

DRAFT BIOTECHNOLOGY POLICY GOVERNMENT OF WEST BENGAL -2008

1. Introduction

Biotechnology has been described as the last great technical innovation of mankind in the 20th Century. It covers a wide range of scientific and technological activities that include the isolation and purification of any targeted DNA, RNA, proteins, enzymes, etc.; cloning and amplification of genes; construction of stream processing methods; production of genetically modified organisms; etc. Human intervention in gene technology has enabled the production of organisms which are either self-replicating or can replicate via host organism. The contribution of biotechnology to world economics is quite significant through applications in diverse areas like healthcare, agriculture, industrial product development and environmental management.

In India, the biotechnology sector is beginning to get global prominence and has taken shape over the past two decades through sporadic and scattered academic and industrial initiatives. It is imperative to integrate these efforts. In spite of remarkable research and development (R&D) work in the field of biotechnology, the growth of biotechnology industry has remained far from satisfactory. This has resulted in under-utilization of knowledge and manpower created in this area. Considering the high return on the investment, it is the high time to take up a suitable strategy for furthering biotech activities in the fields of healthcare, agriculture, medicine and genomics, diagnostics and environmental protection.

2. Possibilities of Application of Biotechnology in West Bengal

Over the last 25 years implementation of rural and land reform programme in West Bengal has unleashed an economic resurgence, which is expected to propel its rapid stride into a highly industrialized state. The policy envisaged would ensure that all sections of the society are equal partners in the march towards progress. The 20th Century technological revolutions in information technology and biotechnology are expected to touch every sphere of human activity. Information technology has already matured and has given huge opportunities for revenue and employment generation. The state should be ready for growth in another quarter so that the human and natural resources of West Bengal are utilized to their fullest potential through biotechnology.

West Bengal covers diverse ecological zones from high altitude sub-alpine Himalayan to coastal and mangrove-covered areas near the Bay of Bengal. This has given the state unique resources in biodiversity, which are gene pools waiting to be tapped by biotechnology. The additional strengths of West Bengal lie in its highly successful agricultural sector and its human capital. Keeping all this in mind, a biotechnology vision statement for West Bengal has been developed to enhance and organize the existing positive aspects and strengthen the weaker but potentially important development programmes.

The mission is to ensure scientific and technological empowerment of the people of West Bengal.

The aim is to create a strong infrastructure both for research and commercialization.

The intention is to launch a major well-directed effort for generation of products, processes and technologies to enhance the cost effectiveness and productivity of agriculture, modern medicine, pollution control, biodiversity conservation and bio-industrial development.

2.1. West Bengal – A bird’s eye view of the positive aspects:

2.1.1. Competent R&D institutions:

The important advantage of initiating any scientific and technical endeavour in West Bengal is the availability of many R&D organizations with a tradition of high quality basic as well as applied research. Of them, many have already existing infrastructure and teams of scientists and technologists with high levels of competence in biotechnology and allied fields. Some of the institutions deserving mention in this context are listed below:

- Indian Institute of Chemical Biology
- Bose Institute
- Indian Institute of Technology, Kharagpur
- Indian Statistical Institute
- Calcutta University
- Jadavpur University
- Bidhan Chandra Krishi Viswavidyalaya
- Kalyani University
- Viswa-Bharati University
- North Bengal University
- Burdwan University
- University of Fishery and Animal Husbandry
- Calcutta School of Tropical Medicine
- National Institute of Cholera and Enteric Diseases
- All India Institute of Hygiene and Public Health
- Indian Association for the Cultivation of Science
- West Bengal University of Technology
- National Institute of Biomedical Genomics

2.1.2. Availability of high quality of human resources:

West Bengal, often described as the intellectual epicenter of India, is well-known for the high quality of human resource it holds. Apart from stalwarts in different fields of natural as well as social sciences, the state has a high concentration of competent skilled manpower suitable for working in upcoming biotechnology ventures. The state has a good network of non-governmental organizations (NGOs) that have been implementing the task of popularizing science among the people in general. The State Government with its decentralized developmental institutions is capable of utilizing the combined strength of the people’s science organizations in generating awareness about the utilities of biotechnology in agriculture among the farmers so as to create an environment demanding the growth of agricultural biotechnology.

2.1.3. Development in the agrarian sector in the last few decades:

The State Government has effectively implemented land reforms in the last few decades. Simultaneously, it has developed a well-established Panchayat system whereby it has been possible to achieve notable success in running an active and interacting institutional framework of decentralized planning and development. The Panchayat institutions, through their efforts at overall development, have contributed towards improving the road network and other infrastructural facilities in rural West Bengal. Through land reforms and related follow-up activities, it has been possible to establish conditions in agriculture suitable for introduction of new and potent technologies.

2.1.4. Upcoming industrial scenario of West Bengal:

The State Government announced Policy Resolutions on Industry in 1994. Since then sustained endeavours for facilitating rapid industrialization have been made. Rich in bioresources and in trained manpower in chemical, pharmaceutical and healthcare industries and in addition to being the gateway to various Southeast Asian countries, the state has a natural potential for developing biotech industries.

