India's Biotechnology Plans for the Next Five Years
By Biswajit Dhar and Sachin Chaturvedi

On paper, India’s new biotechnology plans for the next millennium seem feasible. However, given the broad coverage that these plans envisage, along with the lack of public-private linkages, questions can be raised about successful implementation.

The plans have been designed by a group of experts, including both scientists and industry representatives, who were appointed by the government. They were published in the Report of the Working Group for the Ninth Five Year Plan (1997 to 2002), and contain both short-term and long-term, i.e. longer than five years, research and production goals.

With a proposed expenditure in excess of US$ 255 million over the five year period, the experts have represented the most ambitious plans ever drawn up in India for this technology. Although, compared to previous years, the absolute budget for biotechnology has increased, in relative figures biotechnology research faces a declining share in the overall scientific research that is carried out in the public domain. While the government’s budget for scientific research has increased by 32 per cent, the share of biotechnology has declined from 11 per cent in 1987-88 to 9 per cent in the current financial year.

The basic policy framework for biotechnology has two main dimensions. The first takes into account the priorities of the main sectors in which biotechnology can make a difference. The second includes the discussion on some of the institutional mechanisms that are crucial to the developments in this sector, for instance the issue of intellectual property rights (IPRs). By accepting membership of the World Trade
Organization (WTO), India has committed itself to extending intellectual property protection on living matter, for instance micro-organisms and plant varieties. Another area of institutionalization is to find regulatory mechanisms for biosafety.

**Main objectives**

The priority areas have been identified by the experts based on two objectives: *Firstly*, it has been proposed that the programmes in the various sectors must lead to the generation of additional employment. *Secondly*, the needs of rural women and people from the economically weaker sections of the society have to be kept in sight. Therefore, a number of existing demonstration and training centres are sought which can be strengthened for transferring simple and low cost biotechnologies for economic improvement of these communities. For example, a biotechnology park is being planned in the Southern Indian state of Tamil Nadu. This has been conceived as a commercial venture with the participation of the Department of Biotechnology (DBT) and the Tamil Nadu Industrial Development Corporation. Among the technologies selected for this venture are tissue culture, biological pest control agents and organic compost.

In the report it has also been proposed to establish an advanced centre for biological pest control research. This centre would have regional centres to impart regular training to young scientists, farmers and unemployed youth on, for example, the safe use of biotechnology. In addition, the centre could develop technology packages and would act as a repository for the collection, maintenance and supply of biological pest control agents.

**Agriculture**

The priorities set in the report with respect to the agricultural sector reflect a continuity with past activities. However, there have been some changes. The proposal for the budget for crop biotechnology shows a significant increase: between 1992 and 1997 about US$ 5 million was spent, while a proposed budget of more than US$ 17 million is to be spent in the ensuing five years. The report prioritizes the use of biotechnology for both increasing yields and for the diversification of crops presently under cultivation.

Also, higher crop quality, such as higher nutritional value, is targeted. For instance, DBT has a programme for improving the nutritional value of pulses. In addition, genetic enhancement centres should be established to apply DNA marker technology for crop improvement and the identification of pathogens and pests. The crops identified for this purpose are cereals, pulses, and oil seeds. Besides food crops, attention is also to be given to the improvement and mass propagation of plants for traditional medicinal use, horticultural plants and endangered species.
In the areas of sericulture, which rears silkworms for silk production, and aquaculture, it is proposed that the ongoing programmes for developing diagnostic kits for early detection and prevention of infectious diseases are strengthened. This has become necessary since, due to the growth and intensification of aquaculture, there is increased incidence of diseases in the cultivated organisms.

**Medical biotechnology**

In this area, the allocation proposed in the Ninth Five Year Plan is US$ 18 million, as against US$ 7 million spent in the period 1992-97. This illustrates the ambitions of the plans that have been developed. The proposed prioritization of the programmes is based on several criteria, including the degree of disease-burden, mortality rates, the cost effectiveness of treatment, the emergence and re-emergence of diseases and the potential use of technology at the community level. It is planned to develop cost-effective and quicker diagnostics of tuberculosis, HIV, leishmaniasis, respiratory tract infections, cancer, and rheumatoid heart diseases.

Vaccine development has been one of the principal areas of biotechnological research in medicine. In the past, government initiatives towards vaccine development focused mainly on tuberculosis, HIV, cholera, typhoid and rabies. Now, malaria has been added as a disease that has made a come-back after having nearly been eradicated over the past few decades. The specific problems associated with malaria in India are a significant increase in the recorded mortality rates and the ineffectiveness of conventional drugs due to increased drug resistance.

An added dimension to the proposed research is the development of transgenic animals for biomedical purposes. These transgenic animals would serve as biofactories for biomedical products or as experimental modules for research on human genetic disorders and AIDS.

**Bioinformatics**

Among the proposed initiatives is the development of an effective bioinformatics infrastructure through the establishment of a *National Bioinformatics and Biocomputing Institute* (NBJI) to coordinate the activities of the large number of public bioinformatics centres that have been operating in the country. *A* *Biotechnology Information System* (BTIS) has been established by the major university departments and public sector R&D institutions to fulfil the growing need for information related to biotechnology.

It works as a distribution database and network organization to provide integrated information on all aspects of biotechnology including:
• Genetic resources data, such as germplasm databanks, DNA and protein sequences.
• Bibliographic references.
• Management information, for instance on R&D projects and resource directories. Bioinformatics is seen as a useful mechanism considering the vast volumes of genetic and biological data emanating from the research laboratories. Since major transnational corporations will increasingly use bioinformatics to make their operations more effective, the NBBI might become an important means of attracting foreign investment, especially from transnational companies.

