BIOTECHNOLOGY FOR WEALTH CREATION

6

I. INTRODUCTION

6.01 During the Eighth Plan period, efforts were focused on laying the foundation towards building a competitive biotechnology industry. Human resource development was accorded due emphasis to create skilled workers for biotechnology-related fields. Research and development (R&D) in biotechnology gained prominence and was conducted in accordance with priority areas. Efforts were also directed at enhancing technological infrastructure and facilities to foster innovation and industry development. A significant milestone was achieved with the launching of the National Biotechnology Policy (NBP) in 2005, which provided a comprehensive framework to guide biotechnology development efforts in the country.

6.02 Biotechnology is poised to drive the next wave of knowledge-based industries that will contribute to growth and wealth creation, new investment and employment opportunities as well as deliver social and environmental benefits. For the Ninth Plan period, concerted efforts will be geared towards the implementation of the NBP, with the active participation of the private sector. An enabling institutional, regulatory and financial framework will be developed to promote biotechnology as a major driver of sustained economic growth. Human capital development will be intensified to meet the industry's skill needs and nurture entrepreneurship. The biotechnology infrastructure will be strengthened with the establishment of centres of excellence. A new approach, namely, 'BioNexus' which leverages on the strengths of existing institutions along with parallel developments in industries, will be adopted.

II. PROGRESS, 2001-2005

6.03 Biotechnology was identified as a key technology that could drive and support the nation to evolve into a knowledge-based economy. During the Plan period, the emphasis was on building the capacity and capability of human resource as well as research institutions. The NBP, launched in 2005, provided for a more integrated framework of industry development, outlining a comprehensive set of goals, priorities and strategies. It underscored the need for human resource

development, regulatory and institutional changes as well as fiscal and financial incentives. It also outlined a 15-year implementation horizon to chart the strategic directions of the biotechnology industry. To drive implementation, the Malaysian Biotechnology Corporation was established in 2005 to act as the lead agency in facilitating the development of Malaysia's biotechnology industry.

Human Resource Development

6.04 The quality and skills of human resources is vital to the success of biotechnology. Recognising this, various programmes were implemented to produce a pool of talent and expertise in biotechnology and biotechnology-related fields. During the Plan period, institutions of higher education produced more than 4,000 graduates with Bachelors, Masters and Ph.D degrees, covering a wide range of biotechnology specialisations such as molecular biology, plant biotechnology, bioprocess engineering, bioinformatics and marine biotechnology. The National Science Fellowship (NSF) Programme provided scholarships to 156 Masters and Ph.D students in biotechnology-related fields. The in-service training programme for human resource development in science and technology also provided scholarships to serving officers in research institutions and universities to pursue post-graduate degrees in biotechnology. Despite efforts in manpower development, gaps continued to persist between demand for, and supply of biotechnology skills, as the creation of new employment opportunities in the sector still lagged behind.

Research and Development

6.05 The Biotechnology R&D Grant Scheme established in 2001 under the National Biotechnology Directorate approved a total of RM95.3 million for 47 biotechnology research projects, as shown in *Table 6-1*. Of this total, 11 projects were classified as ready for commercialisation. In terms of intellectual capital, these R&D projects generated 27 patents filed in Malaysia and one internationally filed patent.

Infrastructure and Facilities

6.06 During the Plan period, measures were taken to provide the necessary technological infrastructure and facilities to support biotechnology-related activities. Amongst others, three special laboratories were set up, covering agro-biotechnology at the Malaysian Agricultural Research and Development Institute (MARDI), genomics and molecular biology at the *Universiti Kebangsaan Malaysia* (UKM) as well as pharmaceuticals and nutraceuticals at the *Universiti Putra Malaysia* (UPM). These laboratories provided specialised facilities for the advancement of the country's R&D in biotechnology and its applications as well as training ground for R&D personnel.

TABLE 6-1

PUBLIC R&D PROJECTS ON BIOTECHNOLOGY, 2001-2005

Focus Area	*No. of Projects*	*Grant Approved (RM million)*
Genomics & Proteomics	8	17.9
Plant	4	8.6
Animal	12	17.3
Medical	8	18.9
Biopharmacy	5	3.2
Environment	2	3.8
Food	4	6.4
Natural Products	4	19.2
Total	**47**	**95.3**

Source: Ministry of Science, Technology and Innovation

6.07 The Biotechnology Standardisation and Quality Control Centre (BIOSTAQ) for herbal products in Kulim Hi-Tech Park began operations in August 2004. The centre provided services related to standardisation and quality control of natural products. These services, using advanced technologies, included analysis of microbial and heavy metals, gravimetric testing, extractive value analysis as well as toxicity and purity testing.

