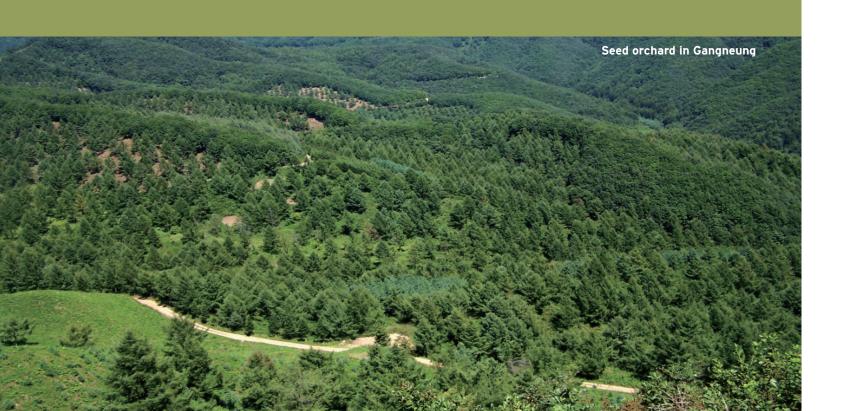


For half a century we've been striving to build valuable forest resources, and our commitment remains unchanged.

Service. It is a government agency established for the evaluation of new varieties and the protection of intellectual property rights, production and supply of good plant seeds through the establishment of



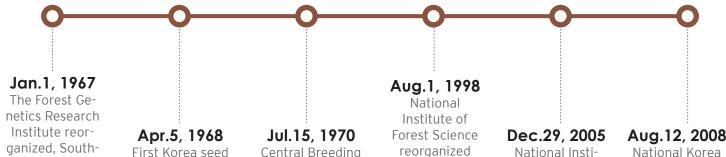
> Three duties of the National **Forest Seed Variety Center**

Evaluation of new seed varieties, sup port plant breeders and protection of ntellectual property rights.

Production and distri bution of high-quality seeds through the development and management of seed orchards to ensure a national management system.

Establishment of sovereignty over natural resources and promotion of the bio industry through systematic management of forest bio resources.

> Brief History



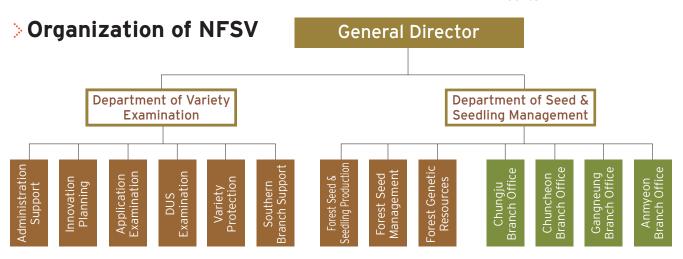
ern Breeding Station was established.

First Korea seed orchard establishing in Chungju

Central Breeding Station of the Forest Genetics Research Institute was established.

National Instithe Western tute of Forest Forestry Exper-Science expandiment Station ed and reorganized the Forest Seed Research Center

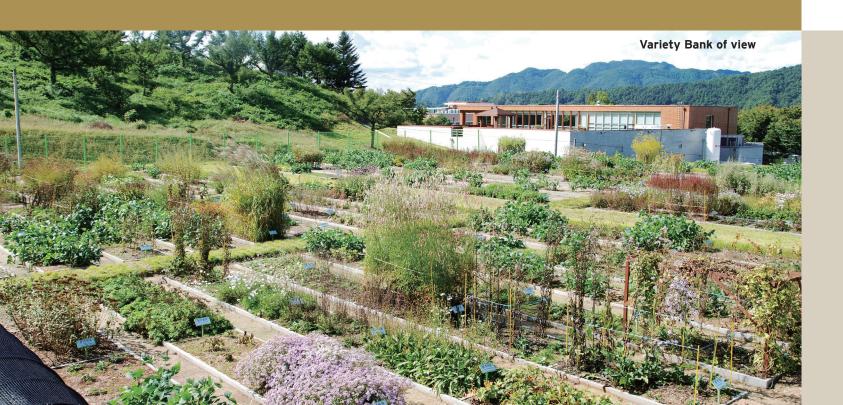
National Korea Forest Seed Variety Center was officially opened by the Korea For est Service

