Private Sector participation in building resilient Agro-Food System:

Stories of Converging ICT & Agriculture in rural Korea

For 2017 APEC CLIMATE SYMPOSIUM
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Ja Heung Koo
Director, Global Business Group

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Why Smart Farm?

2

Smart Farm industry in Korea

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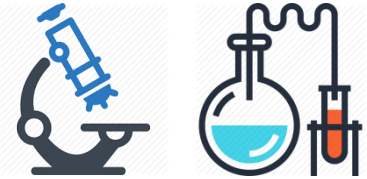
KT Smart Farm

4

Exploring & Experimenting



Why Smart Farm?

- Where are we?
- Finding New Opportunities
- The Situation
- Farm Demographics in Korea
- Smart Farm Definition
- KT in the Value Chain

Where are we?

KT until 2012

Telecommunication Business.

3 SERVICES

- **Mobile** (4G, 3G)
- **Fixed Broadband** (FTTH, xDSL, LAN, Sat)
- **Fixed Phone** (PSTN, VoIP)
- **Pay TV** (IPTV, Sat TV)
- **Others**

2 PLATFORM

- **IDC**

- **Cloud**

- **Big Data**

- **IoT Platform**

- **Security**

1 INFRASTRUCTURE

- **Air**

3G, 4G, 5G, WiMAX

- **Space**

Satellite, land earth station

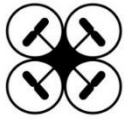
- **Undersea**

Submarine Cable, landing station

- **Underground**

Fiber Optic cable, Copper cable

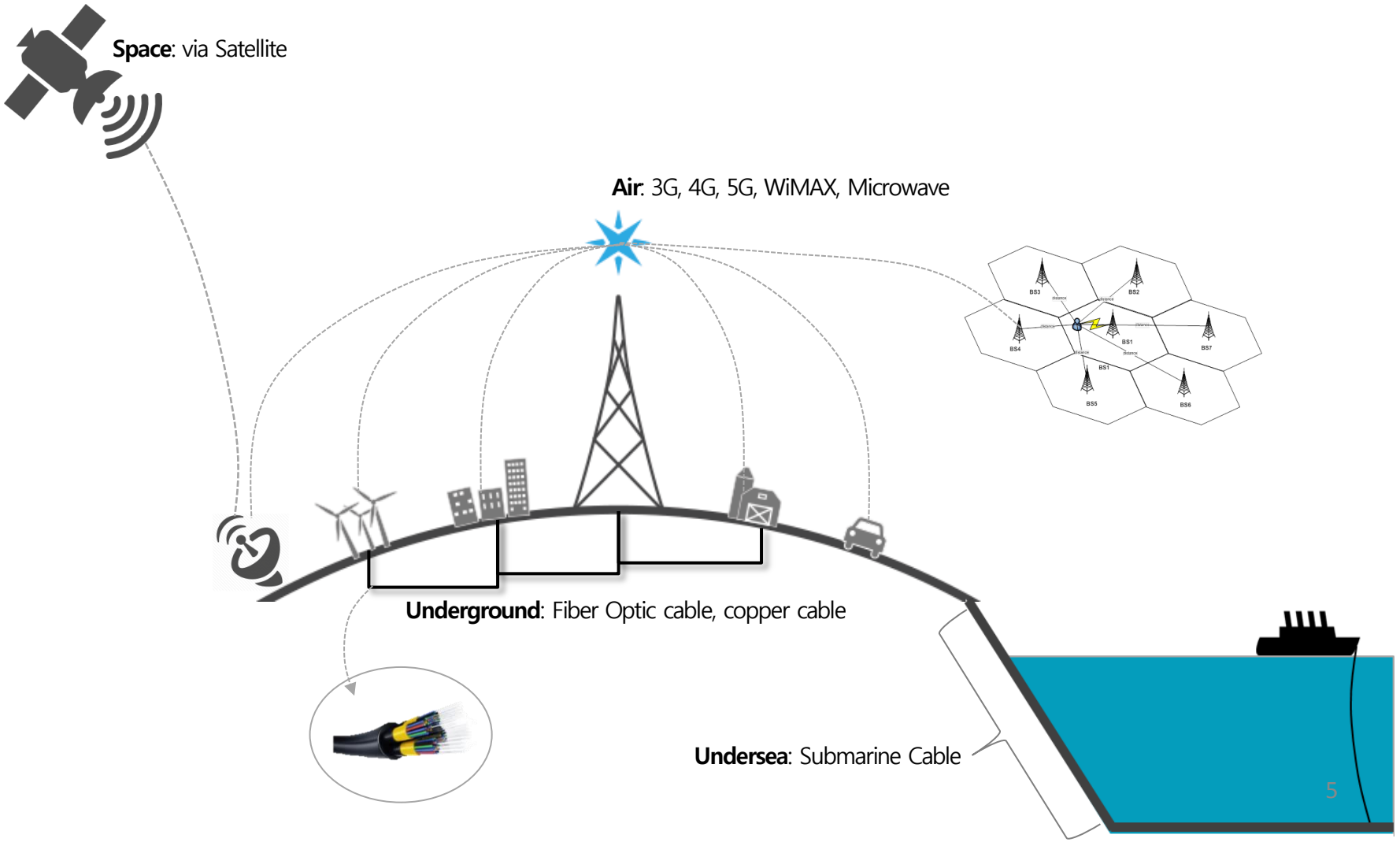
- **Others**



LTE drone, LTE backpack

Where are we?

KT until 2012

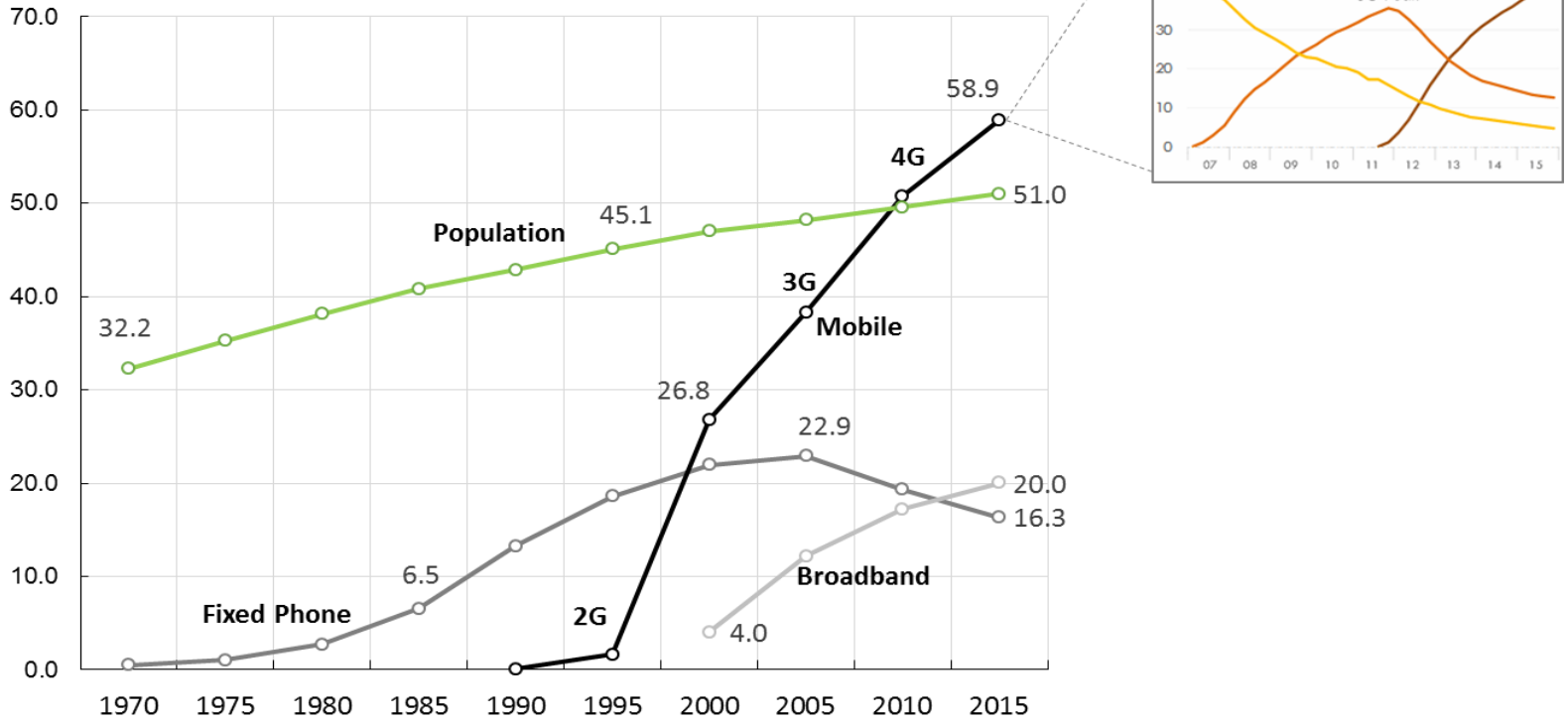


Saturating Market

: Not much room left to grow in the traditional telecom market

[No. of subscribers in Korea's Telecom market]

(Unit: Million)



