Master Plan for Promotion of Smart Agriculture in the Republic of Korea

2022. 8. 24.

Rural Development Administration
Rep. of Korea

Kang Sukwon
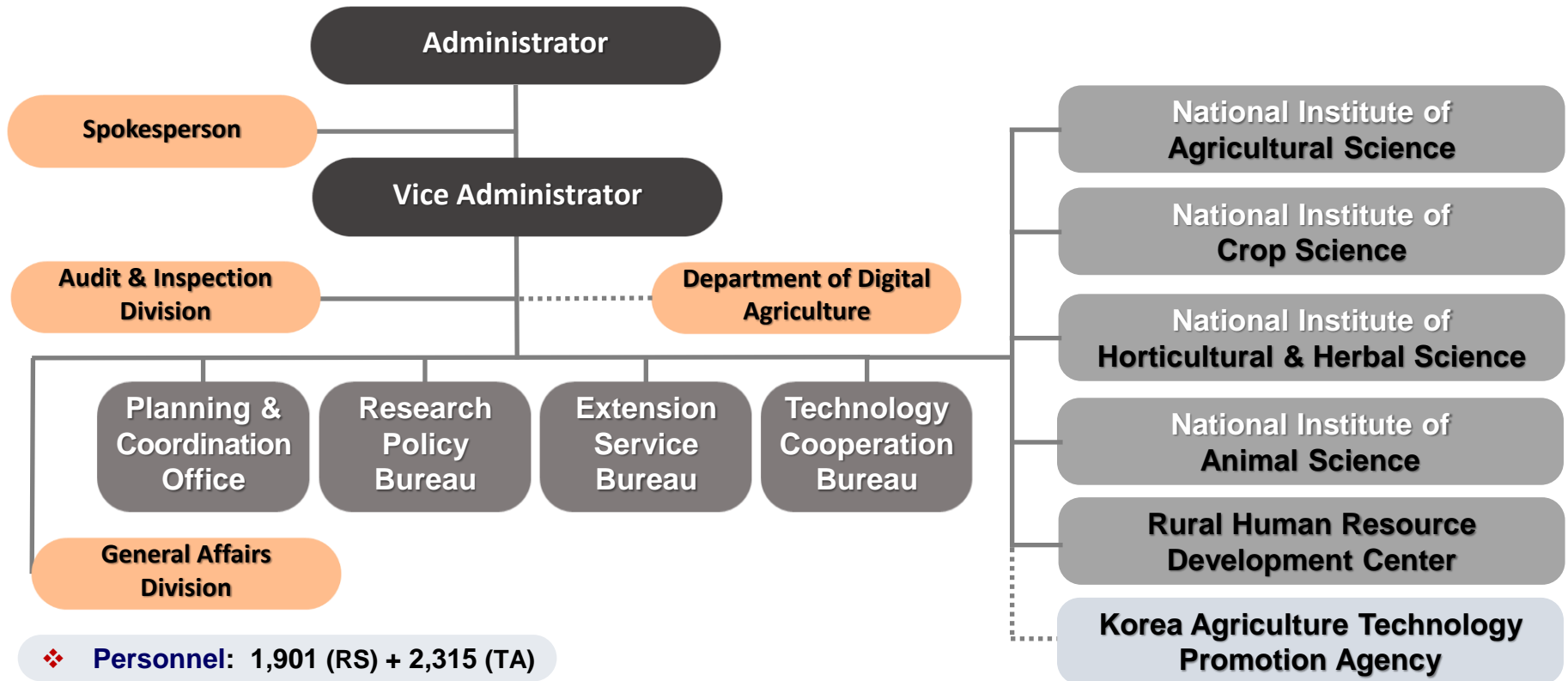
Contents

Rural Development Administration

Introduction of **RDA**

About RDA

Organization Chart : Headquarter (4 Bureaus), 4 National Institutes, 1 Public Institution

Administrator

Spokesperson

Vice Administrator

Audit & Inspection Division

Department of Digital Agriculture

Planning & Coordination Office

Research Policy Bureau

Extension Service Bureau

Technology Cooperation Bureau

General Affairs Division

National Institute of Agricultural Science

National Institute of Crop Science

National Institute of Horticultural & Herbal Science

National Institute of Animal Science

Rural Human Resource Development Center

Korea Agriculture Technology Promotion Agency

❖ **Personnel:** 1,901 (RS) + 2,315 (TA)

❖ **Budget** (2020): **US$ 932 M** (R&D 82%, Operational Expenses 18%)

✓ **9 Provincial Agricultural Research Extension Services**

✓ **156 City/County Agricultural Technical Center**

Role of RDA

International Cooperation

Research & Development

Technology Dissemination

GREATER

Increase of Agricultural Technological Competitiveness

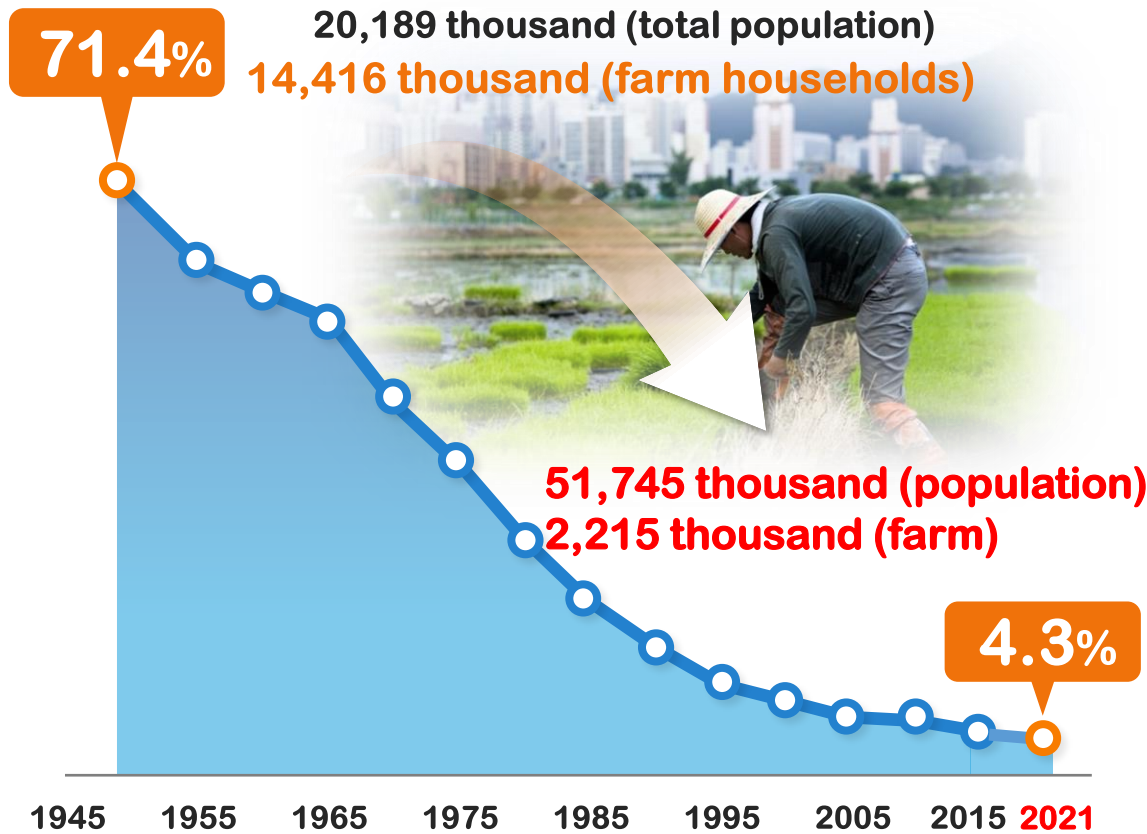**Change** for Value Creation and the 6th Industrialization of Agriculture

