

Figure 1. Seed System under the 1952 Main Crop Seed Law

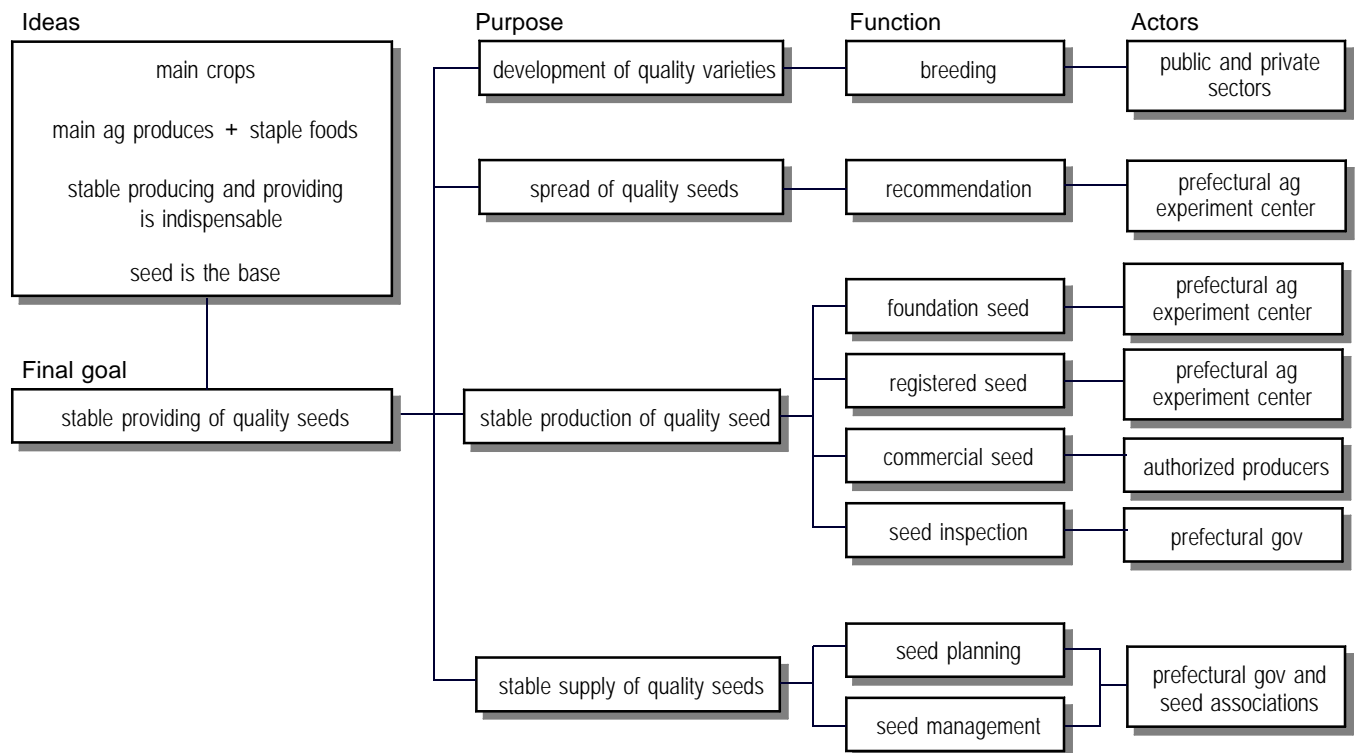


Figure 2. Structure of Main Crop Seed Distribution

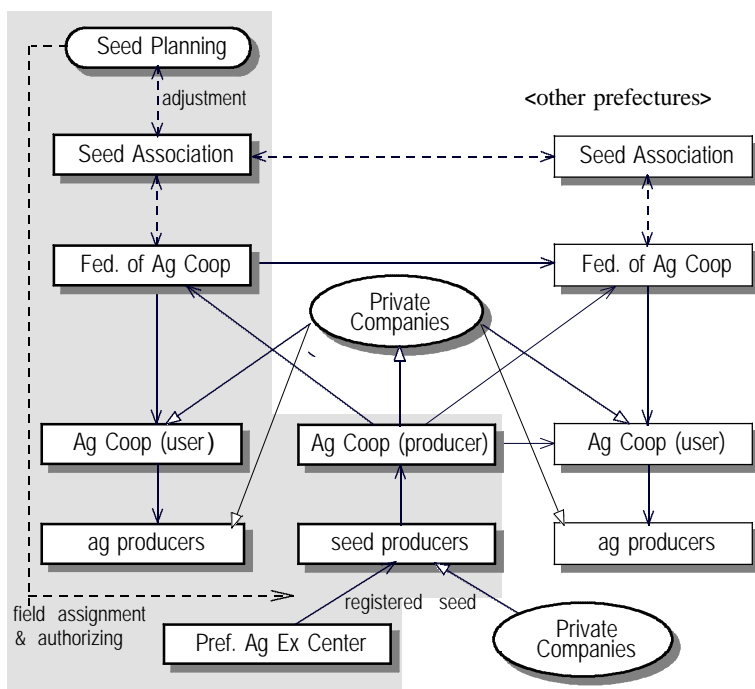


Table 2. Top 20 Varieties of Paddy Rice in Japan

(1000ha, %)

rank		Variety	Developer	1999		1998	
1999	1998			areas	share	area	share
1	1	Koshihikari	Fukui Pref Ag Center	539.0	34.6	526.5	33.6
2	2	Hitomebore	Miyagi Pref Ag Center	144.9	9.3	133.3	8.5
3	4	Hinohikari	Miyazaki Pref Ag Center	133.2	8.6	125.9	8.0
4	3	Akitakomachi	Akita Pref Ag Center	132.6	8.5	131.6	8.4
5	5	Kirara397	Hokkaido Pref Ag Center	73.0	4.7	84.4	5.4
6	6	Kinuhikari	Hokuriku Ag Ex Station	55.1	3.5	53.1	3.4
7	11	Hoshinoyume	Hokkaido Pref Ag Center	39.9	2.6	24.4	1.6
8	10	Haenuki	Yamagata Pref Ag Center	36.0	2.3	31.5	2.0