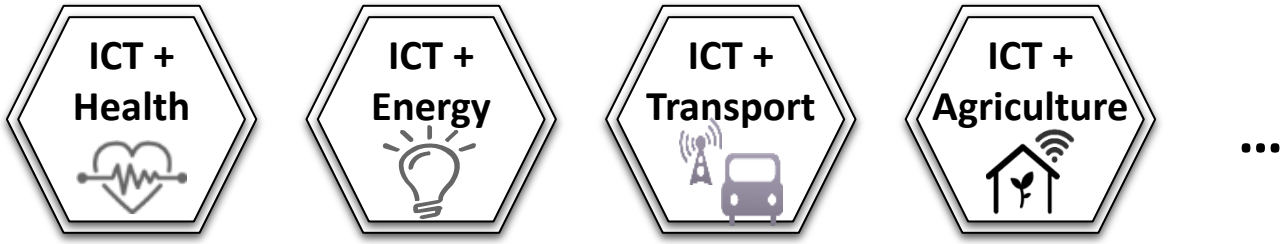
Source: KISDI, MSIP (2017)

Finding New Opportunities

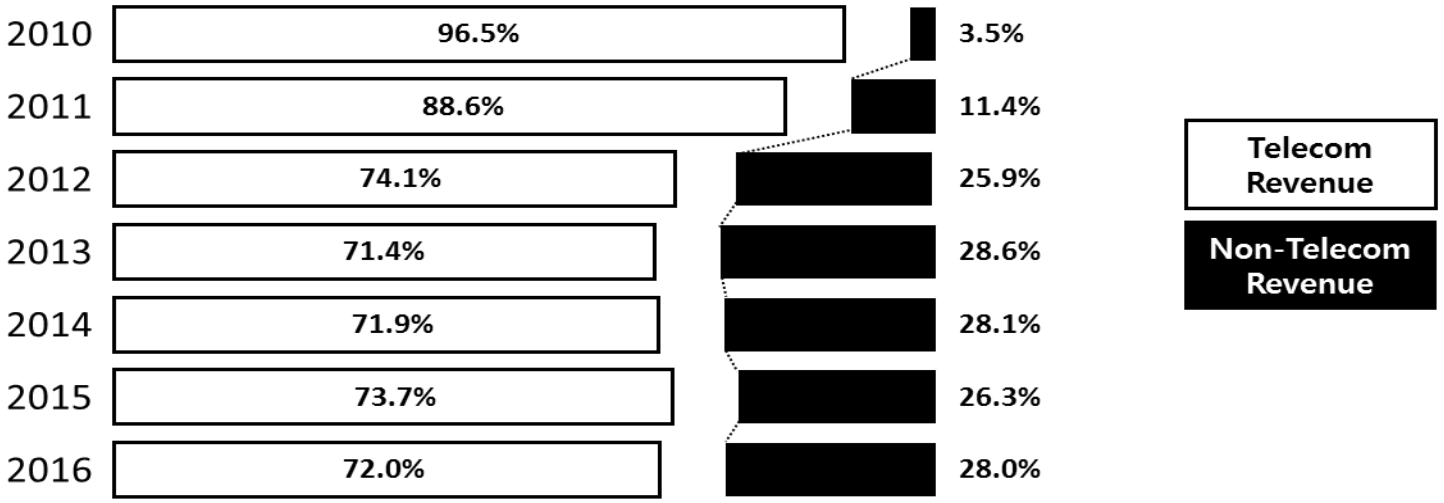
Increasing non-telecom sector

Moving into Convergence Business

: Convergence: Merging of distinct technologies, industries into a unified whole)



[KT Revenue proportion of Telecom vs. Non-Telecom]



Source: KT Investor Relations (2017)

Finding New Opportunities

Adding Convergence layer

4 CONVERGENCE

- Smart Farm
- Smart Energy
- Integrated Safety
- Networked Transportation
- Next Gen. Media
- E-Healthcare
- Fin Tech

3 SERVICES

- **Mobile** (4G, 3G)
- **Fixed Broadband** (FTTH, xDSL, LAN, Sat)
- **Fixed Phone** (PSTN, VoIP)
- **Pay TV** (IPTV, Sat TV)
- **Others**

2 PLATFORM

- **IDC**
- **Cloud**
- **Big Data**
- **IoT Platform**
- **Security**

1 INFRASTRUCTURE

Air	Space	Undersea	Underground	Others
3G, 4G, 5G, WiMAX	Satellite, land earth station	Submarine Cable, landing station	Fiber Optic cable, Copper cable	LTE drone, LTE backpack

The Situation

Looking into Smart Farm Industry

Why Smart Farm?

Government

- Eager to promote Smart Farm industry
- Increase farms using Smart farms / Subsidy, financial instruments and support to farmers in adopting Smart farm / Plans to export Smart Farm overseas in the long term

Demographics

- Farm population average age continues to increase / Farm population continues to decline
- But, Urban to Rural migration is steadily increasing (High competition in Urban areas, Retirement of baby boomer generation) / High ICT Development Index (ITU)

Market

- Market in infancy and expected to grow / Low competition (mostly SMEs in Market)
- Need for Economy of Scale (Smart farm facilities and equipment too costly)
- More competitive food supply from other countries due to FTA
- Need to overcome Lack of Farming manpower through ICT
- Resistance towards large firms entering Agriculture sector from farmers

Technology

- Rapid advancement of ICT that can be used in Agriculture Sector (Sensor, IoT, Big Data, Drone, etc.)

Environment

- Climate Change, difficult to forecast weather

KT

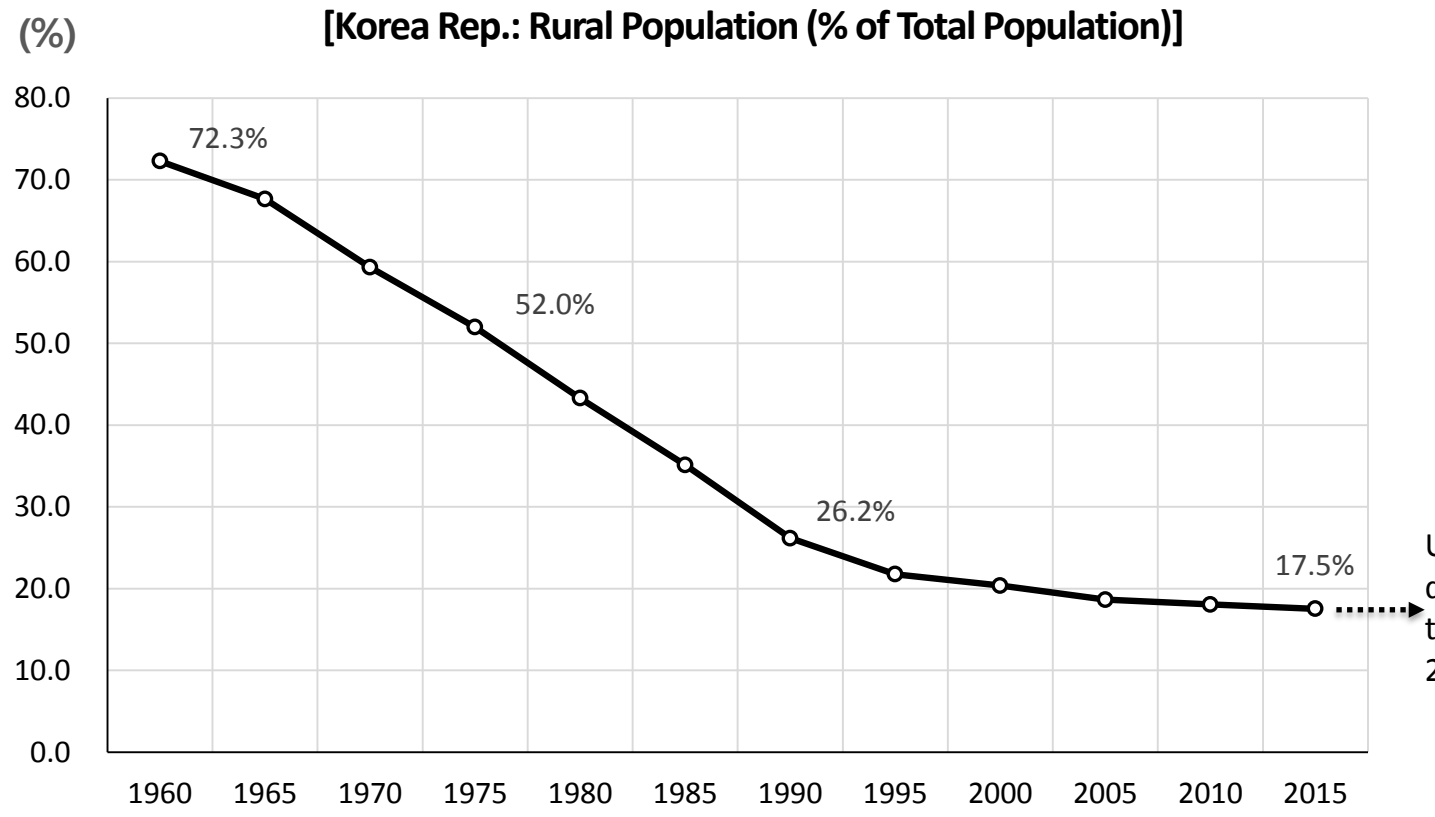
- Need for new market /Use KT's core strength in telecom/ICT
- Possible to provide Smart farm services even in rural and remote areas (Broadband coverage in Korea: 99.7%, 4G LTE coverage in Korea: 99.9%)
- Well known company and brand especially in rural areas
- 257 regional offices 23, 600 staffs covering all of Korea (operation and Maintenance)

Farm Demographics in Korea

Rural Population is already very small

High % of the population in Korea live in Urban areas.