Enjoyment of Agricultural Welfare and Rural Revitalization

Extension through Dissemination and Education of Technology

Sharing Experience and Technology with Other Country
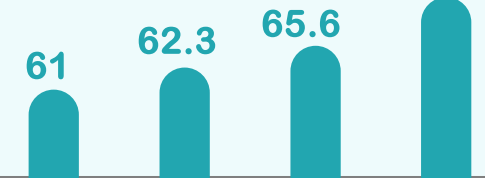
Current status of agriculture of Korea

Ratio of farm households (%)

20,189 thousand (total population)
14,416 thousand (farm households)

71.4%

51,745 thousand (population)
2,215 thousand (farm)

4.3%

1945 1955 1965 1975 1985 1995 2005 2015 **2021**

Avg. age of farmer

※ avg. age of workers 42.6 years

68.2

61 62.3 65.6

2005 2010 2015 **2019**

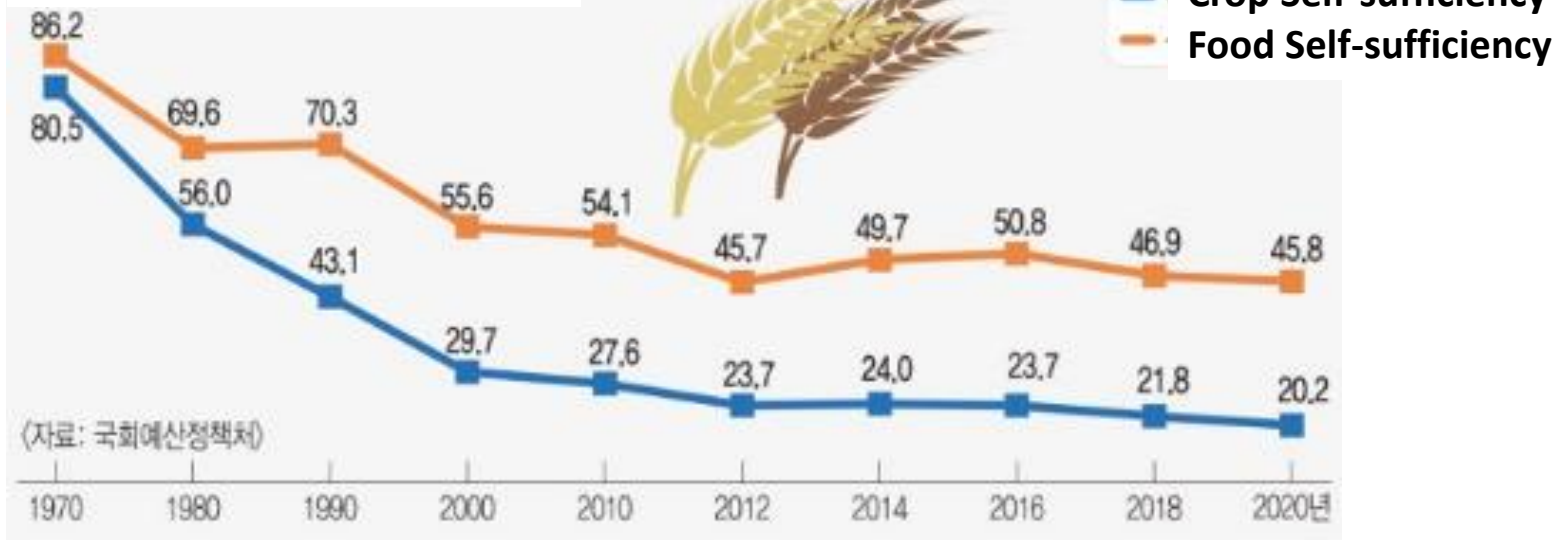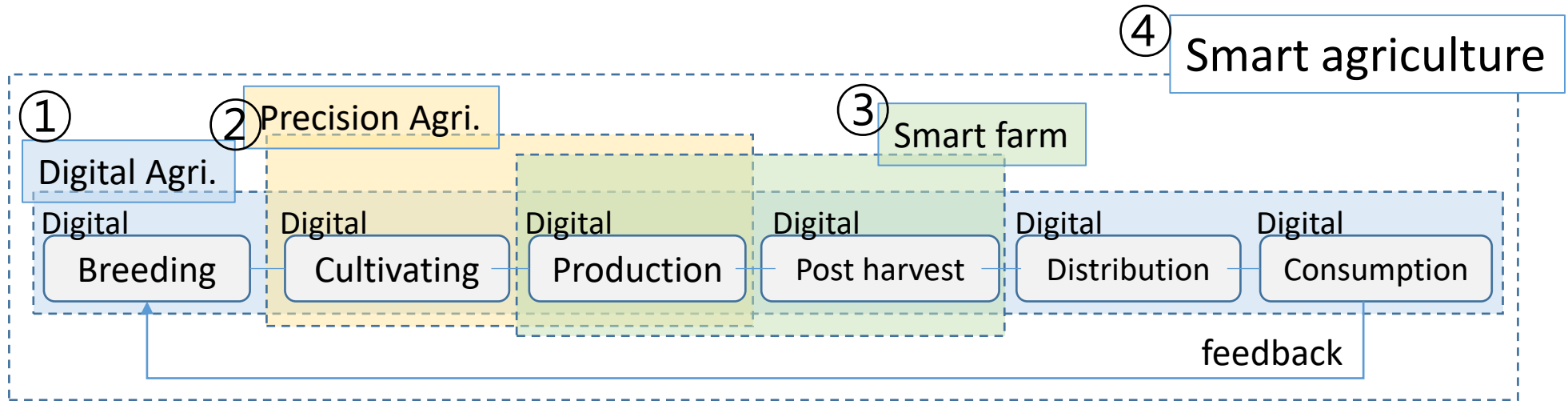## Ratio of 65 years old

