

Note:

The below draft biotechnology policy has been formulated by science and technology department and is placed on the website for inviting comments from general public and all stake holders. Accordingly, the comments / observations, if any, are invited from general public, scientists, researchers, stake holders either by email or by post on below address

E mail address: mushtaqbhat60@yahoo.com

Office Address: Joint Director(M)

***Jammu & Kashmir State Council for Science & Technology
Department of Science & Technology***

*Winter capital
(November to April)
5B/ Gandhi Nagar Jammu –
190001
Phone No 0191-2433045*

*Summer Capital
(May to October)
3rd Floor, Boulevard Road
Srinagar 190 003
Phone No 0191-2479629*

**BIODIVERSITY AND BIOTECHNOLOGY
POLICY FOR
JAMMU & KASHMIR STATE**

J&K STATE COUNCIL FOR SCIENCE AND TECHNOLOGY
DEPARTMENT OF SCIENCE AND TECHNOLOGY
GOVERNMENT OF JAMMU AND KASHMIR

September 2010

**FRAME WORK
FOR
BIODIVERSITY AND BIOTECHNOLOGY POLICY FOR
JAMMU & KASHMIR STATE**

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**FRAME WORK
FOR
BIODIVERSITY AND BIOTECHNOLOGY POLICY FOR
JAMMU & KASHMIR STATE**

MISSION

**"TO DEVELOP A POLICY FRAMEWORK FOR HARNESSING BIOTECHNOLOGY
FOR ACHIEVING CHOSEN SOCIETAL GOALS AND ADVANCING INCLUSIVE
GROWTH"**

SECTION 1 INTRODUCTION

1.1. Background

Biotechnology may be defined as the art and science of using living things or parts thereof to develop products and technologies, useful to living entities. Modern biotechnology has also been used as a tool to unravel the mysteries of science embedded in nature. It offers to manipulate living systems and modify the organisms at molecular level to create new products and processes that find practical and useful applications in various spheres of human activity particularly agriculture, medicine and in the industrial production. Present day biotechnology, because of its help in resolving many issues related to food, health, industrial production and environment is aptly recognized as the **“technology of hope**. As per the Department of Biotechnology, Government of India, therapeutic biotech drugs and vaccines, that are currently being marketed, account for about US\$40 billion, benefiting over a hundred million people worldwide.

Keeping in view the wide usage and potential of biotechnology, Indian R&D centers and industrial houses have also started to use the tools of biotechnologies to harvest the fruit of this newly evolved sector. In order to boost the R&D and industry involving biotechnology sector, Government of India established the Department of Biotechnology in the year 1986. The positive frame work and investment climate offered by the Indian government through DBT has helped the recent advancement of the biotech sector in India.

Today in India, there are around 400 companies producing specialized products, tools/kits and offer services in different sectors of bio technology. Some of the leading biotech companies of the country are Biocon, Nicholas Piramal Limited, Dr Reddy’s Laboratories, Serum Institute of India, Wok hard Limited, Indian Immunologies, Bharat Serum, Krebs Biochemical and Industries Limited, Wipro Health Sciences, Shantha Biotech Ltd., etc. There are also more than 50 R&D laboratories conducting high quality research in specific areas and developing goods and products of common public usage. According to a recent survey, the leading biotech companies contribute around 27 % of the total revenue of the sector.

Some salient features of Indian biotech sector are:

- In value terms biotech sector has crossed one billion US dollars in trade
- Growth in agro biotechnology has been high

- With induction of new technologies this sector has registered growth from Rs 50 crore to Rs more than 600 crore.
- Biotech applications span health, agriculture, energy, information and the environment.

1.2. Biotechnology scope and significance

Biotechnology is the new generation *technology of hope* for prosperity and growth of a country. Like everywhere in the world, it has added to the economy of our country. Many states such as Karnataka, Tamil Nadu, Gujarat, Maharashtra, Himachal Pradesh, and Punjab have exploited the use of this technology to their advantage advancement in employment generation, industrial development and consequently wealth generation but the state of Jammu and Kashmir has yet to harvest the fruit of biotechnology. There is thus a great opportunity to improve the socio-economic status of J&K using the biotech engine. The state has also to create an environment to attract the investors in this sector. Though some measures such as creation of industrial belts, industry development policy, tax benefits and facilitating the supplies and utilities have been taken yet there is need to review the situation, draft a policy that sets the scene for biotechnology entry, shows the direction, identifies the thrust areas of work and also lures the investors for investing liberally in the state of Jammu and Kashmir.

1.3. Biodiversity of the State: Bedrock for biotechnology

Biodiversity is the blanket term for natural biological wealth that undergirds human life and its well being. It is dynamic and is recognized at three levels – species level, genetic level and ecosystem level. Genetic differences between the individuals of a species provide the basis for the diversity that is found between species. India is one of 12 mega biodiversity centers of the world and so far 81,000 species of animals and 49,000 species of plants have been described. Since in nature no organism lives in isolation, each species is dependent on other species. There is complete inter-dependence in nature; change in habitat of one specie shall affect the diversity of the species of the habitat.

Jammu & Kashmir is located in the north of India and is essentially a mountainous zone in the lap of north-west Himalayas. It has international border with Pakistan in the west and China in the north. It is connected to the rest of country through a 30km long border with Punjab and 300 km border with Himachal Pradesh. Jammu & Kashmir has a total area of 222335 sq. km with 22433 sq. kms covered under forest. It has three main regions Jammu, Kashmir & Ladhak, representing sub-tropical temperature and cold arid region which differ in physiography and culture. It is estimated that 30% of global endomology reside in India and 17% of which is endemics to Himalayas. In the global context, roughly over 1% endemics reside in Himalayas.