: Rural population is now 17.5% of the total population



UN DESA predicts developed countries to reach 17.5% in 2035.

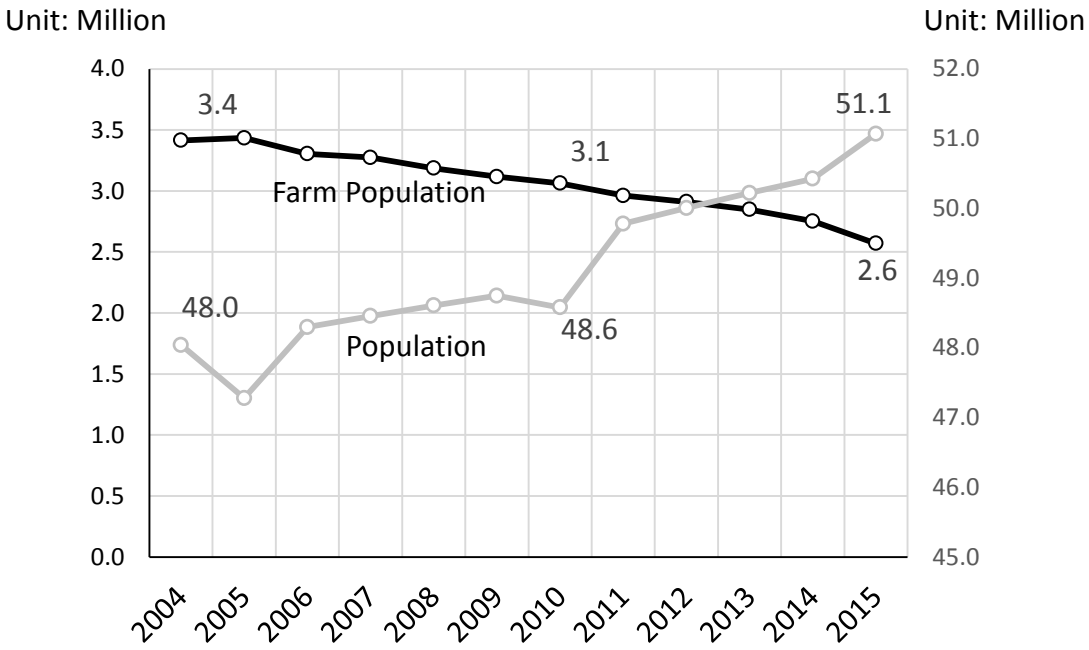
Source: World Bank (2017)

Farm Demographics in Korea

Farm Population ⇩, Average age ⇧

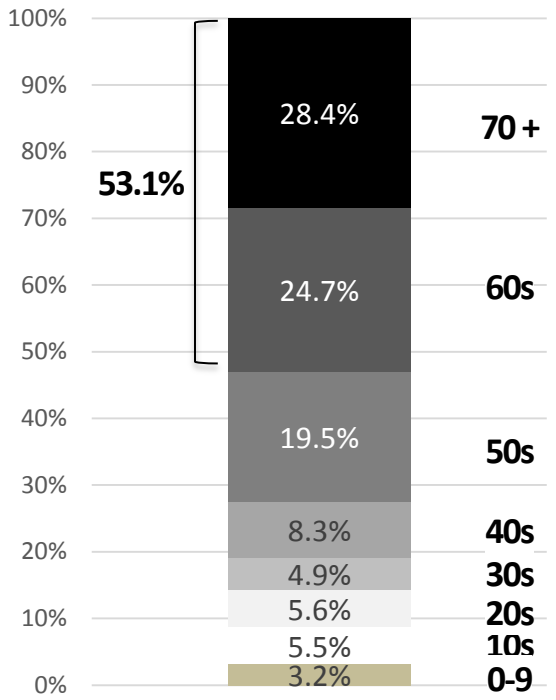
Farm Population continues to decrease.
60+ age group takes up 53.1% of Farm population.

[Korea Rep.: Total Population vs. Farm Population]



Source: Kostat, MAF (2016)

[Farm Population by Age Group]



Source: Kostat, MAF (2017)

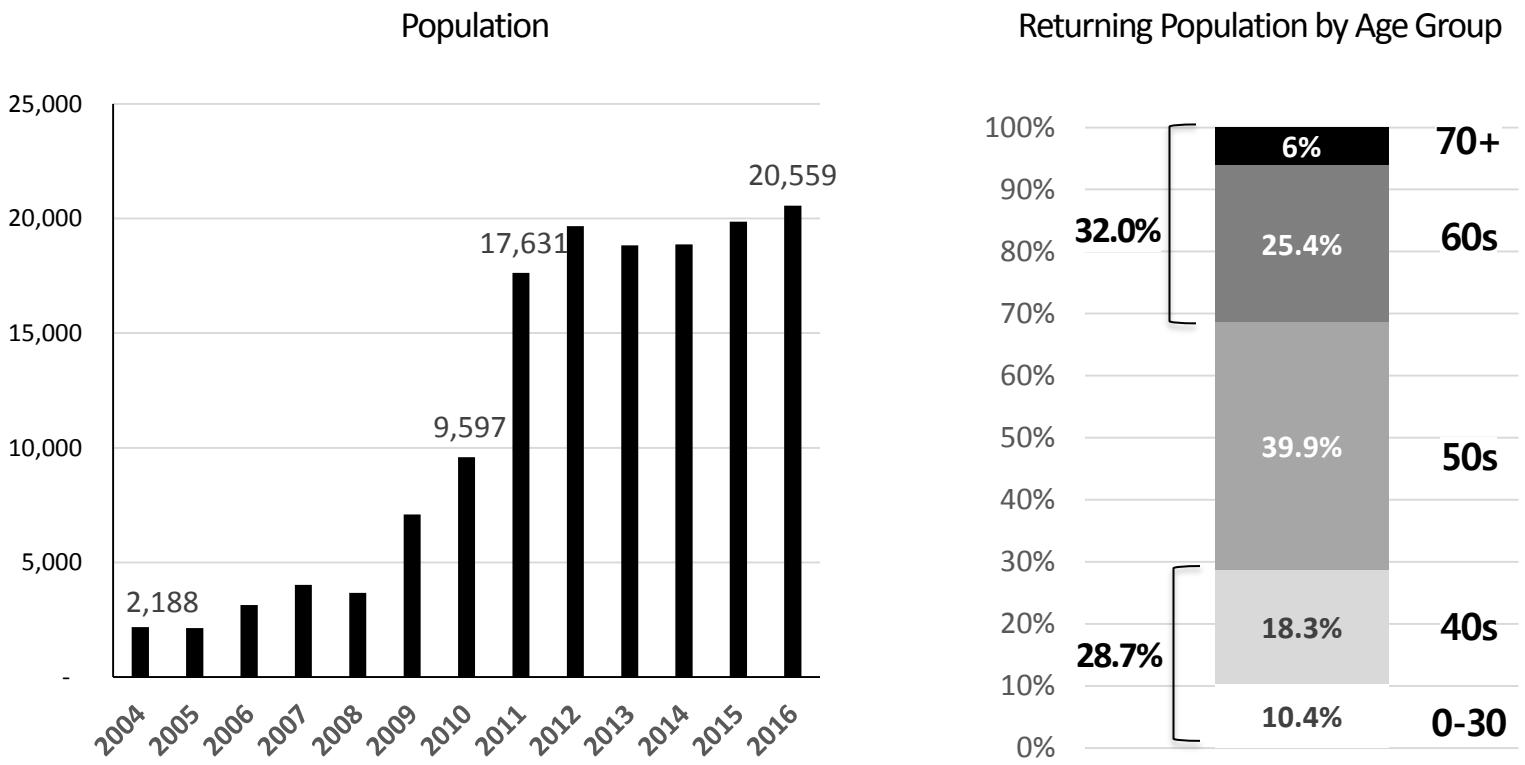
Farm Demographics in Korea

Steady population returning to Farm

Population returning from Urban to Rural area is steadily growing

: High competition in urban areas
Baby boomer generation starts to retire

[Rep. Korea: Population returning to Rural areas for Farming]



Source: Kostat, MAFRA (2017)