※ based on the population 14.9%

46.8%

29.1% 31.8% 38.4%
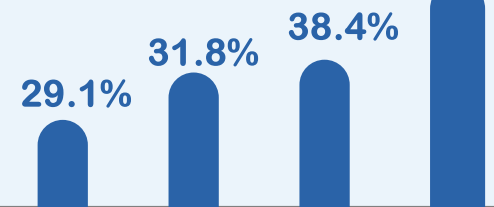
2005 2010 2015 **2021**

Current status of agriculture of Korea

Annual Food and Crop Self-sufficiency (unit:%)

Crop Self-sufficiency
Food Self-sufficiency

④ Smart agriculture

① Digital Agri.

② Precision Agri.

③ Smart farm

Digital	Digital	Digital	Digital	Digital	Digital
Breeding	Cultivating	Production	Post harvest	Distribution	Consumption

feedback

① Digital agriculture : digitization of processes ➜ AI

② Precision agriculture : automation of crop cultivation and production process

③ Smart farm : automation focused on facility agriculture ➜ AI

④ Smart agriculture : improving added value through differentiation

for all processes of agriculture

Ⅰ. 4th Industrial Revolution and Agriculture

Digital Transformation based on Data·AI

Intensifying Competition

as national and corporate competitiveness depends on utilization of data

Transition to Digital Economy

'National AI Strategy(2019)', 'Activation of Data and AI Economy (2019)', 'Korea New Deal (2020)'

Korea

Korea's potential & strength

NEW

New way & strategy

Deal

National Strategy
Transformation & Future

Global Transition to Digital Agriculture

Multinational Company	Japan, Europe
Google, Bayer **Growing investment** * Global investors put $6.4 billion in Agtech(`19)	**Developing data-based technology for each sector**

Current Issues

Climate Change

Growing damages by abnormal weather

Agricultural loss
: (`15) 67.8 billion won → (`17) 362.5 → (`19) 1140.8

Rural Community

Low birth rate & population aging

Rural population:(`14) 2.75million →(`19) 2.25million
45% of city/county facing extinction(Statistics Korea)
Young farmer under 40:(`14) 9,947 → (`19) 6,859 households

Self -sufficiency

Countries reinforcing policies for food security

FAO warns a new virus, 'starvation virus', would threaten humanity(2021)

Big Data & AI as an alternative for Sustainable Agriculture

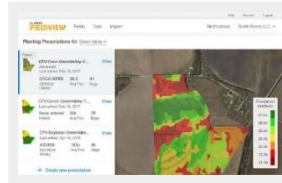# Creating New Value from Agricultural Data

Open Field
U.S.A
「Bayer」

Bayer acquired Climate Corporation and launched data-based service for Farm

* The company provides seed and fertilizer recommendation services by analyzing soil and weather ($999/year)

Greenhouse
Netherlands
「Letsgrow」

Letgrow provides crop growth simulation to forecast yield of horticultural crops in greenhouse

* Decision-making Support Solution ($600~900/year)

Livestock
China
「Alibaba」
「JingDong」

IoT·AI-based management service for pig farms

* Save 30% of production cost and 10% of feed cost, and shorten a shipment time by 5-8 days

Farmers' Demand

Smart Farm
- **greenhouse : ('14) 405ha → ('19) 5,383ha**
- **barn : ('14) 23 barns → ('19) 2,390 barns**
- **convenience satisfactory, productivity less than expectation**

AI Service based Big Data

Increase productivity by using the data of best tomato farm
- **(Farm in Wanju) The sales of serviced farm increased by 1 hundred thousand won/ha.**

Barriers in starting greenhouse farming

High initial investment
- **Glass greenhouse(1ha) : 3 billion won**
- **Plastic greenhouse : 1.8 billion won**

Extend the service to open field
AI service for farmers who want technology

Ⅱ. Vision & Goal

Vison

Sustainable Agriculture by Data-based Digital Agriculture

Goal

Improve agricultural productivity, convenience and environment by digital agriculture

Strategy

Build data ecosystem
for collecting, utilizing and sharing data

Digital innovation
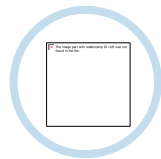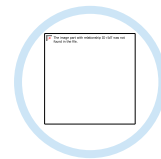in production by automation & AI
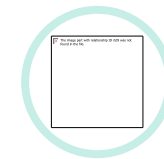
Support supply chain, consumption and policies
through digital agriculture

Programs

Data Ecosystem	Digital Innovation in Production Tech.	Support Distribution & Consumption & Policy
• Collect and manage data • Build AI service platform • Open and share data	• Base tech. for automation & AI • Digital tech. for breeding • Digital tech. for grain production • Digital tech. for horticultural crops • Digital feed management tech.	• Support decision-making on crop selection, distribution & consumption • Support rural & agricultural polices

Innovating Agriculture through Digital Technology

| Innovation cases | | Plan |

Revitalize digital agriculture ecosystem by opening data

Open & share data on production, Distribution, consumption
Connecting big data on soil, weather or market to recommend crops and new business item

- Build & share AI learning/on-farm data (2021~)
- Build an integrated data platform (2023~)

Develop & disseminate various AI services for supporting decision-making

Growth management AI
Recommending optimal model for condition management

Information and warning services for farm management
- **Real-time yield forecast by satellite, drone**
- **Minimize damage by early detecting climate risks(drought, cold wave...)**

- Extend the application of AI(greenhouse* → open-field**)
  *('20)Tomoto→('21)Strawberry, Paprika→('22~)Melon, Cucumber, Watermelon, Chrysanthemum, etc.
  **('21~'24)Rice, Wheat, Soybean, Onion, Kimchi cabbage
- Disease/pest monitoring & control system based on video('25)
- Extend yield forecast service ('22)
  **drone('22~), satellite ('25~)*
- Early Climate Disaster Warning Service
  ('20)29 city/county → ('25)110개 city/county

Develop & disseminate precision agriculture for better convenience

Automation for better convenience and productivity
Disease control drone, self-driving machinery, harvesting robot for saving labor & enhancing productivity

- Plan for field trial test on-farm ('21)

May	June	July
Onion (automatic irrigation, Drone disease control)	**Rice** (Drone direct seeding, self-driving transplanter)	**Cabbage** (auto irrigation, drone disease control)
August	September	October
Rice (water flow management)	**Soybean** (automatic irrigation)	**Wheat** (Drone direct seeding, automatic irrigation)

1. Data Collection & Management

Goal

- **Increase collection, standardization and quality management for research & on-farm data**

Data type

Production	Soil, Climate, Disease/Pest, Cropping
Distribution	Traceability, Wholesale price, Export statistics
Consumption	Consumption, Brand, Food & Nutrition, Public health

Agricultural data have various factors (weather, region, variety), so standardization and systematic management are important!
The Government must play a proactive role.

