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Biotechnology and Development: Challenges and Opportunities for the Asian Region

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Biotechnology in Korea

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Korea Research Institute of Bioscience and Biotechnology &
BioHoldings Inc.
In the 1980s: Implementing stage
- 1982 Korea Biotechnology Research Association was founded.
- 1983 Biotechnology Promotion Law was enacted.
- 1985 KRIIBB was founded.

In the 1990s: Take-off stage
- 1991 Bioindustry Association of Korea was founded.
- 1992 HAN Project was launched.
- 1994 Biotech 2000 Program was initiated.
- 1994 “The Year of Biotechnology” was declared.

In the 2000s: Full-fledged stage
- 2000 The 21st Century Frontier Research Program was launched.
- 2001 The Korean government released its plan to invest US$ 324 mil.
  - to support research activities in genomics, proteomics, bioinformatics and emerging new biotechnology.
  - to establish and operate a national genome research center.
National Drive for the Development of Biotechnology

- **Background**
  - Korea recognized in early 1980s that biotechnology would emerge as a key discipline for the nation’s economic growth in the 21st century.
  - Its policy makers support biotechnology with the highest priority for R&D investment in order to level up the nation’s competitiveness with the “selection and convergence” policy.
  - Korea plans to double its investment for bio-related R&D activities by 2010.
  - Designating 2001 as “The Year of Biotechnology”, the Korean government recently unveiled a major initiative to boost scientific R&D focusing on biotechnology.
Biotech 2000: an Overview

- Set up by the Korean government.
- Objective: to place Korea’s biotechnological capability at the world’s top level.
- Duration: 1994 ~ 2007 (14 years)
- Budget:
  - 1st phase (’94-’97): U$1.5bil. (Government U$482mil. / Industries U$1 bil.)
  - 2nd phase (’98-’02): U$2.3bil. (Government U$729 mil. / Industries U$1.6 bil.)
- Participating Agencies (7 Ministries, coordinated by MOST)
  - Ministry of Science and Technology (MOST)
  - Ministry of Commerce, Industry and Energy (MOCIE)
  - Ministry of Education and Human Resources Development (MOEH)
  - Ministry of Environment (MOE)
  - Ministry of Agriculture, Forestry (MOAF)
  - Ministry of Health and Welfare (MOHW)
  - Ministry of Marine Affairs and Fisheries (MOMAF)
**Biotech 2000: Operating Structure**

**Governmental Agencies**
- MOST, MOCIE, MOEH, MOE, MOAF, MOHW, MOMAF

**Industries**
- Korea Biotechnology Research Association
- Bioindustry Association of Korea
- Private Companies

**Research Institutes**
- Korea Research Institute of Bioscience and Biotechnology
- Other governmental or public research institutes

**Academia**
- Universities
- Science Research Centers
- Engineering Research Centers
- Regional Research Centers
**Biotech 2000: Strategic Objectives**

- The project has three phases. Each phase has its own strategic objective.

<table>
<thead>
<tr>
<th>Phase I</th>
<th>⇒</th>
<th>To establish a scientific foundation for the development of novel biotechnology</th>
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<td>(1994 ~ 1997)</td>
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<tr>
<th>Phase II</th>
<th>⇒</th>
<th>To develop platform technology and improve industrial R&amp;D capability</th>
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<td>(1998 ~ 2002)</td>
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<table>
<thead>
<tr>
<th>Phase III</th>
<th>⇒</th>
<th>To increase the commercializing capability and expand the nation’s world market share of bioproducts</th>
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<tr>
<td>(2003 ~ 2007)</td>
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</table>
- The government invested U$ 482 million during the phase I, and U$ 729 million during the phase II.

- MOST took the major role in R&D investment and followed by MOAF.

(Unit : U$ mil.)