Limitations
Initially, the Ninth Five Year Plan should begin in 1997-98, but due to delays for various reasons, including the elections, it has not yet come into force. When it is implemented, several problems will remain that could endanger the mission of the plan.

* Lack of links: Links between publicly funded research institutions on the one hand and local industry and civil society on the other, are weak. For example, the government-sponsored biotechnology R&D institutes have developed 17 technologies for different private companies, but none has been found commercially viable by these companies. Among these technologies were detection kits for several diseases such as hepatitis B and typhoid fever, tissue culture for bamboo, and an animal birth control injection.

* Lack of focus: Another feature of the proposed policy is that every conceivable sector is included in the list of priority areas, and that the policy therefore lacks focus. Attention is drawn, for instance, to biodiversity conservation, environmental protection, agricultural biotechnology, medical biotechnology and bioinformatics. It is worth noting that this overload of proposed priorities contradicts the fact that the biotechnology sector faces severe resource constraints, even for the continuation of various existing programmes.

* Isolation: Like earlier plans, this report neglects several relevant areas. Mira Shiva from the non-governmental organization (NGO) Voluntary Health Association of India feels that the biotechnology research priorities are still developed in isolation, irrespective of the national requirements. The priorities do not address the lack of access to health care and the development of technologies that meet the requirements of the country’s growing number of poor. Important food crops such as sorghum, millet and cassava do not appear on the list of priorities.

In the area of medical biotechnology, a similar hiatus between the orientation of research priorities and perceived needs can be found. The focus of research in medical biotechnology has remained fairly diffuse. Even basic requirements, such as for the
polio vaccine, which is part of India’s general immunization programme, are mostly met via imports.

*Procedural problems*: Long-winded procedural problems contribute to difficulties concerning the implementation of the programme. The intention is that after the priority areas of research are identified and published, scientists will be invited to send in proposals. A committee inside the institution from which the proposal comes will screen the projects to assess their relevance to the identified priority areas. The eligible projects will then be reviewed by national experts and finally evaluated by a DBT task force, consisting of experts from government departments, scientists from universities and autonomous, publicly funded research institutes. Currently there are 16 biotechnology task forces. The screened projects, eventually cleared by the task force, will finally be reviewed by the finance section of the DBT.

This process has two underlying dangers. *Firstly*, the task forces that scrutinize the project proposals were set up in 1987, and their relevance in relation to recent developments in biotechnology has never been questioned since. For example, among the many task forces established in 1987, one focused on tissue culture propagation techniques.

Since then, several centres have become involved in this area. Therefore, tissue culture no longer needs the public support it once did, and this money could now be used for the solution of urgent problems and the development of more advanced techniques. *Secondly*, as the decision rests with the financial experts, it is likely that they will strive for an optimal allocation of resources by ensuring that each task force receives some assistance. In this process, projects with larger national goals sometimes lose, since not all task forces deal with issues important in terms of national requirements.

In summary, given the large number of activities the DBT proposes to undertake during the next five years, it difficult to see how it would be able to realize these objectives. It remains doubtful whether these activities will help to generate employment and to meet the needs of rural women and people from the economically weaker sections of society.

**Proposed changes**

Several suggestions have been made to ensure that research in the area of biotechnology complements the ongoing research in agriculture and medicine. *Suman Sahai* of the Indian NGO the Gene Campaign, feels that there is a need to develop a
comprehensive National Bioresource and Biotechnology Policy (NBBP). Such a biotechnology policy should clearly articulate the biotechnology goals of the country and identify the problems associated with these goals which cannot be solved by employing traditional technologies. This approach, in Sahai’s view, would compel the domestic R&D agencies to develop a more restricted and home-grown research agenda.

Such an NBBP would also been seen as a framework for ensuring a larger involvement by the private sector in the development of biotechnology on a national level. It has been proposed that the government provides assistance to the private sector for obtaining funds for product development. One of the mechanisms for the development of indigenous R&D that has been discussed in India and elsewhere, for instance in Singapore, is the provision of venture capital funds.

**Pushpa Bhargava**, the former director of the Centre for Cellular and Molecular Biology, one of the leading publicly funded biotechnology laboratories in India, has suggested that the biotechnology research institutions be asked if their research activities can help in establishing a competitive Indian biotechnology industry.

This, Bhargava feels, can help tackle the critical problem of the absence of any accountability, whether scientific, financial or social, in biotechnology research. The lack of accountability could be addressed by the involvement of NGOs in the formulation of the national biotechnology policy. At present, however, this is not the case. Several factors have contributed to this situation.

**Firstly** and most importantly, there are some deficiencies that the NGO sector faces at the present juncture. They are still small in number and most organizations’ capacity to intervene is restricted to their own geographical environment. In fact, the effective functioning of the NGOs could have far larger benefits. The beneficial role that these organizations can play was recently confirmed by several cases in which government research institutions violated biosafety regulations. The NGOs indicated the illegal use of the *Bacillus thuringiensis* (Bt) gene in field trials.

**Secondly**, the DBT has not made any concrete effort to provide a forum for the NGOs. No effort is made to obtain feedback from NGOs on biotechnology policy in general and on the R&D priorities in particular. NGOs have a rich experience arising from the work with people at the local level and their expertise should help to identify areas in which biotechnological intervention could be rewarding.
Sources
Report of the Working Group for the formulation of the Ninth Five Year Plan (1997-2002) for the department of biotechnology, Ministry of Science and Technology, New Delhi, India.

Personal communications with P. Bhargava (Anveshana), S. Sahai (Gene Campaign), M. Shiva (Voluntary Health Association of India), V. Singhal (Biotech Association of India), P. Aggarwal (GreenTech Seeds), R.P. Sharma (National Biotechnology Centre) and R. Roychoudhari (National Institute of Immunology).