

## 1. PREAMBLE

Chhattisgarh along with being one of the largest states of India is also one of the richest in terms of mineral resources and biospheres in India, and is endowed with about twenty-two varied forest types. These have naturally occurring varieties of herbs and shrubs, with proven medicinal and aromatic ingredients. We have over thousands of square kilometres of virgin forest that are yet to be scientifically surveyed. A wealth of varieties of indigenous rice as a source of unexplored gene pool occurs naturally. Established traditional knowledge systems of self-healing and nutrition that are based on knowledge of the Bio-wealth, is a unique feature of various communities of Chhattisgarh.

The State provides good governance and excellent infrastructure for industries in biotechnology.

Biotechnology has a key role to play for our future prosperity. Chhattisgarh is a biodiversity hotspot – and is thus well poised to assume a significant and leading place in the biotechnology sector. The State, given its strengths, would like to benefit from the present global advances in the field of biotechnology & bioinformatics. Given a facilitative environment Biotechnology as a scientific tool holds immense promise in areas as wide ranging as agriculture, health and communication.

Biotechnology, broadly defined, includes any technique that uses living organisms, or parts of such organisms, to make or modify products, to improve plants or animals, or to develop microorganisms for specific use. Genomics has reached major milestones in cracking the code to life's biggest biological mysteries. Biotechnology is a broad field including several related disciplines, which are further translated to productive processes by coupling with such disciplines as chemical engineering, information technology and robotics. Biotechnology will play a key role in harnessing natural resources in an eco-friendly manner, for creating wealth, to make us globally competitive in an increasingly technologically sophisticated world.

The rapid advances in the field of biotechnology the world over, are taking place in an atmosphere that allows a larger participation of the industry and greatly driven by commercial interests. However, at the same time there are global arrangements in place in the form of Intellectual Property Rights (IPRs), Plant Breeders Rights (PBRs) and stringent regulatory issues, which would not only have to be adhered to but to also develop a mechanism within the overall international scenario to ensure custodial rights to local communities of Chhattisgarh.

Chhattisgarh enjoys a unique position in the fields of agriculture, healthcare and sericulture for which we endeavour to bring technological advancement for the overall development of society. We have to look at a logical diversification in our crop-composition, along with an enhanced use of biotechnology products, which would also in the long run enable a better environmental protection and will ensure further growth and increased returns to farmers.

Biotechnology as a tool has the potential to bring a sea change in the socio-economic status of the people living in this region. The positive impact will usher in a new era of food grain production coupled with food-security, significant alterations in the field of animal husbandry and fisheries leading to economic prosperity, assurance of quality food products to the consumers along with environmental protection. In order to foster international cooperation, the nascent State of Chhattisgarh has the necessary drive and desire.

Chhattisgarh sees Biotechnology as another wave of technological revolution after Information Technology as a strategic key for attaining socio-economic prosperity.

## 2. AIMS

We aim to ...

enable the communities of Chhattisgarh, who are the custodians of our bio-resource heritage, to get the optimal advantages of their natural, bio-cultural and bio-knowledge heritage in a sustainable manner;

create an environment where benefits of bio-resources are not dissipated, but available to their natural custodians, whether individually or as a community, and to involve in this enterprise all stakeholders, including knowledge professionals, entrepreneurs and technology leaders;

contribute 5% of the biotechnology output of India by 2012;

achieve substantial productivity gains and substantial reduction of risks to livelihood and environment in sectors relating to agriculture, forestry, animal husbandry and health, with the ultimate objective for ensuring food security and protection of the environment;

institutionalise major capabilities in biotechnology research and development in general with particular focus on the indigenous knowledge systems and their applications in furthering socio-economic growth;

facilitate an environment for research through development of infrastructure, and acknowledgement through appropriate incentives;

leverage convergence between various fields of related disciplines and provide benefits to society at large;

facilitate growth of an Industry through provisions of high quality infrastructure with the required support services for production including facilitation of flow of venture capital and bank credit;

address issues such as Intellectual Property Rights, bio-safety, bio-surveillance and bio-ethics.