Smart Farm definition

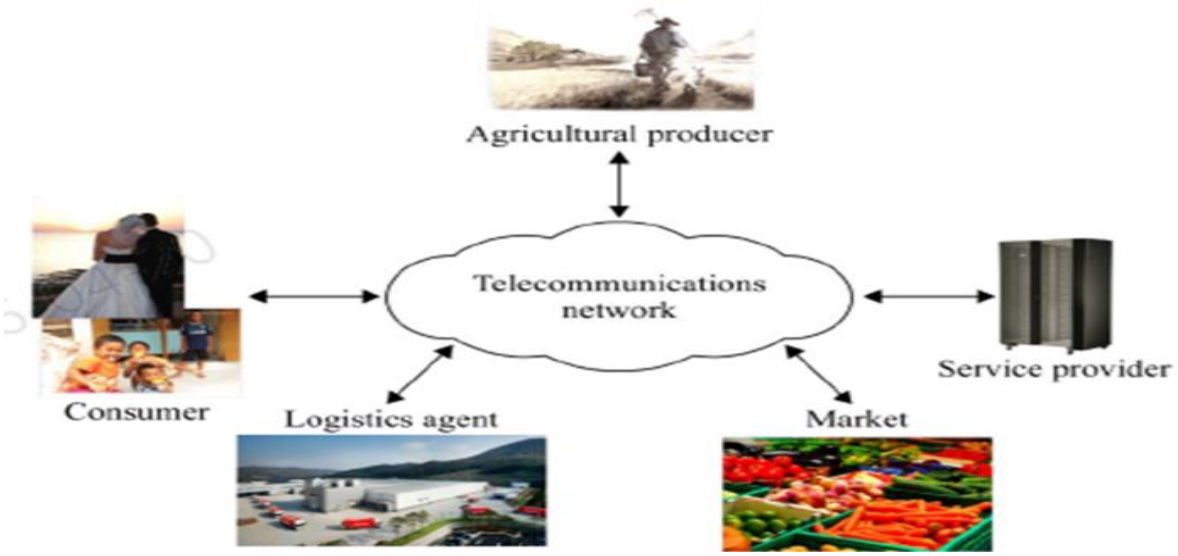
By International Telecommunications Union (ITU)

Definition

Smart Farming: Service using networks to actualize a convergence service in the agricultural field to cope with various problems, e.g., time-varying weather changes, growth condition of farm products, and continual diseases or technical problems, such as battery life, sensor malfunctions due to severe conditions, with the aid of information processing and autonomous control technologies of the information technology (IT) area.

Technology

Internet of Things (IoT), GPS, Sensors, Big Data, FTTH, LTE, etc.



Source: ITU-T Y.2238 (2015)

Smart Farm Value Chain

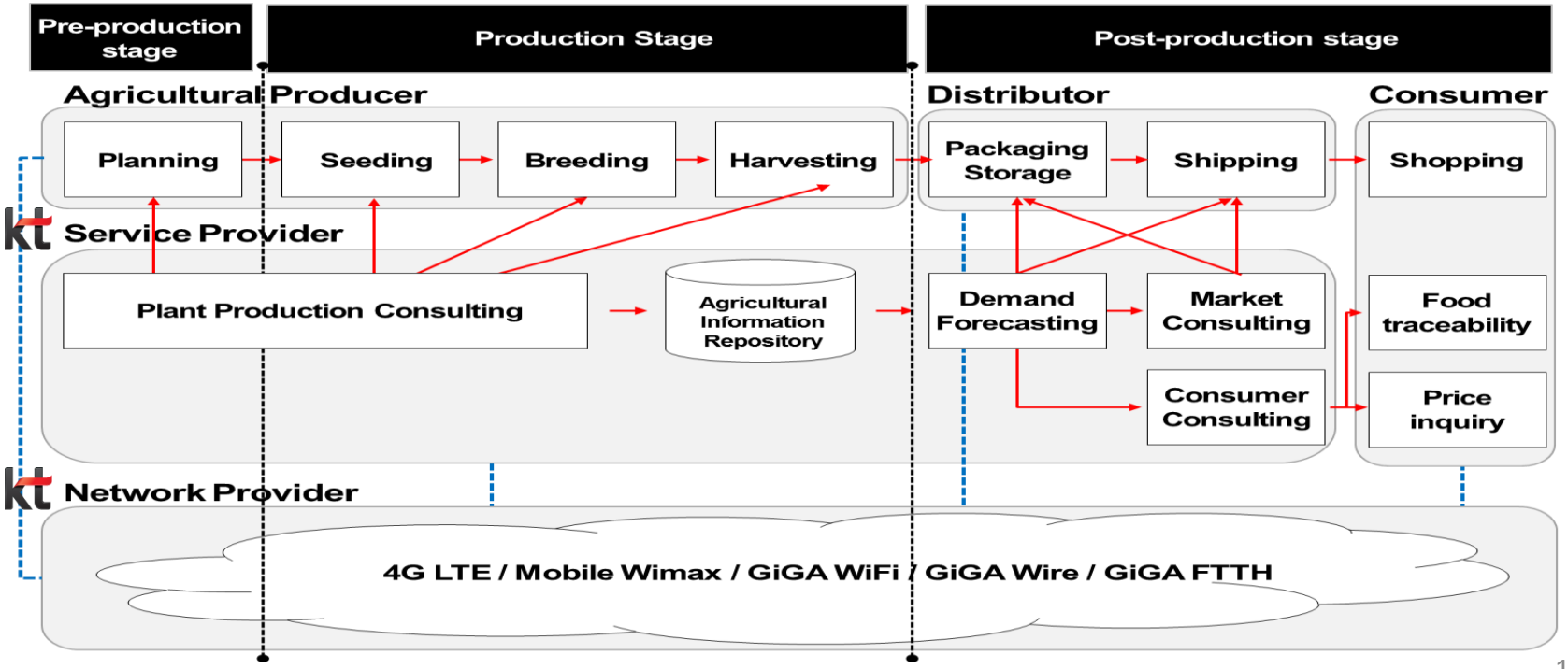
KT in the Value Chain

Major Stakeholders

Agricultural producers, service providers, logistics agents, market distributors, customers and the telecommunications network that interconnects.

Objective

To optimize the yield per unit of farming land by using the most modern means in a continuously sustainable way, to achieve best in terms of quality, quantity and financial return.



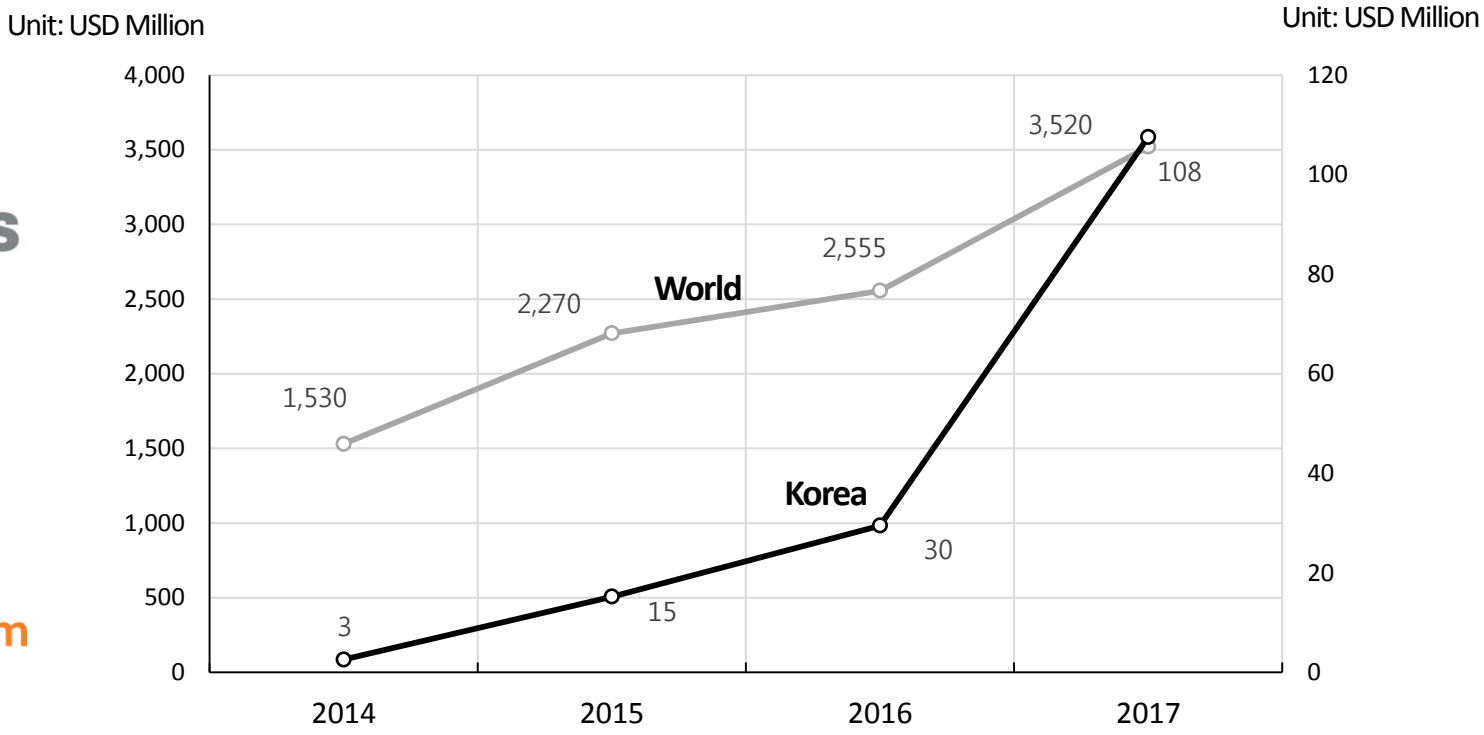
Source: ITU-T Y.2238 (2015)

Smart Farm industry in Korea

- A growing Industry
- Government Support

Korea's Smart Farm industry is still in its infancy.
: But it also means there is room to grow

[Smart Farm Industry expected growth]
World vs. Korea Rep.



Source: KPMG Korea, SMBA, KT (2016)

Government support to Smart Farms

Policy Roadmap

2017

Policy to widespread Smart Farm

2017:
- Provide Smart farms to Controlled Horticulture (4,000 ha), Livestock (700 Farms), Fruit farms (600 farms).

