Korean National Biotechnology (BT)
Fostering Situation

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Comprehensive Adjustment and Development Direction in BT (Office of Science and Technology Innovation)

A. Overview

As of 2003, Korea had become the world’s 11th largest economy following 40 years of unprecedentedly high growth rates. This achievement has been attributed to government-led economic development plans, ample labor resources, low-interest foreign borrowing, and the introduction and amelioration of foreign technologies.

Overall, the nation’s capacity to develop source technologies, however, is still lacking, and despite the government’s continued expansion of R&D investments, the volume of investment stood at only one-eighteenth and one-eighth of that of the Unites States and Japan, respectively, in 2005. Although Korea has fostered substantive manpower in the fields of science and technology, she has yet to boost its quality. College-bound students avoid choosing science and technology as majors, thus posing a pressing social issue.

To overcome this situation and boost its per-capita GDP to over USD 20,000 on the road to achieving status as an advanced nation, Korea is pushing to develop a National Innovation System aimed at achieving technological innovation at the national level in order to monitor its current position accurately and formulate the most suitable growth strategies. This strategy seeks to make the shift to an innovation-led economy aimed at quality growth backed by state-of-the-art technologies and knowledge, thereby pinpointing new growth-engine industries and advancing existing industries to the highest degree.

Last year’s reshuffle of the science and technology administration system forms a part of these efforts, and aims to put science and technology at the center of the bid for achieving per-capita GDP of USD 20,000, improve the quality of Korea’s micro-economies involving science and technology-related industries and manpower, and thus strengthen the base of the nation’s macro-economies. With this reshuffle of the system, the Ministry of Science and Technology has been upgraded to a ministry with its minister serving as a deputy prime minister, and is now empowered to pursue policies on science and technology consistently and efficiently according to national objectives. Furthermore, with the inauguration of
the Office of Science and Technology Innovation, the National Science and Technology Council has been empowered to effectively exercise a coordination role.

**B. Role of the Office of Science and Technology Innovation**

The Office of Science and Technology Innovation has undertaken to oversee and coordinate innovation policies in industries, manpower, and the regions in connection with policies on science and technology innovation, as well as adjust and allocate national R&D budgets according to mid- and long-term national development objectives. This move has fundamentally changed the nation’s 40 years-old administration system of science and technology, thereby leading to a fundamental change in the nation’s economic development strategies. Aiming at bolstering investment efficiency in overall national R&D, the Office of Science and Technology Innovation is responsible for adjusting policies, surveys/analysis/evaluation, and adjusting and allocating R&D budgets. Under this new administrative system, intended for the BT field as well as science and technology, related ministries share their respective roles with the Office of Science and Technology Innovation overseeing the operation.

**Support Policies for BT R&D (Ministry of Science & Technology, MOST)**

**A. Overview**

BT fostering by the government began when the Ministry of Science and Technology gave its support to a specific research and development project in 1982, selecting BT as a core strategic technology. The Ministry then prepared a legal basis for BT fostering support by passing the “Genetic Engineering Promotion Law” in 1983 (currently the “Biotechnology Fostering Law”), on the basis of which it established the “Genetic Engineering Center” (known as Korea Research Institute of Bioscience & Bioengineering, KRIBB) at KIST and launched a full fostering support program.

The specific research development project broadens this support, establishing research support programs such as the Leading Technological Development Project (G7), the Focused Research Development Project, the National Policy Research Development Project, the National Research Laboratory Project (NRL), the 21st Century Frontier Research Development Project, the Nano-Bio-based Technology Development Project, as well as research cooperation centers within the universities such as the Excellent Research Center (SRC, ERC), National Core Research Center (NCRC), and the Basic Medical Science Research Center (MRC).

In December 1993, the Ministry also established the BT Basic Fostering Plan (Biotech 2000, 1994–2007) involving the participation of 8 departments. The 3rd stage (2002–2007) of the plan is now in operation, backed by annual working plans. In order to promote research into the human brain, the Ministry also enacted the “Brain Research Fostering Law”, established the Basic Plan for the Fostering of Brain Research in 1998 (Braintech 21, 1998–2007), and is elaborating annual working plans.
B. Pursuit Directions and Development Assignments

Strengthening the Linkage between BT Development Projects

MOST is poised to strengthen the linkage between nano-bio technology development projects, 21st century frontier R&D projects, and next-generation growth-engine industries in the BT field, activate research in the BT field, and pursue effective R&D.

Strengthening the National Publicity Campaign

As BT is a science which deals with living things, it is necessary to inform people about BT and form public opinion on the matter. MOST is poised to present the future vision of BT and boost national recognition of BT. The ministry is also striving to work together with related ministries such as MOHW and MOCIE in order to raise the legal and systematic foundations relating to embryonic stem cell research, living modified organisms, and others to an international level.