Flora of Kashmir comprises more than 3000 species, Ladhak about 880 species of medicinal plants and Jammu about 500 species which include angiosperms, gymnosperms and pteridophytes. 65 species belonging to 36 families have been phytochemically, taxonomically and pharmacologically studied. These figures include only the angiosperms, gymnosperms and pteridophytes. Lower plants like fungi and algae and microbial wealth has not been studied exhaustively. Due to the diverse climatic conditions and unique location offered by the state of Jammu & Kashmir, the fauna is also diverse. As per the first state survey in the state (Gunither 1864), the fauna population is as below:

Mammals	73 species
Birds	358 species
Reptiles	68 species

Amphibian	14 species
Butterflies	158 species
Fishes	44 species

Many of the plants that are grown in Jammu & Kashmir find tremendous use in Ayurvedic and other traditional formulations; these are legally and perhaps illegally extracted and sold for commerce leading to over exploitation of species. In addition, there are many factors both natural and man made such as climate change, deforestation, land slides/upheavals drought forest fires and herbal trade leading to reduce availability and extinction.

There is a great need to cultivate some of the commercial endemic Himalayan plants, for sustainable use and equitable distribution. Projected demand of some of the endemics is given below:

Projected Demand of Himalayan Endemics

Species	Part	Demand in tones (Estimated for 2004-05)
<i>Taxus wallichiana</i>	Leaves	680
<i>Aconitum heterophyllum</i>	Root	448
<i>Anacyclus pyrethrum</i>	Root	292
<i>Aquilaria malaccensis</i>	Root	420
<i>Berberis lycium</i>	Root	1829
<i>Hypericum perforatum</i>	Root	143
<i>Inula racemosa</i>	Root	759
<i>Nardostachys jatamansi</i>	Root	866
<i>Picrorhiza kurroa</i>	Root	317
<i>Rubia cordifolia</i>	Root /stem	1424
<i>Saussurea costus</i>	Root	1826
<i>Swertia chirata</i>	Herb	1284
<i>Valeriana jatamansi</i>	Root	216
<i>Podophyllum hexandrum</i>	Root	250

TEN TOP OVER-EXPLOITED SPECIES

<i>Aconitum heterophyllum</i>	(Antipyretic)
<i>Dioscorea deltoidea</i>	(Antifertility)
<i>Heracleum candicans</i>	(Antileucodermal)
<i>Nardostachys grandiflora</i>	(Sedative)
<i>Picrorhiza kurroa</i>	(Antihepatotoxic)
<i>Podophyllum hexandrum</i>	(Anticancer)
<i>Saussurea costus</i>	(Anti-rheumatic)
<i>Swertia chirayita</i>	(Antihepatotoxic)
<i>Taxus wallichiana</i>	(Anticancer)
<i>Valeriana jatamansi</i>	(Tranquilizer)

Three species of plants endemic in J&K have also found mention in the Guinness Book of World Records

<i>Arenaria bryophylla</i>	6180msl
<i>Christolea himalyansis</i>	6300msl
<i>Stellaria decumbens</i>	6135msl

1.4. Industry and employment scenario

The green revolution that India witnessed improved the yield of the rice and wheat followed by the white revolution for increasing the milk production, helped in facing the food scarcity in our country to some extent. This had direct bearing on the increase in the annual income of a large number of people involved in this sector. It is estimated that these biotechnological interventions have helped in generating revenues to the tune of US\$5 billion and creating one million jobs. In J&K the economy is essentially based on the ecotourism and the available bio-resources available. Food fodder and house hold utilities including medicines to a large extent, are all derived from plants and animal resources that were abundantly available in the state. Even items of commerce such as fresh and dry fruits, handicrafts, sericulture products e.g., shawl and carpets and woodcrafts are all from natural reserves of the state. As on today the trade in all these sectors is fast decreasing because of unplanned usage.

With all the promise offered by the biotechnology developments, abundance of bioresources in the state of J&K, this state has not witnessed the growth in this sector. On the contrary, the forest cover is fast decreasing and there is depletion in minor and major forest products. The trade of some of the plants of importance is going on without planning for its sustainable use and management. The employment offered in the areas of specialty bio-resource products is fast decreasing. On the other hand the population size of unemployed youth is increasing. As on December 2009, over 5.67 lakh unemployed educated youth have registered with various District Employment and Counseling Centres of Jammu and Kashmir. Out of a total 567358 youth, 272072 belong to Jammu division, 283288 to Kashmir valley and 11998 are from Ladakh region. Besides, 27069 unemployed technocrats, agriculture graduates and post graduates have registered with the district employment and counseling centers

Therefore it is high time for policy planners and thinkers to look into his aspect and promote cultivation of important and endangered and commercial plants, establish industry based on proven technologies, offer important luring packages to the industrialists to invest in J&K and invest locally into the innovative science that has reason, relevance and application to the state of J&K. All this shall eventually lead to boosting the economy and employment generation.

1.5. Sectors Critical to J&K

The opportunities offered by biotechnology are multifaceted. Its application in all the fields is growing. Using the latest biotechnological tools, the following sectors are important to be taken up on priority:

- Agriculture, Crop productivity, crop health
- Medicinal and Aromatic plants
- Floriculture

- Temperate horticulture
- Conservation and commercial cultivation
- Microbial diversity and fermentation biotechnology
- Drugs and Pharma
- Live stock and genetic up-gradation
- Molecular diagnostics
- Sericulture
- Endangered species
- Germplasm Reserves for 1. Tropical, 2. Temperate, 3. High altitude plants
- Leather and leather products