Collection

- Increase data collection
  - **Research** ('21) 20 → ('25) 250 (accumulative)
  - **On-farm** ('21) 14 items 406 farm households → ('25) 30items 1,000 farm households

Standardization

- **Standardization of agricultural research data & ICT devices**
  * Standardized a registration form for research data on green-bio (with Ministry of Science & Technology)
  - **Statistics (accumulative)**
  * ('20) Standards of private sectors(SPS) 8 cases, Korean industrial standard(KS) 2 case → ('21) SPS 10, KS 4 cases

Quality Management

- **Quality Management for the entire data lifecycle**

  * Agricultural research services, technology centers operating a day for data management

2. AI Service

Goal

- **Support farmer's decision-making through AI service**

AI Service Platform Structure
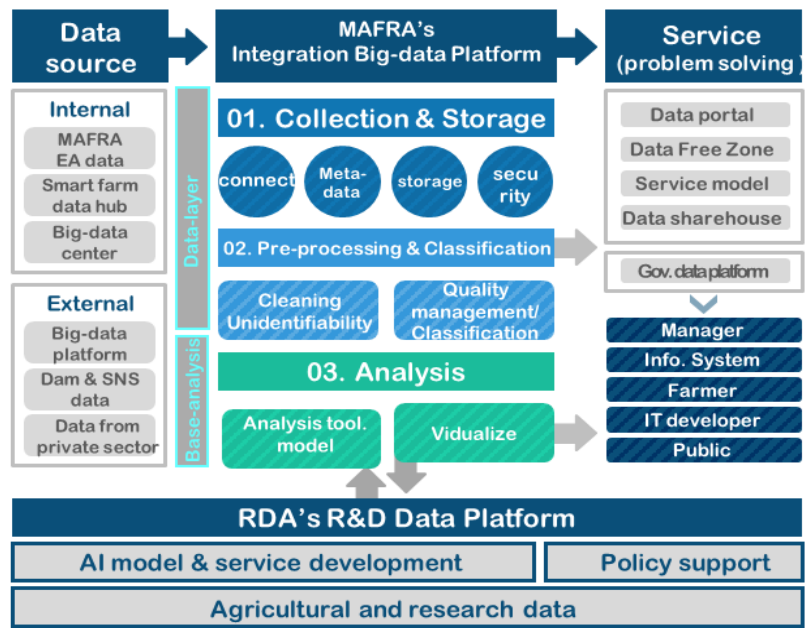
Growth management

- **Further apply AI models for productivity and growth management to crops in open fields and livestock sector**

  Greenhouse

  * ('20) Tomato → ('21~) Strawberry, Paprika, Melon, Cucumber, Watermelon, Chrysanthemum

  Open field/Livestock

  * ('21~'23) rice, wheat, soybean, onion, cabbage
  → ('24~) 5 including apple, Korean native cattle, milk cow

Decision-making support

- **Decision-making support model for crop/site selection and shipment**

  Support to select crops and build marketing plan by connecting bigdata on soil, weather and consumption

3. Data opening, sharing & utilization

Goal

- **Support start-ups & cooperate with other organizations**

Current agri. start-ups in Korea

Farm8 (plant factory), **nThing** (smart farm), **AIS** (growth management), etc.

10 companies

30 companies

100 companies

2021 → 2023 → 2025
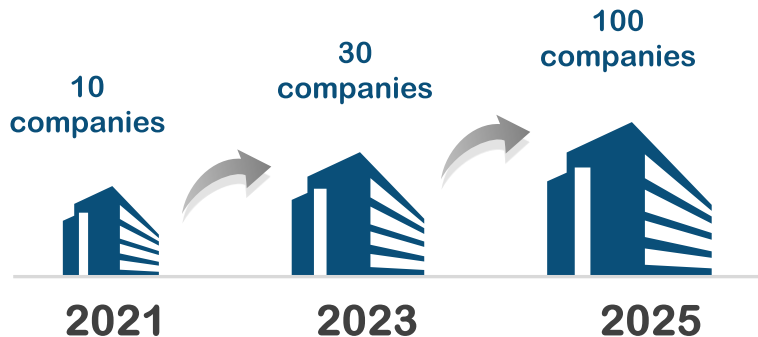
Open & share

- Support start-ups and cooperate with relevant organizations by opening and sharing data
  - * Open bigdata on weather, soil, disease, pest
    : ('20) 143 cases → ('21) 241 cases
  - * Data for AI learning in the agricultural and livestock
    : build image database of pest/disease, etc.

Data Center

- Data Center for systematically storing, managing & sharing
  - * (Phase 1) Field Data Center → (Phase 2) Research Data Center
  - → (Phase 3) Integrated Platform

Regional hub

- To promote local agricultural research services/technology centers as a regional hub for collecting and sharing data

1. Automation and intelligence technology

Goal

Base for Smart Agriculture

Remote sensing, on-farm sensing, Autonomous Driving, Facility Automation

Remote sensing will be used in the various area using the agricultural satellite

On site sensing will be used for site prescription using soil moisture and weather information sensors

Facility automation for greenhouse or barn environment management and automation

Remote Sensing

- Customized technologies to observe growth, cropping and the environment

* Integrated approach to sowing, fertilization, and disease control using drone
* Automated satellite image processing technology for cropping forecasting and area calculation

On-farm sensing

- An automated nutrients and water monitoring system for open-field crops

*(Nutrients & water) automated technology based on soil, weather, and growth models
*(Livestock) monitor biomarker behavior patterns, activity levels, and cough sounds using behavioral images and vocal sounds
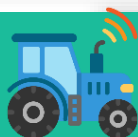
Autonomous driving

- Automated technologies based on remote sensing and autonomous driving

* (Autonomous driving) GPS and image-analysis AI will be applied to autonomous driving
* (Robot) the application of disease and pest control robots in orchards

2. Digital Breeding Management Technology

Goal

Develop new varieties and breeds by establishing and linking a DB of various agro-bio resources.