6.08 As part of efforts to develop a Malaysian biotechnology community, the National Biotechnology and Bioinformatics Network (NBBNet) was set up in 2001. It was initiated to promote closer collaboration and networking among research institutions, universities and industry. It also hosted databases and information on local genetic resources and major R&D activities.

Regulatory Framework

6.09 Recognising the importance of a good regulatory environment in developing the biotechnology industry and in ensuring public safety, the Government assumed a proactive role in shaping the regulatory agenda. In this regard, Malaysia ratified and acceded to several international conventions and protocols on the development of the biotechnology industry. Malaysia is party to the Convention on Biological Diversity and ratified the Cartagena Protocol on Biosafety in 2003 to protect the country from potential risks from living modified organisms (LMOs). The Protocol provided separate sets of procedures, namely for LMOs that are to be intentionally introduced into the environment and LMOs that are to be

used directly as food or feed or for processing other food products, in addition to procedures for advanced information agreement and the establishment of a Biosafety Clearing House mechanism.

6.10 The promulgation of the Control of Drugs and Cosmetics Regulation in 1984 provided the foundation for development of a systematic pharmaceutical regulatory system. To maintain standards and safeguard public well-being, measures were undertaken by the National Pharmaceutical Control Bureau (NPCB) to implement a drug and cosmetic registration and licensing scheme which covered pharmaceutical manufacturers, importers and wholesalers as well as clinical trials. NPCB also provided technical assistance to local pharmaceutical manufacturers to upgrade manufacturing standards to levels equivalent to the requirements of Good Manufacturing Practice (GMP) as recommended by the World Health Organisation (WHO) and other relevant organisations.

6.11 With globalisation and trade liberalisation, efforts were made to ensure the competitiveness of the pharmaceutical industry through continuous improvement in standards and quality assurance requirements. In 2002, Malaysia became the 26th member of the Pharmaceutical Inspection Cooperation Scheme (PICS), a cooperative arrangement between international pharmaceutical inspection authorities in the field of GMP. The acceptance of Malaysia into the PICS paved the way for the local pharmaceutical products to be recognised internationally.

Private Sector Participation

6.12 Based on the Census of Establishments and Enterprises 2005, a total of 117 biotechnology-related companies was established as at 2003, generating value added of RM1.4 billion and creating 10,200 jobs. Companies in the services sector comprised 68.4 per cent of the total, followed by manufacturing and agriculture at 23.9 per cent and 7.7 per cent, respectively. The biotechnology-related services companies generated 65.7 per cent of the total value added in biotechnology and were involved in activities such as repackaging, distribution and marketing of biotechnology-related products as well as consultancy services for regulatory and standards compliance. Agro-biotechnology companies were involved mainly in the application of tissue culture and advanced reproductive techniques for the production of improved crops and livestock.

6.13 In consonance with the private sector-led growth policy, efforts were undertaken to attract investments in biotechnology. During the Plan period, a total investment of RM715.5 million involving 30 manufacturing projects was approved in the areas of agriculture, healthcare and industrial biotechnologies with potential employment of 1,441 jobs, as shown in *Table 6-2*. Of the approved projects, 10 companies commenced operations with a total investment of RM110 million generating 364 jobs. These projects included the production of nutritional immunology supplements based on plant materials, monoclonal antibodies,

polypeptide and formulations as well as diagnostic kits. The remaining approved projects are in the process of setting up manufacturing plants.

TABLE 6-2

APPROVED BIOTECHNOLOGY MANUFACTURING PROJECTS, 2001-2005

Year	*2001*	*2002*	*2003*	*2004*	*2005*	*8MP*
No. of Companies	2	6	4	11	7	30
Employment	56	199	129	519	538	1,441
Proposed Investment (RM million)	6.1	79.8	215.7	237.8	176.1	715.5

Source: Ministry of International Trade and Industry

6.14 As part of efforts to encourage private sector participation in the biotechnology industry, incubator facilities were provided by SIRIM Berhad, Technology Park Malaysia as well as Malaysian Technology Development Corporation (MTDC) in collaboration with UPM, UKM, *Universiti Teknologi Malaysia* (UTM) and the Forest Research Institute of Malaysia (FRIM) to nurture new enterprises. The incubatee companies were given access to common user facilities as well as technical assistance in design, prototyping and product development.