9	7	Mutsuhomare	Aomori Pref Ag Center	33.2	2.1	38.4	2.5
10	9	Nihonbare	Aichi Pref Ag Center	26.6	1.7	34.4	2.2
Top 10				1,213.5	77.9	1,196.5	76.3
11	8	Sasanishiki	Miyagi Pref Ag Center	25.5	1.6	37.4	2.4
12	18	Tsugaru Roman	Aomori Pref Ag Center	14.3	0.9	9.2	0.6
13	13	Hanaechizen	Fukui Pref Ag Center	12.3	0.8	12.3	0.8
14	16	Yumetsukushi	Fukuoka Pref Ag Center	11.0	0.7	10.4	0.7
15	17	Hatsushimo	Anjo Ag Ex Center	9.9	0.6	10.4	0.7
16	14	Asanohikari	Aichi Pref Ag Center	9.5	0.6	11.5	0.7
17	22	Tsukinohikari	Aichi Pref Ag Center	9.3	0.6	11.2	0.7
18	21	Aichinokaori	Aichi Pref Ag Center	8.9	0.6	8.5	0.5
19	24	Matsuribare	Aichi Pref Ag Center	8.2	0.5	7.7	0.5
20	12	Akiho	Hokkaido Pref Ag Center	8.1	0.5	12.9	0.8
Top 20				1,330.4	85.5	1,316.3	84.0
Total				1,556.9	100.0	1,567.8	100.0