Digital Breeding Implementation Plan
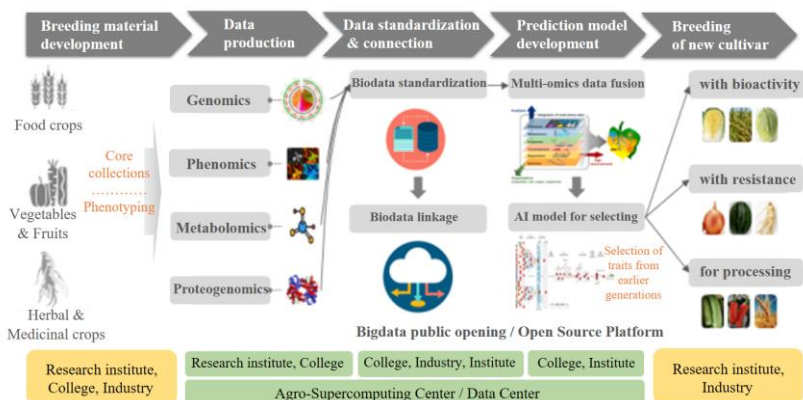
Prediction Model

- Prediction model based on multi-omics information to improve breeding efficiency

  * (Core collections) Core collections to secure genetic diversity
  * (Data) the information on characteristics of genetic resources, genomes, transcriptomes, proteomes, metabolomes, phenomes
  * (AI model) AI model for selecting elite lines

Utilization

- Applied for leading technologies and establish the digital breeding platform('23)

  * Select elite lines : rice(flavor), soybean(functional), wheat(low allergen)
  * Fusion of crop characteristics and omics data , and phenotypic prediction services

Super Com.

- For Digital breeding, support of the super computing infra and education

  * Construct a new super computing center and provide a new super computer

  * Education for big data application (twice per year)

3. Digital Technology for Grain Production

Goal

Enhance food self-sufficiency and save labor

Field application

Geosan — Soy-bean

Gimje — Rice

Yeounggwang — Wheat
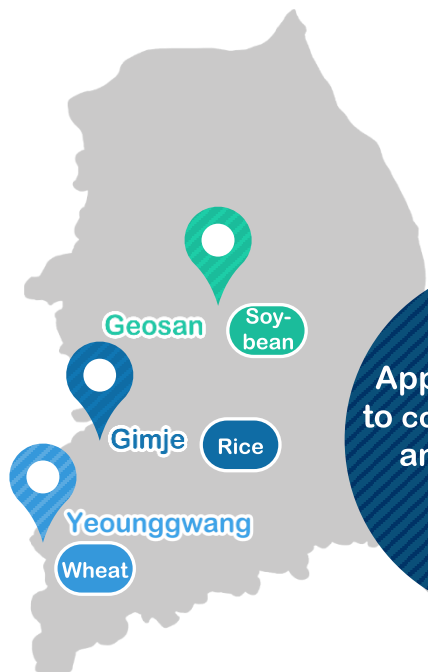
Apply field trial test to counties/cities first, and then spread across the nationwide

Rice

- Drone seeding/disease control, and self-driving machinery for labor saving
- Precision tech. for stable production to respond to abnormal weather

Wheat

- **Recommend a flour variety (for noodle) based on weather/soil data**
- **Precise management of each growth phase for improving productivity and self-sufficiency** *('22~) 20% yield increase model
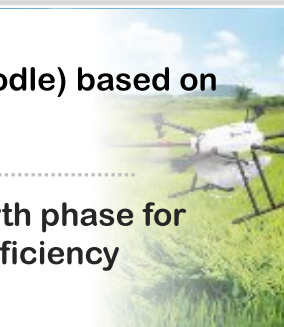
Soybean

- Precision fertilizer recommendation and water management for each growth stage to improve productivity
- Early warning service for abnormal weather

4. Digital Technology for Stable Supply & Quality of Horticultural Crops

Goal

Stabilize demand-supply of vegetables
* cabbage, radish, onion, garlic, pepper, etc.

Field application

Dangjin — Cabbage
Gunwi — Apple
Muan — Onion

Apply field trial test to counties/cities first, and then spread across the nationwide
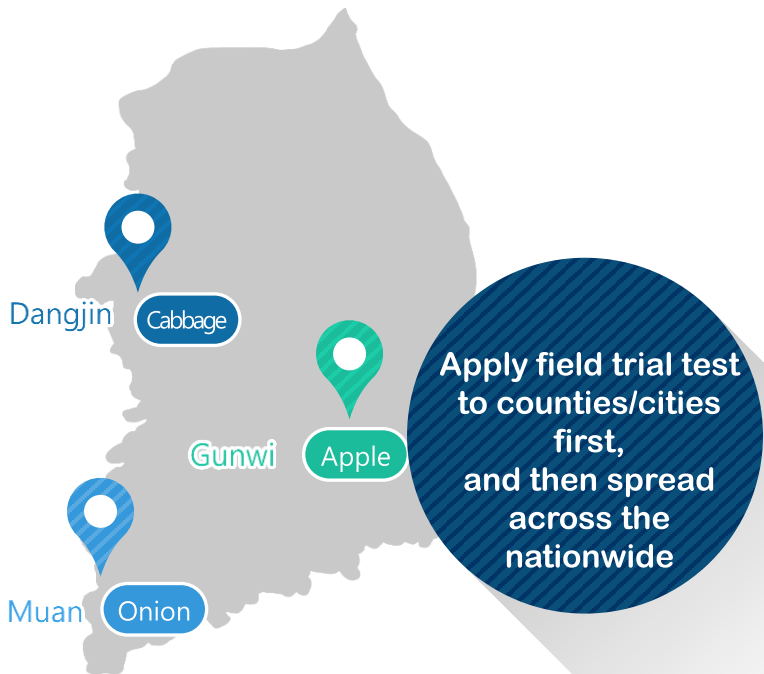
Cabbage
• **Early yield forecast using drone or satellite image for stable supply**
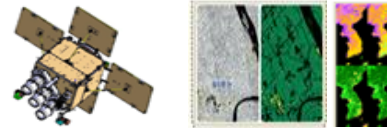
Onion
• **Forecast the yield of major onion producing area**
• **Technology for storage, processing & inventory management**

Apple
• **Recommend the suitable site/c prepare for the climate change**
• **Technology for new value-creating crops**
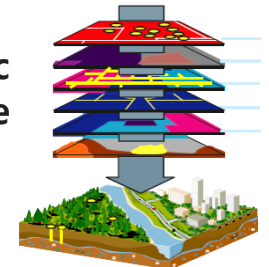
5. Digital Technology for Precision Livestock