6.15 During the Plan period, measures were undertaken to foster closer international collaboration in the field of biotechnology. A number of initiatives contributed towards developing domestic capability in key platform technologies to produce high value added products and generate intellectual property (IP). These included collaborations in research and commercialisation of selected natural products as well as initiatives in the areas of vaccinology, diagnostics and biomaterials.

III. PROSPECTS, 2006-2010

6.16 The biotechnology sector faces a challenging future with increasing global competition. To be competitive, Malaysian biotechnology companies will need to identify and build upon niche products and services in appropriate parts of the global biotechnology value chain. The Ninth Plan will focus on implementing the NBP to develop Malaysia's niches in agriculture biotechnology, healthcare-related biotechnology, industrial biotechnology and bioinformatics. In this regard, the promotion of foreign and domestic investments and close collaboration with foreign entities to access new technology, expertise and markets will be intensified. The BioNexus concept will be employed whereby establishment of biotechnology

companies or projects will be targeted near relevant research institutions and industrial bases to form synergistic linkages amongst these entities and hence, expedite the growth of clusters. Vital to the success of implementation of the NBP will be the follow through of plans, effective implementation of programmes as well as constant monitoring and evaluation of the outcome and impact.

Development Thrusts

6.17 The objective of biotechnology development during the Ninth Plan period will be to harvest its potential as a growing source of wealth creation and enhance applications on biotechnology in various sectors of the economy. The target will be to at least double the number of biotechnology and biotechnology-related companies to 400 by 2010. The emphasis will be on nurturing quality, high value added and knowledge-intensive companies and creating more job opportunities. Towards this end, the strategic thrusts include:

- ❑ *transforming and enhancing value creation in the agriculture sector through biotechnology;*
- ❑ *capitalising on the strengths of biodiversity to commercialise discoveries in health-related products and position Malaysia in the growing biogenerics market;*
- ❑ *nurturing growth opportunities in industrial bioprocessing and biomanufacturing;*
- ❑ *leveraging on the convergence of technologies to grow the nascent bioinformatics industry;*
- ❑ *promoting BioNexus as a unique brand to attract foreign and domestic investments in biotechnology;*
- ❑ *creating an enabling environment with supportive institutional, regulatory and financial framework to facilitate the build up of a strong and diversified biotechnology industry;*
- ❑ *enhancing human capital development to meet national needs; and*
- ❑ *establishing R&D centres of excellence and accelerating technology development, diffusion and commercialisation.*

Biotechnology Development

6.18 As part of efforts to move the economy up the value chain, emphasis will be placed on developing the biotechnology industry. To grow new sources of wealth, measures will be undertaken to strengthen the industry's foundation as well as attract greater private sector participation by investing and establishing businesses in strategic parts of the biotechnology value chain.

Agriculture Biotechnology

6.19 To increase value creation of the agriculture sector, greater efforts will be undertaken to develop national capability in agro-biotechnology. The accumulation of knowledge and expertise developed by institutions such as MARDI, Malaysian Palm Oil Board and the Malaysian Rubber Board will be harnessed and deepened to develop niche areas. New technologies, spearheaded by these institutions as well as the newly designated Malaysian Genome Institute, will include bioinformatics, genetic engineering, functional genomics and proteomics to discover new applications not only in agriculture biotechnology but also in healthcare and industrial biotechnologies.

6.20 Application of biotechnology platform technologies, such as genetic engineering, functional genomics and proteomics will be encouraged to produce agro-biotechnology products that increase plant and livestock productivity as well as improve their agronomic traits. Other agro-biotechnology activities that will be promoted include biopharming, the use of transgenic plants or livestock to produce high-value proteins.

6.21 The National Institute of Agro-biotechnology at MARDI will serve as the centre of excellence for agro-biotechnology R&D, commercialisation and diffusion. The Institute will also develop a synergistic partnership with the Agropolis, which will be established as a centre of excellence for food production and processing. To facilitate the diffusion of modern agricultural technologies and practices, the Agropolis will hold international exhibitions such as the Malaysian Agriculture, Horticulture and Agro-tourism (MAHA) to showcase the country's agricultural businesses and products.

Healthcare Biotechnology

6.22 Biotechnology enables the discovery and development of better healthcare products and treatments. However, given the large investments required to undertake the entire process of discovery to commercialisation, Malaysia must develop niches in strategic areas of the value chain. In line with this, efforts will focus on leveraging the country's extensive biodiversity and local knowledge in traditional/complementary medicine (T/CM) to develop leads for the pharmaceutical and nutraceutical industries. Other niches that will be developed include contract research and development of biogenerics, diagnostics and vaccines, particularly for high-incidence diseases.