(source) Food Agency, MAFF

Figure 4. Outline of National Project for New Rice Seed Development

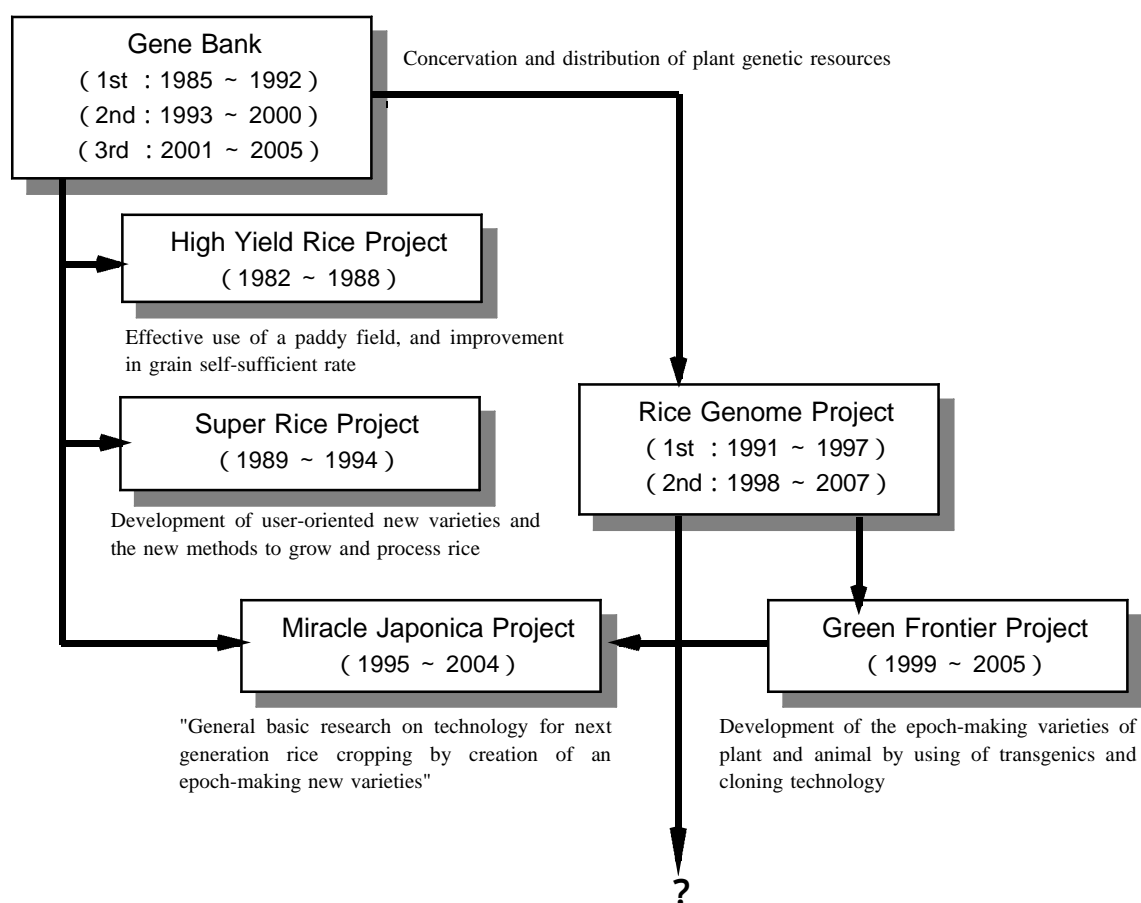


Table 3. The Current Status of GM Rice in Japan

Developer	Status						Transgenic Variety and Strain
	(1)	(2)	(3)	(4)	Food	Feed	
National Agriculture Research Center / National Institute of Agrobiological Resources	1990	1992	1993	1994	-	-	RS Virus Resistance (only for research purpose)
National Institute of Agro-Environmental Sciences / Plantech Research Institute*	1990	1992	1993	1994			RS Virus Resistance (as a model case for safety evaluation)
Mitsui Toatsu (Mitsui Chemical Co.)*	1992	1993	1994	1995	-	-	Low Allergen (withdrawn)
Processed Rice Research Institute*	1991	1993	1994	-	-	-	Low Protein (withdrawn)
National Agriculture Research Center / National Institute of Agrobiological Resources	1990	1992	1996	1997			RS Virus Resistance (only for research purpose)
Japan Tobacco (JT)*	1994	1995	1997	1998			Low Glutelin
Iwate Biotechnology Research Center	1997	1994	1998	-	-	-	Bialaphos Herbicide Tolerance (withdrawn)
Orynova (J.V. of JT and AstraZeneca)*	1997	1998	1999	2000			Low Glutelin
Aventis (former AgrEvo)*	USA	USA	1999	2000			Glufosinate Herbicide Tolerance
Monsanto*	USA	USA	1999	2000			Glyphosate Herbicide Tolerance
Zennoh (Japan Agricultural Co-op)	1996	1998	2000				Lactoferrin Producing
Monsanto* / Aichi Prefectural Agricultural Research Institute	1998	1999	2000				Glyphosate Herbicide Tolerance

