

## Business Models Used for the Development of Agricultural Biotechnology SMEs in Taiwan

2011. 11. 7

Dr. Julie C. L. SUN

 Taiwan Institute of Economic Research

## Agriculture in Taiwan (1/3)

- Taiwan, with nominal GDP \$427 billion dollars and GDP (PPP) per capita \$35 thousand dollars in 2010, is famous for its manufacturing capabilities now. Agriculture seems to lose its importance in every aspect from job creation to domestic production, to international trade. But agriculture is still at the root of the economy and has multi-function beyond production. This is because it not only provides the food we eat, and conserves the environment we live in, it is also a force for social stability.
- Taiwan used to be one of the leading countries in agriculture several decades ago. Since 1959, more than 100 agricultural missions have been dispatched to more than 60 countries, among which about half missions are currently at work in Africa, the Middle East, Latin America, and the Asia-Pacific.

## Agriculture in Taiwan (2/3)

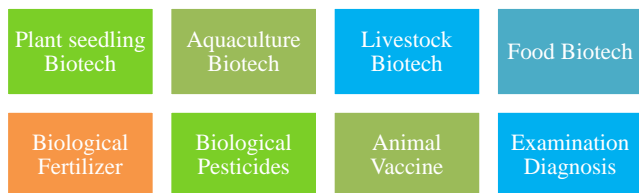
- Taiwan's land area is just about 36,000 square kilometers. As two thirds of this is mountains or slope land, agriculture takes place mainly in the remaining 29 % that is plains. Taiwan is a subtropical island characterized by high temperatures and heavy rainfall. These conditions are great for agriculture, but also lend themselves to the breeding of insects and disease. There are frequently typhoons in summer and autumn every year.
- There have been great changes in agricultural exports over the years in Taiwan however. Early on the only exports were sugar cane, rice, and canned mushrooms or asparagus. Now main exports are aquaculture products such as tuna, eel, tilapia, and so on, as well as leather, and feather. The biggest export markets are Japan, Hong Kong (China) and the United States. Main agricultural imports include corn, soybeans, wine, tobacco, cotton, lumber, beef, and wheat, most of which are from the United States, Brazil and Australia. In 1953, the average value of agricultural production increased 7.3%, with exports increasing at a rate of 9.3 %. But beginning in 1970, agricultural exports fell behind agricultural imports. Now imports are \$12.8 billion dollars, while exports are \$4 billion dollars in 2010.

## Agriculture in Taiwan (3/3)

- Confronting the challenges of WTO, globalization, climate change and knowledge- based economy, therefore, Taiwan government attempts to revitalize agriculture.
- The agricultural biotechnology has its great potentials in Taiwan, including increasing productivity of agricultural products, growing pest-resistant GM crops to reduce use of chemicals, producing GM organisms with ornamental value such as fluorescent fish, using GM pigs for organ transplanting, providing animal models for biomedical research, and using as bioreactors for producing medicinal proteins such as vaccines, growth factors and coagulation factor, etc.

# Status of Agricultural Biotechnology in Taiwan (1/5)

## 8 Categories of Agricultural Biotechnology :



- 2010 Agricultural Biotech Industry (Official Data)
  - 52 companies
  - output value : 142 million US dollars
  - 10.6% of Taiwan Biotech Industry (output value : 1,370 million US dollars)