3. Objectives of Biotechnology Policy:

- 3.1. To conserve, map and sustainably use bioresources.
- 3.2. To spread general awareness for the optimum utilization of biotechnology in the different sectors.
- 3.3. To optimally focus resources for R&D in biotechnology.
- 3.4. To encourage and facilitate introduction of biotechnology at the grass-root level to strengthen the economy of the state.
- 3.5. To encourage agro-based biotechnological activities for the promotion of village level industries in the state and to use knowledge resources from village level experiments.
- 3.6. To facilitate energy security and self-sustainability through promotion of biofuels.
- 3.7. To support employment and livelihood generating schemes in the field of biotechnology.
- 3.8. To create centers of excellence as high quality support services to biotech industries.
- 3.9. To create or act as catalyst for the creation of infrastructure for biotech industries, e.g., biotechnology parks.
- 3.10. To develop competent human resources at different levels in the field of biotechnology.
- 3.11. To promote the field of bioinformatics which draws support from information technology.
- 3.12. To suitably address highly pertinent issues like intellectual property rights (IPR) protection, biosafety and bioethics.
- 3.13. To coordinate and consolidate efforts by the various departments and government undertakings having potential in the area of biotechnology.
- 3.14. To create congenial environment of biotech industry through process simplification in the clearance of the commercial biotechnology projects.

- 3.15. To attract private investment for perceptible growth in biotechnological industries.
- 3.16. To facilitate the flow of venture capital funds and bank credit to biotech companies.
- 3.17. To extend fiscal incentives and concessions to biotechnology industry.
- 3.18. To provide an appropriate institutional framework to achieve the above objectives.
- 3.19. To formulate document on vision for the next ten years to fulfill the kernel of the policy.
- 3.20. To draw up an action plan for the next five years to improve the quality of life through appropriate biotechnology.

4. Sectoral interventions: Priority areas

4.1. Human Resource Development (HRD): Academic and Industry needs

Biotechnology activities being highly knowledge-based, the Government of West Bengal will continuously strive for the development of its human resources in all facets in order to build a successful biotechnology sector. For sustained innovation, talent pools are required in multiple scientific disciplines such as molecular and cell biology, taxonomy, chemistry, physics, engineering, bioinformatics, medicine, agriculture, microbiology, technology transfer and commercialization, bioenterprise and financing, risk assessment, risk analysis and management and intellectual property rights (IPR) management.

A few post-graduate programmes in the various disciplines under biotechnology (including bioinformatics, biochemical engineering and biotechnology) are running in various universities of the state. Introduction of more such courses tailored to industry needs would be encouraged for generation of skilled personnel. There is also need to support PhD programmes in the life sciences and biotechnology for the creation of strong academic leadership. The institutions active in the fields of education and research in biotechnology will be provided support in the pursuit of excellence.

The State Government will promote the setting up of more autonomous institutes under private participation for achieving excellence in specialized areas. To ensure better coordination among different R&D organizations working in biotechnology, the Government of West Bengal will extend support to these institutes for entering into partnerships with private companies for the manufacture, marketing and transfer of technology so that the products of biotechnology research can be brought to the common man.

The State Government will take initiative to:

- 4.1.1. further strengthen the HRD programme by including components of biotechnology to the existing life science teaching courses at the undergraduate as well as the postgraduate levels.
- 4.1.2. ensure minimum standard of education and training at the post graduate and undergraduate levels through teachers training programmes, specification and enforcement of basic requirements for teaching and laboratory infrastructure.

- 4.1.3. enable research institutions, colleges, universities, NGOs, and private organizations to undertake technicians/ technology training courses for specific requirements.
- 4.1.4. conduct balanced popularization and awareness campaigns on the uses, merits and concerns relating to biotechnology in rural and urban areas through lectures, films, TV programmes, exhibitions, etc.
- 4.1.5. introduce courses incorporating biotechnology with business management in the curricula of management and business schools.
- 4.1.6. introduce courses emphasizing biosafety regulations, risk analysis and hazard management, bioenterprise, bioethics and IPR management for the biotech industry.
- 4.1.7. introduce diploma and certificate courses (for 10+2 higher secondary. CBSE, ISC) for training personnel in agricultural biotechnology, animal husbandry, etc. to be initiated by the private and public sector.
- 4.1.8. review and amend course curricula in consultation with the industry and research establishments as needed, to improve job placements scenario. Compilation of database on placement/ employment records of the biotech degree/ diploma holders would help in the analysis of suitability of such course contents as means for training of skilled personnel.
- 4.1.9. encourage industry-university tie-ups to enable professionals to undertake PhD programmes while retaining their jobs.
- 4.1.10. enable scientists working in universities and research institutes to work (as consultant or by sabbatical for a limited period) for industries for commercialization of their research efforts.
- 4.1.11. encourage different NGOs and private institutions to conduct effective villagers' and farmers' training programmes to enable them to optimally make use of applications of biotechnology focused on societal development.
- 4.1.12. compile databases of scientists working in relevant areas of biotechnology in the state and availability of positions in education/ research establishments for proper utilization of academic expertise.

4.2. **Infrastructure development and manufacturing**

In order to enhance the socially relevant biotech activities, the Government of West Bengal will focus on the development of adequate infrastructure within the state. The Government will act to:

- 4.2.1. develop high quality infrastructure through institution of Biotech Park, Agritech Park, Ecology Park, Bioinformatics Park in different regions of the state. Type and quality of infrastructure will be chosen by considering different agro-climatic, agro-economic and other socio-economic parameters specific for a region.
- 4.2.2. create a Centre of Excellence in Biotechnology with state-of-the-art infrastructure for R&D activities by skilled professionals. The Centre of Excellence will have online access to the major institutes and commercial houses of the country. It will

also house a nodal bioinformatics center having active linkage with local biotech parks for dissemination of relevant information to the parks. The Centre will take the initiative to develop new biotechnological products, new processing techniques and will formulate methodologies for certification of biotech products within the state of West Bengal.