1.6. Market driven products and their quality control

So far as the tourism industry of the country is concerned, Jammu and Kashmir is pride of India. We have people from different religions, caste and color from varied economic strata, visiting the state for religious and touristic purpose. Therefore the product that caters to the need of all such people shall be successful. May it be simple portable water or the costly silken carpets? But so far we have not been able to make a dent in the industrial sector. There are good numbers of pharmaceutical companies who have started their establishments in J&K, but it seems these companies lack in their will to continue their production houses in the state. Conditions need to be created to see that they are functional. J&K has the climate suitable for the production of biotech products. We need to acquire technologies and lure the investors to establish such industry in J&K. Some of the product ranges can be from below:

1. Essential oil products
2. Herbal drugs
3. Cut flowers
4. Leather
5. Potable water
6. Dry and wet fruit
7. Carpets,
8. Sericulture, silk and products thereof

The name of Kashmir is in itself a brand, on top of it Mughal gardens, Dal lake, Mata Vaishno Devi are the names of repute. Suitably composed names can create world famous brands. But brands become successful only when there is total quality control and quality assurance of the products. We may be able to sell the products for some time but eventually if the quality standards are not met, the products shall fail. Care has to be taken to maintain the quality standards of the product.

1.7. Premier biotechnology and biodiversity institutions in Jammu and Kashmir

Indian Institute of Integrative Medicine, (CSIR)
Canal Road, Jammu. 180 001, J&K India, 0191-256111, Fax,. 256222

University of Jammu,
Dr. B. R. Ambedkar Road,
Kammu, J&k, India

University of Kashmir,
Hazratbal, Srinagar,
Kashmir, J&K, India

Shri Mata Vaishno Devi University
Sub P.O SMVD University,
Katra, 182320 (J&K),

Baba Ghulam Shah Badshah University,
Rajouri, Jammu, J&K
Sher-e-Kashmir University of Agricultural Sciences and Technology
Shalimar, Srinagar, J&K

Sher-i-Kashmir Institute of medical sciences
Soura Srinagar-190011, J&K

Govt. Medical College,
Bakshi Nagar, Jammu - 180001

Govt. Medical College,
Karan Nagar, Srinagar, J&K

High Altitude Research Laboratory (HARL)
Gulmarg, Kashmir, J&K

Defence Institute of High Altitude Research (DIHAR)
Defense Research & Development Organization (DRDO)
Leh-Ladakh-194101, J&K

Central Institute of Temperate Horticulture (CITH)
P.O. Sanatnagar, Srinagar, Kashmir-190 005, J&K

Department of Agriculture
Directorate of Agriculture, Govt. of J&K
Talab Tillo, Jammu / Lal Mandi, Srinagar
J&K

Central University of Jammu and Kashmir (CUJK)
House No. 101, Baghi – Hyder,
Hyderpora, Srinagar-190014,
J&K

1.8. Biodiversity Management and Biotechnological Applications: Operational mechanism

Internationally knowingly or unknowingly humans have exploited nature or biodiversity to their advantage to meet basic needs such as food, shelter, medicine and clothing not realizing the value of preserving biodiversity for sustainable use and equitable sharing. This has also led to the over extraction and extinction of some important species. Besides being used for immediate needs, biodiversity is a store house of important genetic material. With the advent of biotechnology many such species can be used for a variety of applications to advantage. Besides our moral responsibility to protect the fauna and flora some of which are facing an acute danger of over exploitation and extinction, the opportunity of scientific manipulation of the biodiversity shall also be lost.

Every state of India should and has a responsibility to establish the State Biodiversity and Biotechnology policy for conservation and sustainable use of biodiversity and application of biotechnological advancements for the societal benefit. It shall not be mere inventorisation or protection exercise but also a call for judicious use. The Union Ministry of Environment and Forests (MoEF), India, passed the Biological Diversity Act 2002, with the objective of regulating access to genetic resources and associated knowledge by foreign individuals and institutions and ensure equitable sharing of benefits arising out of use of resources and knowledge available in the country. In short, the Act is aimed to protect and regulate access to plant and animal genetic resources and traditional knowledge (TK). The issues involved in the protection and application of biodiversity and biotechnology have far-reaching consequences and need to be a subject of awareness for the society. The operational mechanism for implementing the policy may be as follows:

- Documentation;
- Policy, rules and regulations for Sustainable Use and Equitable Distribution;
- Conservation measures for biodiversity with special reference to important crops of Jammu and Kashmir;
- Creation of regional gene centers in eco parks;
- Commercial Utilization of Biological Resources;
- Identification of the biotech sectors;
- Identification of biotechnologies and policies;
- Awareness programmes and dialogue;
- Establishing industry for products and employment.
- Public Private Partnership

SECTION 2 VISION AND TARGETS

2.1. THE VISION IS TO DOCUMENT, CONSERVE, SUSTAINABLY UTILIZE, AND ENHANCE BIODIVERSITY THOROUGH APPROPRIATE BIOTECHNOLOGICAL INTERVENTIONS SO AS TO DEVELOP AND TRANSFER BIOTECHNOLOGICAL SOLUTIONS FOR THE END USERS AND THEREBY PROMOTE ENTREPRENEURSHIP, IMPROVE QUALITY OF LIFE, ECOLOGY AND ECONOMY OF THE STATE OF JAMMU AND KASHMIR.

2.2. New products, market and Public visibility

In order to register the importance of the policy locally, nationally and internationally, it is important that some activities suggested in the document IN SECTION 3 be implemented immediately.

2.3. Achieving quicker visibility

At one time there was a booming export of leather and fur goods, herbs, silk products, dry and wet fruits from the J&K state. International agencies now enforced strict compliance of quality control and presence of toxic substances in imported material resulting in decrease in the export of these items. It is therefore time that the state identifies few areas such as Pharma products, Leather goods, essential oils, medicinal plants, dry and wet fruits as important thrust area projects and invest in terms of money and manpower to boost the export of such products from the state. However two things need to be kept in mind. These are brand building and quality control. Care has to be taken that the private sector investors are provided genuine help by the authorities.