### 3. STRENGTHS

Chhattisgarh has what it takes for a competitive biotechnology industry to flourish: resources – both natural and human – as well as inputs like power, large reserve of pure water, besides essentials like a pollution-free, peaceful and hassle-free environment. We are particularly proud of our strength in natural resources, biodiversity and gene pool.

Top-of-the-board institutionalised coordination and implementation, public goods like comprehensive bio-inventorying and holistic bio-conservation, bio parks for ex situ conservation and biotech parks for infrastructure, instituting and synergising capabilities of public and private university systems through programme as well as policy initiatives, human resource development efforts, industry-partnered academic programmes, bio- awareness thrust, investor facilitation services, incentives to biotechnology industry and IPRs are the enablers which will add to our identified strengths.

#### Bioresource

Bio-geographically, India is situated at the tri-junction of three realms namely, Afro- tropical, Indo-Malayan and Palæo-Arctic. The assemblage of three distinct realms makes India rich and unique in biological diversity. Chhattisgarh is situated in the Deccan biogeography; and therefore, houses an important part of India's biodiversity. What is more conspicuous is that the State is significantly rich in endemism with respect to many plants of medicinal importance. Our forests fall under two major types – the Tropical Moist Deciduous and the Tropical Dry Deciduous-and the State is endowed with a range of twenty-two forest sub-types. Bio-geographically, Chhattisgarh falls in the Deccan bioregion comprising representative fauna of Central India. We are proud to be home to numerous rare and endangered wildlife species including the wild buffalo (*Bubalus bubalis*) – our State animal, and the hill mynah (*Gracula religiosa*), declared as our State bird. There is a large variety in the genetic composition within species as well. Chhattisgarh is extremely rich in indigenous varieties of paddy, silkworms and herbs with aromatic ingredients as well as in mixed tropical deciduous forest, tree species. Approximately, 44% of the State is under forests.

## Bio-conservation

We have established protected preserves - 3 National Parks and 11 sanctuaries covering a forest area of 6615 sq. km. We follow a management approach of 'Total Ecosystems Preservation' in the core areas, and eco-development for conservation in the buffer zones. Similarly, the 11 sanctuaries distributed across the State represent between them a majority of forest eco-systems of the region.

## 4. THRUST AREAS

We have identified the following thrust areas to achieve our aims:

Agri-biotechnology

Health care including diagnostics, therapeutics and pharmacogenomics

Bioinformatics

Industrial & environmental biotechnology

The key activities in the thrust areas will be the following:

### 4.1 Agri-biotechnology

Conservation, characterisation and utilisation of genetic bio-diversity;

Identification of the problems and exploration of unique capabilities of biotechnology for their remediation to ensure food-security and food products of high nutritional value;

Introduction of genetically engineered plants / crops after clearance by relevant national institutions / authorities;

Micro propagation of horticultural and ornamental crops for mass multiplication;

Replacement of chemical fertilisers, weed-killers and pesticides by eco-friendly substances and development of integrated nutrient management for various crops to minimise cost of fertilizers;

Lowering the costs of agricultural inputs;

Genetic improvement of medicinal aromatic and timber yielding species;

Increased productivity of animals through embryo transfer technology, genetic improvement, vaccines and disease diagnostics;

Exploration of unique capabilities of biotechnology and their utilisation in aquaculture.

#### 4.2 Healthcare and disease control

Biotechnology for disease diagnosis and management;

Drug development;

Development of natural products in healthcare based on indigenous knowledge and practices.

#### 4.3 Bioinformatics

Develop new collaborative projects, particularly those that are multi-disciplinary;

Develop links with and contribute to a broad view of bioinformatics including areas such as statistical genetics, chemometrics and image processing;

Disseminate relevant software, database and information to the scientific communities, both academic and industrial.

#### 4.4 Industrial & Environmental Biotechnology

Production of enzymes having applications in food technology and industrial processes;

Production of biopolymers;

Production of acids for industrial use;

Development and promotion of the use of bio-sensors, bio-monitors and bio-remedying agents;

Detoxification of wastes, industrial effluents and waste water;

Bio-conversion of industrial waste;

Bio-leaching of ores.