# Status of Agricultural Biotechnology in Taiwan (2/5)

## Diagnosis for the Virus of Orchid



# Status of Agricultural Biotechnology in Taiwan (3/5)

## Producing Taxol by using Taiwan Yew



# Status of Agricultural Biotechnology in Taiwan (4/5)

## High Value Ornamental Fishes -Transgenic Fluorescence Fishes



# Status of Agricultural Biotechnology in Taiwan (5/5)

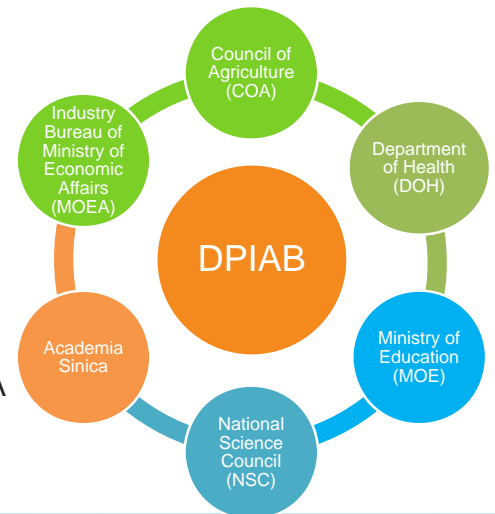


Embryo replacing Technique  
- Using Cattle to Breed Cow



# Industrialization of Agriculture Biotechnology in Taiwan

- In 2009, the Executive Yuan approved the "Development Program of Industrialization for Agricultural Biotechnology" (DPIAB) for a 5-year period (2009-2013).
- The DPIAB is supported by multi-agencies with COA as the major agency in charge of administrative coordination.

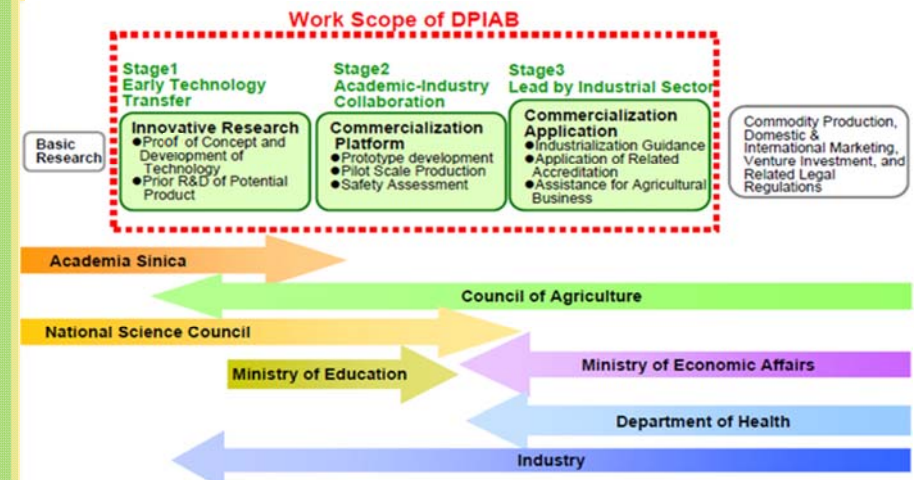


# Development Program of Industrialization for Agricultural Biotechnology (1/2)

- 6 development strategies

- Setting up an intergovernmental task force for promotion
- Forming demand-oriented S&T policy
- Linking industry-academia R&D system
- Building up commercialization platform
- Training of business talents
- Speeding up agricultural transformation

# Development Program of Industrialization for Agricultural Biotechnology (2/2)



Multicountry Observational Study Mission on the Development of Biotechnology Business Models for SMEs in Agribusiness

## Firm Survey of Taiwan Agricultural Biotechnology in 2011

2011. 11. 7

Dr. Julie C. L. SUN

Taiwan Institute of Economic Research

## Firm Survey of Taiwan Agri-Biotech (1/19)

Year Established	All	Percent age	Plant Seedling	Percent age	Live stock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
Before 1981	14	6.9%	1	4.2%	2	6.5%	3	17.6%	3	4.5%	3	13.0%
1981-1985	3	1.5%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
1986-1990	8	3.9%	3	12.5%	2	6.5%	1	5.9%	3	4.5%	2	8.7%
1991-1995	12	5.9%	2	8.3%	2	6.5%	0	0.0%	5	7.5%	0	0.0%
1996-2000	25	12.3%	4	16.7%	3	9.7%	2	11.8%	11	16.4%	4	17.4%
After 2000	104	51.0%	11	45.8%	17	54.8%	4	23.5%	33	49.3%	11	47.8%
N.A.	38	18.6%	3	12.5%	5	16.1%	7	41.2%	12	17.9%	3	13.0%
<b>Total</b>	<b>204</b>	<b>100.0%</b>	<b>24</b>	<b>100.0%</b>	<b>31</b>	<b>100.0%</b>	<b>17</b>	<b>100.0%</b>	<b>67</b>	<b>100.0%</b>	<b>23</b>	<b>100.0%</b>