2.4. International visibility of S&T Endeavor

In the area of science and technology, it is important to register visibility in international scientific community by publishing in high impact factor science journals. This can be done by identifying areas of R&D that can be pursued in the institutes already existing in the state of Jammu and Kashmir. In case there is a need of collaboration between the local institutes and elsewhere in the world, forging the linkages can be established and promoted to publish in high quality science journals.

2.5. Identification of institutes of excellence /areas of priority

On the basis of published output, the state may identify at least one area of expertise in each reputed institute. The Advisory committee for S&T of the state may identify peer review committees for each area to identify the research thrust for each institute and suggest the required liberal funding to facilitate high impact research work in that institute. Based on the available information, following are the areas of expertise in the state institutes.

<u>INSTITUTE</u>	<u>AREA OF EXPERTISE</u>
1. Indian Institute of Integrative Medicine, (CSIR), Canal Road, Jammu. 180 001, J&K India,	DRUG DISCOVERY
2. University of Jammu, Dr. B. R. Ambedkar Road, Kammu, J&k, India	BIOTECHNOLOGY
3. University of Kashmir, Hazrat Bal, Srinagar, Kashmir, J&K, India	BIODIVERSITY AND BIOTECHNOLOGY
4. Shri Mata Vaishno Devi University Sub P.O SMVD University, Katra, 182320 (J&K),	GENOMICS
5. Baba Ghulam Shah Badshah University, Rajouri, Jammu, J&K	BIODIVERSITY
6. Sher-e-Kashmir University of Agricultural Sciences and Technology Shalimar, Srinagar, J&K	SAFFRON
7. Sher-i-Kashmir Institute of medical sciences Soura Srinagar-190011, J&K	GENETIC DISORDERS
8. Govt. Medical College, Bakshi Nagar, Jammu - 180001	MEDICINE AND DIAGNOSTICS
9. Govt. Medical College, Karan Nagar, Srinagar, J&K	MEDICINE AND DIAGNOSTICS
10. High Altitude Research Laboratory (HARL) Barc, Gulmarg, Kashmir, J&K	HIGH ALITITUDE RESEARCH
11. Defence Institute of High Altitude Research (DIHAR), Defence Research & Development Organization (DRDO) Leh-Ladakh-194101, J&K	HIGH ALTITUDE MEDICINAL PLANTS
12. Central Institute of Temperate Horticulture CROPS(TEMPERATE) (CITH), P.O. Sanatnagar, Srinagar, Kashmir-190 005, J&K	HORTICULTURE
13. Department of Agriculture Directorate of Agriculture, Govt. of J&K Talab Tillo, Jammu / Lal Mandi, Srinagar, J&K	DEVELOPMENT & EXTENSION
14. Central University of Jammu and Kashmir (CUJK) House No. 101, Baghi – Hyder,	ACADEMICS TO BE INITIATED

2.6. Training & retraining

It is important to realize that in the area of science and technology training and retraining in the latest techniques is very important. No innovation is possible unless trainings are imparted to the staff to understand and implement the latest trends and techniques. In view of the specialized funding that will be required the advisory committee shall recommend the resources required and structure training and retraining of the project team. This shall facilitate quick output through tested and validated techniques and upgrading skills of the local manpower in the areas of advanced learning.

2.7. Targets and Milestones

Each project shall have identified doable objectives and targets. The monthly /quarterly milestones shall also be clearly mentioned in the project document to monitor the progress of work. Each project staff shall be responsible for the work assigned to him/her. The PI shall have the responsibility for the overall progress of the project.

2.8. Monitoring mechanism

Advisory committee shall identify a monitoring committee (MC) for each sector. The monitoring committee shall meet at least once in a year to monitor the projects. The MC shall have the power to suggest foreclosure of the projects not showing satisfactory progress. The decision of the MC shall be respected by the authorities.

2.9. Fellowship

In order to ensure that Biotechnology is used in an effective way for socio-economic development of the State, it is essential that we generate trained human resource. While our students are able to perform at highest levels in various National and International Institutes, we need to provide infrastructural support to retain quality students of the State for undertaking research work on problems of local and regional importance. Many of the intelligent, hardworking students are not able to secure fellowships at National level in view of the tough competition and limited number of fellowships. Therefore, the State council for S & T could set up a mechanism of providing fellowships to these research scholars working in the area of Biotechnology in various Institutes of the State. While this is not being proposed to dilute the academic standards, such a support will definitely encourage the students to choose Biotechnology as a career, which is essential if the State intends to harness the benefits of Biotechnology. The criterion of identifying the fellowship awardees could be:

1. Conducting a separate test for Biotechnology research students and /or
2. Providing fellowships to all CSIR-NET LS or SET qualified students

2.10. Teaching/ Research Positions

The Biotechnology Departments of all the Universities of the State have severe shortage of faculty. For most of the courses, faculty has to be invited from outside. Generally, either the expert is not available in a specific area or it is difficult for him/her to spare adequate time for teaching. These issues are adversely affecting the quality teaching in Biotechnology. The Govt. of J & K should provide at least 3-5 faculty positions to each of the Universities so that generation of trained and quality manpower can be ensured.

SECTION 3 SECTORIAL ROAD MAP

3.1. Agriculture, Crop productivity, Crop health

The **State of Jammu and Kashmir** is the northern most state of India situated between 32.15 degree and 37.05 degree north latitude and 72.35 degree and 83.20 degree east longitude. The J&K is the 11th largest state of India having a geographical spread of 101387 Sq. Kms accounting for 3.20% of the total area of the country. Besides, it is 19th most populous state of India having a population of 101.44 lac souls (census 2001). The projected population of the J&K state in the year 2007 was 118.72 lacs. The State of J&K has 22 districts, 71 tehsils, 141 blocks, 2690 panchayats, 6652 villages.