- 4.2.3. ensure better coordination between different R&D organizations working in the area of biotechnology.
- 4.2.4. encourage organizations involved in entrepreneurship development programmes to enter partnerships with private companies for manufacture, marketing and transfer of technology.
- 4.2.5. create an environment for the growth of biotech industry through entrepreneurship development programme.
- 4.2.6. set up service centers either by the government or in partnership with business groups for diagnosis of diseases by sophisticated biotechnological methods.
- 4.2.7. create animal house facilities with WHO-mandated Good Laboratory Practices (GLP) for testing candidate vaccines and biotherapeutics.
- 4.2.8. create testing facilities including for toxicological, teratological and allergenicity studies for genetically engineered organisms/ living modified organisms (GEOs/LMOs), their products and for recombinant pharmaceuticals.
- 4.2.9. set up core facilities for genomics, proteomics and bioinformatics which may be used by research and industry organizations on payment of fees.
- 4.2.10. create infrastructure support for the implementation of grass-root level rural biotechnology programmes at the district level highlighting the needs of agriculture, animal husbandry, fisheries, waste management, biomass development for animal, poultry, fish, biofuels, bioremediation, etc.
- 4.2.11. create central facilities for preservation and storage of value added agricultural products to ensure effective marketing strategy.
- 4.2.12. encourage private participation in infrastructure development like roads, power and water supply, effluent treatment and emissions control.

4.3. **Biotechnology Parks and incubators:**

Biotechnology parks facilitate licensing of new technologies to biotech companies to start new ventures, and to get early stage value enhancement with minimum financial inputs. They help in the lab to land transfer of the technologies through partnership between R&D institutes and industry. Biotech parks should have a viable business plan and management strategy, with partners and their respective roles being clearly defined.

Minimum components of biotech parks should include research laboratories, multi-purpose pilot facility for manufacturing and process development, quality control and validation of technologies, common effluent treatment centre, a GLP animal house, a recognized human resource training centre, administrative support centre, etc. The biotech parks should be easily accessible for all the stakeholders with road connections and power and water supplies. Energy

efficiency should be one of the parameters for designing of incubators and biotech parks to keep running costs low. Non-conventional sources of energy should be adopted wherever feasible, for example for lighting of the premises.

The Government of West Bengal intends to promote the creation of biotechnology parks within the state.

- 4.3.1. Biotechnology Park will act as an instrument to develop biotech industries for socio-economic development of the state.
- 4.3.2. This will be a combined venture of industries, academia and government with clearly specified responsibilities of each. It will be a self-sustaining set up for business start up support, business attraction and technology support in areas of biotechnology.
- 4.3.3. The strategy of creating such biotech parks is to make a common ground for the development of prospective technologies and the commercialization of ventures with minimum gestation time.
- 4.3.4. In accordance with the strengths of the state of West Bengal the major thrust in such biotech parks will initially be given towards agri-biotechnology and bio-pharmaceuticals. The park will act as an incubator and will lead to the development of biotech industries, improvement of the quality of life, environmental improvement, employment generation and finally sustainable development in rural sectors.
- 4.3.5. The parks will contain industrial, commercial and R&D infrastructure, developed plots of land, power, water and telecom facilities for users. The parks will act as the technology providers to the small-scale biotech industries which will be housed within the park. These will lend R&D support to the prospective entrepreneurs. They will provide training to the farmers in order to enable them to adopt the new technological activities. The parks will further provide marketing support to the users.
- 4.3.6. In order that the parks appear attractive to the biotech industries, the Government of West Bengal will evolve and set up effective administrative mechanisms so that quick approvals under the various statutes are duly facilitated.

4.4. R&D in Biotechnology:

West Bengal has many R&D institutions of excellent expertise and manpower quality. It is worthwhile to concentrate on further development of the biotechnology R&D facilities.

4.4.1. Agriculture and food biotechnology

Biotechnology has the potential to increase agricultural production and achieve food security. It can help face challenges like lower productivity of agricultural crops, livestock and fisheries, crop damage from pests and stress induced by salinity, drought and alkalinity. Certain guiding principles had been proposed by a taskforce headed by Dr M S Swaminathan (2004) under the Ministry of Agriculture, Government of India, which include:

- A comprehensive and integrated view should be developed of r-DNA and non r-DNA based applications of biotechnology with other technological components required for agriculture as a whole. Genetically engineered and non-genetically engineered new varieties arising out of applications of advance technology need equal emphasis.
- Integrated pest management system and the use of conventional biotechnologies (for example, biofertilizers, biopesticides, bioremediation technologies, molecular assisted grading, plant tissue culture, etc.) should continue to be encouraged and supported.
- A precautionary, yet promotional approach should be adopted in employing transgenic R&D activities based on technological feasibility, socio-economic considerations and promotion of trade.
- Public funding should be avoided in low priority research areas or those that reduce employment and impinge on the livelihood of rural families.

For West Bengal priority tasks ahead are:

- 4.4.1.1. Development of genetically modified hybrids and new varieties of crops like rice, mustard, chickpea, potato, tomato and other vegetables. Target traits should be yield increase, pest and disease resistance, salinity/ drought tolerance, enhanced nutritional quality, and increased shelf life.
- 4.4.1.2. Improving jute and tea cultivation through biotechnological interventions.
- 4.4.1.3. Development of high yielding agro-forestry plantations to reclaim denuded land and to supply the wood-based industries.
- 4.4.1.4. Development of horticulture and floriculture using clonal propagation.
- 4.4.1.5. Extension of regional hardening facilities for tissue culture raised plants to facilitate greater penetration of the technology.
- 4.4.1.6. Cultivation of medicinal and aromatic plants.
- 4.4.1.7. Establishment of gene-banks and germplasm repositories for maintenance and propagation of plants.
- 4.4.1.8. Improvement of sericulture and quality of varieties of silk including tussar.
- 4.4.1.9. Development of biofertilizers to enhance soil fertility and to decrease dependence on chemical fertilizers. Priorities should include screening of elite strains of microbes. Integrated nutrient management system needs to be strengthened.
- 4.4.1.10. Identification of indigenous micro-flora for development of bacterial or fungal consortium useful as biofertilizers, biopesticides, etc.
- 4.4.1.11. Development and application of biotechnological methods for enhancing milk yield in cattle.
- 4.4.1.12. Development of better strains of livestock.