<table>
<thead>
<tr>
<th>Description</th>
<th>Phase I ('94-'97)</th>
<th>Phase II</th>
<th>Sub Total</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1998 1999 2000 2001 2002</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOST</td>
<td>269 49 55 62 71 80</td>
<td>317</td>
<td>586</td>
<td></td>
</tr>
<tr>
<td>MOEH</td>
<td>25 5 6 6 7 8</td>
<td>32</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>MOAF</td>
<td>90 21 23 27 30 34</td>
<td>135</td>
<td>225</td>
<td></td>
</tr>
<tr>
<td>MOCIE</td>
<td>21 13 38 46 22 22</td>
<td>141</td>
<td>162</td>
<td></td>
</tr>
<tr>
<td>MOHW</td>
<td>56 3 9 10 12 13</td>
<td>47</td>
<td>103</td>
<td></td>
</tr>
<tr>
<td>MOE</td>
<td>11 4 6 7 9 10</td>
<td>36</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>MOMAF</td>
<td>10 4 4 4 5 21</td>
<td>21</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>482 99 141 162 155 172</td>
<td>729</td>
<td>1,211</td>
<td></td>
</tr>
</tbody>
</table>
Supports for R&D activities ranging from basic science to application

G-7 Project
21st Century Frontier Science Program

- Main Area: Screening of lead compounds and commercialization

- Duration: 2000-2010 (10 years), Total Budget: US$3.6 billion
- Main Areas:
  - Functional analysis of human, microbial and crop genomes
  - Biodiversity of indigenous plants
  - Stem cell biology and therapeutic applications
  - Proteomics research
  - Screening of novel compounds for bioregulators
Ministry of Commerce, Industry and Energy

Basic Role
- Builds an infrastructure for industrialization

Major Projects
- Industrial Platform Technology Development
  - Develops common platform technology, mid-term core technology, and technology for next generation
  - Duration: 1992~, Total Budget: U$10.5 million (as of 2001)
  - Major Areas:
    - Development of bioprocesses for commercialization
    - Development of biosensors, BIOMEMS, Biomimics
    - Development of DNA and protein chips (Lab-on-a-chip)
    - Bioinformatics
    - Nanobiotechnology
Supports for the development of biotechnology in public health and medical sectors

Health Science and Medical Biotechnology

- Prevention, diagnostics, and treatments of diseases to improve public health
- Duration: 1997-2010, Total Budget: US$ 246 million
- Major Areas:
  - Development of vaccines
  - Anti-aging and anti-cancer drugs
  - Neurobiology
  - Drug delivery system
Supports for R&D in agrobiotechnology and horticulture

Development of agrobiotechnology and horticulture

- Collection, assessment, preservation of genetic resources
- Development of breeding technology
- Research on animal and plant genomics
- Biosafety issues on GMOs
Ministry of Education and Human Resources Development

- **Brain Korea 21**

  - Entering the 21st century, there is a consensus in Korea that the human resources development in higher learning and industrial skills should be an urgent national priority.

  - The Ministry of Education and Human Resources Development initiated the High Quality Human Resources Development Program (Brain Korea 21) in 1999 to reform higher education programs and upgrade the graduate research infrastructure in various fields including biotechnology.

- **Number of Ph.Ds in Biotechnology**

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<tbody>
<tr>
<td>Total Number</td>
<td>7,832</td>
<td>8,230</td>
<td>8,485</td>
<td>9,584</td>
</tr>
<tr>
<td>Universities (%)</td>
<td>50.4</td>
<td>52.3</td>
<td>54.0</td>
<td>55.4</td>
</tr>
<tr>
<td>Private Companies (%)</td>
<td>28.7</td>
<td>27.8</td>
<td>27.1</td>
<td>25</td>
</tr>
<tr>
<td>Government Research Institutions (%)</td>
<td>20.9</td>
<td>19.9</td>
<td>18.9</td>
<td>19.6</td>
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</table>
Biotechnology-related investment by bioindustry

(Unit: US$ mil.)