The State has been regarded as a heaven on earth, and is also called the biomass state of India. The State is rich in the cultural diversity of the people, as well as diversity of plants, animals and microbes. The economy of Jammu and Kashmir is essentially based on biomass. With a rich biological diversity, and people that are traditionally dependent on biomass based resources, it is easy enough to see that the subsistence requirements of the people for food grains, firewood, and fodder, timber for housing, food, milk and medicines are derived from the bioresearches available in the state. Even the industrial and commercial sectors have large inputs from the biomass resources of the State.

Thus, it is essential that the critical sectors of the economy of the State are identified; analyzed and possible biotechnological interventions that would pave way for socio-economic development of the State are implemented at an earliest. A brief appraisal of the critical sectors of the economy is presented below:

Agriculture

Agriculture is the main stay of the State's economy as more than 75% of the population derives their income directly or indirectly from this sector. As per Census 2001, 18.38 lakh persons comprising 15.92 lakhs as cultivators and 2.46 lakhs as agricultural labourers depend directly on agriculture for their livelihood forming 49 percent of the total working force (37.54 lakh persons). as revealed by 1995-96 Agriculture Census. During 2007 the food grain production in the State was about 18 lac MTs against a requirement of about 23 lac MTs. Besides 46% deficit in food grains, the State experiences a deficit of 70% and 30% in oilseed/pulses and vegetable, respectively. Considering these issues, there is an urgent need to promote

1. Higher production and productivity of each major cereal through scientific interventions in order to achieve the required targets.
2. High yielding, disease resistant varieties need to be developed to increase agricultural productivity and biotechnology, in this regard, could go a long way in ameliorating widening gap between demand and supply.

3.2. Aromatic plants

Aromatic plants are the cash crops which yield more monetary returns than the presently grown paddy in the state. It is high time to propagate these tested varieties among the masses in the state. IIIM, Jammu has a long experience in this sector and has on the shelf ready agro technologies of a few aromatic crops which have over a period of time become popular in the

world market. Some of these crops such as **rose, lavender, clarysage** have already been adopted by a few progressive farmers of the state. It is important to organize the following:

1. Conduct the awareness programmes,
2. Farmers meet to demonstrate the technologies.
3. Conduct the buyer seller meet to popularize the availability of the oils and sign the long term agreements of supply and purchase.

3.3. Medicinal plants

Jammu and Kashmir also has rare species of aromatic and medicinal plants. This newly emerging sector has vast scope in the State for providing required raw material for manufacturing plant based drugs and high grade perfumes and cosmetics having ever increasing demand world over. Research points out that the State has as many as 623 plant species of medicinal importance alone. However efforts need to concentrate on the cultivation, yield improvement, variety improvement and development of disease free /resistant varieties of *Ginkobiloba*, *Artemesia annua*, *Crocus sativa*, *Hipophea*.

3.4. Temperate horticulture

The State of Jammu & Kashmir is blessed with vast potential for growing all kinds of fruits. The State has four distinct agro-climatic zones i.e. sub-tropical, intermediate (Sub-temperate), temperate and cold arid zone. Apple, Pear, Peach, Plum, Apricot and Walnut are successfully grown in temperate and cold arid areas (Kashmir Division) while as Olive, Pecan nut and Kiwi offer enormous scope for cultivation in Intermediate zone(Jammu Division) of the State. Similarly sub-tropical areas offer potential for cultivation of Mango, Citrus, Ber, Aonla, Guava, Litchi and loquat (Jammu Division).

Besides, cash crops and other high value low volume horticultural crops like strawberry etc. having relatively inelastic market demand, can thrive well in both the divisions of the State. With an annual turnover of fruits and dry fruits of the order of Rs.2000 crores, horticulture plays a significant role in the economy of Jammu and Kashmir. Around 6 lakh farm families comprising 25 – 26 lakh people are connected directly or indirectly with the horticulture sector. The total fruit production in the State has reached about 14.88 lac MTs.

The areas of concern in this sector are less productivity, post-harvest losses of about 20-30%, climate change induced yield declines. To rejuvenate this sector of economy, several initiatives, such as area expansion under fruit crops, rejuvenation of old/senile orchards using high quality planting material, besides other interventions such as breeding of disease resistant, high yielding varieties. Apart for apple, special attention needs to be focused on saffron, walnut, cherries, apricots and other rosaceous fruits.

3.5. Floriculture

Amongst the diversity of plants, the indigenous wild potential ornamental plants could be exploited for promotion of floriculture. Floriculture, an important branch of horticulture involves the cultivation of flowers and it includes ornamental gardening and landscaping. Floricultural products constitute a small but important segment of the international trade. These are high value products that are used for their beauty and elegance and they reap very high economic returns when compared to other agricultural and horticultural products. The world floriculture market is growing significantly at the rate of 10-12% per annum and is estimated to

touch USD 200 billion by 2015. The global exports of floriculture stood at USD 25 billion in the year 2007-08. Over the past decade, flower and pot plant business in the world has increased to US \$ 40 billion. The annual rate of growth in the floriculture industry is about 15 percent. The floricultural products include cut flowers, which contribute about 60 percent of the global trade, flowering and green potted plants and bedding plants from a small segment of the floricultural crop production worldwide. India's share in this global floriculture market is around 0.75%.

State of Jammu & Kashmir has ideal climatic conditions for floriculture and there a number of wild plant species that could be exploited for use in floriculture industry. The need of the day is to use more advanced technological application for commercial exploitation of such plant species. All quantitative and qualitative traits have to be exploited through conventional and modern biotechnological tools and molecular techniques.