2015

2015:
Smart Farm expansion directives
1. Promote smart farm / 2. Increase productivity rate of smart farm
3. Create a sustainable eco-system for Smart Farms

2014

Policy to widespread use of ICT Convergence

2014:
- Smart Fart adoption to focus on “controlled horticulture” and “Livestock” industry

2013

2013:
- Analyze current Agriculture industry (production, distribution, consumption) to find where to use ICT
- Expand ICT + Agriculture convergence model
- Promote Smart Farm model / Build policies for Smart farm / Foster related R&D

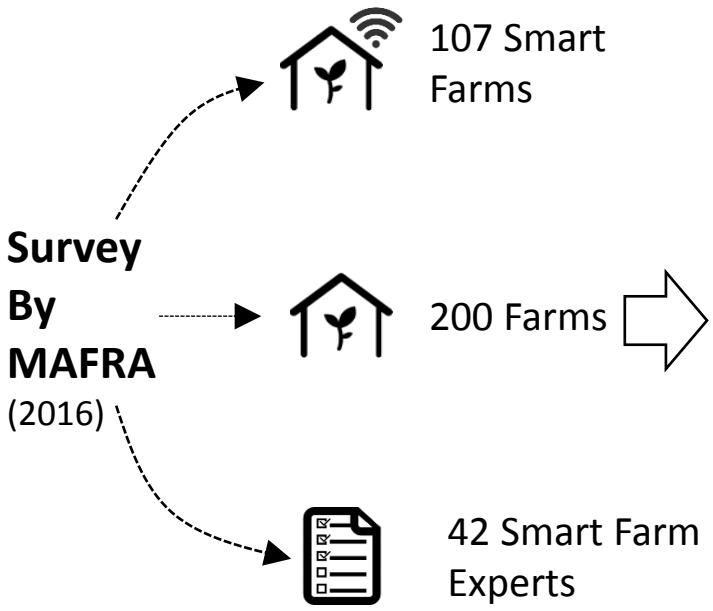
2010

2010:
- Create ICT + Agriculture model to apply to controlled horticulture, livestock, distribution sectors of Agriculture industry.

Source: MAFRA, KPMG (2016)

Government support

Farmer's Expectations and Concerns



Expected Benefits	Concerns	Government Support
Productivity increase	**Need for Financial Support** (Initial Smart Farm cost is too high)	Fund for Smart Farms Use of crowd Funding Leasing farm facilities
Income increase	**Reliability issue** Will Smart Farm or technology really help?	Advertise best practice through media, forums, exhibitions, etc.
Quality enhancement		
Reduced labor	Technical limitations Difficult to use ICT Need for continuous training Lack of standardization of core technology and parts.	Provide training and education. Assist in technology development (R&D)
Extra income		
More personal time		

*MAFRA: Ministry of Agriculture, Food and Rural Affairs

Government support

What Government provides

Government Support		
Eligible sector	**Specific items**	**Subsidy**
Horticulture Smart farm	Smart farm (sensors, control panel, etc.) & related equipment (nutrient, sunblock, Co2 etc.)	Government subsidy 20%, Government loan 30%, Rural government subsidy 30%, Farmer 20% Loan condition: interest rate per annum 2% (3 year grace period, 7 year payback)
Fruit Smart farm	Equipment to prevent environment hazards, disease, pests, control equipment to spray water, nutrient, pesticides, information system, etc.	
Livestock Smart farm	Feeding and management Software, stable management system and automatic feeder, instrument grader, etc.	Government subsidy 30%, Government loan 50%, Farmer 20% Loan condition: interest rate per annum 2% (3 year grace period, 7 year payback)

Source: MAFRA (2016)

KT Smart Farm

- Concept & Service Overview
- Smart Farm related Organization
- Support to Smart Farmers
- Smart Farm Benefits
- Journey so far (Reference)

Concept

Sensing Automation

I Maintain Optimal Environment

Sensing	• Sensor → Collect/Send Environmental Data
Automation	• Automatic Control of Facility Equipment

Smart Farm Platform

II Cloud/Big Data based Control

Control Center	• Sensor/Environment info Monitoring • Emergency Notification, A/S alert
Smart Farm Platform	• Green House Oper. / Manag. System, Crop Cultivation support System • Cloud Based IoT Platform

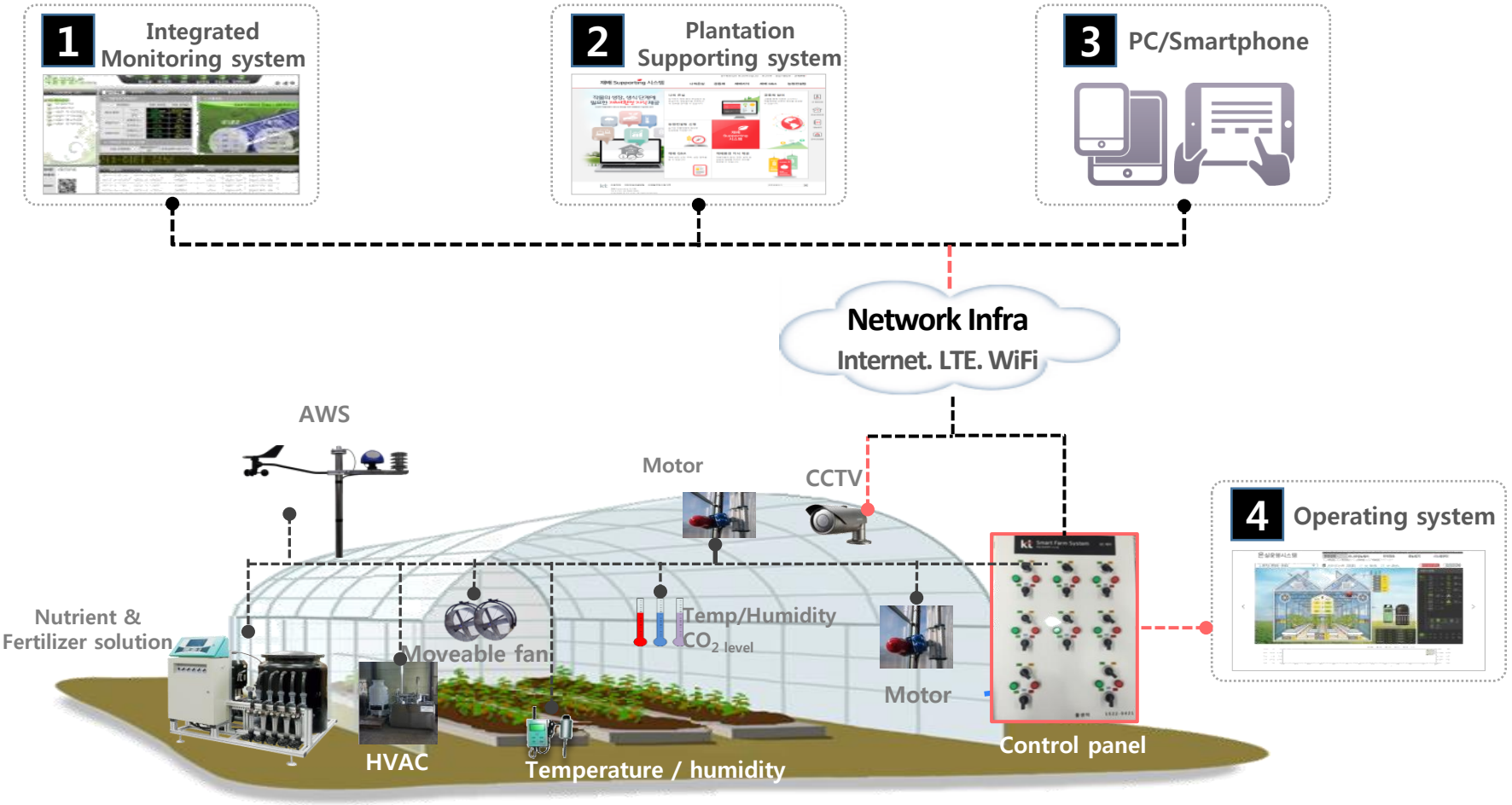
Smart Device

III Remote Monitoring/Control

Various Devices	• Remote monitoring/control via PC, Smart mobile devices.
Convenience	• Farming Journal • Optimal Crop Cultivation Environment

Overview of Services

Smart Farm consists of an operating system that can monitor and analyze crops using Network and control panels.



Major Components

- **External weather service**
  - temperature sensor, humidity sensor, etc.

- **Internal sensor**
  - temperature sensor, humidity sensor

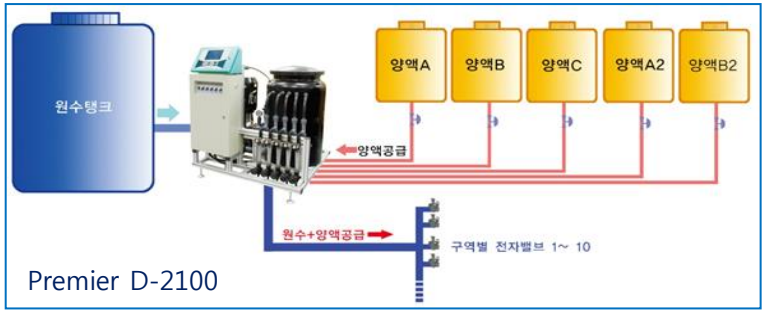
- **Controller**
  - wire/wireless combined

- **Power panel**
  - magnetic switch, manual control

- **CCTV**
  - motion detection/moisture-proof

Nutrient(watering) control system: automatically provides nutrient(watering) to plant via our control system.