Strengthening Overseas Cooperation

In order to accelerate the domestic technological level in the BT field and foster world-class BT industries, it is necessary to acquire the excellent research techniques of advanced countries by drawing positively from excellent overseas institutes. MOST is set to establish common biological resources research centers in overseas areas with ample biodiversity, systematically gather local biological resources, and thus secure diverse biological materials, as well as receive the transfer of technologies through joint research with superior overseas researchers, by strengthening overseas partnerships.

Bio-industry Fostering Policies
(Ministry of Commerce, Industry, and Energy, MOCIE)

A. Overview

MOCIE is pushing the 3.12 Bio-industry Development Project, formulated in July 2005, which aims to bolster Korea’s bio-industry competitiveness. First, with the presentation of the policy vision of exploring first-class corporations and achieving exports of USD 10 billion by 2010 by commercializing traditional bio products as world-class products: to this end, the ministry is intent on developing technologies that will prompt the industrialization of cutting-edge BT products, create infrastructures designed to spur regional innovation and lead the advance into the global market, and improve corporate management conditions in the bio-industries. To achieve these three policy objectives, the ministry has set and is tackling twelve policy tasks.
B. Policy Vision

Foster bioindustries as a national economic growth engine in the post-IT age. Explore super first-class corporations, and advance traditional bio products into global products, thus attaining an export of USD 10 billion by 2010.

Policy Goals

1. R&D: Develop industrialization technologies of facilitating the commercialization of state-of-the-art BT.
2. Infrastructure: Structure infrastructures that will lead regional innovation and entry into global markets.

Policy Tasks

1. Formulate bioindustry technology development roadmap.
2. Invest in BT industrialization R&D intensively.
3. Explore fusion technologies for exploring future markets.
5. Structure regional bio centers, the leader of regional innovation.
6. Construct and operate CMOs.
7. Expand the common assessment and test base for industries, schools and research agencies.
8. Foster professional manpower in BT.
9. Form strategic partnerships between participants in the value chain.
10. Encourage the private sector to invest in BT through the improvement of financing systems.
11. Reshape the distribution and trade systems in bioindustries.
12. Attract strategic FDI and step up global cooperative systems. Structuring the support system for pursuing the 12 tasks.

Policies for Basic Science Promotion and Manpower Cultivation in BT (Ministry of Education and Human Resources Development, MOE & HRD)

A. Overview

Recently, somatic cell cloning and human embryonic cloning tests have been successful, and rapid progress has been made in gene research and nerve net research. As such, the latest biotechnologies are signaling big changes in our life. A large number of diseases are being eradicated and life expectancy is increasing due to the development of new medical treatments and medicines through the application of basic science. The achievements in bioscience have been made possible by the development
of the relevant basic science fields. In other words, they have been derived from the results of experimental technologies in basic scientific fields such as biology, biochemistry, physiology, and biophysics. Furthermore, with an increasingly ageing society, demands are rapidly rising for the activation of industries for elderly people and other BT areas, and with the trend of fusion and development together with IT, NT, and ET, BT is under an intense spotlight as one of the areas that will lead the development of the 21st century cutting-edge industrial society.

B. Pursuit of Promotion

Basic Science Promotion

The MOE&HRD has been pushing for an academic research creation project since 1963 to balance the fostering of basic sciences (humanities and sociologies, and basic sciences), strengthen professors’ basic research capabilities, bolster graduate school students’ research abilities, and structure the nation’s basic research infrastructure. Of these projects, those relating to science and technology include support for pure basic research groups, as well as support for basic science research aimed at facilitating the production of creative scientific and technological knowledge.

Status of Pursuit of Projects Transferred by MOST

Of the projects transferred in October 2004 from MOST, Support for Fostering Leading Scientists and Support for Leading Basic Science Laboratories are aimed at supporting R&D in the pure basic sciences and enhancing their quality, boosting the morale of researchers, and fostering manpower.

BT Fostering Policy in the Agricultural Field

(Ministry of Agriculture & Forestry, MOAF)

A. Overview

Agricultural BT is receiving attention as part of the policy to overcome the aftermath of the deterioration of the agricultural environment and traditional agriculture following the opening of the country’s agricultural import market, reshuffle agriculture into the ranks of the nation’s major wealth-producing industries, and convert it from an essentially labor-intensive industry into an environmentally-friendly, high added-value, knowledge-based industry.

