Delhi; and Centre for DNA Fingerprinting and Diagnostics (CDFD), Hyderabad. The CSIR laboratories were involved in major biotechnology-related research and they governed other research centres, such as the Centre for Biochemical Technology (CBT), Delhi; Centre for Cellular and Molecular Biology (CCMB), Hyderabad; Indian Institute of Chemical Technology (IICT), Hyderabad; Central Drug Research Institute (CDRI), Lucknow; Institute of Microbial Technology (IMT), Chandigarh; Indian Institute of Chemical Biology (IICB), Calcutta and Central Food Technological Research Institute (CFTRI), Mysore. [1, 3, 4, 7, 18]

Many other centres have also risen over the years, including the Tata Institute of Fundamental Research (TFIR) and National Centre for Biological Science (NCBS) in Bangalore, which carries out basic research in biological sciences. The ICMR established centres for developing molecular medicine at the Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGIMS) New Delhi, the All India Institute of Medical Sciences (AIIMS), Lucknow, the Post Graduate Institute of Medical Education and Research (PGIMER), Chandigarh, and the Jawaharlal Nehru University (JNU), New Delhi. The ICAR has also established a National Research Centre on Plant Biotechnology (NRCPB) at the Indian Agricultural Research Institute (IARI), New Delhi. [1, 4, 7, 8]

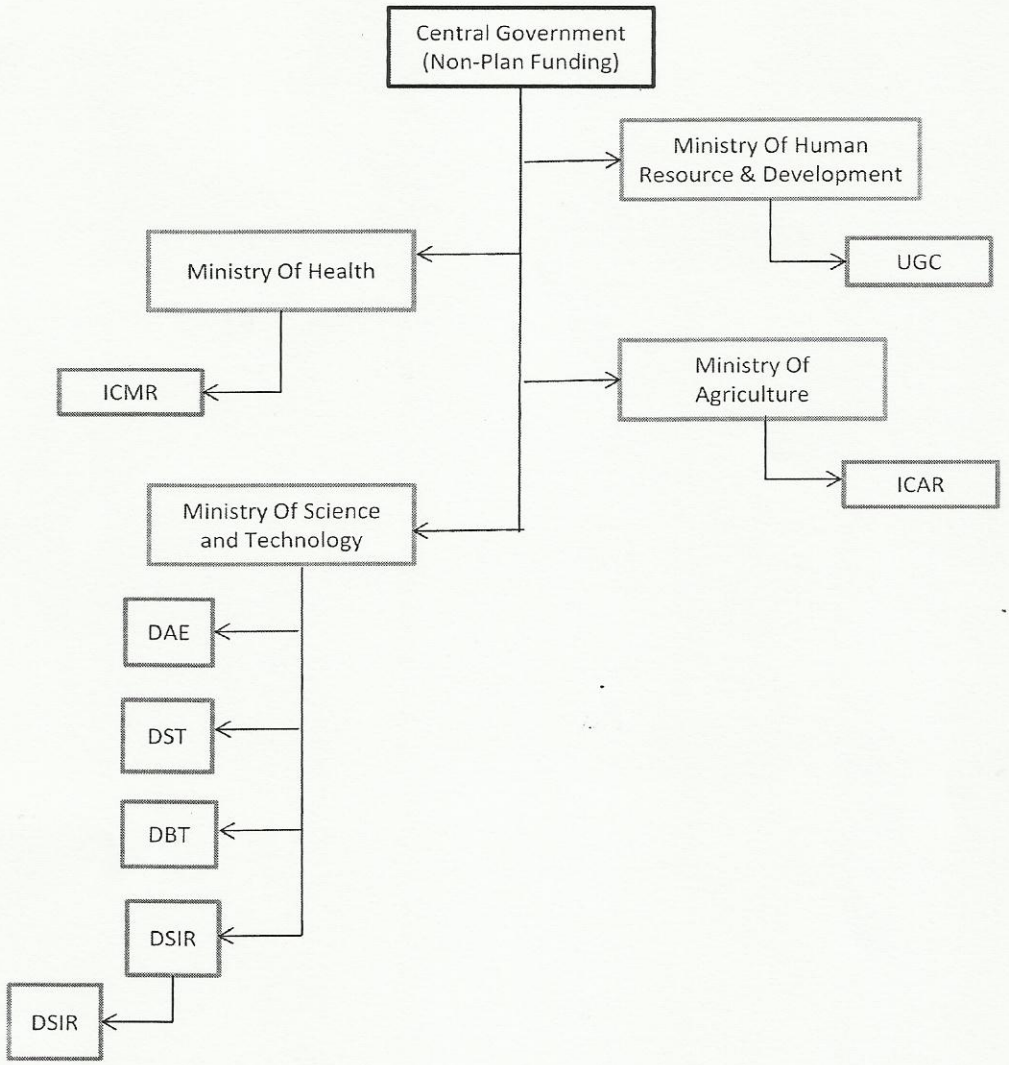
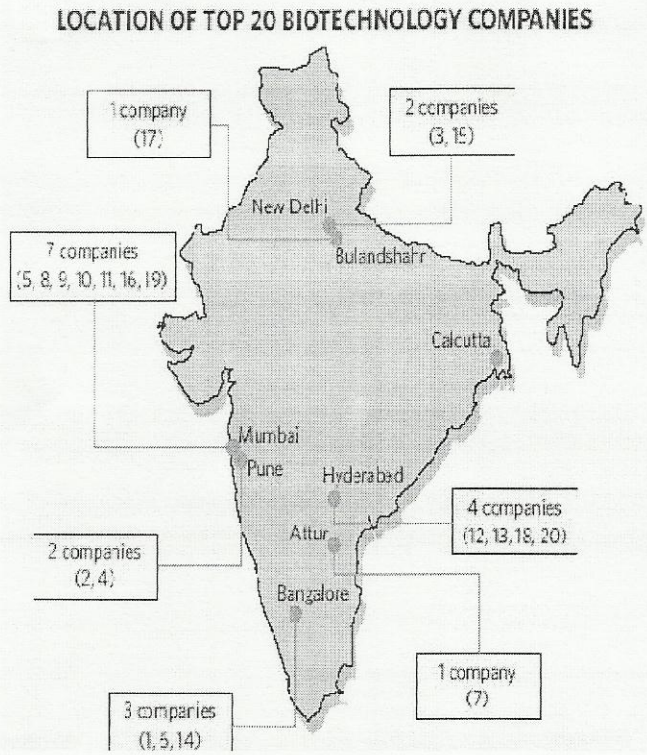