Goal

Prevent diseases and enhance productivity

Farm Application

Pyeongchang

Cheonan

Hanwoo
Poultry

Pig
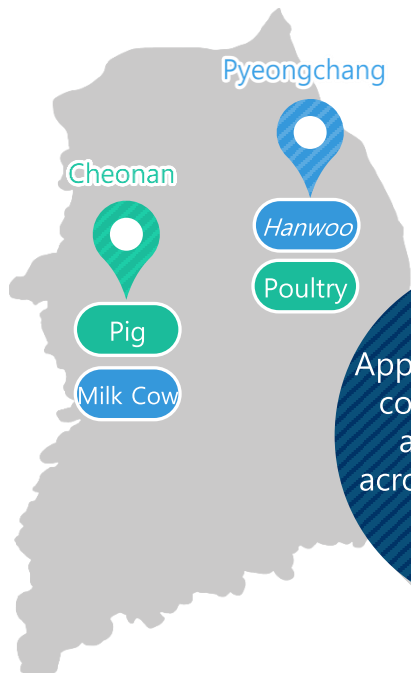
Milk Cow

Apply field trial test to counties/cities first, and then spread across the nationwide

Hanwoo · Milk Cow

- **Predict estrus, fertilization and delivery time for each cow**
- **Data-based Precision Feeding Technology for meat quality and productivity**
- **Develop Korean automated feeder, milking robot**

no. of steps (sensor)

Swine · Poultry

Swine: **Data-based optimal growth and disease prevention model based on feed intake or activity**

Poultry: **Selecting abnormal individual through image analysis, Intelligent management**

100.1
100
90
80

1. Decision-making on Crop & Distribution & Consumption

Goal

· **Replace oversupplied crops with profitable introduced crops**
· **Support consumer choose agricultural products**

Field Application

Book about delicious diabetic meal

닥터키친의
맛있는
당뇨 밥상

Crop selection
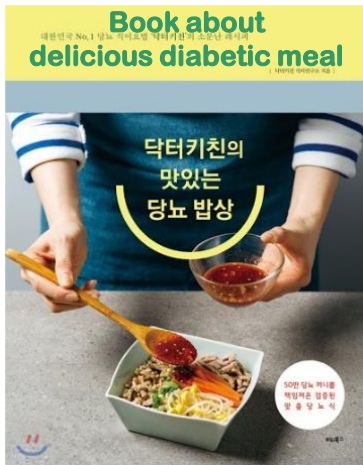
• **Recommend profitable crops for each region by linking data on soil, climate and profitability**

Consumption
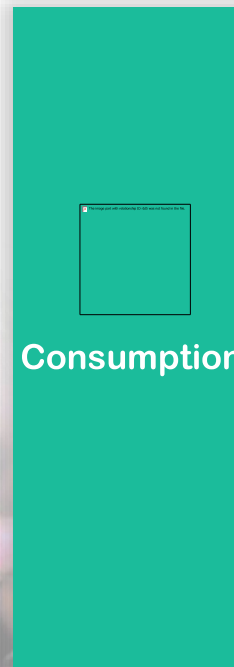
• **Personalized healthy diet**

• **Research on the relation between food, health and genetic factors (with MOHW)**

2. Support for Rural Community and Policies

Goal

Inspect farmers' compliance of fertilizer use regarding direct payment policy

Policy support using drone, satellite

Check farm's compliance and predict demand-supply using satellite
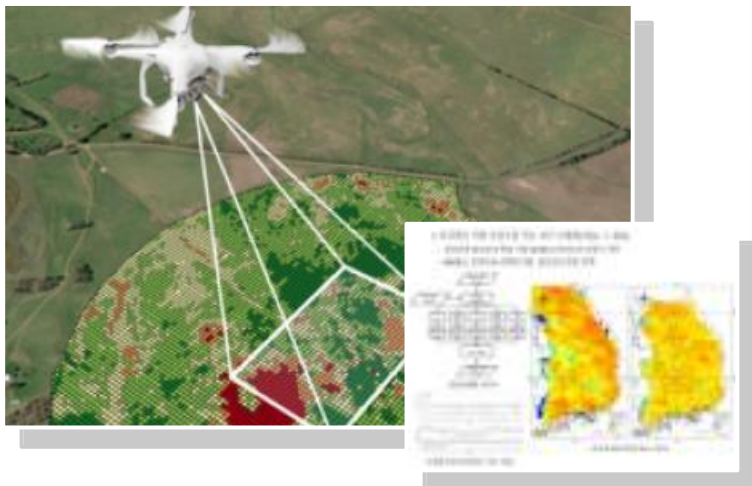
Direct Payment

- **Settle direct payment system by checking farms' compliance of fertilizer use by crop**

  * **Connect the information on soil, farm management and fertilizer sale**

Safe Products

- **Develop an integrated hazardous substances management system**

  * **Hazardous materials : pesticide, heavy metal, food-poisoning bacteria**

Revitalizing Rural Community

- **Predict fallow/abandoned land and support new farmers with customized management model**

Ⅳ. Implementation Plan

VISION	**Implementation of World's Best Digital Agriculture for Human**
GOAL	**Securing Agricultural Competitiveness and Sustainability through Digital Transformation of Agriculture**
DIRECTION	➤ **Digital Innovation of Agricultural Technology using Data and AI** ➤ **Spread of Digital Agricultural Technology through Digital Ecosystem**

KEY WORK

① Smart Farm	② Open-field Precision Agriculture	③ Agriculture Robot	④ Agricultural Weather Forecast	⑤ AI Pest Diagnosis
Development of Smart Farm Optimal Environment Control System	Development of an open-field precision farming system	Autonomous mobile Machinery and agricultural robots	Agricultural weather forecast and early warning service for meteorological disasters	AI Pest Diagnosis Service
⑥ Smart Livestock	⑦ Digital Breeding	⑧ Agricultural Management	⑨ Rural Regeneration	⑩ Technical Consultation Chatbot
Livestock management and disease early detection service	Construction of Data-based digital breeding system	Data-based agricultural management diagnosis service	Development of digital-based rural space regeneration model	Development of agricultural technology guide chatbot service

FOUNDATION CONSTRUCTION

① Data construction for AI learning ② Construction of digital agricultural infrastructure
③ System improvement, Establishment of cooperation system
④ Manpower training, Culture creation

Digital Transformation of Korean Agriculture

Securing AI-based agricultural sustainability and leading future agriculture

Agricultural Producer

Precision production management
- Smart farm environment management
- Precision amniotic moisture management
- Livestock breeding and disease management

Automation/Robots/Breeding
- Robots and autonomous machinery
- Weather and pest diagnosis
- digital breeding

Distribution / Consumer

Sales/Distribution/Consumption
- Agricultural products shipment adjustment
- Agricultural management analysis
- Promotion of agro-food consumption, etc.