Controlled horticulture nutrient control system



- ✓ Automated control and detection of abnormal status
- ✓ Premier type can cultivate 2 kinds of plants with 5 kinds of nutrient line

Nutrient control system for fruit trees

- ✓ Prevent sunscald and leaf burn through automatic watering with temperature presets
- ✓ Our system can promote the growth of fruit by adding liquid fertilizer supplying line

Overview of Services

Major Components

Internally developed system by KT that increases agricultural production and cultivation efficiency.

Operation Management

✓ Adjusting cultivation environment for each crop

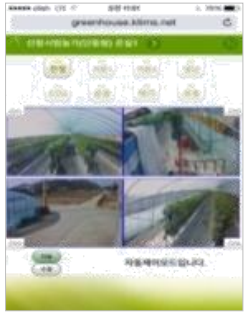
Cultivation Support System

✓ Providing information and knowledge for cultivating crops

Integrated Control

✓ Monitoring the environment of green house

Using Mobile Application



✓ Integrating the control system via smartphone and tablet application

Overview of Services

Type of Smart Farm

4 types of Smart Farm subject to ecology and scale of crop.

1 Single-span

Individual greenhouse

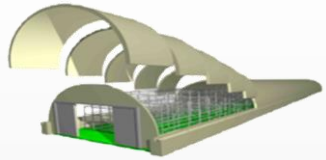
- ✓ Small sized greenhouse (0.08hectare)
- ✓ Simple environmental control : single environmental element control(fewer sensors, motors)
- ✓ Representative crop : strawberry, melon

2 Multiple

Interlinked multi-greenhouse

- ✓ Large scale greenhouse (> 0.33hectare)
- ✓ Complex environmental control : over two environmental element control (insolation, CO2, humidity, etc)
- ✓ Representative crop : tomato

3 Dome house



- ✓ Non-photosynthetic plant
- ✓ Simple environmental control : fewer sensors – no need to control light
- ✓ Representative crop : mushroom

4 Plant factory

- ✓ Advanced farming under automatically controlled facility (insolation, temperature, humidity, nutrients, etc
- ✓ Representative crop : lettuce, ginseng

Overview of Services

Implementation process

Foundation

- Consider Soil, bearing power
- Grounding and leveling work
- Drainage work

Steel-frame work

- Width /height : 8m/5.5m
- Column space/beam : 4m/8m
- Steel frame fabrication

Sheathing work

- Material : PO film(polyolefin)
- Thickness : 0.15mm

Curtain installation

- Horizontal full-wire system
- Heat reserving /light shading → dual screen

Heating work

- Rail heating considering uniform heat generation (6lines/bay)
- Select boiler capacity / thermal storage tank

Nutrient solution irrigation

- Slab : 6 lines/bay
- Consider Plumbing space / hot water/nutrient /acid tank

Bed

- 6lines per greenhouse
- Able to adjust the height
- Elevated bed for easy farming

Smart farm solution

- Support PC, mobile access
- Remote integrated control
- Provide correlation between growing environment and crop (in near future)

Overview of Services

Connected Drones for Smart Farming

Using the industrial drone in agriculture to support labor force, to increase productivity of crops and to support controlling Smart Farm's facilities.

[Composition of Agricultural Drone]

Farm field

GCS(Ground Control System)

Remote Monitoring & Operation

Effects: Reducing resources and increasing Productivity

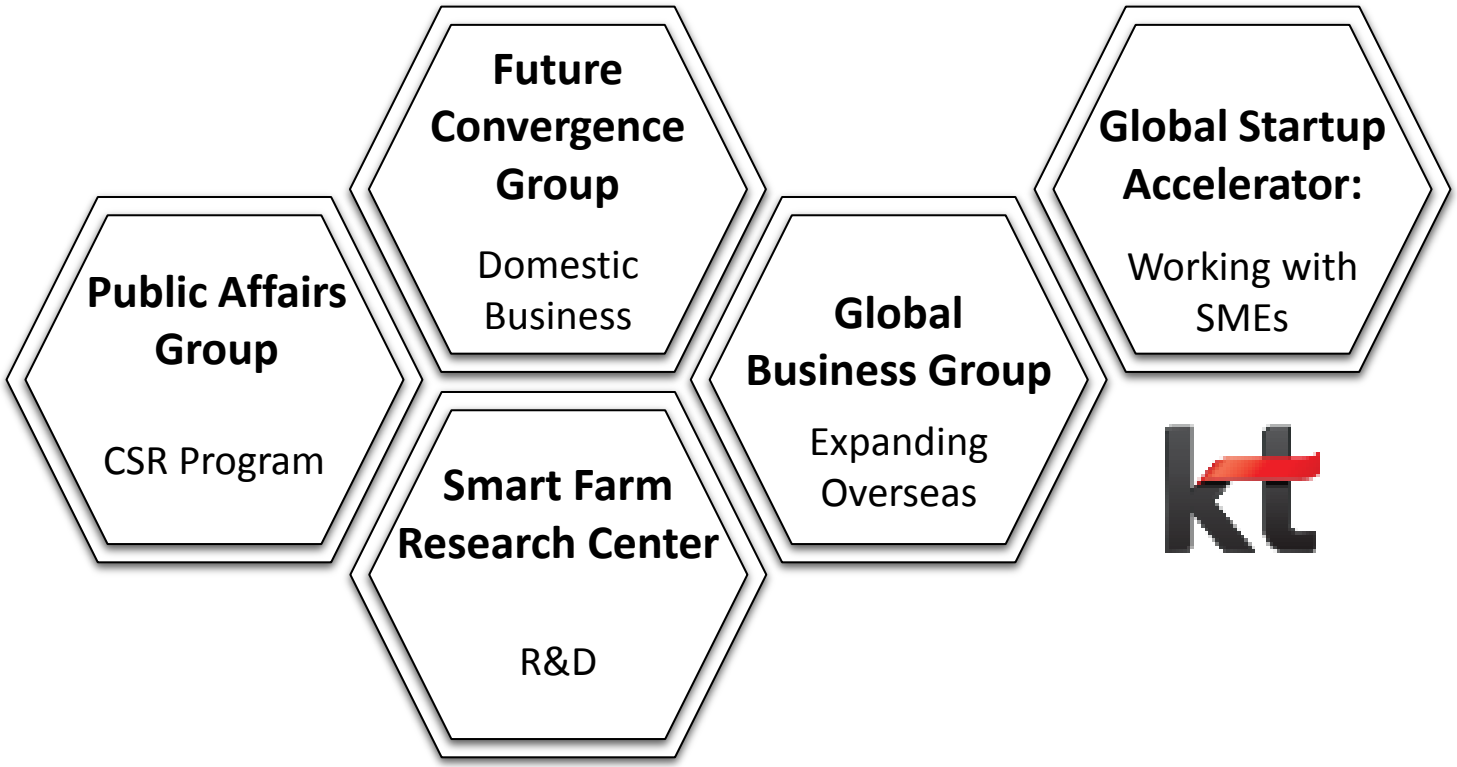
① Support labor force in rural area
② Rapid decision using detailed monitoring and analyzing
③ Possible to control larger area
④ Effective distribution of fertilizer and pesticide

Coverage

① Monitoring the farm
② Distribution of fertilizer and pesticide
③ Monitoring insects and crops
④ Predict crop production

Smart Farm related organizations in KT

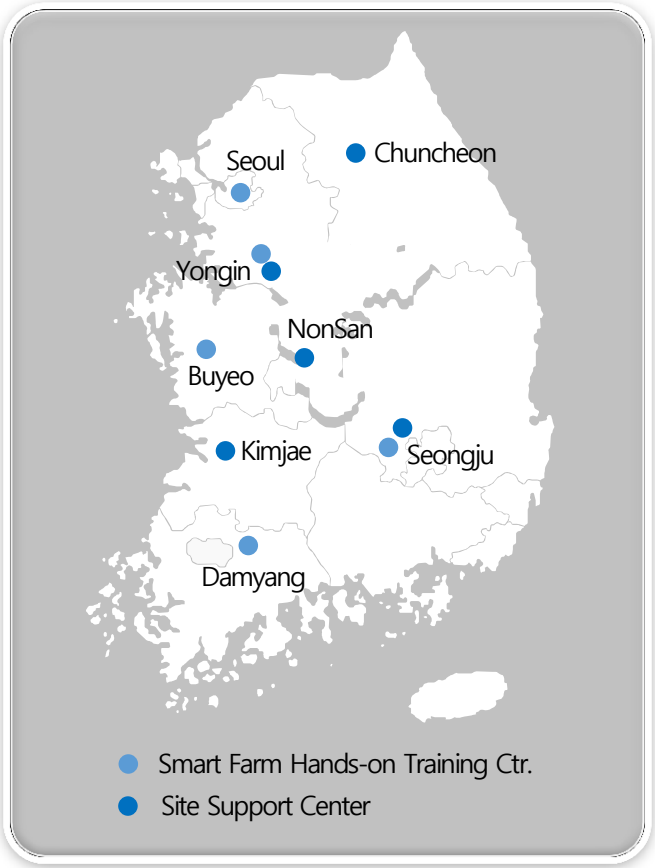
From Research Centre to SMEs



Support to Farmers

Nationwide support and Training Center

Help and support available in order to solve difficulties in ICT Technology use in collaboration with RDA (Rural Development Administration).