Figure 3: Indian Government Agencies for Funding of Public Research Sectors

The foremost reasons for India to become the hotbed of biotechnology is the availability of leading edge scientific expertise of prestigious universities and high degree of co-operation and technology transfer between academic institutions and private sector research laboratories. India continues to attract both national and foreign investments in the field of bioscience through a sustained national effort in areas such as liberal but competitive trade policy, governmental incentives, public and private support in funding, efficient regulatory framework and a steady pool of talented biological scientists and engineers. This is evident through the large number of biotechnology companies which have been established over the years (Figure 4). With these consistent practices, India is on the right track in reaching the pinnacle in the global biotechnology scenario.



INDIA'S TOP 20 BIOTECHNOLOGY COMPANIES

Company name	Revenue 2003-04 (US$million)	Revenue 2004-05 (US$million)	Growth (percentage)
1. Biocon	115	148	29
2. Serum Institute of India	126	130	3
3. Panacea Biotec	34	50	46
4. Venkateshwara Hatcheries	20	43	114
5. Mahyco Monsanto	12	38	208
6. Novo Nordisk	25	31	23
7. Rasi Seeds	–	20	–
8. Aventis Pharma	17	19	15
9. Bharat Serums & Vaccines	18	19	2
10. Chiron Behring Vaccines	15	18	16
11. GlaxoSmithKline	14	18	28
12. Indian Immunologicals	13	17	28
13. Shantha Biotechnics	9	16	75
14. Novozymes	12	16	30
15. El Lilly & Company	15	16	1
16. Wockhardt	9	15	68
17. Bharat Immunologicals & Biological	5	12	147
18. Bharat Biotech	8	9	14
19. Advanced Biochemicals	7	9	31
20. Biological E	9	8	-6