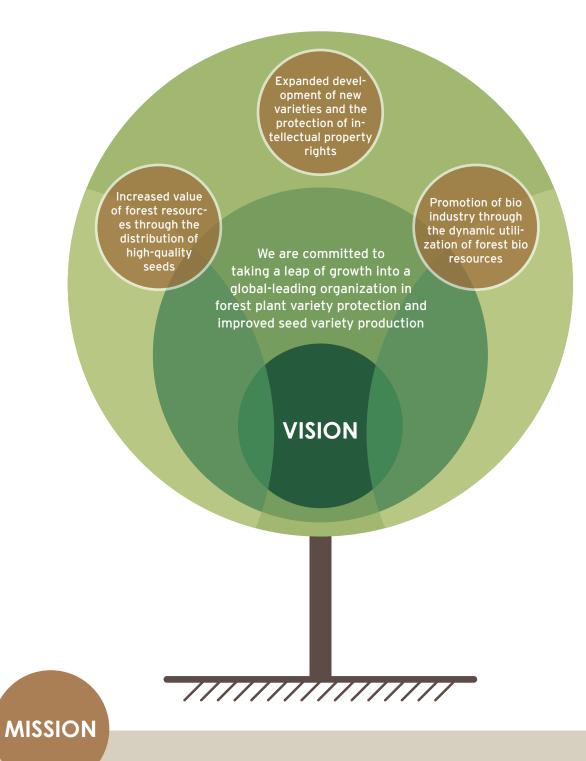


* A total of 120 employees working at two departments, nine teams, and four branch offices (35 government employees and 85 other hires)

National Forest Seed Variety Center is taking the lead in the future knowledge industry.

Plants are national wealth and future resources. NFSV has been spearheading the future knowledge industry by supporting the development of new varieties and also by producing and distributing high-quality seeds in our continuous endeavor to take a leap and become an internationally recognized organization that protects and produces forest seed varieties and seedlings.





Support the development of new varieties, high-quality seed production and distribution



Plant Variety Protection (Forest PvP)

- Evaluate new varieties and support breeders
- DUS test
- Protect intellectual property rights through reinforced distribution research



Ongoing management of Seed orchards

- Pruning, tinning, irrigation and fertilization
- Flowering induction seed prediction and production



Forest Bio Resources Management

- Forest bio resources collection, preservation and informatization
- Characterization and DNA analysis
- Support domestic and overseas distribution and industrialization

National Forest Seed Variety Center is taking the lead in building the foundation and protecting plant varieties, future resources, and forest of life.

It is an international trend to acknowledge and protect intellectual property rights of plant varieties.

The National Forest Seed Variety Center operates a new variety protection system for the development of new varieties and carries out cultivation testing for the development of new varieties and growth of the seed industry, builds analysis tools such as control and check variety preservation centers, and promotes the advancement of a domestic seed market through strict control of distribution.



> The Protection of new varieties of plants

A convention established by the WTO's TRIPS agreement to protect new varieties of plants by codifying intellectual property rights for plant breeders and ensuring the breeders' exclusive rights to commercialize them.



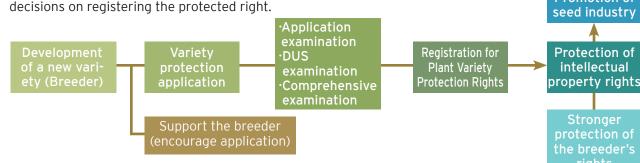
> Legal Basis

- The Plant Variety Protection Act: The Act covers the promotion of new variety development, application examination, DUS examination for PBRs (Plant breeder's rights)
- Seed Industry Act: The Act covers the distribution of healthy seed and the promotion of seed industry. (Five-Year Plan for Seed Industry Promotion)
- International regulations for the protection of intellectual property rights for new varieties in accordance with TRIPS/WTO agreements and the UPOV convention.
- Intellectual Property Basic Law: Establish master plan and carry out implementation plan for national intellectual property

New variety examination procedure and examinationrelated projects

When a new variety is submitted, it is examined for its novelty and denomination before going through a scientific DUS examination (DUS: Distinctness, Uniformity, Stability) and making decisions on registering the protected right.