- 4.4.1.13. Development of diagnostics and vaccines for major livestock diseases such as foot and mouth disease, rabies, septicemia, anthrax, etc.
- 4.4.1.14. Establishment of cell lines and sperm banking facilities for maintenance and propagation of superior quality livestock.
- 4.4.1.15. Development of improved methods for pisciculture of katla, rohu, magur, etc. and cultivation of fresh- water and sea-water prawns.
- 4.4.1.16. Development of diagnostics for bacterial and viral diseases of local fishes and prawns.
- 4.4.1.17. Development of biotechnology-based tools for evaluating food safety, detection of food-based pathogens, and detection of genetically engineered organisms and their products in food.
- 4.4.1.18. Development of nutraceuticals, food supplements, bio food additives and pro-biotics for therapeutic purposes.

4.4.2. Bioresources

There is need to conserve biodiversity and utilize it in a sustainable manner for the conversion of bioresources into commercially useful products. The traditional knowledge base can serve bioprospecting. However benefit sharing has to be guided by concerns about ethics and equity. A comprehensive information network on bioresources of West Bengal is required. The priority actions are:

- 4.4.2.1. to take initiative in the inventorization and mapping of the bioresources within the state.
- 4.4.2.2. molecular characterization and bioprospecting of indigenous resources.
- 4.4.2.3. development of database documenting bioresources and their natural compounds in economically and ecologically important spots such as the Sundarban mangroves region, Himalayan and sub-Himalayan regions, plains of Purulia, Birbhum, Bankura and Midnapore.
- 4.4.2.4. identification and development of crops and extremophiles as sources of biofuels and bioenergy.
- 4.4.2.5. preparation of inventory of microbial biodiversity in the different regions of the state including wetlands, coastal regions, forests, hilly and terai areas.
- 4.4.2.6. development of genetic markers for plant and animal breeding programmes.
- 4.4.2.7. generation of awareness at the grass root level to prevent biopiracy.
- 4.4.2.8. monitoring of information regarding patents granted in India and abroad relating to bioresources and commercial compounds arising from them to keep track of illegal movement and exploitation of bioresources indigenous to the state.
- 4.4.2.9. setting up of facilities for testing of products of bioprospecting before commercial production.

4.4.3. Environmental biotechnology

The enforcement of environmental laws is not always strict or uniform; offenders often get away without paying for polluting. The immediate cost of effluent treatment is also substantial. The goals of environmental biotechnology include providing cost-effective and clean alternatives for risk assessment and quality monitoring, restoration of degraded and polluted areas, conversion of toxic recalcitrant chemicals into harmless compounds, waste management, creation of value-added products from biomass and control of biological invasion. Hence priority lies in:

- 4.4.3.1. bioremediation and waste recycling in specific locations by microbial consortia.
- 4.4.3.2. development of bio-indicators and bio-sensors for pollution control.
- 4.4.3.3. biotechnological interventions for pollution and waste management for specific ecosystems.
- 4.4.3.4. development and improvement of efficiency of biological/ enzymatic treatment of paper pulp and jute fibres to reduce chemical pollution.
- 4.4.3.5. development of efficient waste disposal strategies using biotech methods.
- 4.4.3.6. ensuring effective and closer linkages between research scientists and user corporate groups for better product acceptance.
- 4.4.3.7. encouraging public-private partnership in research and application of clean technologies.
- 4.4.3.8. building of public awareness relating to crucial need for pollution control and the benefits of use of clean technologies.
- 4.4.3.9. creation of awareness for protection of proprietary rights of microbial consortia through appropriate methods.
- 4.4.3.10. greater coordination between the various departments regarding implementation of the clean technologies.

4.4.4. Industrial biotechnology

Industrial biotechnology or white biotechnology uses biological systems for the production of useful chemical compounds. Sometimes agricultural crop residues are used as raw materials instead of fossil fuels. The strategic actions include:

- 4.4.4.1. development of joint R&D programmes between basic research scientists and private industries for commercially viable projects.
- 4.4.4.2. setting up of production units for commonly used biotechnological and biomedical instruments.
- 4.4.4.3. reduce chemical and toxic load in effluents.

- 4.4.4.4. production and commercialization of recombinant biologicals and related materials like disposable plastic wares.
- 4.4.4.5. modernization of industries using fermentation technology for production of alcohol and other important solvents and industrial enzymes.
- 4.4.4.6. production of value-added by-products from microbial sources such as *Spirulina*, fungi etc for use in the pharmaceutical and food industry.
- 4.4.4.7. use of biotechnology to upgrade industrial products currently in the market.
- 4.4.4.8. development of knowledge base using biotechnological research and promotion of contract research.
- 4.4.4.9. to set up biotech product development fund and technology platforms.
- 4.4.4.10. to replace synthetic and fossil fuel-based products by developing new biological material-based products.
- 4.4.4.11. development of small scale industrial sector for bio-pesticide, bio-fertilizers, food processing and packaging industries.
- 4.4.4.12. focus on developing green technologies in industrial processing.