## 5. INSTITUTIONAL ARRANGEMENTS

### 5.1 Chhattisgarh Infotech and Biotech Promotion Society (also known as CH PS)

CH PS ensures top-of-the-board institutionalised coordination and implementation of State's plans for enabling Bio-benefits. A Registered Society promoted by the State Government, it acts as the nodal agency and prime mover for propelling biotechnology (including bioinformatics) and Information Technology growth in Chhattisgarh.

The Chief Minister of Chhattisgarh heads the High Powered Governing Council of CH PS. The Council includes eminent persons from Knowledge and Technology Sectors, representatives from Government of India and national agencies and key State Government Departments.

It will address issues such as bio-safety, bio-surveillance, bio-ethics and Intellectual Property Rights in the field of biotechnology. It will assist in issues regarding compliance by all concerned and would enable benefits to the society at large.

CH PS would co-ordinate the efforts of the Government and interact with agencies located outside the State for promoting biotechnology and ensuring that benefits accrue to our State and our people. At the same time, CH PS will help the Government to review and monitor the developments, play a key role in framing policies for future progress and assist in formulating guidelines in all matters relating to biotechnology.

Inter alia, CH PS will undertake the following activities:

- a) create awareness amongst the potential user groups and various stakeholders;
- b) facilitate investment in industry;
- c) help place appropriate safeguards in place.

### 5.2 Biotechnology Development Fund

The Government will set up a special Biotechnology Development Fund with an initial corpus of Rs. Thirty Crores. This fund will receive contributions from various Departments (like Agriculture, Forest, Health, Education, Mining etc.) and agencies (Corporations, Federations and Boards etc.) of State Government who would be the users

of and developers of biotechnological tools. The fund would be managed by CHPS.

Further augmentation of the fund would be through grants from various funding agencies and incomes from contract research that would be undertaken by the Centre of Excellence.

## 6. STRATEGIC INITIATIVES

The State has identified three broad strategic initiatives for achieving its aims:

- 1) Encouraging and facilitating Research and Development;
- 2) Providing excellent infrastructure for industry;
- 3) Human resource development.

### 6.1 Encouraging and facilitating Research and Development

The capabilities of scientists and professionals from India in knowledge-based industries are widely acknowledged. It is believed that the initial growth in biotech industry will focus on research and development. There is also significant scope for undertaking contract research for the development of solutions to problems in the agricultural, health and industrial sectors.

The Government will provide special one-time grants for setting up of research and development facilities in public universities.

As part of this strategy, the following activities would be undertaken:

#### 6.1.1 Chhattisgarh Centre of Excellence in Biotechnology

This will be established as a fast growing research and development cum high-end educational centre of international standards. It will provide start-of-the-art infrastructure and R&D facilities to our scientists for undertaking research and development. The centre will play a key role in organising, coordinating and promoting biotechnology related activities in the State and would co-ordinate developments, innovations in research and development with organisations, centres and institutions at other places in India. This will offer the best of both worlds: the intellectually stimulating atmosphere expected of a research centre and affording competitive and attractive remuneration to talented scientists. A registered society comprising existing scientists in the public domain to be later augmented by new entrants on a selective basis, would manage the centre as an autonomous self-financing entity while getting start-up assistance for setting it up.

The following would be key components of the Centre:

#### 6.1.1.1 Advanced facility for Genomics

The first and foremost task would be that of creating a bio-inventory and thereafter characterisation of the biodiversity at the molecular level using DNA fingerprinting. An advanced facility for Genomics would be established, with the above mandate, which would not only help to characterise, document and catalogue the bio-diversity in state but also help to protect Property Rights. This facility would be developed at Indira Gandhi Agricultural University, Raipur.

#### 6.1.1.2 Advanced facility for transgenic research

A large number of transgenic crops with desirable traits have already been developed by various national and international institutes and are ready for field-testing. Transgenic research in agricultural sector will bring another revolution in food production. An advanced facility for transgenic research would be set up at Indira Gandhi Agricultural University, Raipur.