## Firm Survey of Taiwan Agri-Biotech (2/19)

Employees	All	Percent age	Plant Seedling	Percent age	Live stock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
Less than 25 employees	88	43.1%	12	50.0%	19	61.3%	10	58.8%	27	40.3%	11	47.8%
26~50 employees	33	16.2%	2	8.3%	5	16.1%	2	11.8%	10	14.9%	5	21.7%
51~75 employees	19	9.3%	5	20.8%	2	6.5%	2	11.8%	6	9.0%	2	8.7%
76~100 employees	13	6.4%	2	8.3%	1	3.2%	0	0.0%	4	6.0%	3	13.0%
More than 101 employees	44	21.6%	3	12.5%	3	9.7%	2	11.8%	17	25.4%	1	4.3%
N.A.	7	3.4%	0	0.0%	1	3.2%	1	5.9%	3	4.5%	1	4.3%
<b>Total</b>	<b>204</b>	<b>100.0%</b>	<b>24</b>	<b>100.0%</b>	<b>31</b>	<b>100.0%</b>	<b>17</b>	<b>100.0%</b>	<b>67</b>	<b>100.0%</b>	<b>23</b>	<b>100.0%</b>
<b>Average</b>	<b>302</b>		<b>661</b>		<b>71</b>		<b>103</b>		<b>661</b>		<b>41</b>	

## Firm Survey of Taiwan Agri-Biotech (3/19)

Principal Capital	All	Percent age	Plant Seedling	Percent age	Live stock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
Less than NT\$50 millions	79	38.7%	15	62.5%	16	51.6%	8	47.1%	22	32.8%	9	39.1%
NT\$50~100 millions	27	13.2%	1	4.2%	6	19.4%	1	5.9%	8	11.9%	5	21.7%
NT\$100~500 millions	52	25.5%	4	16.7%	5	16.1%	5	29.4%	18	26.9%	4	17.4%
NT\$500+~1,000 millions	15	7.4%	0	0.0%	1	3.2%	0	0.0%	4	6.0%	1	4.3%
More than NT\$1,000 millions	17	8.3%	3	12.5%	1	3.2%	1	5.9%	10	14.9%	1	4.3%
N.A.	14	6.9%	1	4.2%	2	6.5%	2	11.8%	5	7.5%	3	13.0%
<b>Total</b>	<b>204</b>	<b>100.0%</b>	<b>24</b>	<b>100.0%</b>	<b>31</b>	<b>100.0%</b>	<b>17</b>	<b>100.0%</b>	<b>67</b>	<b>100.0%</b>	<b>23</b>	<b>100.0%</b>
<b>Average (NT\$ Million)</b>	<b>3,392</b>		<b>9,178</b>		<b>177</b>		<b>237</b>		<b>7,827</b>		<b>172</b>	