Source: Bio- Spectrum Industry Survey [1]

Figure 4: Map of India showing different biotechnology companies

GEOGRAPHIC ADVANTAGE

India's population has a very interesting demography that creates almost a perfect environment for biotech companies to shift bases there. In addition, the Indian sub-continent, which occupies only 2.4% of the total global surface area, has the most varied species of flora and fauna. A study shows that, in percentage terms, India has about 7.6% of total mammal species, 12.6% of bird species, 11.7% of fishes and roughly 6.0% of total flowering plants that are present in the world [17]. Biotech companies, by moving to India, can utilize this immense bio-diversity, and conduct field research much more efficiently. Adding to this, India has one of the largest agriculture sectors in the world, with varied climatic zones that can help in research and development of different agric-biotech products applicable worldwide [19]

Geographically, the biotech companies in India have developed into three major bio-clusters across the country. The largest, in terms of revenue generated, is the western India, followed by the south and the northern area. Exports contributed to 42.17 per cent of the total business, with bio-pharma products currently contributing to 73.15 per cent of the exports. [9]

EDUCATION & RESEARCH EXCELLENCE

Biotechnology is a knowledge-based industry and, therefore, the quality of science behind the R&D efforts is important. In terms of modern biotechnology based on hard-core molecular

biology, including recombinant DNA manipulations, structural biology of macromolecules, cell and developmental biology, bioinformatics, downstream processing, there were hardly any groups in India in the late 1970s, with expertise in these areas [7].

The growth of the biotechnology sector is largely dependent on the availability of trained resources. Universities through its master's and Post Graduate programmes, churn out many highly trained and skilled MSc and PhD graduates. Entrepreneurship also goes hand in hand with this development, such that graduates set up their own biotech companies, which in turn contribute to the biotechnological boom.

The quality of education in the field of biotechnology is fundamental for the development of the industry. India has invested heavily into higher education since decades; establishing world class universities and research institutes. At present, there are 50 Indian recognised universities, teaching post-graduate biotechnology courses and 300 college levels educational and training institutes, offering degrees and diplomas in biotechnology, bio-informatics and other biological sciences. As a result, each year 500,000 undergraduate students, 300,000 postgraduates and 1500 PhDs qualify in the biosciences [15]. There are over 100 National Research Laboratories, and world class research has been recorded in some prestigious institutes, such as the Indian Institute of Science in Bangalore (IISc), the National Center for Biological Sciences in Bangalore (NCBS), which is a branch of the Tata Institute of Fundamental Research.

There are also over 30 universities offering Masters of Science in Biotechnology through a joint entrance examination being conducted by the Jawaharlal Nehru University (JNU). Apart from this, Goa University is offering a two years Master of Science course in Marine Biotechnology, while All India Institute of Medical Sciences (AIIMS) offers a similar course in Medical Biotechnology. There are a couple of institutions offering Post Graduate Diploma Courses in Molecular and Biochemical Technology. Indian Institute of Technology (IIT) at New Delhi and Kharagpur offer a Five Year integrated course in Biochemical Engineering and Biotechnology. There is a Post MD/MS Certificate Course in Medical Biotechnology being offered by Post Graduate Institute of Medical Education and Research, Chandigarh and Sanjay Gandhi Post Graduate Institute of Medical Education and Research, Lucknow.

India's strength in research is also expressed by the high number of patent applications: In 2004, India ranked 2nd with regard to the number of patents filed for pharmaceutical products, second only to the US and surpassing Germany. Currently, about 500 biotechnology patents are filed annually [10].