5 Smart Farm Hands-on Training Centre.

- **Experience & Learn about Smart Farm & Available Hands on Training**
  - Hands on Education & Training
  - Experience convenience & efficiency of Smart Farming

5 Site support Centre

- **A/S support near main production site**
- **Dedicated Smart Farm Call Center** (1522-0421)

[KT Smart Farm training centre in Yong-in city Agricultural Technology Centre]

Smart Farm Benefits

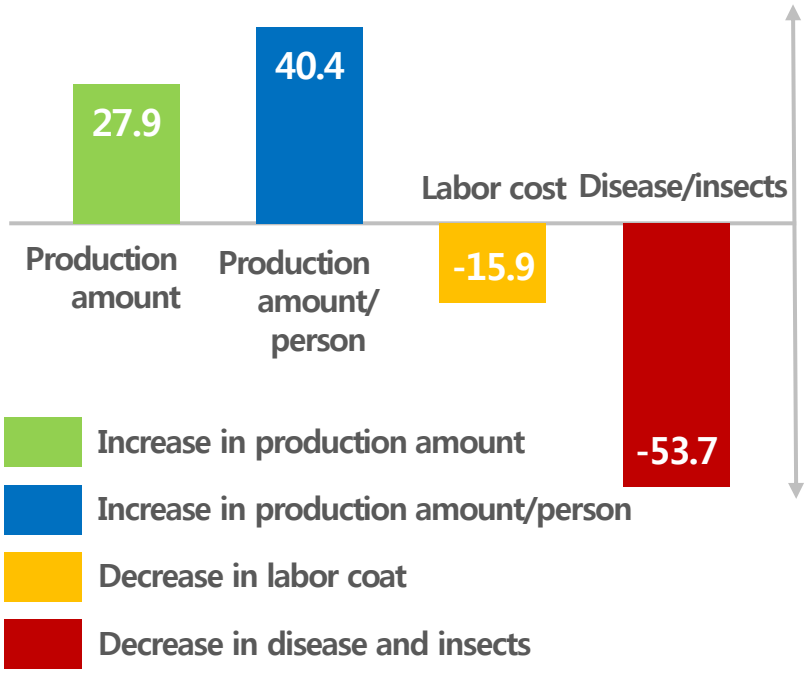
Still a long way to go

Strengthening agricultural Competitiveness and increasing profit.

Gaining competitive edge through Smart Farm

- **Extension of income base**
  - Controlling harvesting environment based on use of big data
  - Easy implementation using both S/W and H/W module
- **Stable profit growth all year round**
  - Harvest crops all year round
- **Helping new farmers to settle in**
- **Sharing new farming technologies, knowledge (best practice)**
- **Assist in marketing and promotion**

Smart Farm productivity breakdown* (Scale: %)



✓ Implementation of Smart Farm results in increasing production amount, but decrease in labor cost, disease and insects.

Source: MAFRA, SNU (2016)

Journey so far
Reference

KT has various ICT convergence references in agriculture field.

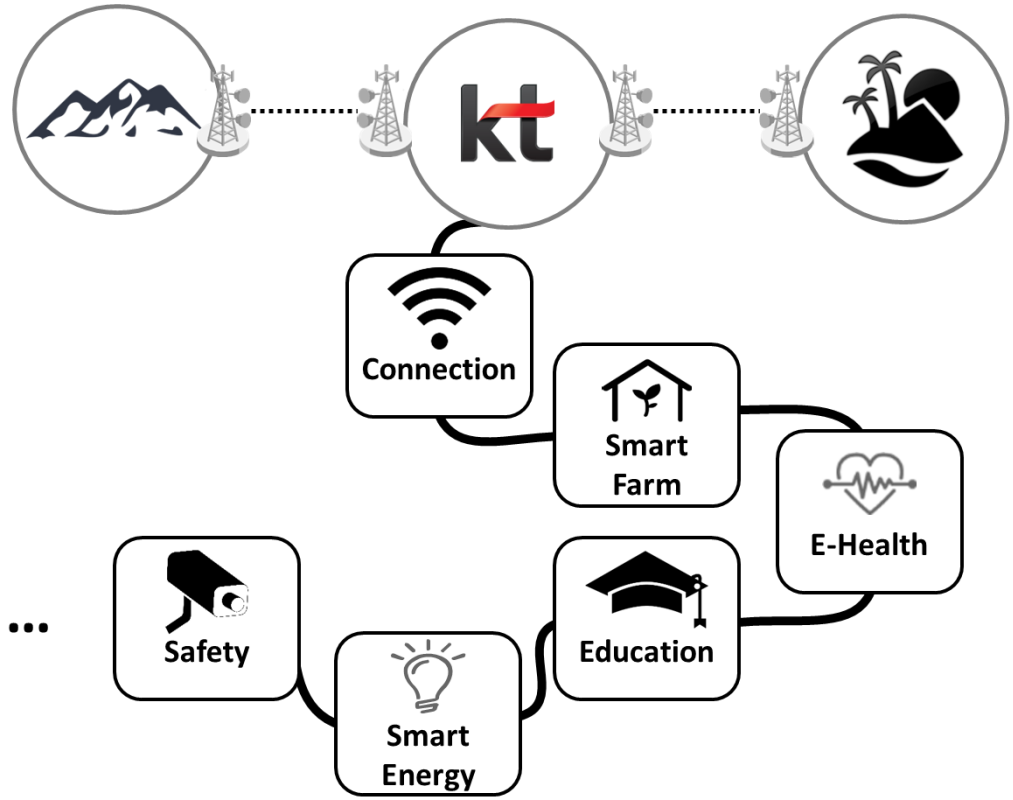
Date	Project
2017	• Mushroom Smart Farm construction (Yeosu region) • Mushroom Smart Farm construction (Jeju Island region) • Single/Multiple unit Smart Farms construction: 100 farms
2016	• Mushroom Smart Dome House (Jinju region) • Smart Farm for the Disabled (Namyangju region) • Single/Multiple unit Smart Farms construction: 200 farms
2015	• Mushroom Smart Farm construction (Masan region) • Controlled environment system construction for Tomato Smart Farm • Smart farm village environment control system construction: Ministry of Agriculture and Forestry • Strawberry Smart Farm construction
2014	• Smart Farm construction (Shiitake- Kaneong Satdol village) • Controlled environment system construction for Smart Farm
2013	• Nutrient system construction • Nutrient system construction (Japan) • Fruit tree Nutrient system construction
2012	• Operation system construction (Kyunggi province Eco-Distribution Center)

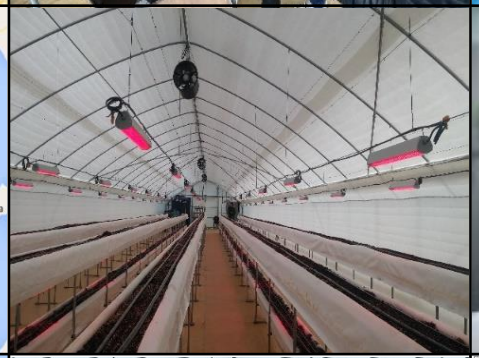
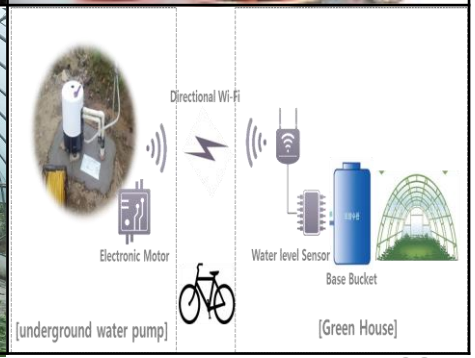
Exploring & Experimenting

- Smart Farms to Bridge gaps
  (LED & Heating, for Schools, for the Disabled, simple sensors).
- Others
  (GS1 Agri-food information, e-commerce platform)

GiGA Island projects (2014 -)

: Connecting 6 remote and isolated areas



1	**Imja Island** a. Standard Smart Farm b. Smart Farm for School			
2	**Baengyeong Is.** a. Standard S. Farm + b. LED lighting c. Hotwire Heating			
3	**Gyodong Is.** a. Standard S. Farm + b. Water level sensors			