## Firm Survey of Taiwan Agri-Biotech (4/19)

Revenues in 2010	All	Percent age	Plant Seedling	Percent age	Live stock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
Less than NT\$10 millions	32	15.7%	9	37.5%	4	12.9%	1	5.9%	13	19.4%	5	21.7%
NT\$10~50 millions	56	27.5%	5	20.8%	12	38.7%	7	41.2%	15	22.4%	10	43.5%
NT\$50~100 millions	18	8.8%	2	8.3%	3	9.7%	0	0.0%	5	7.5%	0	0.0%
NT\$100~500 millions	44	21.6%	6	25.0%	6	19.4%	3	17.6%	15	22.4%	5	21.7%
More than NT\$500 millions	33	16.2%	2	8.3%	5	16.1%	4	23.5%	12	17.9%	0	0.0%
N.A.	21	10.3%	0	0.0%	1	3.2%	2	11.8%	7	10.4%	3	13.0%
<b>Total</b>	<b>204</b>	<b>100.0%</b>	<b>24</b>	<b>100.0%</b>	<b>31</b>	<b>100.0%</b>	<b>17</b>	<b>100.0%</b>	<b>67</b>	<b>100.0%</b>	<b>23</b>	<b>100.0%</b>
<b>Total revenues for biotech (NT\$ Million)</b>	<b>51,196</b>		<b>1,906</b>		<b>5,070</b>		<b>3,693</b>		<b>26,459</b>		<b>347</b>	
<b>Average revenues (NT\$ Million)</b>	<b>10,171</b>		<b>30,719</b>		<b>297</b>		<b>466</b>		<b>29,297</b>		<b>69</b>	

## Firm Survey of Taiwan Agri-Biotech (5/19)

R&D Expenditures in 2010	All	Percent age	Plant Seedling	Percent age	Live stock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
Less than NT\$1 million	30	14.7%	4	16.7%	8	25.8%	5	29.4%	10	14.9%	5	21.7%
NT\$1~5 millions	60	29.4%	10	41.7%	11	35.5%	4	23.5%	20	29.9%	7	30.4%
NT\$5~10 millions	24	11.8%	4	16.7%	4	12.9%	2	11.8%	7	10.4%	2	8.7%
NT\$10~50 millions	29	14.2%	2	8.3%	3	9.7%	1	5.9%	8	11.9%	3	13.0%
More than NT\$50 millions	25	12.3%	2	8.3%	1	3.2%	2	11.8%	10	14.9%	2	8.7%
N.A.	36	17.6%	2	8.3%	4	12.9%	3	17.6%	12	17.9%	4	17.4%
<b>Total</b>	<b>204</b>	<b>100.0%</b>	<b>24</b>	<b>100.0%</b>	<b>31</b>	<b>100.0%</b>	<b>17</b>	<b>100.0%</b>	<b>67</b>	<b>100.0%</b>	<b>23</b>	<b>100.0%</b>
<b>Average (NT\$ Million)</b>	<b>36.5</b>		<b>89.8</b>		<b>15.6</b>		<b>38.6</b>		<b>57.9</b>		<b>18.3</b>	

## Firm Survey of Taiwan Agri-Biotech (6/19)

Ratio of R&D Expenditures to Revenues	All	Percent age	Plant Seedling	Percent age	Live stock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
0% ~25%	148	81.8%	16	66.7%	27	90.0%	13	86.7%	49	81.7%	14	70.0%
25%+ ~50%	9	5.0%	2	8.3%	2	6.7%	1	6.7%	2	3.3%	2	10.0%
50%+ ~75%	3	1.7%	0	0.0%	0	0.0%	0	0.0%	2	3.3%	1	5.0%
75%+ ~100%	4	2.2%	1	4.2%	0	0.0%	0	0.0%	0	0.0%	1	5.0%
100%+	17	9.4%	5	20.8%	1	3.3%	1	6.7%	7	11.7%	2	10.0%
<b>Total</b>	<b>181</b>	<b>100.0%</b>	<b>24</b>	<b>100.0%</b>	<b>30</b>	<b>100.0%</b>	<b>15</b>	<b>100.0%</b>	<b>60</b>	<b>100.0%</b>	<b>20</b>	<b>100.0%</b>
<b>Average</b>	<b>0.4%</b>		<b>0.3%</b>		<b>5.2%</b>		<b>8.3%</b>		<b>0.2%</b>		<b>26.4%</b>	