<table>
<thead>
<tr>
<th>Description</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
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<tbody>
<tr>
<td>Total</td>
<td>447</td>
<td>478</td>
<td>525</td>
<td>584</td>
<td>676</td>
</tr>
</tbody>
</table>

Investment plan in biotechnology by private sector

- LGCI: US$ 50 mil. fund to invest for bioventures in 2000
- Hanwha Chemical Co.: US$ 50 mil. for R&D in 2000
- SK Global: US$ 35 mil. fund to invest for bioventures in 2000
- Hansol: US$ 150 mil. for R&D from 2000 to 2006
- Isu Chemical: US$ 150 mil. for R&D in the period of 2000 - 2005
Korean government’s initiative to boost bioventure business

- MOCIE pushes a five-year program to encourage the bioventure business. It will earmark a US$ 30 million fund in FY 2000's budget to develop the infrastructure needed by bioventure start-up companies.

- Focusing on commercialization of biotechnologies, the Korean government announced a package that envisages to create 600 bioventure start-up companies by the end of 2003 and to expand the number to 1,200 by 2010.

<table>
<thead>
<tr>
<th>&lt;Current Status &amp; Future Prospects of Bioventures in Korea&gt;</th>
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<tbody>
<tr>
<td><strong>No. of Bioventures</strong></td>
</tr>
<tr>
<td>No. of Employees</td>
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## Patents & Publications

### Patents

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<tbody>
<tr>
<td>Biopharmaceuticals</td>
<td>747</td>
<td>813</td>
<td>1,007</td>
<td>866</td>
</tr>
<tr>
<td>Agriculture / Food</td>
<td>79</td>
<td>89</td>
<td>128</td>
<td>132</td>
</tr>
<tr>
<td>Environment</td>
<td>93</td>
<td>131</td>
<td>121</td>
<td>266</td>
</tr>
<tr>
<td>Others</td>
<td>200</td>
<td>187</td>
<td>210</td>
<td>257</td>
</tr>
<tr>
<td>Total</td>
<td>1,119</td>
<td>1,220</td>
<td>1,466</td>
<td>1,521</td>
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### Publications

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</thead>
<tbody>
<tr>
<td>Overseas Publications</td>
<td>451</td>
<td>545</td>
<td>641</td>
<td>797</td>
</tr>
<tr>
<td>Domestic Publications</td>
<td>1,009</td>
<td>1,335</td>
<td>1,747</td>
<td>3,221</td>
</tr>
<tr>
<td>Total</td>
<td>1,460</td>
<td>1,880</td>
<td>2,388</td>
<td>4,018</td>
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</table>
Facts and Status of Korean Biotechnology Development

- Amino acids: 20% share of the world market in 2000 (US$ 75 million)
- Ryfamycin: 10% share of the world market in 2000 (US$ 7.5 million)
- Hepatitis B Vaccine: Developed in 1987 by Korea Green Cross Corp. World market share was rapidly increased (40% in 1999)
- Bioinsecticide (Bt): Developed in 1990 by KRIBB (patent filed in 27 countries)
- First domestic new drug for anticancer developed in 1992 by SK Chemical Ltd. Technology transferred to Johnson & Johnson Co.
- About 300 new drugs are under development. Among them, 23 new drugs are in progress or in completion of clinical trials for FDA approval.
Vision for Korean Biotechnology

2000

Competitiveness
13th in the world

Investment
5% of total governmental R&D investment
Compared with G-7 economies
- Basic science: 60%
- Application: 70%
- Screening: 40%

R&D Capability

Bioindustry
Market Size:
- World: US$ 54 bil.
- Korea: US$ 0.9 bil.
- Share: 1.7% of world market

2010

G-7 level

10% of total governmental R&D investment
Compared with G-7 economies
- Basic science: 80%
- Application: 100%
- Screening: 90%

Market Size:
- World: US$150 bil.
- Korea: US$ 10 bil.
- Share: 6.6% of world market
Conclusion & Recommendations

- Biotechnology is a key platform to accelerate the national economic growth in Korea.

- Korea has to set up a solid strategy to achieve international competitiveness by leveraging existing capabilities and creating new strengths.
  - “selection and convergence” on the areas with high international competitiveness
  - promotion of international cooperation
  - implementation of pan-governmental strategy for biotechnology development
Thank you!