4 Smart Farm for the Disabled

① Easy Access to the disabled people

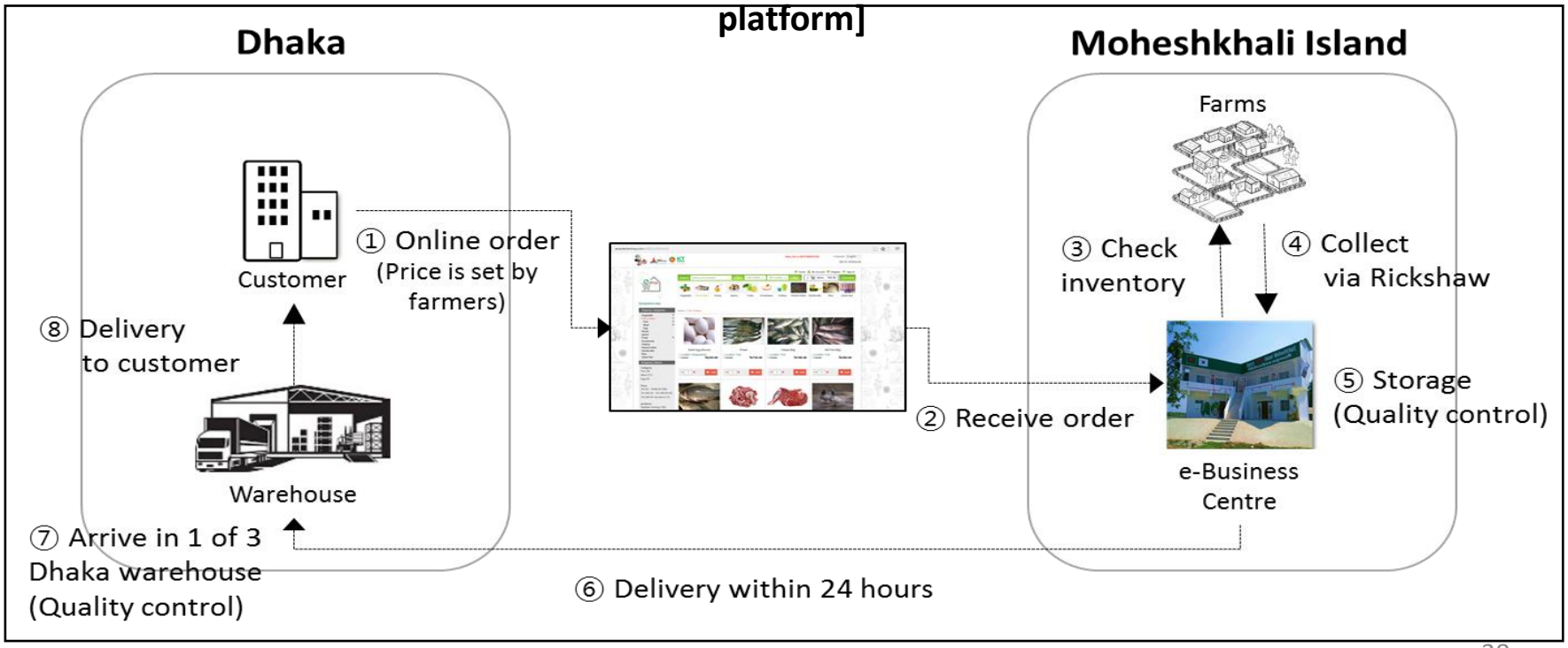
② Height adjustment & Space utilization

③ Floors with wheelchair access

5 e-Platform for Agriculture

Working together to create an e-platform for local agriculture in Moheshkhali island (Bangladesh).
: Telecom infrastructure already built by KT

[Overview of e-platform]

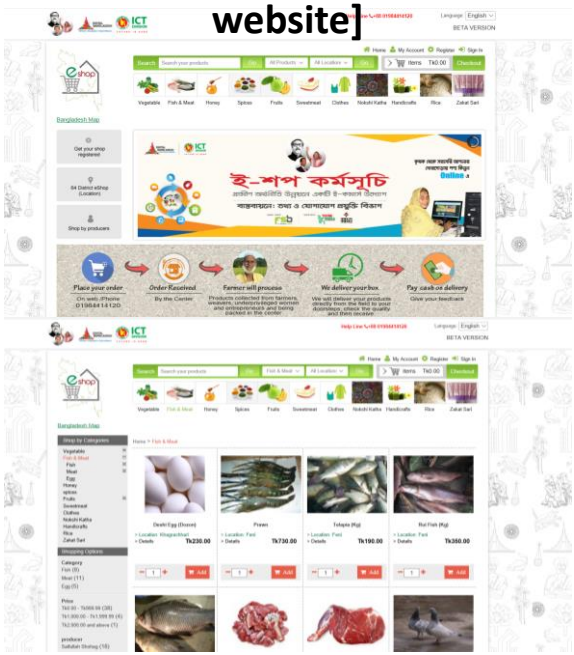


5 e-Platform for Agriculture

An on-going project in Moheshkhali Island (Bangladesh)

[e-Business Centre in Moheshkhali Island]

[e-commerce website]



6 GS1 for Food Safety

What's Next

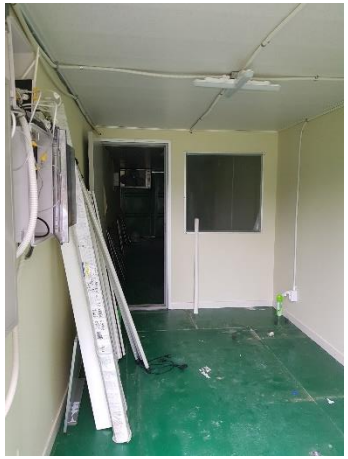
Smart Farm Test Bed

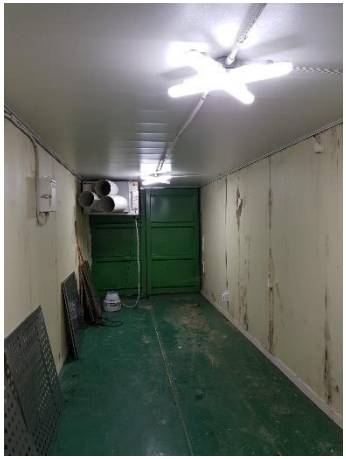
Exploring & Experimenting

Convergence R&D Centre:

: Experimenting with Household Smart Farm, Container Smart Farm, Vertical Smart Farm.

: Experimenting with new agriculture products





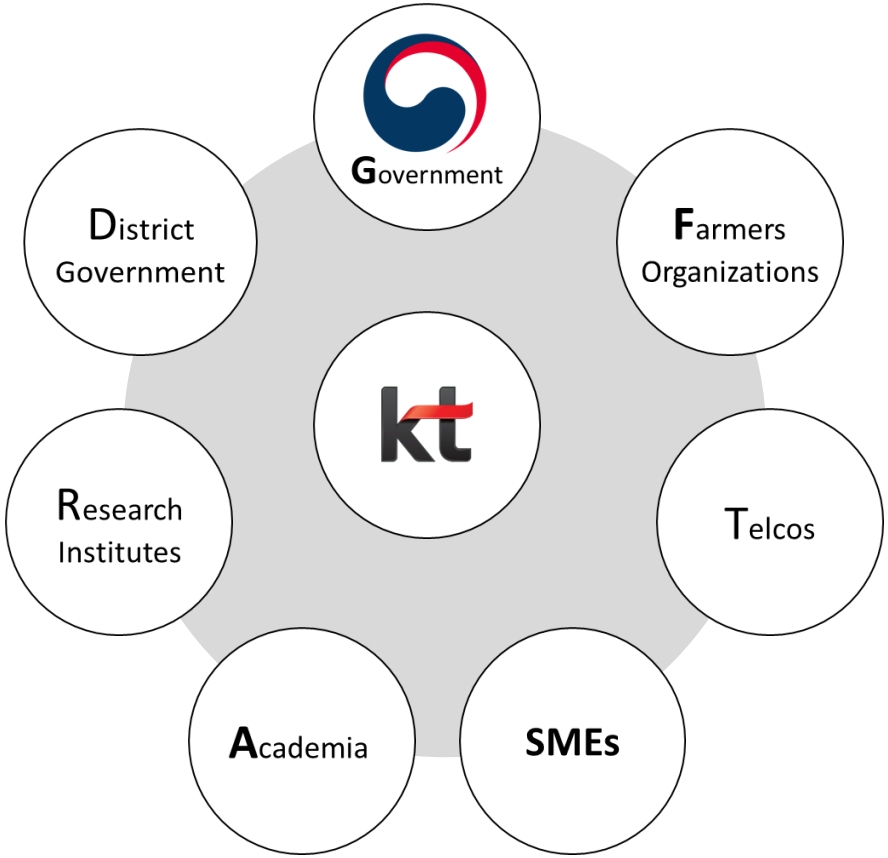
A lesson for ICT companies entering the Agriculture Sector
: LG CNS plans to build 76 ha Smart Biopark in Korea (2016) cancelled.

"Smart Farm experts know about Technology and ICT
But there are only a very few who really know about the agriculture industry. "
- Interview from a farmer

[LG CNS Smart Biopark]

[Protest against LG CNS (2016)]

Source: Local newspaper article (2016)


Government
District Government
Farmers Organizations
kt
Research Institutes
Telcos
Academia
SMEs

Thank you

KT
Overview

Korea Telecom

- Established : December 10, 1981
- Revenue : USD 20.7B (2016)
- No. of Employees : 23,600 (As of Sep 2016, kt only)
- Stock Exchange Listings : Korea, New York
- Credit Rating : A3 (Moody's) / A- (S&P, Fitch)

Number of Subscribers (As of Dec 2016)

Mobile	Fixed Broadband	Fixed phone	Pay TV
30.6% (18.9M) LTE: 14.3M 3G: 4.6M	41.4% (8.5M)	80.6% (12.7M)	51.9%[1] (9.3M) IPTV: 5.0M IPTV+SatTV: 2.0M Satellite TV: 2.3M

1) IPTV only

Source: kt, Ministry of Science ICT Future Planning, Korea Communications Commission