6.23 The National Institute of Pharmaceuticals and Nutraceuticals (NIPN) and the National Institute of Natural Products, Vaccines and Biologicals (NINPVB) will be set up as centres of R&D excellence in the field of healthcare-related biotechnology. The NIPN will focus on the optimal utilisation of natural bio-resources from plant, marine and microbial origins for use in nutraceuticals, cosmeceuticals and phytopharmaceuticals. The NINPVB will implement

programmes to promote herbal medicine by harnessing local knowledge in T/CM and to increase the production of vaccines. In addition, a Bioproducts Validation Centre will also be established in Johor to validate herbal, nutraceutical and phytopharmaceutical product claims for the purpose of regulatory registration and quality assurance.

Industrial Biotechnology

6.24 The country's strength in manufacturing and processing industries offers a wide range of opportunities for the development of industrial biotechnology. The identified areas of growth include the development of biocatalysts such as enzymes for food and feed preparations, cleaning products, textile processing and other industrial processes. Bioprocessing is another growth area which can be applied in the production of biomaterials such as bioplastics, biofuel, specialty chemicals such as cosmetics ingredients and electronic chemicals. The third growth area is contract biomanufacturing.

6.25 As part of the efforts to promote biomanufacturing, a current good manufacturing practice (cGMP) facility, designed in accordance to international guidelines and standards, will be completed and be fully operational by June 2006. This facility will pave the way for Malaysia to become a player in active pharmaceutical ingredient contract manufacturing. The multi-product facility will be used for the production of a full range of biopharmaceuticals based on mammalian and human cell culture.

6.26 High crude oil prices coupled with the need to find renewable energy to replace depleting fossil fuel has presented biofuel as viable area of growth. The demand for biodegradable fuels including palm diesel by developed countries is expected to reach 10.5 million tonnes by 2007. Malaysia, with 3.9 million hectares of oil palm plantation and more than 360 palm oil mills has the capacity and capability to meet the increasing global demand for biofuel. In line with the National Biofuel Policy, which was announced in August 2005, various strategies will be undertaken to increase the use of biofuel as an alternative to petroleum-based diesel.

Bioinformatics

6.27 With vast amounts of data and information being generated due to advances in myriad of technologies, there arises a need to organise and manage information. The convergence of ICT and biotechnology, commonly known as bioinformatics, provides an important support function to gather, store, classify, analyse and distribute biological information derived from gene sequencing as well as functional analysis of research projects. In addition to being a new source of growth, bioinformatics is making a significant contribution towards discoveries and product development. Strategic initiatives will be rolled out for bioinformatics and grid computing to support the country's biotechnology development.

6.28 The existing strength and wealth of ICT platforms in research institutions including MIMOS, universities and the Multimedia Super Corridor (MSC) will be optimally utilised to accelerate the development of the bioinformatics subsector. Grid computing will be adopted as a means to reduce the cost of investment in R&D through the sharing of facilities. In this regard, the second phase of the Malaysian Research and Education Network (MyREN) will be initiated to enhance connectivity among the various universities and research institutions as well as industry and international linkages to increase research collaboration efforts.

Building a Malaysian Brand

6.29 Concerted efforts will be undertaken towards making Malaysia a preferred destination for investments in biotechnology. The Malaysian Biotechnology Corporation will focus on attracting investment, sourcing partnership opportunities as well as supporting local biotechnology entrepreneurs in setting up their businesses. Towards this end, the brand "BioNexus" will be promoted to market Malaysia's biotechnology initiative to investors and potential partners. To strengthen the brand, an attractive package of incentives will be offered to domestic and foreign BioNexus-status companies.

Creating an Enabling Environment

6.30 With the biotechnology policy framework in place, focus will be on creating an enabling environment to provide the essential building blocks to develop the biotechnology industry. This will require a multi-prong approach in addressing the critical success factors such as conducive regulatory framework, adequate financing infrastructure, human capital development and R&D capabilities.

Regulatory Framework

6.31 Recognising the necessity of a conducive regulatory framework for the development of biotechnology, the Government is in the process of formulating and enacting a number of legislations. These include the Biosafety Bill and the Access and Benefit Sharing (ABS) Bill. The ABS Bill seeks to ensure fair and equitable sharing of benefits from the use of Malaysia's biological resources and protect against biopiracy. It requires parties that wish to conduct research, export or sell local biodiversity resources to apply for specific permits for such activities.