4.4.5. Medical biotechnology and genomics

Biotechnology offers advance technological tools for prevention and cure of diseases. However it is important to match the technology and the product with the local needs to improve acceptance and facilitate penetration into health practice. For West Bengal the priority areas include:

- 4.4.5.1. development of diagnostic kits for major infectious and tropical diseases and for genetically inherited disorders.
- 4.4.5.2. upscaling and commercialization of already developed ELISA and PCR based diagnostics.
- 4.4.5.3. characterization of anti-bacterial and anti-viral agents from bioresources and natural products.
- 4.4.5.4. microbial production of recombinant therapeutic agents at low cost.
- 4.4.5.5. development of stem cell lines for research and tissue regeneration.
- 4.4.5.6. undertaking reproductive health and contraceptive research.
- 4.4.5.7. developing strategies for prevention and cure of faulty diet and lifestyle induced diseases like diabetes, heart diseases and obesity.
- 4.4.5.8. product development focused on vaccines, new therapies based on cell and tissue replacement, therapeutic antibodies, pharmaceuticals, plant based medicines, drug and vaccine delivery systems and new anti-microbial agents.
- 4.4.5.9. creation of testing facilities for the biotechnology-based products including for toxicological, teratological and allergenicity studies.

- 4.4.5.10. coordination between the various departments regarding clinical trials and commercialization of medical biotechnology products.
- 4.4.5.11. development of facilities for creation of DNA polymorphism maps and databases about the population of West Bengal to facilitate evaluation of appropriate gene therapy models.
- 4.4.5.12. public awareness creation to allay fears regarding the new technology.

4.4.6. *Bioengineering and Nano biotechnology*

Bioengineering encompasses tissue engineering, biomaterials for therapeutics, biomedical devices and instrumentation, biomedical sensors, etc. There are opportunities for indigenous development of surgical implants and medical devices. Development of new biomaterials for nano-particle encapsulated drugs improves the drug delivery systems, minimizes side effects and increases efficacy of therapy. The research emphasis on priority basis will be on:

- 4.4.6.1. development of tissue engineered organs.
- 4.4.6.2. development of biomaterials for drug delivery and controlled release.
- 4.4.6.3. development of advanced wound and burn dressings.
- 4.4.6.4. bioinstrumentation.
- 4.4.6.5. development of dental and orthopedic materials based on polymer-ceramic composites.
- 4.4.6.6. development of bio-molecular chips for analysis.
- 4.4.6.7. test methods for safety evaluation of tissue engineered and combinatorial products.
- 4.4.6.8. coordination between the various departments regarding trials and commercialization of biotechnology-based products.

4.5. *Bioinformatics and IT-enabled biotechnology:*

Bioinformatics has the potential to reduce the cost and time of development of new drugs, vaccines and other products. It also helps to integrate databases relating to full genome sequences, microarrays, proteomics and species data. Pharmacogenomics combines biotechnology and information technology skills to aid high-speed data mining of information pertaining to defective or missing genes. The Government of West Bengal aims to:

- 4.5.1. enhance bioinformatics capability for analytical and computational ability to infer gene function based on sequence informatics.
- 4.5.2. assist in development of new algorithms, software and tools for data mining and warehousing applications.
- 4.5.3. encourage the establishment of software groups and companies developing competence to identify useful genes.

- 4.5.4. facilitate the setting up of dedicated network centres for developing data ware houses, data design and mining from single and multiple data bases.
- 4.5.5. encourage development of strong bioinformatics machinery for exploitation of microbial genome information.
- 4.5.6. develop an institutional framework of autonomous bioinformatics centres within the state.
- 4.5.7. give priority to the training of personnel to get adequate number of experts in bioinformatics within a reasonably short time.
- 4.5.8. set up Bio-IT parks for the promotion of the bioinformatics industry.
- 4.5.9. encourage biopharmaceutical companies to include pharmacogenomic data in their drug submissions.
- 4.5.10. provide incentives under W.B. Incentive Scheme,2004 if the fixed capital investment in a project is more than Rs.500 lakhs and under W.B. Incentive Scheme, 2007 if the same is up to Rs.500 lakhs as applicable and updated from time to time.

4.6. *Biotechnology for societal development:*

Biotechnology has both multidimensional and multi functional role for achieving social development in the face of the challenging problems of growing population. The government under its own initiative would conduct trial organic farming in a few agricultural farms.

The Government of West Bengal intends to take up the following tasks:

- 4.6.1. Essential emphasis will be laid in rural sector. The concept of bio-village would be spread throughout the state.
- 4.6.2. Location and natural resources specific projects shall be developed.
- 4.6.3. Cultivation of *Spirulina* as a high value low cost nutrient for rural and tribal areas.
- 4.6.4. Facilitate training of rural women in preservation and packing of products, vegetable cultivation, mushroom cultivation, lac cultivation,vermicomposting etc.
- 4.6.5. Assist in training and motivating the people of rural areas in the conservation and cultivation of medicinal and aromatic plants.
- 4.6.6. Propagation of green house cultivation, low cost tissue culture and organic farming through out the state.
- 4.6.7. Introduction of improved methods of scientific poultry rearing, pisciculture, beekeeping, freshwater pearl culture, ornamental fish culture, tussar cultivation in rural and tribal areas.
- 4.6.8. Genetic counseling centres will be set up with diagnostic centres for genetic disorders for helping the needy.
- 4.6.9. Development of pre-cooked, ready-to-eat, nutritionally fortified food using biotechnological methods.