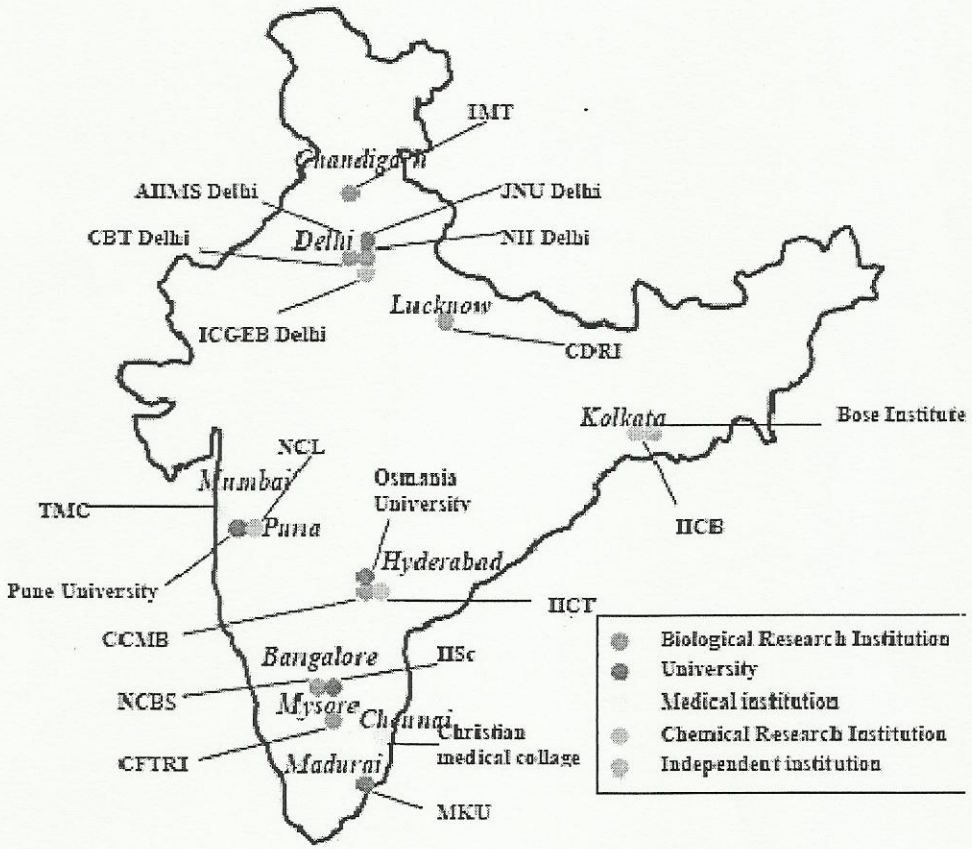
SCHOLARSHIPS AND NETWORKING

There are about 50 approved MS, postdoctoral, and MD training programs in biotechnology in progress or just about to start, in different institutions and universities covering most Indian States. [13] Short-term training programs, technician training courses, fellowships for students to go abroad, training courses in Indian institutions, popular lecture series, awards, and incentives form an integral part of the human resource development activities in India. A special feature of the program has been that since 1996 many students after completion of their training course join industries or work in biotechnology-based programs in institutions and laboratories. Scholarships

for students interested in pursuing their PhD in biosciences have been instituted to combat the brain drain issue.

Special awards like the National Bioscience Career Development Awards (NBCDA) have been instituted. Awards for women scientists and scholarships to the best students in biology have been instituted to help promote biotechnology in India and give recognition and reward to the active and emerging scientists. [13]

Another interesting incentive given by the Indian government for education and research is the extra-mural support. This means that the support has gone beyond the DBT and DST institutes to creating infrastructure and research competence in other agency (e.g. CSIR, ICAR) laboratories and universities. The concept of extra-mural research support practised by all government funding agencies in India is vital for the growth of science beyond their own institutions, and has made networking in research possible. Initial experience with networking different institutions was a challenge but the country has come a long way since then. Today, almost all mega projects involve the participation of multiple institutions. At the same time, there is also scope for smaller, single investigator-based projects. [16]



Source: [17]