MAF is striving to foster and utilize agricultural BT, develop our unique source technologies and application technologies, cultivate diverse new-function items of agricultural products, and secure national competitiveness in agriculture. It is also endeavoring to develop cutting-edge BT industrializing materials and convert agriculture into a high added-value knowledge-based industry, thereby enhancing the quality of life in rural areas.
B. Prospects for Development

Farmers also Prefer Living Modified Organisms, Citing Economy and Labor Savings

8.25 million farmers from 17 nations currently prefer LMOs because they have proved to be effective in increasing output, reducing labor, and preventing environmental pollution in particular. Genetically, modified beans are now cultivated in over 60% of the world’s entire bean cultivation area.

Table 1: Examples of LMOs.

<table>
<thead>
<tr>
<th>Description</th>
<th>Economical Gain (Crop Increases, and Production cost Decreases)</th>
<th>Preventing Environmental Pollution (Use of pesticides Decrease)</th>
<th>Reducing Labor (Sprays decrease)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vermin-resistant Transgenic Corn</td>
<td>150$/ha</td>
<td>6%</td>
<td>14%</td>
</tr>
<tr>
<td>Vermin-resistant Transgenic Cotton</td>
<td>514$/ha</td>
<td>14%</td>
<td>22%</td>
</tr>
<tr>
<td>Herbicide-resistance Transgenic Bean</td>
<td>160$/ha</td>
<td>28%</td>
<td>30%</td>
</tr>
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</table>

The Market for New-function LMOs is Rapidly Growing

The central axis of BT is forecast to gradually move from the medical BT field to the agricultural, environmental, and energy BT fields. The market for new-function LMOs is forecast to expand rapidly. Since 1996, when the cultivation of LMOs first began on 1.7 million ha of farming land, the cultivation area has increased to 81 million ha in 2004, an increase of 48 times.

The Key Issue is How to Evaporate Distrust in Consumers with Regard to LMOs

As agricultural biotechnology has a low possibility of success and invested funds have a slow recovery period, it is difficult to attract positive investment from civil enterprises, and a widespread lack of faith in LMOs works as an obstacle to commercialization, thereby hampering the constant development of agricultural biotechnology. Thus, publicity efforts should also continue to clarify that LMOs are safe.
BT Fostering Policies in Healthcare Field
(Ministry of Health and Welfare, MOHW)

A. Overview

Standard concepts of healthcare are likely to change as it is fused together with BT, IT, and NT, and the corresponding social structure and lifestyles are likely to change considerably as well. Consequently, the Ministry of Health and Welfare is to implement strategies for investment in R&D, construction of infrastructure, and industrialization support, thereby maintaining its vision of a ‘rich healthy country achieved through the fostering of high-tech bio-health industries.’

Table 2: Strategies for BT Fostering Policy.

<table>
<thead>
<tr>
<th>R&amp;D Investment</th>
<th>Infrastructure Construction</th>
<th>Industrialization Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project for Developing Novel Drugs</td>
<td>Osong Bioscience Complex Construction Genome Practicalization Project</td>
<td></td>
</tr>
<tr>
<td>Project for Developing Bio OrganTechnologies</td>
<td></td>
<td>HealthCare Technology Transfer Project</td>
</tr>
<tr>
<td>Project for Developing Medical Equipment</td>
<td></td>
<td>Enterprise-supported Fund Construction/Management</td>
</tr>
<tr>
<td>Project for Developing Medical IT</td>
<td></td>
<td>ExportPromotion Project</td>
</tr>
<tr>
<td>Project for Developing Health-Functio Products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project for Developing Healthcare BT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project for Developing Healthcare Technology Infrastructure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BT Fostering Policies in IT Field
(Ministry of Information and Communication, MOIC)

A. Overview

IT-BT fusion technology is expected to become a core technology in addressing future social problems such as health problems in the ageing society, and environmental and safety problems. Futurologist Alvin Toffler once mentioned that Korea should, based on the fusion of IT and BT, create new industries and markets, as its future may well depend on fusion technologies. The European Union and other advanced nations have recognized the possibilities being raised by the growth of fusion
technologies and their ripple effects, and have established developmental strategies for fusion technologies in order to prepare for the fusion technology revolution. In 2004, the EU established strategies for fusion technologies aimed at building knowledge-based societies. Korea, which is strong in IT and IT infrastructure, needs to develop rapidly the promising fusion technologies backed by its IT, create new markets, and ensure safe and healthy lives for its citizens.

Development Vision and Pursuit Strategy of Fusion Technologies

The government is set to strengthen the nation's IT fusion technology R&D, facilitate the industrialization of fusion technologies, and create the initial market, thereby ranking the nation among the world's three IT fusion technology powers and gaining a 5% share of the global fusion technology market by 2015. As such, it is poised to create a base for fulfilling a healthy and safe future society.