6.32 To foster innovation and safeguard investments in biotechnology, efforts will be intensified to improve the IP policy and management framework. A comparative study on the best practices of IP policy and management will be conducted to identify areas for improvement in IP regulations and processes. Guidelines on IP sharing for researchers in public research institutions and in business collaborations as well as for local and foreign ventures will be introduced. Related standards such as good laboratory practice (GLP) and cGMP will be enhanced to attract outsourcing of clinical trials and contract manufacturing.

6.33 To increase the stock of intellectual capital, appropriate incentives for IP registration of inventions and discoveries will be provided. A resource and referral centre will also be established to offer technical advice on issues such as IP and regulatory compliance. Capacity building and awareness programmes will be conducted to encourage researchers to patent their findings and products. In this regard, a comprehensive IP guide and management manual will be developed. Efforts will also be targeted at developing an adequate number of IP-related human resource including patent specialists, technology evaluators, lawyers and examiners.

Financial Infrastructure

6.34 Biotechnology projects are confronted with issues such as high risk, long gestation period, substantial upfront investment and stringent regulatory compliance. In order to transform the nascent biotechnology industry into a vibrant one, access to financing across the entire value chain will be a critical factor for success. Towards this end, a comprehensive funding structure and financial incentives will be put in place to address the gaps in financing. Increasing emphasis will be placed on R&D and commercialisation, strategic technology acquisition, business and entrepreneurship development as well as the building of the requisite infrastructure. In this regard, the public sector will complement private sector financing and investment efforts, with an allocation of RM2.0 billion, which include a number of programmes to improve access to financing by the private sector.

6.35 Funding for R&D in biotechnology will be provided through existing sources as well as new funds such as the ScienceFund and TechnoFund. To support commercialisation of research findings, applications for matching grants can be made via the Commercialisation of R&D Fund (CRDF) under the Malaysian Technology Development Corporation (MTDC). To complement these sources, a dedicated Biotechnology Commercialisation Fund with an allocation of RM100 million will be set up to provide matching grants to R&D companies or companies conducting in-house R&D.

6.36 Early stage financing can be accessed through MTDC's newly established Malaysian Life Sciences Fund. Soft loans will be made available for international business development, especially those that require intensive technology and product evaluation, due diligence as well as complex registration and approval processes prior to entry into international markets. Funds will also be channelled through commercial banks, financial institutions and venture capital entities to make available sufficient resources for enterprising firms, consortia or individuals intending to venture into the biotechnology sector.

Human Capital Development

6.37 In view of the high reliance of biotechnology on intellectual capital and knowledge-intensive applications, measures will be intensified to enhance human

capital development. The human resource development programmes will be fine-tuned and new ones introduced to meet the skill requirements of activities along the entire biotechnology value chain. The institutions of higher education will enhance undergraduate and post-graduate courses in order to expand scientific and specialised skills, especially in the fields of genomics, microbiology, bioprocessing as well as in related engineering and business fields. The colleges and skills development training centres will concentrate on matching the demand for technical human resource such as biotechnology research assistants, GMP personnel and technicians in biomanufacturing, metrology and quality control.

6.38 To create greater synergy and collaboration between the research institutions, universities and the industry, measures will be undertaken to create highly dynamic and motivated R&D personnel. A mechanism to facilitate IP ownership and IP sharing among various stakeholders will be put in place. Avenues will be provided to enable the participation of public sector scientists and researchers in private sector biotechnology projects and clinical trials. The National Brain Gain Programme will be implemented to enhance domestic technology capacity and capability as well as fill the gaps in skills and expertise. To address the issue of brain drain and attract overseas talent, the remuneration and reward system will be reviewed and made more attractive and performance-driven.

6.39 In order to commercialise R&D and create new spin-off companies, measures will be undertaken to nurture a critical mass of biotechnology entrepreneurs. A biotechnology entrepreneur development programme, with an initial allocation of RM50 million, will be implemented to develop core competencies in business negotiations, technology and financial due diligence, preparation of viable business plans and business management. Efforts will also be directed at disseminating information on business opportunities, sources of funding and incentives for the biotechnology industry.