Figure 5: Map showing the various biotechnology Institutes in India

GOVERNMENTAL CONTRIBUTION

India is among the first few countries in the developing world to have recognised the importance of biotechnology as a tool for advancing growth in the agriculture and health sectors. The Government of India should be complimented for taking the initiative to create the National Biotechnology Board (NBTB) in the Department of Science and Technology (DST) in 1982. NBTB graduated into a full-fledged Department of Biotechnology (DBT) in 1986 and serves as a body to identify priority areas and evolve a long-term plan for the development of biotechnology. [14]

The DBT has set up many Centres of Excellence in the country. These centres are responsible for generating skilled manpower as well as supporting R&D efforts of private industries. This has promoted interactions between the academia and the industry which has resulted in the growth of the biotechnology sector in India.

The Indian government's strong and committed support has been an important factor in the development and growth of the biotechnology sector. The government provides fiscal incentives to the biotechnology sector by granting a 150% weighted average tax deduction on R&D expenditures as well as on international patenting costs until 2010. In addition, it offers exemptions on import duties on key R&D and clinical trial equipment. Considering biotechnology as a priority sector, the government encourages banks to lend money to biotech companies. Plans were also in place to remove the duty on raw materials imported into India, where the finished product is imported duty free, thereby facilitating drug development in India8. [10]

The government has also put in place a bioinformatics and a genomics centre at Tidel Park in Chennai to explore the Indian genetic pool, leveraging on the pool of Indian bioinformatics scientists and low cost software skills. This would facilitate research and enable entrepreneurs to commercialise their findings. DBT provides a single window processing mechanism for all mega biotechnology projects involving foreign direct investment (FDI) of US$ 22 million or more under the Foreign Investment Implementation Authority (FIIA) with its Fast Track Committee (FTC) [7].

The Indian Government has evolved bio-safety guidelines and has helped to lay down patent rules. It has also participated in technology transfers and international collaborations. The Indian government has laid down a decent **regulatory framework** to approve Genetically Modified (GM) crops and r-DNA products for human health. A proactive government policy allows stem cell research in the country while having in place sound ethical guidelines. [6]

COLLABORATIVE VENTURES

To further directly promote the growth of biotechnology and modern biology, various universities have joined forces with the government. For instance, the University of Hyderabad

has teamed up with the Government of Andhra Pradesh to create a 'Knowledge and Innovation Park' which will house R&D activities of global biotech players. [16]

Moreover, various foreign collaborations have been established by the government, universities and research centres based in India; most of which are majorly with the United States of America, Columbia, Australia and Switzerland.

PRIVATE AND PUBLIC SECTORS OF BIOTECH

The private sector has huge networks of companies ranging from small-intensive to large multinational companies. It has large R & D funding available to carry out high return short-term and long-term biotechnology projects. It has a good understanding of market knowledge and distribution systems. It has large talent pool of scientific research resources and demand-driven efficient R & D facilities. To maximise these benefits, developing countries like India have begun to depart from the tradition of viewing the private sector as being a profit-propelled establishment and have taken up collaborative measures in order to benefit from the private sectors.

At present several projects under this umbrella have been initiated like biotechnological approaches for improvement of plant species with special reference to pulp and paper, value-added polymeric materials from renewable resources: lactic acid and lactic acid-based polymers, biodegradable polymers from agricultural wastes: cellulose esters based on bagasse-derived cellulose etc. [20]

ACADEMIA – INDUSTRY ALLIANCES

Alliances have become very popular since most companies are competing to achieve higher returns in their R & D operations. Innovations have become the key to survival and growth in this highly growing technological era. As companies realise they can no longer afford to rely solely on their own R & D and need to acquire ideas from others and they have resorted to contracting academicians who have expertise in this field for new innovations and consultations. This way the transfer of knowledge between the research centres and the firms is quickened and made more effective, enabling India to catch up with the industry in the west.

THE INDIAN EDGE

India's competitive edge in the biotechnology sector globally is owing to a number of factors such as; a large and strong pool of qualified scientists and engineers, good network of research laboratories, access to intellectual resources of NRIs in this area, existing and upcoming research facilities and institutional networks, rich and diverse species of flora and fauna, which is an added advantage for biotech companies to carry on their research and drug discovery effectively, strong and committed government support in the form of incentives given at both state and central levels, a large base of trained english speaking and skilled individuals and increasing acceptance of Indian clinical data. These attributes, both innate and developed, have helped India tide over being recognised as a poor developing nation and set a pace of technology development that many should try to imitate.