The policy for the development of IT-BT fusion technologies is as follows: (i) early occupation of technologies in strategic fields; create the initial market; and synchronize the facilitation of industrialization to achieve cyclical development of fusion technologies; (ii) pursue strategies for developing the existing NT/BT technologies and differentiating service-oriented technologies (synchronization with source technologies/parts and materials/systems); (iii) expand interdisciplinary research forums where experts in diverse fields of technologies can freely research and discuss; (iv) install and operate an organization to closely oversee, coordinate, and develop fusion technology development strategies, R&D, manpower, and the fostering of related industries; (v) seek interdisciplinary joint research, and install and operate a cooperative system to share roles among industries, schools and research centers, and between related ministries and agencies.

BT Fostering Policies in the Environmental Field

(Ministry of the Environment, MOE)

A. Overview

In general, Environmental Technology (ET) concerns technology which reduces, prevents, and rehabilitates environmental pollution. The law on Environmental Technological Development and Support defines ET as a technology which improves the self-purifying abilities of the environment, suppresses and eliminates environmental damage-inducing factors (human and natural), as one needed to maintain, manage, and rehabilitate a polluted and damaged environment, and as one which will help to prevent environmental pollution in the first place.

In the field of ET, EnviroBio Technology (EBT), which has been created through the application of biotechnology (BT) and the bio-processing of ET in order to reduce, prevent, and rehabilitate environmental pollution,
requires the organic cooperation of environmental science, ecology, and molecular biology.

Table 3: Changes in the Field of ET

<table>
<thead>
<tr>
<th>Description</th>
<th>1st generation environmental technology R&amp;D</th>
<th>2nd generation environmental technology R&amp;D</th>
<th>3rd generation environmental technology R&amp;D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental recognition</td>
<td>It is inevitable to create pollutants in the course of pursuing economic development</td>
<td>Minimize the creation of environmental pollutants fundamentally</td>
<td>Maintain sustainable environments from the perspective of socio-economic integration</td>
</tr>
<tr>
<td>Main features of technology development</td>
<td>Waste treatment technologies</td>
<td>Prevent pollution and produce environment-friendly products</td>
<td>Restore, preserve and reproduce environments, and forecast and response to environmental changes in the long-term</td>
</tr>
<tr>
<td>Academic area</td>
<td>Environmental/chemical engineering, and mechatronics</td>
<td>Environmental/chemical engineering, mechatronics, new materials, and BT</td>
<td>BT, new materials, nano technologies, IT, etc.</td>
</tr>
</tbody>
</table>

Of the basic core biotechnologies, EBT utilizes mainly bioprocess technologies (fermentation process control, separation and refinement, and design and manufacturing of culturing equipment) and technologies for using microorganisms (technologies for separating and culturing microorganisms and exploring anticancer substances). Such EBT has not yet proven its role and weight to a great extent, but with the recent positive development of cutting-edge technologies in various fields, EBT is expected to expand from the remediation of polluted environments to pollution prevention and pollutant detection based on biological methods.

**BT Fostering Policy in Marine Biology and Fisheries (Ministry of Maritime Affairs and Fisheries, MOMAF)**

**A. Overview**

BT, together with IT, NT, aerospace technology, ET, and cultural technologies, constitutes the primary field of cutting-edge technology
Biotechnology in Korea

and will lead the development of the nation in the 21st century. As such, BT can address the crucial issues faced by humankind such as the surge in population, the exhaustion of resources, and environmental pollution, playing a revolutionary role in changing human lives. In BT-related R&D and industries, marine BT using marine biota has gained in importance. The ocean represents about 71% of the earth's surface and is inhabited by 80% of the earth's animals and plants, while the peculiar bio structures and bio functions of marine biota that are adjusted to diverse marine environments are crucial material for BT. As the search for useful new materials shifts from landside biota to marine biota, the development of unmanned submarines and other cutting-edge equipment will enable us to gain access to polar zones and deep sea waters that were inaccessible in the past, and explore and report on new deep-sea marine resources, thus expanding the scope of research.

B. Future Project Direction

Marine BT has a wide range of applications such as the securement of gene resources in marine biota, the production of drugs and new materials using marine natural materials separated from marine biota, the production of fishery food resources through molecular breeding and the genetic transformation of useful marine biota, and the management of genetically modified marine products in the fields of environment, industrial new materials, food resources, health, hygiene, and energy. The ministry, aware of the importance of marine BT, is pursuing policies to foster the marine bio-industry as a natural cutting-edge industry of the future.

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