R&D and Technology Acquisition

6.40 The knowledge- and technology-intensive nature of biotechnology compels an urgent need to invest in R&D programmes and, more importantly, in subsequent commercialisation to generate economic gains. For the Ninth Plan, R&D programmes will cover a range of research areas including improvement of productivity in agriculture and animal husbandry, medical diagnostics and pharmaceuticals. Increased resources will be made available to develop domestic R&D capacity and capability in a number of research institutions and universities. In downstream commercialisation and marketability of potential products, collaboration with the industry will be enhanced through a variety of modalities such as joint-ventures, sharing of high-technology facilities and specialists as well as equity participation. Research scientists and engineers from research institutions and universities will be given opportunities to participate in and, develop new ventures as well as manage and market IPs.

6.41 To boost research productivity and shorten the time required to bring products to market, the acquisition of platform technologies will be given emphasis. In this regard, the strategic acquisition of biotechnology-related IP and technologies in key areas will be adopted to fast-track developments. For this purpose, a special RM100 million fund for biotechnology acquisition will be established. Potential acquisition will undergo a stringent process of due diligence and will be licensed to selected companies or research institutions. International collaboration will also be enhanced to facilitate technology transfer and expertise as well as improve access to a wider pool of knowledge.

IV. INSTITUTIONAL SUPPORT AND ALLOCATION

6.42 The Biotechnology Implementation Council will set the overall policy direction, oversee the implementation of the nation's biotechnology initiatives and provide the forum to ensure inter-ministerial coordination. The Ministry of Science, Technology and Innovation in collaboration with the relevant ministries will formulate strategies and implement programmes to harness biotechnology as a new source of growth and wealth creation. Key ministries, including the Ministry of Agriculture and Agro-based Industry, Ministry of International Trade and Industry, Ministry of Health and Ministry of Plantation Industries and Commodities will facilitate the development of niche areas in agriculture, industrial and healthcare biotechnologies. The Malaysian Biotechnology Corporation will work in close partnership with the relevant ministries and stakeholders to attract

TABLE 6-3

DEVELOPMENT EXPENDITURE AND ALLOCATION FOR BIOTECHNOLOGY, 2001-2010
(RM million)

Programme	*8MP Expenditure*	*9MP Allocation*
Research and Development (R & D)	**190.0**	**463.0**
Biotechnology R&D Initiatives	190.0	363.0
Biotechnology Commercialisation Fund	–	100.0
Biotechnology Acquisition Programme	**–**	**100.0**
Biotechnology Business Development	**216.8**	**529.8**
Technology & IP Management	69.9	100.0
Entrepreneurship Development	–	50.0
Agro-biotechnology Projects	46.9	79.8
Institutional Support and Equity	100.0	300.0
Biotechnology Infrastructure	**167.6**	**928.5**
Total	**574.4**	**2,021.3**

Source: Economic Planning Unit

investment and increase private sector partcipation in the biotechnology industry. The Ministry of Higher Education will be responsible for ensuring that an adequate and qualified supply of human resource in biotechnology and biotechnology-related fields is developed.

6.43 For the Ninth Plan period, an allocation of RM2.0 billion will be provided for biotechnology development, as shown in *Table 6-3*. Of this total, 45.9 per cent will cater for physical infrastructure development while the remaining 54.1 per cent will be allocated for soft infrastructure development including R&D and commercialisation as well as business development programmes.

V. CONCLUSION

6.44 During the Eighth Plan period, measures were undertaken to provide the requisite technology infrastructure as well as develop domestic capacity and capability in biotechnology. The NBP was launched to provide a comprehensive framework for the sustainable development of the biotechnology industry. For the Ninth Plan period, the focus will be on implementing the strategic thrusts of the NBP to generate new sources of growth in agriculture, healthcare and industrial biotechnologies as well as bioinformatics. To attract private sector investment in biotechnology, among others, a package of customised incentives including matching grants for R&D will be made available to BioNexus-status companies. Centres of excellence in biotechnology will be established to provide shared facilities and the necessary technical expertise and R&D support to the emerging industry.

6.45 Programmes will be implemented to harness the nation's biodiversity and build upon existing capabilities and capacity to create economic value, especially through high-technology and knowledge-intensive activities. Efforts will be undertaken to accelerate the development of the biotechnology industry through the implementation of R&D, technology acquisition and commercialisation programmes in collaboration with the private sector. Emphasis will be placed on human resource development and the provision of adequate financing. Measures will also be undertaken to provide a supportive institutional and regulatory environment including an enhanced IP system to attract investment and encourage innovation. The prime objective will be to develop a competitive and leading biotechnology industry for increased employment and wealth creation as well as enhancement of the social well-being of the people, further contributing towards moving the economy up the value chain as highlighted in the first thrust of the National Mission.