Promotion of seed industry



The right of variety protection is granted to the breeder after comprehensively examining novelty, denomination, ${\bf D}$ is tinctness, ${\bf U}$ niformity and ${\bf S}$ tability.

> Examination of the applied variety for plant variety protection

- Development of Test Guidelines (TG) and international cooperation with UPOV members
- * Carried out contracting projects for the establishment and revision of TG for 18 varieties and participated in four
- Examination of requirements for candidate variety protection right, decision to grant and register candidate varieties protection right
- Publication of official Gazette, New Forest Seed Varieties Explanation Book, to support breeders and encourage the application of protected varieties



Test Guidelines

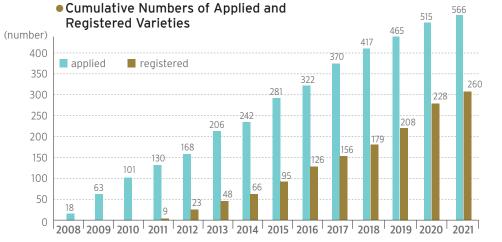


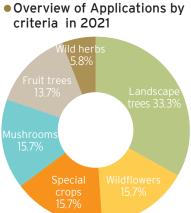




(UPOV and others)

- Explanation Book
- An annual average of about 40 new varieties are applied, a 10% annual increase - Major applied varieties include 17 landscape trees, 8 wildflowers, 8 special-use plants, 8 mushrooms, 7 mountain fruit trees, and 3 wild vegetable varieties





> Creation of new forest varieties cultivation complexes

- Create a foundation for the forest life industry using new forest varieties with high added value
- Serve the public interest by establishing social cooperative corporations that create jobs in the local community and increase the income of local residents
- Create and operate new forest varieties cultivation complexes for mass production and industrialization of new forest varieties

> Current status of new forest cultivation complexes





- 1 Scabiosa mansenensis 'Blue Moc

- **4** Shiitake 'Sanbaekhyang'



Cultivation experiment and the establishment of seed variety bank

- Applied new variety is examined for more than two growing seasons in accordance with the international standard, DUS Testing Guidelines (distinctness, uniformity, stability)
- ※ Cultivation experiments: 162 varieties (2019)→183 varieties (2020)→192 varieties (2021)
- Establish and maintain a variety bank in addition to the collection and preservation of existing varieties for speedy and accurate cultivation experiment
- ** Comparison variety collection and protection: 1,479 varieties (trophsome 675 varieties, seeds 248 varieties, hypha 556 varieties)
- Distribution of the cultivation test sites: 9.9ha (Chungju 2ha, Chuncheon 0.7ha, Ochang 3.2ha, Sacheon 4ha)

Supporting of Breeders and reinforced protection of intellectual property rights

- Encourage breeders to develop new varieties and provide them with opportunities to study breeding skills in advanced countries
- ** Technology development promotion costs of a new variety: Supported KRW3 million won per variety (private breeder), and KRW1 million (job promotion), KRW5 million won (Overseas application)
- Promotion of various plant grower support projects including funding for technological development of new forest varieties (private growers) and compensation for government employee job training (registration compensation and disposition compensation)
- Operation of on-site customized consulting for the promotion of new variety applications (64 times in 2021)
- Confirmation of import requirements for domestic market protection, test for import adaptability, and management of production and import sales report of varieties
- ** Import requirement approvals: 14,379 cases, the production and import sales reports of varieties: 3,419 cases, import adaptability test: 9 cases
- Prevention of consumer complaints through protection of intellectual property rights and implementation of distribution survey on illegal or bad seeds and spawns



ariety protection briefing and incentive support



Cultivation test and characterization manual



On-site customized consulting



Distribution survey

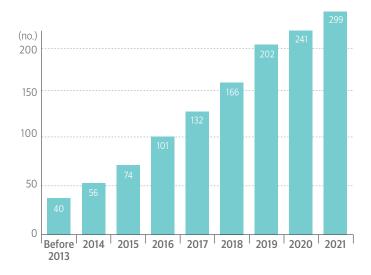
Accumulated number of forest seed distribution surveys