Note) In columns of "Status", numbers indicate the year when the crops were acknowledged to use in (1) closed greenhouse, (2) semi-closed greenhouse, (3) isolated field and/or (4) open field.; The developers name with "*" are private companies.
Source) Innovative Technology Division, MAFF, June 2000.

Table 4. Current Situation of GM Rice Research and Development in Japan

Developer	Contents of Development
Japan International Research Center for Agricultural Sciences / Institute of Physical and Chemical Research	The environmental-stress resistance gene derived from <i>Arabidopsis</i> (1998)
National Institute of Agrobiological Resources / Kyoto University food science research institute	Glycinin producing gene derived from soybean which lowers the cholesterol value in blood (1998)
Hokuriku National Agricultural Experiment Station / National Agriculture Research Center / National Institute of Agrobiological Resources	Reproduction efficiency improvement of high quality rice (1998)
Miyagi Prefectural Agricultural Center / National Institute of Agrobiological Resources	Foot-rot bacteria disease resistance gene derived from Oat (1998)
National Institute of Agrobiological Resources / Nagoya University / Kagawa University, etc.	Photosynthesis course introduction enzyme gene derived from corn / high quantity (1998)
Mitsui Chemical*	Photosynthesis course introduction enzyme gene derived from corn / high quantity (1998)
Mitsui Biotechnology Research Institute*	Blast disease resistance by using of antibacterial activity guidance gene of rice (1998)
Hokko Chemical* / National Agriculture Research Center	High content of Tryptophan by alteration of its synthetic mechanism (1998)
University of Tokyo	Alkali soil and iron-lack resistance gene derived from barley (1999)
Meijo University / Nagoya University	Salinity resistance gene derived from cyanobacteria (1999)
Nissan Chemical* / University of Tokyo numerator cell biology research institute	Blast disease resistance by using of detoxification enzyme (1999)
Iwate Biotechnology Research Center / Iwate Prefectural Agriculture Research Center, etc.	Blast disease resistance by raise in antibacterial protein (1999)
National Institute of Agrobiological Resources / Central Research Institute of Electric Power Industry*	Ferritin gene of soybeans which accumulates contents of iron (1999)
Nagoya University / Meijo University / Plantech Research Institute (Mitsubishi Chemical)*	Stress resistance by introducing of Glutamine composition enzyme (1999)
Aichi Prefectural Agricultural Research Center / Hokkaido Agricultural Experiment Station	DNA marker which carries out the simple judging of the illness noxious insect resistance (1999)
Nara Institute of Science and Technology	Pest resistance guidance gene (1999)
National Institute of Agrobiological Resources	Photosynthesis gene derived from corn (1999)
National Institute of Agrobiological Resources	Specialization of Gibberellin synthesize gene which regulate growth and bloom, Absciscic acid synthesize gene which enable dryness tolerance, Chlorophyll composition promotion gene which higher photosynthesis, etc. (2000)

Note) The asterisk marks (*) indicate private sector.
Source) compiled from several news sources

Table 5. Numbers of GM Rice Approved for the Field Test Releases in the U.S.A.

Institution	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000*	Total
AgrEvo (Aventis)							1	3	16	6	6	32
Monsanto								1	6	21	4	32
Louisiana State Univ	1	1	1	2		2	3	1	2	5		18
Applied Phytologics								1	2	3	1	7
Univ of California/Davis							1	1				2
American Cyanamid								1	1			2
USDA-ARS								1				1
Pennsylvania State Univ	1											1
Phenotype	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000*	Total
Herbicide Tolerance				1		1	3	6	24	26	11	72
Product Quality		1	1	1						2	1	6
Insect Resistance		1	1	1		1	1			1		6
Agronomic Properties									1	2		3
Bacterial Resistance							1	1				2
Others*	2							2	2	4	1	11
Total	2	1*	1*	2*	0	2	5	9	27	35	11*	95*

Note: *1 Until the end of June. /*2 Some varieties have two phenotypes. /*3 Others include Marker Gene, Pharmaceutical Proteins, and Trade Secret.