## Firm Survey of Taiwan Agri-Biotech (7/19)

Funding Sources of Establishment	All	Percent age	Plant Seedling	Percent age	Live stock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
Domestic Enterprises	67	32.8%	7	29.2%	6	19.4%	5	29.4%	22	32.8%	5	21.7%
Foreign Enterprises	10	4.9%	1	4.2%	1	3.2%	2	11.8%	0	0.0%	0	0.0%
Domestic Venture Capital Firms	16	7.8%	1	4.2%	3	9.7%	0	0.0%	6	9.0%	0	0.0%
Foreign Venture Capital Firms	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Domestic Angel Investors	158	77.5%	15	62.5%	29	93.5%	15	88.2%	55	82.1%	21	91.3%
Foreign Angel Investors	8	3.9%	1	4.2%	1	3.2%	1	5.9%	2	3.0%	0	0.0%
Taiwan Government Funds	13	6.4%	2	8.3%	0	0.0%	0	0.0%	7	10.4%	0	0.0%
Other	1	0.5%	0	0.0%	0	0.0%	0	0.0%	1	1.5%	0	0.0%

## Firm Survey of Taiwan Agri-Biotech (8/19)

Intellectual Property Right as Equity when Established	All	Percent age	Plant Seedling	Percent age	Live stock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
Zero	134	70.9%	20	90.9%	23	76.7%	15	93.8%	41	65.1%	13	59.1%
Less than 5%	22	11.6%	1	4.5%	3	10.0%	0	0.0%	9	14.3%	4	18.2%
5%+~10%	9	4.8%	1	4.5%	1	3.3%	0	0.0%	3	4.8%	1	4.5%
10%+~20%	15	7.9%	0	0.0%	2	6.7%	1	6.3%	4	6.3%	1	4.5%
More than 20%	9	4.8%	0	0.0%	1	3.3%	0	0.0%	6	9.5%	3	13.6%
<b>Total</b>	<b>189</b>	<b>100.0%</b>	<b>22</b>	<b>100.0%</b>	<b>30</b>	<b>100.0%</b>	<b>16</b>	<b>100.0%</b>	<b>63</b>	<b>100.0%</b>	<b>22</b>	<b>100.0%</b>

## Firm Survey of Taiwan Agri-Biotech (9/19)

Ratio of Annual Licensing-in Fees to Capital	All	Percent age	Plant Seedling	Percent age	Live stock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
Zero	93	47.9%	9	37.5%	20	64.5%	10	58.8%	32	50.0%	13	56.5%
0%+~10%	90	46.4%	13	54.2%	8	25.8%	6	35.3%	29	45.3%	10	43.5%
10%+~20%	8	4.1%	1	4.2%	3	9.7%	1	5.9%	2	3.1%	0	0.0%
20%+~30%	2	1.0%	1	4.2%	0	0.0%	0	0.0%	1	1.6%	0	0.0%
More than 30%	1	0.5%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
<b>Total</b>	<b>194</b>	<b>100.0%</b>	<b>24</b>	<b>100.0%</b>	<b>31</b>	<b>100.0%</b>	<b>17</b>	<b>100.0%</b>	<b>64</b>	<b>100.0%</b>	<b>23</b>	<b>100.0%</b>

## Firm Survey of Taiwan Agri-Biotech (10/19)

The Time from Development to Commercialization	All	Percent age	Plant Seedling	Percent age	Live stock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
Less than half year	8	4.0%	0	0.0%	2	6.9%	1	6.3%	3	4.6%	0	0.0%
Half to one year	40	20.2%	0	0.0%	4	13.8%	1	6.3%	16	24.6%	6	26.1%
One to three years	85	42.9%	11	45.8%	14	48.3%	7	43.8%	30	46.2%	9	39.1%
Three to five years	43	21.7%	9	37.5%	7	24.1%	6	37.5%	10	15.4%	5	21.7%
More than five years	22	11.1%	4	16.7%	2	6.9%	1	6.3%	6	9.2%	3	13.0%
<b>Total</b>	<b>198</b>	<b>100.0%</b>	<b>24</b>	<b>100.0%</b>	<b>29</b>	<b>100.0%</b>	<b>16</b>	<b>100.0%</b>	<b>65</b>	<b>100.0%</b>	<b>23</b>	<b>100.0%</b>