700

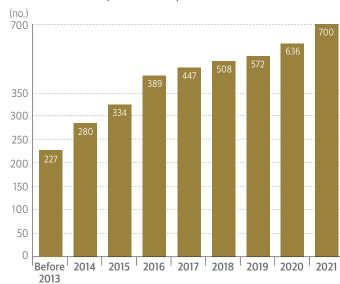
times

Accumulated number of onsite customized consultations for new forest varieties

Forest seed distribution survey (cumulative)



On-site customized consulting for new forest varieties (cumulative)





- Areal view of a plant cultivation area Establishment of a variety bank
- **3, 4** Characterization test and study



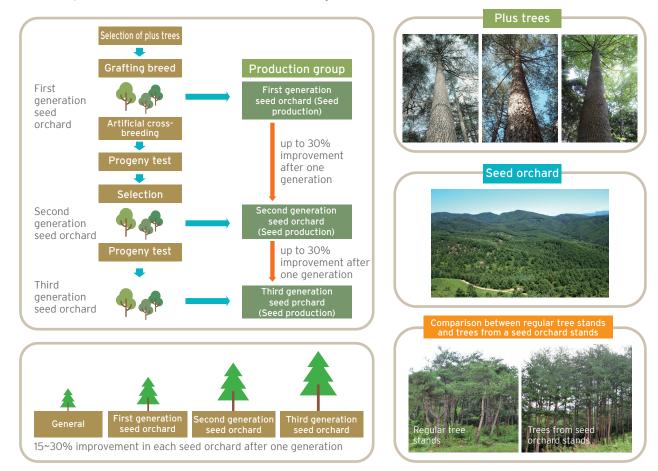
NFSV is continuously trying to promote the economic and public values of forest resources by producing and providing high-quality forest seeds.

NFSV has an important role in Korea's national forest seed management system. Even massive trees that are over 100 -years old started from small seeds. NFSV establishes and manages seed orchards that could produce genetically improved forest seeds. It is planning to expand seed orchards to 1,250 ha by 2030 to provide more high-quality seeds for the national afforestation program. Furthermore, NFSV is also continuously advancing technology for seed quality control and long-term storage.



> Seed orchard

- A production population consisting of genetically superior trees that is intensively managed to produce frequent, abundant, easily harvested seed crops. It is established by setting out clones (as grafts or cuttings) or seedling progeny of trees selected for desired phenotypes.
- Tree improvement effects are seen in advanced generations of seed orchards.



> Legal Basis

- Framework Act on Forests: Target is to produce 72 tons of forest seeds by 2050
- Forest Resources Creation and Management Act: Contribute to promoting valuable forest resources by producing a high-quality forest seed under the national management system of forest seeds in accordance with the Act.

> Economic Effect

- Seeds from seed orchards are expected to have more than 30% improvement over those from unimproved general trees
- About KRW 170 billion of economic impact in a year when 20,000 ha of land is afforested

> Seed orchard establishment and seed production

- The importance of seed orchards and the national management system
- All seeds for the national afforestation projects need to be produced from seed orchards, and their quality and source should be certified



- Forest seed production stands (2,267.4 ha): Seeds produced in seed orchards (998 ha) have priority in use for national afforestation, and deficits are supplemented by seeds produced in other seed production areas (1269.4 ha).
- * As afforestation requires a long-term investment, the distribution of illegal or bad seeds can cause significant loss because it is impossible to visually identify the genetic quality of seeds.

> Overview of the establishment of Seed orchards by period

Period Area	1960s	1970s	1980s	1990s	2000s	2010s
998ha	71ha	397ha	87ha	36ha	109ha	298ha

* As of 2021

Seed orchard Management

- Intensive management for more frequent, abundant, and more easily harvested seed crops: fertilization, pruning, and disease and insect control
- Management to improve the genetic quality of seeds : clone planting design, and preventing pollen contamination from outside
- Mechanization for the improved productivity of seed orchards, and the construction of the seed orchard database