Source: Information Systems for Biotechnology (<http://www.nbiap.vt.edu/index.html>)

Table 6. Transnational Company Entering into Rice Seed Business

Company	Year	Contents
AgrEvo (Aventis)	1996.8	Acquisition of PGS which was doing research cooperation with JT from 1989
	1998.1	Acquisition of the rice breeding section of Brazilian seed company Granja
	1999.5	Acknowledged for the first field examination as foreign company in Japan
Monsanto	1996.1	Entering into a research cooperation with JT
	1999.7	Acknowledged the first field examination as foreign company for commercial growing in Japan
Zeneca (AstraZeneca)	1997.8	Entering into grain seed business
	1998.1	Seeking the partner for joint development of rice variety in Japan
	1999.6	Establishment of the joint venture for rice development with JT (start in October)
	2000.5	Announce a plan about commercialization of the "golden rice (beta carotene content)"
DuPont	1998.9	Entering into rice seed business
	1998.1	Research cooperation with Lynx for genome analysis, including rice
American Cyanamid	1998.9	Research cooperation with Louisiana State University for rice development
	1999.2	Cooperation with Horizon Ag for rice seed marketing
Rhône Poulenc	1999.3	Participation in France public genome analysis project, including rice
	1999.3	Cooperation with the public research organization of Singapore for rice development and genome analysis
Novartis	1999.9	Cooperation with Myriad for genome analysis, including rice

(source) compiled from several news sources

Table 7. Plant Genome Size Comparisons

Relative Genome Size (compared to rice)		Relative Genome Size (compared to Arabidopsis)	
Arabidopsis	0.34	Arabidopsis	1.00
Rice	1.00	Rice	2.97
Sorghum	1.74	Sorghum	5.17
Tomato	2.21	Tomato	6.55
Corn	5.81	Corn	17.24
Barley	11.4	Barley	33.79
Wheat	37.22	Wheat	110.34

Source) NSTC, *National Plant Genome Initiative*, 1998

Table 8. Some Agreements between AgBiotech Companies and Genomics Companies/Institutions

Ag Company	Genomics Company and Institution	Date	Crops
Agribiotech	Salk Institute of Biological Studies	1998	Forages
AstraZeneca	Incyte Pharmaceuticals	1998	?
Aventis (AgrEvo)	Kimeragen	1997	?
	Lynx Therapeutics	1999	?
Aventis (Rhobio)	INRA, CIRAD, etc (France)	1998	French crops
	Celera AgGen	1999	Corn
Aventis (Rhône-P)	Institute for Molecular Studies (Singapore)	1999	Rice
Aventis	Vilmorine Clause (Limagrain), etc	2000	Vegetables
Dow AgroSciences	Biosource Technologies	1998	?
DuPont	John Innes Centre, Sainsbury Lab, etc (UK)	1998	Wheat
	Lynx Therapeutics	1998	Corn, Soy, Wheat, Rice
DuPont (Pioneer)	Human Genome Sciences	1996	Corn
	Affymetrix	1997	Corn
	CuraGen	1997	Corn
	Oxford Glyco Science	1998	?
	Maxygen	1999	Corn
Monsanto	Incyte Pharmaceuticals	1996	?
	ArQule	1997	?
	Mendel Biotechnology	1997	Fruits, Vege, Corn, Soy
	Millenium Pharmaceuticals	1997	?
	IBM	1997	?
	Genetrace	1998	Crops and animals
	Pangea	1998	?
	Paradigm Genetics	2000	?
Novartis	Clemson University	1998	Rice
	Diversa	1999	?
	Univ of California Berkeley	1998	?
	Myriad Genetics	1999	Cereals

Source) GRAIN, "Genomics: Whole Genome, Total Control", *Seedling*, March 2000

Figure 6. Actors Network in the Genomics Racing