- 4.6.10. Use of cheap and locally available materials, waste and lingo-cellulosic materials for development of economically viable animal feed and fish feed with the help of biotechnological interventions.

4.7. Promotion of Biofuels:

Fossil fuels are non-renewable and 70% of the demand in India is met through imports. The over-dependence on foreign oil exposes India to the unstable global oil market that can adversely affect the country's domestic economy, development and sovereignty. Concomitant to economic development, the total number of vehicles on the roads is growing continuously. Combustion of petrol and diesel in motor vehicles causes air pollution and associated health problems. Vehicle emissions standards are becoming more stringent and hence the demand for cleaner burning fuels is increasing.

Biofuels are renewable and being indigenous, assist in achieving domestic energy security. Apart from causing lower levels of pollution, renewable energy systems can have decentralized sources of energy production, and enable easier distribution in the rural zones and thus aid economic development. The two main biofuels for the transport sector are biodiesel and bioethanol. Biodiesel can be produced from plant seed oils and animal fats. Ethanol can be made through fermentation of carbohydrates. Since India is not self sufficient in edible oils, thrust is therefore given on extraction of biodiesel from non-edible oils of tree-origin.

Cultivation of tree borne oilseeds (TBOs) like *Jatropha*, karanj, mahua, tung, neem, sal, etc. will bring into use vast areas of wasteland in the state, prevent soil erosion, improve the quality of the soil and generate rural employment. Once an adequate area of land comes under TBO cultivation, biodiesel units can operate profitably and may be set up.

Leguminous species among the TBOs like karanj can fix atmospheric nitrogen and enhance soil fertility. They are important sources of minor forest produce like leaves, medicines and flowers for the local population. It is desirable therefore to use these indigenous TBOs for afforestation. Though currently India's biodiesel programme has been based on *Jatropha* seeds, for reduced operating cost a multiple feedstock-based strategy is needed. This can be met from plantations of the indigenous TBOs. The priority tasks ahead are:

- 4.7.1. popularization of the cultivation of TBOs on wastelands in the state.
- 4.7.2. promotion of use of straight seed oil for lighting, lubrication, as cooking fuel as well as for making of soaps and candles etc.
- 4.7.3. promotion of setting up of transesterification plants for production of biodiesel.
- 4.7.4. encouragement of cultivation of indigenous TBOs which can be regarded as a long-term investment.
- 4.7.5. support of R&D to increase yield (number of seeds and oil content), reduce generation time, improve storage and viability of seeds, develop more efficient methods for micropropagation, transesterification, oil expulsion, etc.
- 4.7.6. strengthening of buy-back systems to encourage the growers.
- 4.7.7. creation of facilities for certification and identification of quality planting materials and improved varieties of seeds for raising of plantations.

4.7.8. local awareness generation about alternative uses of the TBOs for making their cultivation more attractive.

4.7.9. formulation of a specific biofuels policy for West Bengal.

4.8. Promotion of industry and trade:

There is need to domestically develop own biotechnological and pharmaceutical products to ensure quality and affordability for the population, and for competitive advantage in the global trade. The policies should be enabling to increase public-private partnerships and support for product development, improved communication among the various stakeholders and increased transparency for confidence building and greater product acceptance.

4.8.1. Fiscal incentives and concessions

Industrial units in biotechnology sector shall be eligible to get incentives under West Bengal Incentive Scheme 2000. The salient features of the Scheme are given below:

4.8.1.1. Applicability of the 2000-scheme:

The 2000 Scheme shall generally be applicable to all large, medium, cottage and small-scale projects to be set up and also to expansion projects of existing units on or after the 1st January 2000. The units may be in the private sector, co-operative sector, joint sector as also companies/ undertakings owned or managed by the state government.

4.8.1.2. Eligibility criteria for incentives under the 2000-Scheme:

4.8.1.2.1. Any industrial project in the large and medium sector to which this Scheme applies, shall be eligible for securing an eligibility certificate provided:

- (a) The project is covered by a detailed feasibility report/ project report prepared for the purpose.
- (b) The project has been approved and sanctioned by an All India Financial Institution or a Commercial Bank or a State Financial Institution, as the case may be. In the case of a project with arrangements of finance from own resources, issue of eligibility certificate shall be considered provided the WBIDC is satisfied about the arrangement of such finance.

4.8.1.2.2. Any industrial unit in the small scale sector shall be eligible for incentives under this Scheme subject to the fulfillment of the conditions specified below:

- (a) The unit in the small-scale sector shall be registered with the District Industries Centre concerned finally or permanently. Such permanent or final registration must be valid and remain in force.

However, in respect of subsidy on investment in plant and machinery the undertaking concerned may be provisionally or temporarily registered on or after the 1st April 1999 and valid registration to that effect may be accepted in place of permanent or final registration and the amount of subsidy shall be judged on the quantum of investment in plant and machinery as sanctioned and disbursed by the financial agency concerned.

- (b) Industrial cooperatives, undertakings assisted by K.V.I.C or W.B.K.V.I. Board as well as the undertaking set up under IRDP/ SESRU/ IUEP/ SEEUY and other similar self-employment schemes receiving benefits in respect of any of the items specified under this Scheme shall also be eligible to get the benefit of other items only under this Scheme.

- 4.8.1.2.3. For the benefit of subsidy for conversion to piped gas and for gas charges, an existing unit shall require registration with Greater Calcutta Gas Supply Corporation Ltd. and also a certificate of expenditure approved by the Greater Calcutta Gas Supply Corporation.