BIOTECHNOLOGY DEVELOPMENT - CHALLENGES FACED BY AFRICA

Although many initiatives have been taken to put in place structures and mechanisms for development of biotechnology in Africa, major differences exist between countries in relation to the level of application. These include: (1) the development of a knowledge base appropriate to decision making in the use of biotechnological approaches; (2) priority setting for biotechnology aimed at solving specific problems of national importance; (3) establishment of policy and regulatory structures for bio-safety and intellectual property protection; (4) capacity development for enhancement of the above issues; and (5) establishment of linkage and cooperative mechanisms for biotechnology development, its transfer, and sustainable applications in Africa.

African countries face a compelling need to develop long-term policies on biotechnology that (a) promote national biotechnology needs assessment and targeted research; (b) provide incentives for creation and financing of local private biotechnology enterprises; (c) promote local public R&D of foreign industry partnerships; (d) improve and enhance scientific capacities and technological infrastructure; and (e) integrate biotechnology risk management into existing environmental, health, and agricultural regimes.[5]

THE CROSS ROAD BETWEEN INDIA AND AFRICA

The combination of low operational costs, low-cost technologies, a skilled human resource base with proficiency in english, a large network of research laboratories and the availability of raw material such as plants, animals and human genetic diversity served as the backbone to India's Biotechnological success. On comparing African countries to India, it is clear that they share a number of similarities. Africa's population is 520 million today and is projected to increase to 1.3 billion in the next 25 years indicating that the continent has the highest population growth rate in the world. Also, the biodiversity in Africa is known to be rich in un-tapped flora and fauna, which are of great economic importance. Moreover, the continent is enriched with zealous youth with proficiency in English.

Yet it is depressing that in a continent with a large number of universities; hardly a dozen universities qualify to be centres of major R & D in the area of biotechnology. A serious introspection is needed and the issues involved are complex. The government should invest more in strengthening the higher education and equipping the universities with working biotechnology laboratories. More Scholarships for Postgraduate education in Biotechnology should be offered to outstanding students and incentives offered to scientists in this filed.

In order to become a major player in the biotechnology industry, the government needs to invest not only into research infrastructure but also into basic infrastructure such as roads, airports, telecommunications, convention centres or primary education. The federal governments should continue to finance large research projects and stimulate competition between the various states by providing funds to the most successful districts. The domestic industry needs to build partnerships with foreign companies or acquire their assets to improve its International Patent portfolio. Larger companies need to invest the proceeds they gain from generics into R&D to eventually start discovering drugs themselves. For the smooth and efficient management of the

biotechnology sector, a governing body for biotechnology can be established that will formulate guidelines and policies that will ensure its growth.

While the biopharmaceutical sector will continue to dominate, smaller companies should aim to look for niches such as bioinformatics where synergies with the IT industry could be leveraged and a global centre for bioinformatics could be created.

The government should implement policies that will attract foreign companies to start investing in Africa in order to benefit from the low cost research infrastructure. Government should offer loans for small and medium scale industrial set up and should tap into the technology transfer opportunities offered by various countries like India.

The private industry as well as the government should provide incentives to attract the brightest brains of the skilled Africans living and working overseas. In long-term, Africa should also try to attract scientists from other parts of the world mirroring the success of American research based companies and universities.

Africa has been blessed with nature's endowments yet, there are many obstacles the biotechnology industry is facing. Thus, it is up to her to now adopt and implement policies and action plans which have worked for other developing countries like her, for the betterment of her people. This might end up being the long awaited recipe to accomplish the long-term goal of eliminating poverty in Africa.