3.6. Conservation and commercial cultivation

Biological diversity represents a combination of life forms and their interactions with one another, and with the physical environment that has made Earth habitable for humans. The Millennium Ecosystem Assessment has recently confirmed the overwhelming contributions made by biodiversity to human life and well-being. Yet even as we begin to better understand what is at stake, genes, species and habitats are rapidly being lost. The Jammu & Kashmir State, though endowed with rich and unique biodiversity, is also witnessing unprecedented anthropogenic impact on ecosystems that results in loss of biodiversity with debilitating consequences for regional development. Since biodiversity represents bedrock for biotechnology, urgent initiatives are needed to document and characterize biodiversity of the State employing conventional and modern molecular methods. Besides, in situ and ex situ measures are required for conservation of biodiversity and its sustainable utilization in regional development.

3.7. Endangered species

Medicinal Plant Board of India has notified the list of plants that are endangered and the plants that are in the red book. An initiative can be taken to create reserves for the plants belonging to 1. Tropical 2. Temperate, 3. High altitude regions. These plants can be planted in these areas to create a reserve of gene bank of these plants for future usage and supply. This shall be a great contribution for this area.

3.8. Forestry

The forests which inhabit rich biodiversity in the Jammu & Kashmir state occupy an actual forest area (satellite data by FSI) of 20,433 km² though as per forest records forest area is 20,230 sq. km out of which 54% is dense and 46% open forest. As per FSI 1995 report, 9.13% accounts for the actual worthwhile forest area with a crown density above 40%. The coniferous forests are spread over 8,127 km² and broad leaved over 12,055 km². The area under forest is 50.97% in Kashmir, 45.89% in Jammu and 0.06% in Ladhak. Out of 101,387 sq. km geographical areas, an area of 20230 sq. km constitutes 19.95% that is much below the level of 66% prescribed for hill states in the National Forest Policy of 1988. According to one estimate, 56.6% households' meet 50-75% of their fodder needs from forest and about 97% households meet 80% of their timber needs from forest. An average family in Kashmir consumes 7 tons of fuel wood. Because of these and several other reasons the forests of J&K State have degraded to various extents and necessary measures to salvage such forests is need of the hour. Special

focus is to be laid on use of genetically superior planting material for reforestation and afforestation programmes. In view of low survival of seedlings of conifers used for rehabilitation of forest ecosystems, use of mycorrhizal inoculation needs to be taken up on a large scale so as to ensure survival, growth and establishment of conifers.

3.9. Sericulture

Sericulture is an agro-based labor intensive cottage industry providing gainful employment to rural people. Profile of sericulture activity in the State indicates that 21000 families in 2210 villages of the State were engaged in this pursuit. Production of cocoons during the year 2006-07 was 8.34 thousand quintals showing an increase of 15.83% over previous year. It is discouraging that the silk industry, which has seen a glorious past, is on decline. Various reasons are attributed to this declining trend in the silk industry. Inadequacy of mulberry leaves and damage caused by insects and pests has caused problems in the development and expansion of mulberry trees. Despite several initiatives taken by the State government, the number of mulberry trees is still very low. Due to the lower return from the activity and lack of proper attention to the plantation at the establishment stage, growth of mulberry plantation is slow. The inconsistency in the production of cocoons due to the climatic limitation of the state and inadequate rearing equipment is another matter of concern. As a result, proper growth and development of silkworms does not take place. The initiatives that need to be undertaken include breeding of superior varieties of disease-resistant silkworm species suitable to local conditions in order to boost silk production, and integration of high quality mulberry cultivation with farm and horticulture activity can provide more income and employment to the rural agricultural labor force.

3.10. Live stock and genetic up-gradation

Livestock plays very vital role in the economic development of the State and forms an integral part of State's agriculture. Livestock rearing is the subsidiary occupation of the people who are directly or indirectly connected with agriculture as these two sectors are interdependent. Livestock sector engages sizeable number of working force not only in rearing of animals but also in processing, transportation and sale of the animal products. As per the provisional results of livestock census 2003 total livestock in the State has increased from 9.175 million in 1997 to 9.899 millions showing an increase of 7.9%. This sector provides direct employment to about two lakh people, indirectly benefiting people who are dependent on agriculture. This sector needs more attention and initiatives to achieve adequate expansion and increase in production and productivity to bridge the huge demand-supply gap.

Fisheries

The importance of the fisheries sector has been highlighted as a major food source and also a means of attraction for tourists. As an important activity allied to agriculture, it strengthens the productive base of agricultural economy and generates self-employment. Total fish caught during 2006-07 stands at 192 thousand quintals as against 191.50 thousand quintals in 2005-06. The production of famous Kashmiri Trout has increased from 1.5 thousand quintals in 2005-06 to 1.52 thousand quintals in 2006-07. The production of Mirror Carp has increased from 116.68

thousand quintals in 2005-06 to 116.84 thousand quintals in 2006-07 while as the production of Country Fish has increased from 42.93 thousand quintals in 2005-06 to 43.03 thousand quintals in 2006-07. To increase fish seed production of commercially important fish species the upgrade the existing fish farms by way of increasing their rearing and hatching capacities and other suitable technological interventions.

3.11. Molecular diagnostics

In the country today although there is enough critical mass and expertise in diverse areas of modern medical biology and biotechnology yet, there is a paucity of reliable, efficient, cost-effective and readily available service available under one roof for molecular diagnosis of human genetic disorders. A simultaneous back-up support of research for such a set up for continuous up gradation of the skills and the technology also is scanty. The J&K state mirrors this deficiency. There is a great need to develop molecular tools on the basis of the knowledge and information of human genome in diverse ethnic groups of J&K for diagnosis of both simple disorders and also for the susceptibility to complex diseases, such as type2diabetes, cancer. Further on the basis of genomic information and diagnosis, it is also feasible to look into the therapeutic responses of the patients and suggest a drug regimen which is suitable metabolically, an area of pharmacogenomics.