For the benefit of subsidy for installation of plant facilities for use of piped gas and for gas charges, a new unit/ an existing unit for its expansion project shall require registration certificate of Directorate of Industries or registration certificate from DIC, as the case may be, eligibility certificate of WBIDC and a certificate of expenditure approved by the Greater Calcutta Gas Supply Corporation Limited.

4.8.1.3. Classification of developed areas and backward areas:

- 4.8.1.3.1. For the purpose of determination of types and quantum of incentive available under this Scheme for the approved projects, according to their location, the state shall be classified in the following groups:

Group A – Calcutta Municipal Corporation.

Group B – Howrah, Hooghly, North 24-Parganas, South 24-Parganas, excluding the area under the jurisdiction of the Calcutta Municipal Corporation, Burdwan, Nadia and Midnapore districts.

Group C – Murshidabad, Birbhum, Purulia, Bankura, Malda, Coochbehar, North Dinajpur, South Dinajpur, Jalpaiguri and Darjeeling districts.

- 4.8.1.3.2. No incentive will be granted to any unit set up in the area under Group-A except to the extent provided in the Scheme.

4.8.1.4. State Capital Investment Subsidy:

4.8.1.4.1. An eligible industrial unit located in Group-B area and set up in the state on or after the 1st January 2000, will be entitled to State Capital Investment Subsidy @15% of the Fixed Capital Investment subject to a limit of Rs 150.00 lakhs.

4.8.1.4.2. An eligible industrial unit located in Group-C area and set up in the state on or after the 1st January 2000, will be entitled to State Capital Investment Subsidy @25% of the Fixed Capital Investment subject to a limit of Rs 250.00 lakhs.

4.8.1.5. Interest Subsidy:

4.8.1.5.1. An eligible industrial unit for its approved project will be entitled to interest subsidy to the extent of 50% of the annual interest liability on the loan borrowed from a Commercial Bank/ Financial Institution/ NBFC approved by Reserve Bank of India, for implementation of the approved project, subject to a limit of Rs 100.00 lakhs per year depending on the location of the unit as follows:

- i) Group-B area : 5 years.
- ii) Group-C area : 7 years.

4.8.1.5.2. The interest subsidy will be payable annually subject to submission of a statement/ certificate by the lending Banks/ Financial Institutions/ NBFC stating that the unit has paid the due interest to the institution on the due dates.

4.8.1.6. Waiver of electricity duty:

An eligible unit for its approved project will be entitled to waiver of electricity duty on the electricity consumed for its production/ operation activity for a period of 5 years from the date of commercial production / operation.

4.8.1.7. Employment Generation Subsidy:

4.8.1.7.1. An eligible industrial unit in the large or medium sector will be entitled to reimbursement to the extent of 50% of the expenditure incurred by it for paying its contribution towards Employees State Insurance (ESI) and Employees Provident Fund (EPF) Scheme depending on the location of the unit as follows:

- i) Group-B area : 5 years.
- ii) Group-C area : 7 years.

4.8.1.7.2. An eligible industrial unit in the small scale sector will be entitled to reimbursement to the extent of 75% of the expenditure incurred by it for paying its contribution towards Employees State Insurance (ESI) and

Employees Provident Fund (EPF) Scheme depending on the location of the unit as follows:

- iii) Group-B area : 5 years.
- iv) Group-C area : 7 years.

4.8.1.7.3. The reimbursement of the expenditure prescribed at para 4.8.1.7.1. and 4.8.1.7.2. above will be payable annually based on minimum statutory limit subject to the condition that the unit has paid its contribution towards ESI and EPF on due dates.

4.8.1.8. Remission of Stamp Duty and Registration Fee:

- 4.8.1.8.1. An eligible industrial unit irrespective of its location will be entitled to exemption from payment of 50% of stamp duty and registration fee required for the purpose of registration of documents within the state relating to purchase/ acquisition of land and buildings for setting up of the approved project.
- 4.8.1.8.2. Notwithstanding anything contained anywhere in the Scheme the incentive prescribed at para 4.8.1.8.1. above shall be admissible from the date of issue of the notification of this Scheme.

4.8.1.9. Subsidy for conversion for use of piped gas:

- 4.8.1.9.1. An existing unit irrespective of its location undertaking conversion for use of piped gas for manufacture/ operation on or after the 1st January 2000 will be eligible to subsidy equal to 75% of the investment for necessary conversion of furnace etc., subject to a limit of Rs 10.00 lakh.
- 4.8.1.9.2. A new unit for its approved project set up on or after the 1st January 2000 envisaging use of piped gas for manufacture/ operation will be entitled to the benefit prescribed at para 4.8.1.9.1. above for installation of necessary equipment in the units for use of piped gas.
- 4.8.1.9.3. An existing unit or a new unit mentioned at para 4.8.1.9.1. and 4.8.1.9.2. above will be entitled to subsidy of 20% of gas charges on gas used for manufacture/ operation for a period of 5 years from the date of commencement of supply of gas for commercial manufacture/ operation of the unit.

4.8.1.10. Subsidy for quality improvement in the Small Scale Sector:

An eligible industrial unit in the small-scale sector shall be reimbursed 50% of the expenditure upto a minimum of Rs 5.00 lakhs for installing pollution control devices and obtaining ISI Certification/ ISO 9000 from approved institutions/ research laboratories.