#### 6.1.1.3 Advanced facility for Animal Biotechnology

Biotechnology has a great potential to improve the productivity of the livestock. Biotechnological tools will be used for the production of vaccines, drugs and hormones and for disease diagnostics. College of Veterinary Sciences and Animal Husbandry at Anjora, District Durg, has taken a lead in this area and has been using ETT (Embryo Transfer Technology). An advanced facility by upgrading the existing Centre will, therefore, be undertaken, so that a large-scale production of good quality livestock can be taken up along with accompanying research in these areas.

Dissemination of knowledge will be a priority. Private companies will also be encouraged to develop animal vaccines, hormones, monoclonal antibodies and diagnostic kits. Techniques for multiple ovulation in livestock would be developed. At the same time steps to improve the quality of cattle feed would also be under taken and techniques would be developed to improve the yield and quality of the cattle feed. The advanced facility would be developed at College of Veterinary Sciences and Animal Husbandry, Anjora, District Durg.

#### 6.1.1.4 Advanced facility for healthcare related biotechnology

An advanced facility would undertake studies relating to disease diagnosis, drug formulation and development as control of diseases through counselling and medication depend on the analysis and understanding of genetic / genomic variation within human beings. These facilities would be developed at Pt. Jawaharlal Nehru Memorial Medical College, Raipur and Pt. Ravi Shankar Shukla University, Raipur.

#### 6.1.1.5 Advanced facility for bioinformatics

Bioinformatics is central to the interpretation and exploitation of the wealth of biological data being generated in the post-genome era with the consequential major clinical and commercial benefits. The mission of this facility would be to promote and coordinate research and training of international standards in bioinformatics within Chhattisgarh as also assimilate and provide data and information to scientists. This facility would be developed in the College of Engineering, Raipur.

#### 6.1.2 Department of Biotechnology, Indira Gandhi Agricultural University to be upgraded to serve as an adjunct facility to the Centre of Excellence in Biotechnology in the sphere of Agricultural Biotechnology

Department of Biotechnology, Indira Gandhi Agricultural University, Raipur has the basic capability and resources for high-quality research in biotechnology. The Department has ongoing collaborations with institutions of international and national repute such as IRRI (International Rice Research Institute, Manila), ICRISAT

(International Crop Research Institute for the Semi-Arid Tropics, Patancheru), ICGEB (International Centre for Genetic Engineering and Biotechnology, New Delhi), IARI (Indian Agriculture Research Institute, New Delhi), CICR (Central Institute for Cotton Research, Nagpur), and several research centres all over India.

The Department offers national level postgraduate programme in biotechnology and doctoral programme in biotechnology sponsored by the Department of Biotechnology, Government of India, besides organising State-level training courses in biotechnology. To encourage education and research and development in biotechnology, Department of Biotechnology, Indira Gandhi Agricultural University would be strengthened and upgraded to serve as an adjunct facility to the Centre of Excellence in Biotechnology in the sphere of Agricultural Biotechnology.

## 6.2 Providing excellent infrastructure for biotechnology industry

### 6.2.1 Biotechnology Parks

We envisage setting up a network of Biotechnology Parks in Chhattisgarh as also leveraging on the natural endowments, we plan to create ex situ Bio Parks in identified areas. High quality infrastructure would be provided at competitive rates along with relevant integrated services to manufacturing units in Biotechnology Parks. Joint venture and wholly private initiatives in investments are welcome in Chhattisgarh. Government of Chhattisgarh would provide public goods such as databases on human resource availability, networking with academia and centres of research along with one-stop- services.

The focus of these Parks would be on biotechnology industries of relevance to our agriculture, horticulture, animal husbandry, forestry and environment protection in the different agro-climatic zones.

In the Joint ventures, Government's share in equity would ordinarily be in kind, such as in the form of land on long-term lease on concessionary terms allotted through appropriate Government promoted agencies.

Biotechnology Parks would provide quality services for Biotechnology industry in terms of:

- basic infrastructure such as piped water supply, telecommunication facilities, uninterrupted power supply and approach roads;

- database on availability of skilled professionals;

- networking between research and academic institutions with the industry.