Government / Business

Policy/Corporate
- Rural space regeneration
- Technical consultation chatbot
- Agtech companies, etc.

AI-based agricultural decision-making support and related industries development

Agricultural Cloud Service Platform

Image Processing

Data Labeling

Data Analysis

Machine Learning

AI Learning

AI Diagnostics

- Optimal Environmental Control
- Growth Diagnosis
- Pest Detection
- Production Forecasting
- Decision Support

Agricultural AI

Ag. Bigdata Model

Construction of agricultural big data using satellites, robots, drones, etc.

Environment / Management / Safety
- Soil (tension, etc.), Weather (temperature, etc.)
- Safety (agricultural work, labor burden, etc.)
- Ag. business, Ag. product income

Growth / Pest / Post-harvest management
- Crop growth (growth length, etc.)
- Pests by crop (powdery mildew, etc.)
- Livestock specifications and diseases, etc.

Seed / Nutrition / Consumption
- Varieties (climate), price (wholesale market,
- Food nutrition (food ingredients, etc.)
- Agri-food consumption (Items, Amount, etc.)

Satellite	Robot	Drone	Autonomous mobile	Facility	Sensor	Camera

Smart farm supply status

농촌진흥청

Supply 7,000ha of controlled horticulture facility,
livestock facility 5,750 house holds
by 2022

Controlled horticultural facility

6485
5985
5383
4900
4010
1912
769
405
232   181   430   801

Live stock facility

4785
3463
2390
1425

2014   2015   2016   2017   2018   2019   2020   2021

Ⅴ. Expected Outcomes

Farmer

Transition from experience and intuition-based decision-making to
Data-based Tech.

- Help ICT-savvy young or beginning farmers start new business and successfully settle in rural life

- Increase farmer's income by enhancing productivity/quality and assisting marketing

Realizing sustainable agriculture · rural community by increasing convenience, productivity and income

Consumer

Promote Consumption through price stabilization & traceability system

- Contribute to stabilizing price by reducing price fluctuation of agricultural commodities (e.g., vegetables)

- Make reliable and trustworthy production and distribution system for agricultural products

Promote the consumption of domestic farm produce

Corporate

Innovate Technology by linking data on production, distribution & consumption

- Create new business model by opening and using agricultural data

- Create jobs to revitalize rural community

Promote the innovative growth of relevant industries by linking data in value chain

VI. Recommendations for other countries

1. Establishment of government-level basic plan
   - Divided into fields such as vegetables, food crops, fruit trees, and livestock etc.
   - Developing the necessary skills for each step for the approach

2. Creating a trial complex
   - Smart farm technology demonstration (equipment, sensor etc.)
   - Farmhouse education and test (pilot project)
   - (if necessary) rental business for a certain period

Smart Farm Innovation Valley of Korea

Gimjae

- **Size** 21.3 ha
- **Crops** Lettuce, Eggplant, Asparagus, Cucumber
- **Specialization Strategy**
  - Functional crops
  - ICT technology
  - New seed varieties

Goheong

- **Size** 33 ha
- **Crops** Strawberry, Tomato, Melon, Tangor
- **Specialization Strategy**
  - Subtropical crops
  - Korean Smart farm
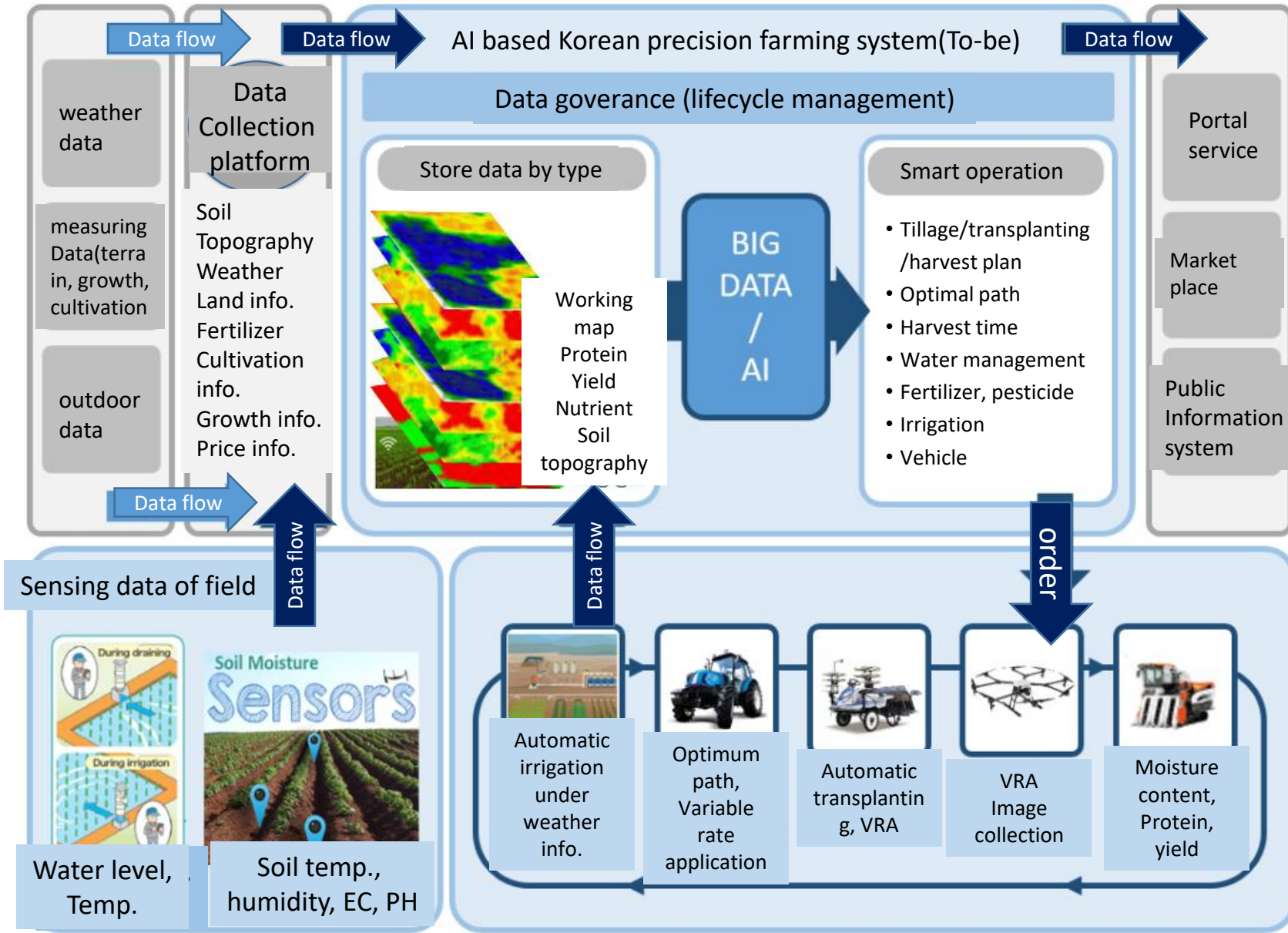 - Resident participation complex