Clonal seedling production



Establishment of seed orchard



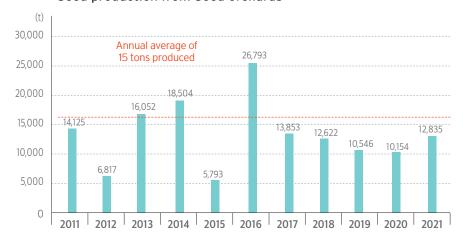
Disease and insect control



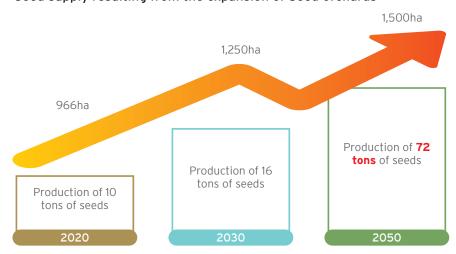
Seed harvesting

The 2050 target use rate of seeds from seed orchards in national afforestation is up to

Seed production from Seed orchards



• Seed supply resulting from the expansion of Seed orchards



* While seed production will not reach peak levels until 2030, production is expected to start increasing rapidly after 2040 as the seeds produced from seed orchards reach maturity.



- **3** Graft nursery



> The locations of Seed orchards 11 regions, 62 tree species, 998ha (as of 2021) Gangneung 149ha 412ha Sacheon 30ha

> Forest seed quality control

- Regular seed testing to monitor the seed quality of stored forest seeds
- Providing a seed test certification to secure transparent seed distribution
- Seed priming and coating to enhance seed germination performance in a tree nursery









Seed germination test

Seed viability test

Seed coating

Seed test certificate

> Storage and supply of forest seeds

- Safe storage and supply of forest seeds for the national afforestation program in accordance with the Forest Resource Creation and Management Act
- Storage of forest seeds to aid North Korea for inter-Korean forest cooperation (about 20 species including larch, acacia, and cypress)







Seed storage

Seed vacuum packaging

Seed Management System (SMS)

Operation of the Smart Forest seed Processing System (SFPS)

- Mechanization and automation of the forest seed production process (drying, seed extraction, and cleaning)
- Increasing capacity and seed processing efficiency, via the introduction of the advanced seed technologies and equipment









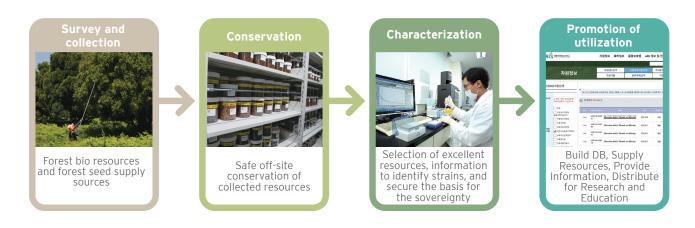
NFSV is devoted to the systematic management of forest bio resources and to making them available for various research and educational activities.

NFSV surveys and collects forest bio resources to securely preserve diverse bio resources in the Gene Bank, while exploring the utilization value of forest resources through characterization and DNA analysis projects. In addition, NFSV builds a database of native plants to ensure the sovereignty of natural resources while promoting the use of forest bio resources in the bio industry.



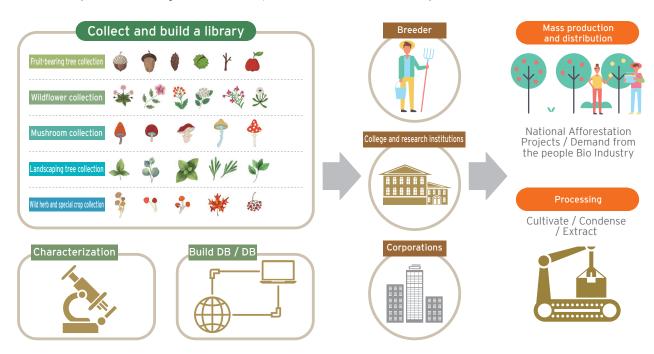
> Forest Bio Resources Management

• Forest bio resources are the nation's new growth engine for the promotion of the bio industry.



New forest variety industrialization system

• The DNA library built through the management of forest bio resources can be applied to a wide variety of fields and grow into a competitive national bio industry.



> Legal Basis

- Master plan for agricultural bio resources in accordance with the Agricultural Bio Resources Preservation, Management and Utilization Act
- Execution of the Convention on Biological Diversity (CBD) supplement of the Nagoya Protocol on Access and Benefit Sharing (ABS) in accordance with the Act on Access to and Utilization of Genetic Resources and Benefit-Sharing.

National management system for forest bio resources by Korea Forest Service



forest bio resources

Enacting, revising, and establishing policies that are related to forest bio resources.