The advantages of the park are envisaged as follows:

- providing a thrust to areas of priority;

- help growth and development of industry through sharper focus;

- facilitating ease in effecting mid-course correction(s) in the subsequent phases of development;

- reducing capital outlay requirement for successful enterprise;

- improving rate of return on investment.

To make the park attractive to biotechnology companies, Government will facilitate the following on its own efforts and / or by soliciting the support of appropriate agencies / Departments of the Government of India and funding institutions:

A new legislation for providing one-stop investor facilitation services is already in place. Chhattisgarh Industrial Investment Promotion Act, 2002 has created a High Powered State Investment Promotion Board, which has been mandated to provide services within specific time frames;

Assist the private joint venture partner and wholly private entrepreneurs to attract well-reputed services utility providers for establishing their units in the Park to provide specialised services to the park-users on a commercial basis. These could be utilities such as providers of deionised double distilled water, instrumentation and testing facilities etc;

Assist the private joint venture partner and wholly private entrepreneurs in getting grants / equity / soft loans from Government of India as well as Financial Institutions and / or donor organisations.

#### 6.2.2 Bio villages

Assistance would be provided through funding from Government and / or other sources for effective and efficient transfer of technology from lab to land. To this end, bio villages would be started in various parts of the State for efficient transfer of technology as well as for ensuring a sustainable utilisation of natural resources. It will be an endeavour to establish these in 50% of the villages within the next five years.

#### 6.2.3 Commercial plant tissue culture units

Plant cell and tissue technology will be used in agriculture, horticulture, forestry, agro-horticulture, agro-forestry in the State with a thrust on clonal propagation, disease elimination, germplasm conservation, gene transfer by wide hybridisation, molecular genetic engineering, variant selection including somaclonal variation. Initially, the new techniques will be applied to crops such as sugarcane, banana, turmeric, ginger, mango, ornamental plants of commercial significance, forests species and plants with medicinal or cosmetic properties. Plant tissue culture units on commercial lines would be established through State Government Departments, Panchayats and various other agencies while promoting private investment and participation for the same.

## 6.3 Human resource development

### 6.3.1 Introduction of postgraduate and graduate courses in biotechnology-related disciplines in higher education, medical education and technical education institutions

In view of the critical role played by the scientific and technical man power in the growth of a knowledge-driven industry, Government of Chhattisgarh will encourage introduction of various new courses in the field of biotechnology and allied areas such as biomedical engineering, biochemical engineering, medicinal biotechnology, Bioinformatics, technical courses in biotechnology etc. at the graduate and post graduate levels in higher education, medical education and technical education institutions while ensuring sharing of physical, human and knowledge resource amongst such institutions for effecting economy as well as multidisciplinary strengths.

Universities will be provided necessary support for starting full-time graduate and postgraduate programs in biotechnology and bioinformatics and related disciplines.

Efforts will be made to establish collaboration in teaching and research between Universities in Chhattisgarh and leading universities across the world in the field of Biotechnology. These interventions would be put in place within the next three years. It is significant to note that Government has already started two new courses viz B.E. Biomedical Engineering and B. Tech. in Biotechnology in the engineering college, Raipur from the academic year 2003-04.

### 6.3.2 The Private Universities (Establishment & Regulation) Act, 2002

Chhattisgarh has five public Universities in the conventional mode, while two at Raipur and one at Bilaspur have been in existence for a long time, two have been freshly established in Jagdalpur and Ambikapur. Of these we have an internationally renowned Agriculture University at Raipur. The three older Universities offer postgraduate programmes in biotechnology. While we continue to encourage activities of teaching, research and development in biotechnology in the public university system, we are also aware of the limits to public funding both in terms of the quantum as well as the range.

We believe that public-private partnership and encouragement to private initiative is the key to attracting investments required for development of human resources in the field of biotechnology as in the other frontiers of knowledge.

As in other spheres, we are committed to encouraging establishment of institutions affording quality education in biotechnology. To this end, a legal frame unique for India has been put in place in the form of the Chhattisgarh Private University (Establishment and Regulation) Act, 2002. Under the provisions of the Act, the Government encourages establishment of Private Universities by offering time-bound permissions without financial barriers to entry, academic and administrative autonomy, land grants in lieu of affirmative action / reservations for students belonging to poorer and / or weaker sections etc. The private sponsoring body of such institutions can recoup interest costs on their investments besides recouping a management fee out of the university corpus of funds.