3.12. Drugs and Pharma

Jammu and Kashmir is the store house of a lot of medicinal plants. There may also be some which have not been explored for the biological activity. There is a need to screen the plants for biological activity such as **cancer, antibacterial and immune-modulators** for which there is a lot of demand. Any success in these areas shall certainly put the state on the world map in the drug discovery area.

3.13. Microbial diversity and fermentation biotechnology

In view of varied agro-climatic zones, terrestrial and aquatic habitats/ecological niches, the State of Jammu & Kashmir is reportedly rich in microbial diversity which till date has remained largely unexplored and almost unexploited for commercial purposes. Microbial diversity is an unseen national resource that deserves greater attention. Too small to be seen no longer means too small to be studied or valued. The observation that microorganisms are valuable natural resources for industry is not new. Bioprospecting for new industrially important organisms and bio-molecules from such organisms will be of importance for the Jammu & Kashmir State. Particular focus should be mycorrhizal fungi, including mushrooms. Mycorrhizal fungi play a crucial role in plant nutrient uptake, water relations, ecosystem establishment, plant diversity, and productivity of plants. Mycorrhizas also protect plants against root pathogens and toxic stresses. Being abundant and very diverse in the State, special focus would on documentation, characterization and exploitation of certain mycorrhizal fungi as bioinoculants and biofertilizers and in bioremediation and rehabilitation of degraded ecosystems.

Besides, standardization of agro techniques for mass cultivation of prized edible indigenous mushrooms could also be undertaken to boost rural economy. In fact, the world market for the mushroom industry in 2005 was valued at over \$45 billion. The total consumption of mushrooms in the US is around 8,00,000 tons out of which almost half is imported. The annual demand for mushrooms that was around 5,000 tons in 2001 in the India has doubled to 10,000 tonne in 2004 and the demand is expected to grow at a good pace of 25% every year for many years to come. It is high time to organize modern mushroom houses on the basis of latest technology (which can be imported) to produce mushrooms for local and export business. Latest quality mushroom products can also be made to value add the material for better returns.

3.14. Leather and leather products

Roughly about 5000 sheep and goat skins are daily available in the state as a by product of the meat industry. These are exported out of the state and purchased back after processing into value added products such as Napa, suede, shoe uppers and furs. It is also in the interest of the state to identify a couple of industrialists who after appropriately supporting in terms of technology and funds can set up a leather or fur industry to produce the value added products in the state itself. This can give encouragement to the industry and employment to a large number of technical and non technical unemployed youth of the state. The industry can be established in two phases. In the first phase semi finished leather can be produced. After establishing the market linkage, experience and stability a second phase can be started in which completely finished leather can be produced on the large scale. It may be mentioned that complete technology of this sector is available within the country.

SECTION 4 INFRASTRUCTURE REQUIREMENTS

4.1. Liberated administrative eco-system

In order to have the desired results from the policy suggested in this document, it is important that the state government also facilitates the project implementation with liberal thinking and policy. Science and technology promotion requires a different thought process and attitude and cannot thrive under conventional administrative system. Therefore the need is to operate it under liberated administrative eco-system. It is also important to mention that government agencies need to promote science and technology, pharma and biotech sectors to modernize the state of Jammu and Kashmir. The following among others will be required:

1. Relaxation on entry tax for importing scientific equipments and machinery and raw material from other states
2. Tax relaxation to promote industrial investment and scientific institutions in J&K state.
3. Fast track approval of projects.
4. Creation of policy and centralized effluent and pollution treatment mechanism.
5. Create mechanism for incentives for R & D units.
6. Create training facilities for industries.
7. Defining clear cut policy for setting up industry in J & K.
8. Exchange program of representative from industry to assess the state of art facility and guidelines for its improvement.
9. Relaxation in more than 75% participation of local people recruitments in the Industry.

4.2. DST Council as an Autonomous body

It is proposed that the present system of State Council of Science and technology be modified. From the various models available in the country, it is suggested that State Council of Science and technology be operated as an autonomous body. The Science Advisory Committee to Chief Minister can be the governing council(GC) of the S&T council, which shall advise CM on the frame work and rules and regulations. The GC should be made a powerful operative instrument under the patronage of CM on the functioning of the S&T Council.

4.3. CEO (Head)

State Council of Science and technology should be headed by a scientist of repute, and named as Chief Executive Officer, appointed by a search committee nominated by CM especially for this purpose. The CEO shall have the powers to over see the functioning of the council and mostly act upon the suggestions put forth by monitoring committees, advisory committees etc.

4.4. Financial support to the institutions for capacity building

The advisory committee shall approve the projects for implementation on priority basis keeping in view the clarity on mandate, objectives and milestones. These projects may be research and development projects, production units, awareness programs, organization of seminar/symposia, call for investment in J&K etc. These shall be submitted to the relevant funding agencies. Where ever required, the PI in association with the committee shall identify the year wise requirements in terms of manpower, equipment and consumables. The funding agency shall be duly apprised of the requirements so that the project does not suffer in implementation at any stage. There shall be strict monitoring of the projects by the monitoring committees and the projects can be foreclosed or extended depending on the recommendation and outcome of the project.

SECTION 5 POLICY REQUIREMENTS

5.1. Mega project involving major R&D centers in the State

There needs to be a mega project in the state for quick results. This may be on the basis of a high impact product that has at least a national impact. The project can be on drug discovery program or on the biodiversity issue involving biotechnology interventions. The project also shall need the clearance of the advisory committee of the state council for Science and technology.