REFERENCES

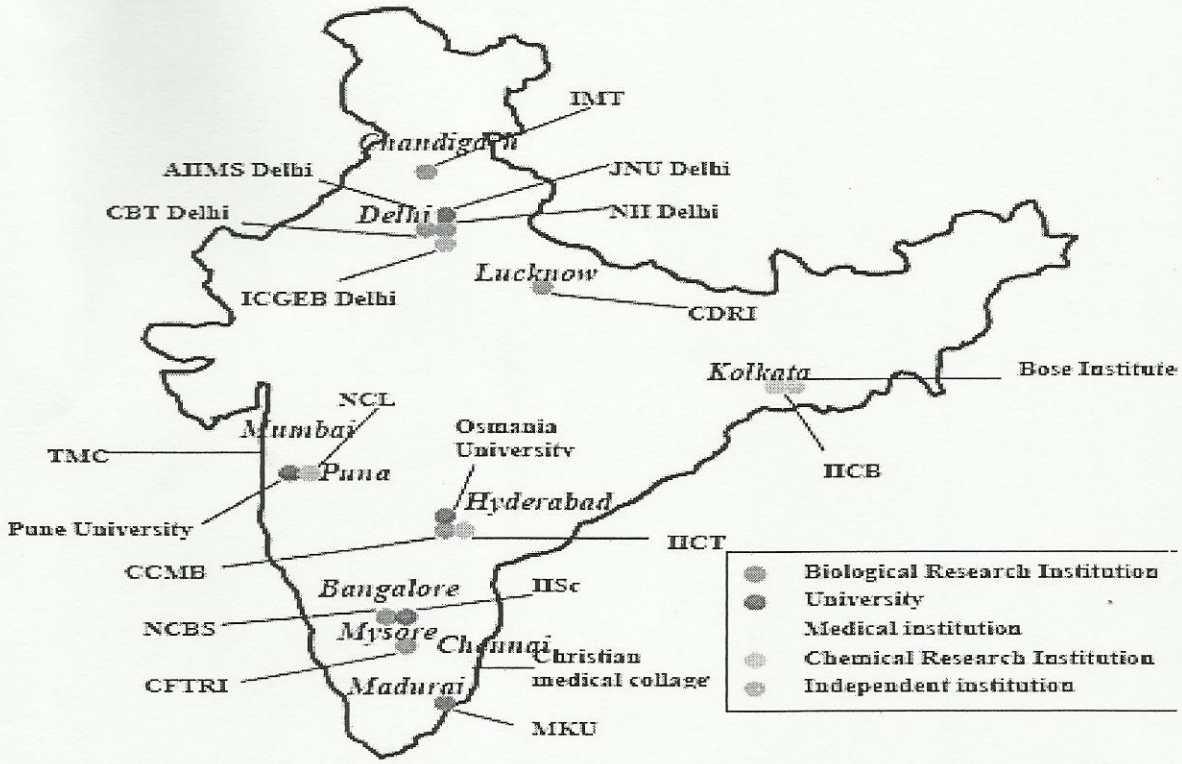
1. **Biospectrum India;** 2006"India's Top Biotech Schools"; http://www.biospectrum india.com/content/bstop20/10601115.asp
2. **Biospectrum India;** 2006. "India Can Become Significant Global Player by 2010 "; http://www. biospectrumindia.com/content/columns/10604111.asp
3. **Council of Scientific and Industrial Research**, Government of India (2007): http://www.csir.res.in.
4. **Charuvedi S.,** 2002, Status and Development of Biotechnology in India: An Analytical Overview. Ris: Discussion Papers.
5. **Cyrus G.** Ndiritu. 1999. Kenya: Biotechnology In Africa: Why the Controversy? Agricultural Biotechnology and the Poor, Pp. 109-114
6. **Doyle, J.J.,** and G.J. Persley. 1996. Enabling the Safe Use of Biotechnology: Principles And Practice. Environmentally
7. **Department Of Biotechnology,** Government of India (2007): http://dbtindia.nic.in.
8. **Department Of Science And Technology**, Government of India (2007): http://dst.gov.in.
9. **The World Bank,** 2006, Sustainable Development Studies and Monographs Series No. Washington, D.C.: 74 P.
10. **Ernst & Young;** 2005 "Drug Patents" India is 2nd globally"; http://inhome.rediff.com/money/2005/aug/16patent.html
11. **Falnitkar U.** 2000. "Biotechnology in India", http://www.altassets.com/casefor/ countries/ 2002/nz2910.php