## Firm Survey of Taiwan Agri-Biotech (11/19)

Burn Rate	All	Percent age	Plant Seedling	Percent age	Live stock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
No R&D	10	5.1%	2	8.3%	3	9.7%	2	12.5%	1	1.6%	0	0.0%
Less than half year	9	4.6%	0	0.0%	2	6.5%	1	6.3%	3	4.8%	1	4.5%
Half to one year	39	19.9%	3	12.5%	5	16.1%	3	18.8%	15	23.8%	4	18.2%
One to two years	33	16.8%	8	33.3%	7	22.6%	3	18.8%	10	15.9%	6	27.3%
More than two years	105	53.6%	11	45.8%	14	45.2%	7	43.8%	34	54.0%	11	50.0%
<b>Total</b>	<b>196</b>	<b>100.0%</b>	<b>24</b>	<b>100.0%</b>	<b>31</b>	<b>100.0%</b>	<b>16</b>	<b>100.0%</b>	<b>63</b>	<b>100.0%</b>	<b>22</b>	<b>100.0%</b>

## Firm Survey of Taiwan Agri-Biotech (12/19)

The Major Part of R&D Expenditures	All	Percent age	Plant Seedling	Percent age	Live stock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
Licensing-in Fees	56	27.5%	6	25.0%	11	35.5%	8	47.1%	17	25.4%	5	21.7%
Labor Cost	154	75.5%	21	87.5%	25	80.6%	13	76.5%	53	79.1%	17	73.9%
Materials	133	65.2%	15	62.5%	22	71.0%	9	52.9%	48	71.6%	15	65.2%
Equipments and Facilities	117	57.4%	14	58.3%	20	64.5%	8	47.1%	42	62.7%	14	60.9%
R&D Collaborations	36	17.6%	4	16.7%	4	12.9%	2	11.8%	13	19.4%	6	26.1%
Rents	17	8.3%	1	4.2%	3	9.7%	1	5.9%	6	9.0%	3	13.0%
Other	12	5.9%	1	4.2%	2	6.5%	1	5.9%	3	4.5%	2	8.7%

## Firm Survey of Taiwan Agri-Biotech (13/19)

Type of R&D Activities	All	Percent age	Plant Seedling	Percent age	Livestock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
In-house R&D	167	81.9%	19	79.2%	24	77.4%	11	64.7%	56	83.6%	16	69.6%
Collaborative R&D with competitors or other firms in Taiwan	20	9.8%	3	12.5%	3	9.7%	2	11.8%	8	11.9%	4	17.4%
Collaborative R&D with customers or suppliers in Taiwan	27	13.2%	2	8.3%	3	9.7%	1	5.9%	10	14.9%	3	13.0%
Collaborative R&D with academia and research institutes in Taiwan	126	61.8%	14	58.3%	22	71.0%	12	70.6%	46	68.7%	20	87.0%
Collaborative R&D with competitors or other firms abroad	8	3.9%	3	12.5%	0	0.0%	0	0.0%	1	1.5%	1	4.3%
Collaborative R&D with customers or suppliers abroad	17	8.3%	2	8.3%	4	12.9%	3	17.6%	5	7.5%	0	0.0%
Collaborative R&D with academia and research institutes abroad	16	7.8%	0	0.0%	0	0.0%	0	0.0%	3	4.5%	2	8.7%
Taking part in the research projects initiated by Taiwan government	25	12.3%	6	25.0%	2	6.5%	2	11.8%	10	14.9%	2	8.7%
Taking part in research projects subsidized by Taiwan government	84	41.2%	10	41.7%	15	48.4%	7	41.2%	32	47.8%	12	52.2%
Other	4	2.0%	0	0.0%	2	6.5%	1	5.9%	0	0.0%	0	0.0%