### 6.3.3 Industry-partnered educational programmes

The current emphasis on campus-based stand-alone teaching by the university system in the State would be modified and a programme of collaboration with industries in the field of biotechnology would be worked out as part of the strategy for human resources development in this sector.

Retooling and reorienting the personnel already working in the field of biotechnology related areas of knowledge and industry is also among our priorities. Short-term programmes in training would be sponsored with emphasis on hands-on exposure in emerging areas of focus for the personnel.

### 6.3.4 Introduction of Biotechnology in the High School Curriculum

A beginning will be made in commencing biotechnology education at the plus two level in schools along with necessary laboratory infrastructure, books, teachers and training.

## 7. BIO-SAFETY

Safety guidelines laid down by Government of India towards research in the field of Biotechnology shall be adhered to strictly and provisions for augmenting security arrangements as required from time to time shall be made in addition.

## 8. INTELLECTUAL PROPERTY RIGHTS

We recognise Intellectual Property Rights as being a central issue in the sphere of biotechnology from equity, ethical and economic perspectives. Appropriate initiatives

based on wide consultation would be taken on this to make the stakeholders and the citizens at large aware of IPR issues. Special inputs would be incorporated in education courses at all levels and, in particular, the postgraduate level, so that the various stakeholders and users are sensitised to IPR issues. Further, inputs for law students would be organised in consultation with the legal fraternity to being special focus to Patent law and IPR related issues relevant to biotechnology.

## 9. INCENTIVES AND ADVANTAGES FOR BIOTECHNOLOGY INDUSTRY

1. Government would continuously devise smoother and easier clearance procedure for commercialisation of biotechnology products and for investment in biotechnology industry while providing adequate intellectual, social and economic safeguards.
2. Incentives for ISO certifications and other global standards would be provided as already indicated in our Industrial Policy.
3. State Government may give preference in purchases to biotechnological products produced within the State of Chhattisgarh in appropriate cases after appropriate notification.
4. Biotechnology industries have been treated as a sunrise sector along with Information Technology industries and the State's policy is to promote technology and knowledge industries in the sunrise sector.
5. Several industries in the biotechnology sector have been included under Thrust Area in the Industrial Policy under the condition that a minimum of Rs. Fifty Lakhs would be invested on the plant and machinery. These are bio fertilizer, tissue culture, cocoon rearing, rhizobium culture and blue green algae. Further additions to the list of Industries may be made from time to time by the Government.
6. All bioinformatics units would enjoy blanket exemption from pollution control regulations and may be established without any restrictions on location. They can be established in residential, industrial or commercial zone / areas.
7. Biotechnology units would be exempt from payment of stamp duty on acquisition of land.
8. Assistance will be given to small scale sector biotechnology industrial units located in the places other than industrial area to the extent of 25% of the infrastructure cost

subject to maximum Rs. 1 crore and interest subsidy @ 5% per annum to maximum Rs. 5 lakhs.

9. Government of Chhattisgarh will provide, wherever satisfied that it will further the aims of this policy and would serve to substantially increase benefits to the State and its people, Government land on lease, or as its share in equity for joint ventures, for Biotech parks, if the site is otherwise found suitable for such projects.
10. Biotechnology units would be provided uninterrupted power supply.
11. Biotechnology industrial units would have to pay power tariff as in industrial tariff which is Rs. 2.97 per unit (up to 25 h.p.).
12. All new biotechnology industrial units would be exempt from liability to pay electricity cess for a period of ten years from the date of commencement of commercial production.
13. Chhattisgarh has perhaps the most peaceful industrial relations scenario in India. This region has the lowest number of man-days lost in industrial disputes. In addition the time taken for conciliation of industrial disputes is much lower than the national average. This heritage would be promoted in the future as well.
14. The strengths enumerated under the chapter on strengths (Chapter 3) are also important advantages the State offers to biotechnology industry.