4.8.1.11. Additional incentive for industrial units in biotechnology sector:

- 4.8.1.11.1. With effect from 01.07.2001 new units in the area of biotechnology located in Group-A shall be eligible for the same incentives as are normally admissible to a new unit located in Group-B area.
- 4.8.1.11.2. With effect from 01.07.2001 new units in the area of biotechnology located in Group-B and Group-C areas will be entitled to additional interest subsidy of 10% of interest liability subject to a further ceiling of Rs 20.00 lakhs. The total interest subsidy will be available for an additional period of 2 years in all such cases.
- 4.8.1.11.3. With effect from 01.07.2001 new units in the area of biotechnology irrespective of their location will be entitled to full exemption from payment of stamp duty and registration fee required for registration documents relating to purchase/ acquisition of land and buildings for setting up of the approved project.

4.8.1.12. Incentives for approved expansion project of an existing unit:

An existing unit for its approved expansion project will be entitled to all the incentives mentioned above in this Scheme subject to fulfillment of the conditions prescribed for the respective item for a new unit.

4.8.1.13. Mega projects (projects with an investment of Rs 25 crores and above):

Notwithstanding anything contained anywhere in the Scheme the State Government may consider special package of incentives under this Scheme to a Mega Project giving due regard for the following characteristics of the project, on a case by case basis:

- i) size of investment
- ii) special nature of industry
- iii) employment potentiality
- iv) down-stream effect of the industry
- v) ancillarisation effect of the industry
- vi) export potentiality.

4.8.2. Venture Capital Fund

The capital-intensive biotechnology industry has historically relied on venture capital from public and private sources. The Government needs to provide active support through incubator funds, seed funds and incentives to develop the sector. The venture capital fund would help to involve scientific innovators in development of products and processes of high societal relevance. It will create opportunities for starting new biotechnology-based businesses by science entrepreneurs, stimulate technological

innovation, and increase product commercialization in public-private sector derived from government-funded R&D.

4.9. Regulatory mechanisms:

4.9.1. Biosafety:

Use of recombinant DNA technology for economic development and benefits to the society is interlinked with concerns about biosafety-related issues. India is a mega-biodiversity country and wild varieties of most of the major crops occur freely. Threat of genetic pollution from uncontrolled release of genetically engineered organisms in the environment is important. In case of unforeseen adverse health and environment effects, it would be very difficult to take remedial measures. Hence a precautionary approach which gives due regard to biosafety risk assessment, analysis and hazard management, intensive stringent and scientific testing and trials with standardized protocols while not hindering product development and commercialization, is needed. Transparency in all sectors including about parameters for granting of approval for release of products and trial and safety data are expected to add to consumer confidence and acceptance.

India is a signatory to the Cartagena Protocol on Biosafety that governs trans-boundary movement of Living Modified Organisms (LMOs). The neighbouring countries have also taken up biotechnology-based programmes. The state will adopt biosafety practices so that the technology adopted (for example for production of pest resistant crops) does not get obsolete fast from indiscriminate use or from proliferation of spurious seeds.

The Rules for the Manufacture, Use/ Import/ Export and Storage of Hazardous Microorganisms/ Genetically Engineered Organisms or Cells, 1989 (formulated by the Ministry of Environment & Forests, Government of India) and the Recombinant DNA Safety Guidelines of 1990 and its subsequent amendments in 1994 and 1998 (formulated by the Department of Biotechnology, Government of India) under the Environment Protection Act of 1986 serve to regulate the biosafety scenario. Under these biosafety rules, the creation of Institutional Biosafety Committee in all centres engaged in genetic engineering R&D and production activities is mandated. Other competent authorities to be created are the State Biotechnology Coordination Committee and the District Level Committees to monitor the implementation of the safety regulations.

The State Government would ensure setting up of adequate institutional mechanisms for implementation and monitoring of biotechnological programmes as per established biosafety rules and guidelines.

4.9.2. Bioethics

Bioethics controls the potential of biotechnological applications, what can be done with the tools of this technology getting tempered with what should be done. In the society ethical concerns range from biopiracy, plagiarism of products of research and informed consent by subjects of trials to types of R&D that can put the survival of mankind at risk. The reception of biotechnological products by the public depends on their opinions and perceptions about the system in general. To maintain an atmosphere of trust and

confidence, there is need to engage the stakeholders in a multi-perspective approach towards decision-making. Transparency induced by access to information by the government and the industry is expected to facilitate greater consumer acceptance. Public awareness campaigns through the network of government agencies, voluntary organizations and independent media, balancing the risks and benefits will contribute to sustainably achieve the optimal potential of biotechnology in West Bengal.

4.9.3. IPR and Patent law

Keeping in view that biotechnology has a pervasive role in agriculture and industry, food and medicine, environment and ecology, plant and animal propagation, and also the fact that biotechnology is a knowledge-based industry requiring high financial capital, approach to the question of intellectual property protection will be positive rather than defensive. In view of the complexities involved in patenting biotechnological innovations, an appropriate intellectual property rights (IPR) system is needed over time. A state-level IPR centre with special emphasis on biotechnology patent information and IPR issues is to be set up.

4.10. Formation of Working Group

The Government shall set up a Working Group on Biotechnology with the Minister-in charge, Biotechnology Department as the Chairman and representatives of the departments concerned as members to coordinate activities related to biotechnology in the state of West Bengal.

4.11. Constitution of West Bengal State Council of Biotechnology

The Government has set up a permanent body under the name: 'The West Bengal State Council of Bio-technology' to deal with mainly the following issues:

- 4.11.1. Coordination of the activities between different agencies (universities, central institutes/ research laboratories and industries) working in the sphere of biotechnology.
- 4.11.2. Providing advisory services to all R&D institutions and commercial activities in biotechnology in public and private sectors.
- 4.11.3. Collection and dissemination of information and formulation of plans and policies relating to biotechnology.
- 4.11.4. Promotion of industries, new/frontier areas for R&D and appropriate applications of biotechnology.