12. **Federation of Indian Chambers of Commerce and Industry (FICCI)** (2004). Overview of Biotech Sector in India, Federation of Indian Chambers of Commerce and Industry (FICCI) Report.
13. **Hamilton W.F.**, 2001. The Biotechnology Revolution: Lesson for Technology Management Research and Practice. Int. Journal of Biotechnology, Vol. Nos. 1/2.
14. **Indian Department of Biotechnology** "National Biotechnology Strategy"; http://dbtindia.nic.in/biotechstrategy/biotechstrategy.pdf
15. **Indian Department of Biotechnology,** Ministry Of Science And Technology, http://dbtindia.nic.in/
16. **Itp News Network Mumbai.** 2003. Lecture Series on Strategic Change, Biotechnology; http://www.expressitpeople.com/20030127/careers1.shtml
17. **Maria A.,** J. Reut, M-H Zerah, 2003. Report Commissioned By the French Embassy in India, Biotechnology in India
18.**Padmanaban G.,** Growth Of Biotechnology In India, Current Science, Vol. 85, No. 6, 25 September 2003, Pg 712 – 719
19. **Sharma Manju.** 2000. India: Biotechnology Research and Development, Agricultural Biotechnology and the Poor. 51-57
20. **Viren Konde.** 2008. Biotechnology in India: Public – Private Partnerships. Journal of Commercial Biotechnology. Vol 14. No 1. 43–55

ABBREVIATIONS

AIIMS - All India Institute of Medical Sciences
CBT - Centre for Biochemical Technology
CCMB - Centre for Cellular and Molecular Biology
CDFD - Centre for DNA Fingerprinting and Diagnostics
CDRI - Central Drug Research Institute
CFTRI - Central Food Technological Research Institute
CSIR - Council of Scientific and Industrial Research
DAE – Department of Atomic Energy
DBT - Department of Biotechnology
DST - Department of Science and Technology
FDI - Foreign direct investment
FIIA - Foreign Investment Implementation Authority
FICCI - Federation of Indian Chambers of Commerce and Industry
FTC - Fast Track Committee
GM – Genetically Modified
GIOs - Genetically improved organisms
IARI - Indian Agricultural Research Institute
ICAR - Indian Council of Agricultural Research
ICGEB – International Centre for Genetic Engineering and Biotechnology
ICMR - Indian Council of Medical Research
IMT - Institute of Microbial Technology
IICB - Indian Institute of Chemical Biology
IICT - Indian Institute of Chemical Technology
IISc - Indian Institute of Science in Bangalore

JNU - Jawaharlal Nehru University
MKU – Madurai Kamaraj University
NBCDA - National Bioscience Career Development Awards
NBTB - National Biotechnology Board
NCBS - National Centre for Biological Sciences
NBRC - National Brain Research Centre
NCCS- National Centre for Cell Science
NCL – National Chemical Laboratory
NCPGR - National Centre for Plant Genome Research
NII - The National Institute of Immunology
NRCPB - National Research Centre on Plant Biotechnology
PGIMER - Post Graduate Institute of Medical Education and Research
R&D - Research and development
SGPGIMS - Sanjay Gandhi Post Graduate Institute of Medical Sciences
TFIR - The Tata Institute of Fundamental Research
TMC – Tata Memorial Centre
UGC - University Grants Commission


IMT
Chandigarh
AIIMS Delhi
JNU Delhi
CBT Delhi
Delhi
NII Delhi
Lucknow
ICGEB Delhi
CDRI
Kolkata
Bose Institute
NCL
Mumbai
Osmania University
TMC
Puna
IICB
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NCBS
Mysore
Chennai
Christian medical collage
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Madurai
MKU
Biological Research Institution
University
Medical institution
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Independent institution