5.2. Web enabled science information system.

It has been observed that most of the scientific institutes in the state are not well informed about the latest trends in research and development work being carried world over because inability to subscribe to the appropriate scientific journals. These journals have become cost prohibitive but are very important for any scientific institute pursuing high quality science. Indian institute of integrative medicine at Jammu is spending huge resources for access to quality information. It contributes to the Sci-finder, Annual Reviews, Expert Opinion and Trends series, Nature

Journals, Science, Cell, PNAS, JCI, NEJM, JI, JBC, JB, ACS & RSC, etc. But there is an agreement for limited usage. The students from other institutes in the vicinity can also access the same at IIIM, Jammu. In case the access has to be extended to other departments/institutes, the publishers can be approached for the same. This shall involve some additional payments to the publishers. These funds need to be appropriately sourced from various agencies. It is important to mention here that the access to quality information system is the basis of quality of science that can be done at any institute.

5.3. Annual conference

It should be the annual feature to conduct a high quality science conference in all the selected areas. All the national and international experts the field should be asked to present the paper or chair the sessions. This shall be to gather the expertise, direction, latest trends and visibility of the research groups in the world arena.

5.4. Public Private Partnership (PPP)

Public Private Partnership can be the appropriate model to involve the stake holder right from the start of the projects. It shall be in his interest to have the hand holding from the beginning to know the nitty gritty of the project. The stake holders can invest under an appropriate agreement to have the first right to lift the technology.

5.5. Intellectual Property Rights

There has to be an IPR committee in all the institutes to screen the publications coming out of the institutes. The IPR committee shall have two important functions (1) not to allow the cheap publications in the non SCI journals and (2) identify the research work of IPR value such that before going in for the publications , patent is filed for the work to value add the impact of the institute.

5.6. Innovation in Science Pursuit for Inspired Research (INSPIRE) Programme

"Innovation of Science Pursuit for Inspire Research (INSPIRE)" is one such innovative programs proposed by the Department of Science & Technology to attract talent towards science. The basic objective of INSPIRE would be to communicate to the youth population of the country the excitements of creative pursuit of science and attract talent to the study of science at an early stage and build the required critical human resource pool for strengthening and expanding the Science & Technology system and R&D base.

INSPIRE Scheme has included three components. They are a) Scheme for Early Attraction of Talents for Science (SEATS), b) Scholarship for Higher Education (SHE) and c) Assured Opportunity for Research Careers (AORC).

All the institutes shall contribute their might to attract talent in this programme by conducting regularly the awareness programs and workshops.

SECTION 6 RECOMMENDATIONS

"The State of Jammu & Kashmir presents a unique agro-climatic region that is rich in biodiversity and therefore offers great scope for biotechnological applications for preservation, conservation, product development and value addition for the benefit of its people. The following salient recommendations are offered to establish a structure for science promotion, research based development and oversight to identify realistic and relevant targets and allocation of financial investments for realizing identified objectives that emanated from prolonged deliberations:

1. Constitute Science Advisory Committee to the Chief Minister (SAC-CM) as an apex body for science endeavour in the state. It will function as Governing Council for the State Council for Science & Technology besides its advisory.
2. The State Council of Science & Technology is given an autonomous status so that science activities can prosper in the essential liberated administrative ecosystem.
3. R&D areas identified after due deliberation which deserve to be pursued include:
 - Establishing reserves for tropical, temperate, and high altitude biodiversity conservation.
 - Intensification of efforts to improve crop productivity and crop health including horticultural species.
 - Focused improvement of sericulture and floriculture.
 - Medicinal plants such as *Ginko biloba*, *Artemesia annua*, *Crocus sativus*, *Hippophea*.
 - Aromatic plants such as *rose*, *lavender*, *clarisage rhamnoides*.
 - Traditional knowledge-based interventions for containing cancer incidence, and developing antibacterial & immune regulating products/processes.
 - Molecular biodiversity and molecular diagnostics for health care.
 - Livestock including fisheries- genetic up-gradation
4. Financial support for institutions/departments of excellence for capacity building.
5. Identifying and funding - Area specific projects and mega projects of state relevance.
6. Packages and incentives for promoting (a) Industries such as Pharma, Leather, Biotechnology and (b) scientific meetings & conferences.
7. Encourage PPP for translation of available technologies
8. Take active action on INSPIRE programme of the Govt. of India
9. Set up more Biotechnology Institute, equipped with the most modern facilities.

SECTION 7 CONTRIBUTORS

- 1. Prof. V.L. Chopra** Chairman
Former Member,
Planning Commission,
Government of India
- 2. Dr. P. S. Ahuja**
Director,
Institute of Himalayan
Bioresource Technology, P.O Box 6,
Palampur-176061
- 3. Prof. R.N.K. Bamezai**
Vice Chancellor
Shri Mata Vaishno Devi University
Campus, Sub P.O SMVD University,
Katra, 182320 (J&K),
- 4. Dr Ram Vishwakarma,**
Director,
Indian Institute of Integrative
Medicine, Canal Road, Jammu
180 001, J&K India
- 5. Prof. A. K. Koul**
Director,
Baba Ghulam Shah Badshah University,
Rajouri, Jammu, J&K, India
- 6. Dr. Javed. N Agrewala**
Scientist
Institute of Microbial Technology
Sector 39 A, Chandigarh, 160036
- 7. Prof. S.N. Raina,**
NASI, Sr. Scientist,
Department of Biotechnology,
Amity University, Sector 125,
NOIDA, UP, 201303
- 8. Mr. Atal Dulloo**
Commissioner Secretary,
Science and Technology,
JK State, J&K, India
- 9. Prof. Zafer A Reshi**
Deptt of Botany,
Kashmir University,
Srinagar, Kashmir, J&K,
- 10. Prof. Manoj K. Dhar**
Director, School of Biotechnology
University of Jammu,
Jammu, J & K
- 11. Dr. R. K. Raina**
Scientist, G
Indian Institute of Integrative Medicine,
Canal, Jammu, 18000