Sangju

- **Size** 42.7 ha
- **Crops** Strawberry, Tomato, Melon, Cucumber
- **Specialization Strategy**
  - Ag. Robot,
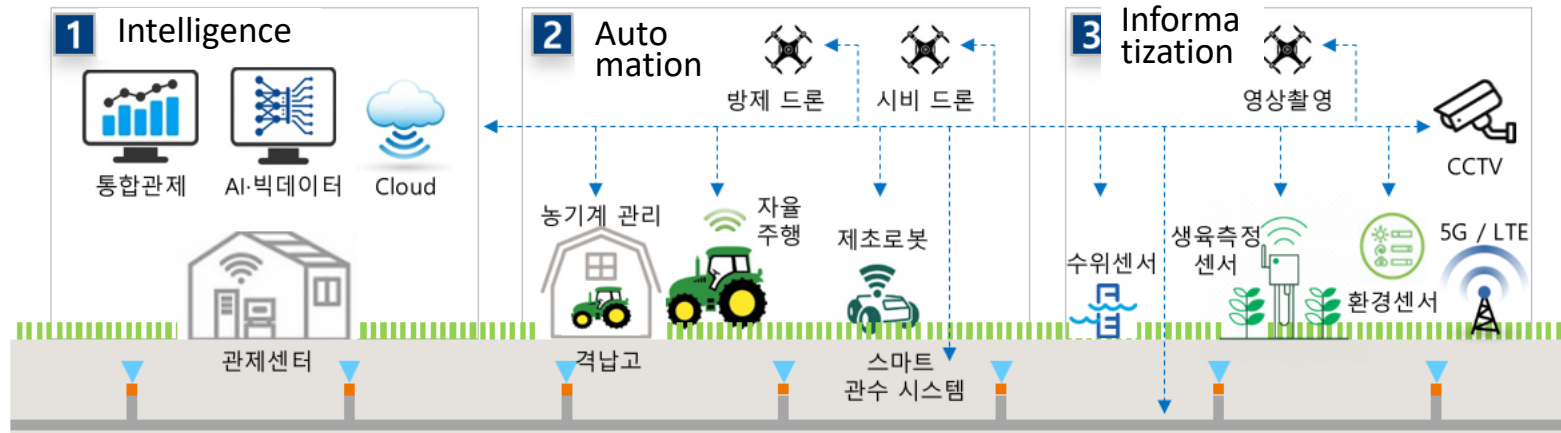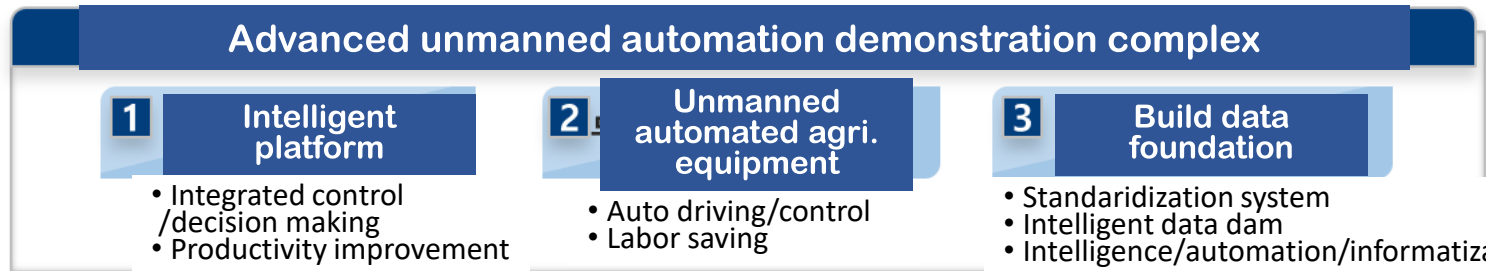 - Pest research
  - Plant export

Milyang

- **Size** 22.1 ha
- **Crops** Paprika, Tomato, Banana, Papaya
- **Specialization Strategy**
  - Nano industry integration
  - Export strategic items
  - Energy saving

Sangju

Gimjae

Milyang

Goheong

Advanced unmanned automation demonstration complex(1/2)

Data flow → **Data flow** → AI based Korean precision farming system(To-be) **Data flow** →

Data goverance (lifecycle management)

weather data

measuring Data(terrain, growth, cultivation)

outdoor data

Data flow →

Data Collection platform

Soil
Topography
Weather
Land info.
Fertilizer
Cultivation info.
Growth info.
Price info.

Data flow →

Store data by type

Working map
Protein
Yield
Nutrient
Soil topography

BIG DATA / AI →

Smart operation

- Tillage/transplanting /harvest plan
- Optimal path
- Harvest time
- Water management
- Fertilizer, pesticide
- Irrigation
- Vehicle

Portal service

Market place

Public Information system

Data flow (vertical)

Data flow (vertical)

order (vertical)

Sensing data of field

Water level, Temp.

Soil temp., humidity, EC, PH

Automatic irrigation under weather info.

Optimum path, Variable rate application

Automatic transplanting, VRA

VRA Image collection

Moisture content, Protein, yield

Advanced unmanned automation demonstration complex(2/2)

Advanced unmanned automation demonstration complex

1 Intelligent platform
- Integrated control /decision making
- Productivity improvement

2 Unmanned automated agri. equipment
- Auto driving/control
- Labor saving

3 Build data foundation
- Standaridization system
- Intelligent data dam
- Intelligence/automation/informatizatio

1 Intelligence
- 통합관제
- AI·빅데이터
- Cloud
- 관제센터

2 Auto mation
- 방제 드론
- 시비 드론
- 농기계 관리
- 자율 주행
- 제초로봇
- 격납고
- 스마트 관수 시스템

3 Informa tization
- 영상촬영
- CCTV
- 수위센서
- 생육측정 센서
- 환경센서
- 5G / LTE

thank
YOU

농촌진흥청