• The National Forest Seed and Variety Center is one of the Forest Bio Resources Management Authorities designated under the Act on the Conservation, Management, and Use of Agricultural Bio Resources, and it carries out the following tasks for forest seed supply sources, forest varieties and related resources:

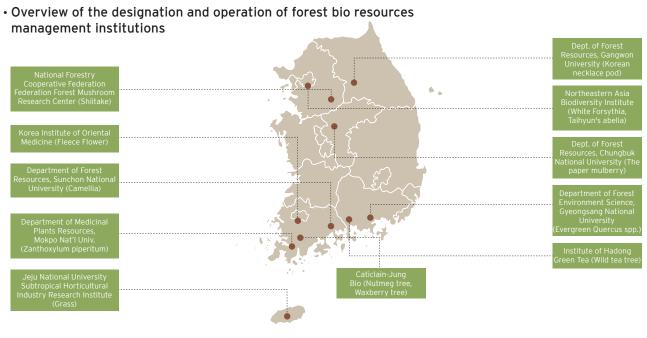
Tasks on securing, conserving, managing and using

Establishment of an integrated information system

Tasks on mid-to-long term conservation and research

Tasks on international cooperation with regards

- Operation of forest bio resources management institutions
- Began designating and operating forest bio resources management institutions in 2010 and is operating 11 forest bio resources management institutions as of 2021
- Collects and preserves 4,187 pieces of resources from 68 species including grass and tea trees and carries out characterization and evaluation for industrialization





Grass resources conserved in Jeiu National University



Tea tree resources consereved in Hadong Green Tea Institute



Camellia resources conserved in Suncheon National University



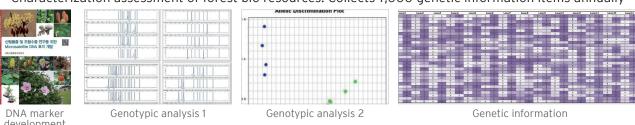
Shiitake resources conserved in Forest Mushroom Research

> Establishment and execution of implementation plans for forest bio resources

• Survey and collection of forest bio resources: approximately 316,000 pieces of resources (as of 2021)



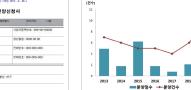
• Characterization assessment of forest bio resources: Collects 7,000 genetic information items annually

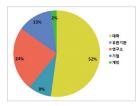


• Conservation and utilization of forest bio resources: Strengthening the research resources distribution via the informatization of BRIS-linked bio resources

Presale application







Research resource distribution

Spread of the distribution

> Producing and supplying forest bio resources by tissue culture (clonal propagation)

• As part of the project to improve the production system of larch tissue-cultured plantlets on-site in accordance with the Forest Service Business Plan of the Korea Forest Service. NFSV aims to produce and supply 200,000 tissue-cultured plantlets annually.







Genetic resources DB

Proliferation of cell



Primary dissociation and proliferation of plantlets



Secondary dissociation and proliferation of

Transplantation

Over three months



Acclimatizing plantlets



> Operation of the forest bio resources Gene Bank

• Storage and supply control of excellent seeds for national afforestation projects and stable conservation of forest bio resources

Major Facilities

Division	Contents						
Short-term storage facility (1°C)	2 rooms, 34-ton capacity						
Mid-term storage facility (-15°C)	2 rooms, 34-ton capacity						
Super low temperature storage facility (-75°C, -190°C)	Capable of storing up to 300,000 DNA/tissue specimen						
Sample storage facility	Capable of storing 20,000 seed and plant samples						
DNA analysis room	DNA extraction equipment, PCR equipment, 3730 DNA analyzer, etc.						

Management and operation of the Smart Forest-seed Processing System, SFPS

• Mechanization and automation of drying, seed separation and selection process of forest seeds for national afforestation projects

Major Facilities

Division	Contents							
Seed processing plant	Dryer, pine and nut pine tree seed separation, seed sorter							
Short-term storage facility (1°C)	2 rooms, 25-ton capacity							
Mid-term storage facility (-15°C)	2 rooms, 45-ton capacity							
Seed testing room	Germination chamber, X-ray sorter, hyperspectral imaging analysis precision sorter							

- 1 Full view of the Gene Bank
- **2** Full view of the Smart Forest -seed Processing System, SFPS
- **3** Forest genetic resources bank
- **4** Fingerprint DNA analysis lab
- **5** Seed processing plant
- **6** Seed transporting robot
- **7** Seed testing lab



> Important Statistics

(2021. 12. 31.)