## Firm Survey of Taiwan Agri-Biotech (14/19)

Sources of Skilled Workers and R&D Staffs	All	Percent age	Plant Seedling	Percent age	Live stock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
Recruit graduates from universities or colleges in Taiwan	179	87.7%	20	83.3%	27	87.1%	15	88.2%	60	89.6%	18	78.3%
Recruit talents from other companies in Taiwan	27	13.2%	1	4.2%	6	19.4%	3	17.6%	10	14.9%	6	26.1%
Recruit talents from research institutes in Taiwan	52	25.5%	8	33.3%	11	35.5%	6	35.3%	20	29.9%	9	39.1%
Recruit overseas Taiwanese scientists	15	7.4%	0	0.0%	2	6.5%	1	5.9%	3	4.5%	0	0.0%
Recruit foreigners	5	2.5%	0	0.0%	1	3.2%	0	0.0%	2	3.0%	1	4.3%
Other	13	6.4%	4	16.7%	1	3.2%	1	5.9%	2	3.0%	2	8.7%

## Firm Survey of Taiwan Agri-Biotech (15/19)

Performance of R&D Activities	All	Percent age	Plant Seedling	Percent age	Live stock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
Reducing labor costs	20	9.8%	3	12.5%	2	6.5%	3	17.6%	6	9.0%	2	8.7%
Expanding production capacity	42	20.6%	7	29.2%	7	22.6%	4	23.5%	14	20.9%	5	21.7%
Extending product pipeline	80	39.2%	10	41.7%	15	48.4%	8	47.1%	27	40.3%	6	26.1%
Upgrading quality of products	106	52.0%	9	37.5%	15	48.4%	6	35.3%	37	55.2%	12	52.2%
Developing new technologies	76	37.3%	7	29.2%	11	35.5%	3	17.6%	35	52.2%	13	56.5%
Increasing number of patent filings	47	23.0%	8	33.3%	5	16.1%	0	0.0%	16	23.9%	6	26.1%
Increasing licensing-out revenues	10	4.9%	0	0.0%	3	9.7%	0	0.0%	5	7.5%	2	8.7%
Increasing revenues or profits	86	42.2%	11	45.8%	16	51.6%	6	35.3%	29	43.3%	9	39.1%
Insignificant results	13	6.4%	1	4.2%	1	3.2%	0	0.0%	3	4.5%	2	8.7%

## Firm Survey of Taiwan Agri-Biotech (16/19)

Sources of Revenues	All	Percent age	Plant Seedling	Percent age	Live stock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
Licensing-out technologies	15	7.4%	3	12.5%	4	12.9%	0	0.0%	6	9.0%	1	4.3%
Contracted research	28	13.7%	0	0.0%	1	3.2%	2	11.8%	6	9.0%	2	8.7%
Matching or supporting services	13	6.4%	1	4.2%	3	9.7%	0	0.0%	3	4.5%	0	0.0%
Production	109	53.4%	14	58.3%	17	54.8%	6	35.3%	41	61.2%	17	73.9%
Product sales	155	76.0%	19	79.2%	26	83.9%	13	76.5%	57	85.1%	20	87.0%
Capital gains	6	2.9%	0	0.0%	2	6.5%	1	5.9%	3	4.5%	2	8.7%
Other	9	4.4%	0	0.0%	0	0.0%	0	0.0%	1	1.5%	0	0.0%

## Firm Survey of Taiwan Agri-Biotech (17/19)

Major Target Market of Product / Technology	All	Percent age	Plant Seedling	Percent age	Live stock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
Taiwan	152	74.5%	16	66.7%	26	83.9%	13	76.5%	56	83.6%	18	78.3%
China	103	50.5%	8	33.3%	18	58.1%	5	29.4%	42	62.7%	16	69.6%
Japan	54	26.5%	14	58.3%	9	29.0%	2	11.8%	13	19.4%	4	17.4%
South- East Asia	65	31.9%	3	12.5%	15	48.4%	8	47.1%	23	34.3%	9	39.1%
US	73	35.8%	10	41.7%	5	16.1%	1	5.9%	17	25.4%	8	34.8%
Europe	52	25.5%	14	58.3%	7	22.6%	1	5.9%	10	14.9%	4	17.4%
Other	11	5.4%	2	8.3%	1	3.2%	2	11.8%	3	4.5%	0	0.0%