Year	Unit	Sub-total	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
	No.	566	101	29	38	38	36	39	41	48	47	48	50	51
New variety application	cumulative		101	130	168	206	242	281	322	370	417	465	515	566
New variety registration	No.	260	-	9	14	25	18	29	31	30	23	29	20	32
(Intellectual property right)	cumulative	260	-	9	23	48	66	95	126	156	179	208	228	260
Characterization	species	318	57	32	21	37	32	_	53	14	18	18	18	18
TG publication	cumulative		57	89	110	147	179	179	232	246	264	282	300	318
Cultivation experiment	species	1534	113	52	65	104	112	132	136	138	146	162	183	191
Create tree planting	ha	9.9	1.7	1.0	0	0	3.2	0	0	0	2.0	2.0	0	0
fields and variety Conservation centers	cumulative	9.9	1.7	2.7	2.7	2.7	5.9	5.9	5.9	5.9	7.9	9.9	9.9	9.9
Collection of similar varieties	No.	910	-	-	65	85	85	85	90	100	100	100	100	100
On-site consulting	No.	700	80	45	51	51	53	54	55	58	61	64	64	64
Report on	No.	3,419	358	654	328	250	401	154	129	324	340	183	137	161
production, import and sale of varieties	cumulative	3,419	358	1,012	1,340	1,590	1,991	2,145	2,274	2,598	2,938	3,121	3,258	3,419
Seed manager registration	No.	50	-	-	-	-	-	-	6	12	14	7	6	5
Seed import	No.	14,379	-	251	426	523	970	1,443	1,708	1,562	1,701	1,776	1,853	2,166
requirement approval	cumulative	14,379		251	677	1,200	2,170	3,613	5,321	6,883	8,584	10,360	12,213	14,379
Control the	No.	299	4	10	12	14	16	18	27	31	34	36	39	58
distribution of forest seeds	cumulative	299	4	14	26	40	56	74	101	132	166	202	241	299
Creation of seed	ha	998	7.6	5	11	9	3.6	18.4	4	51	39	50	41	32
orchard	cumulative	998	731	736	747	758	762	781	785	836	875	925	966	998
Clone Bank	ha	80	-	-	-	-	-	-	-	-	-	-	-	80
Production of grafts (Grafts for the creation of seed orchard)	1,000	233	-	1	-	-	25	21	21	28	26	29	59	24
Creation of Mugunghwa Garden	ha	0.4	-	-	-	-	-	-	0.4	-	-	-	-	-
Seed production	kg	345,274	197,190	14,125	6,817	16,052	18,494	5,793	26,793	13,853	12,622	10,546	10,154	12,835
Storage of seeds for afforestation	ton	-	-	-	-	-	-	13	3	12	10	14	15	29
Storage of seeds for South- North Afforestation Cooperation	ton	-	-	1	-	-	12	12	26	31	32	35	34	35
Seed test	No.	_	96	110	120	347	419	483	704	1,212	795	792	755	611
Bio resources conservation	cumulative 1,000	317	-	-	23	48	86	120	171	230	300	306	315	317
DNA fingerprints	species /1,000	_	-	-	1/4	6/6	6/7	8/6	10/4	6/6	7/7	6/7	4/7	2/3
DNA marker development	species	34	5	2	2	5	4	2	2	3	3	3	3	-
Distribution	piece	589	-	-	-	82	30	103	30	13	35	189	35	72
of forest bio resources	cumulative	589	-	_	-	_	112	215	245	258	293	482	517	589
Tissue culture seedling production (Cloned seedlings for afforestation project)	1,000	642	-	150	150	50	50	38	12	17	93	26	26	30
Designated bio	No.	12	1	1	3	-	-	-	-	2	3	-	2	-
resources management institutions	cumulative	12	1	2	5	5	5	5	5	7	10	10	12	12



Mountain is the home of forest, our life.

Forest is the home of trees.

Trees come from seeds.

That's the reason we created the site of seeds, which is the beginning of a forest.