## Firm Survey of Taiwan Agri-Biotech (18/19)

Barriers to Biotechnology R&D	All	Percent age	Plant Seedling	Percent age	Live stock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
Access to capital	66	32.4%	8	33.3%	12	38.7%	3	17.6%	25	37.3%	9	39.1%
Access to technology/information	76	37.3%	11	45.8%	15	48.4%	7	41.2%	23	34.3%	8	34.8%
Access to skilled human resources	93	45.6%	10	41.7%	17	54.8%	9	52.9%	29	43.3%	11	47.8%
Access to international markets	26	12.7%	2	8.3%	3	9.7%	0	0.0%	11	16.4%	3	13.0%
Lack of distribution and marketing channels	26	12.7%	4	16.7%	4	12.9%	0	0.0%	12	17.9%	3	13.0%
Public perception / acceptance	14	6.9%	1	4.2%	5	16.1%	1	5.9%	9	13.4%	3	13.0%
Regulatory requirements	57	27.9%	5	20.8%	8	25.8%	8	47.1%	17	25.4%	8	34.8%
Patent rights held by others / high licensing costs	42	20.6%	7	29.2%	6	19.4%	3	17.6%	14	20.9%	4	17.4%
Access to raw materials/key components	44	21.6%	6	25.0%	8	25.8%	3	17.6%	18	26.9%	4	17.4%

## Firm Survey of Taiwan Agri-Biotech (19/19)

Barriers to Biotechnology Commercialization	All	Percent age	Plant Seedling	Percent age	Live stock	Percent age	Animal Vaccine	Percent age	Functional Food	Percent age	Herbal Medicine	Percent age
Access to capital	36	17.6%	8	33.3%	5	16.1%	2	11.8%	12	17.9%	3	13.0%
Access to technology/information	34	16.7%	1	4.2%	6	19.4%	4	23.5%	14	20.9%	4	17.4%
Access to skilled human resources	38	18.6%	8	33.3%	9	29.0%	5	29.4%	11	16.4%	3	13.0%
Access to international markets	96	47.1%	10	41.7%	14	45.2%	8	47.1%	37	55.2%	11	47.8%
Lack of distribution and marketing channels	101	49.5%	14	58.3%	18	58.1%	9	52.9%	39	58.2%	13	56.5%
Public perception / acceptance	51	25.0%	8	33.3%	7	22.6%	3	17.6%	19	28.4%	7	30.4%
Regulatory requirements	66	32.4%	7	29.2%	6	19.4%	6	35.3%	18	26.9%	8	34.8%
Patent rights held by others / high licensing costs	15	7.4%	4	16.7%	2	6.5%	1	5.9%	2	3.0%	1	4.3%
Access to raw materials/key components	14	6.9%	1	4.2%	1	3.2%	1	5.9%	1	1.5%	2	8.7%

Multicountry Observational Study Mission on the Development  
of Biotechnology Business Models for SMEs in Agribusiness

## Five Cases of Agricultural Biotechnology Business in Taiwan

2011. 11. 7

Dr. Julie C. L. SUN  
 Taiwan Institute of Economic Research

[www.biotaiwan.org.tw](http://www.biotaiwan.org.tw)

# Thank you for your attention!



<http://agbio.coa.gov.tw/>

 Taiwan Institute of Economic Research  
Biotechnology Industry Study Centre  
Intellectual Property Valuation Service Centre  
<http://www.biotaiwan.org.tw>  
TEL: (02)2586-5000  
FAX: (02)2597-9641

 台灣經濟研究院 Taiwan Institute of Economic Research