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The Characteristics of Irrigation Facilities of Traditional Irrigation Agricultural System in Uiseong



CHO, Hyeon-Ho Department of Landscape Architecture, Graduate of Pusan National University

LEE, Yoo-Jick Department of Landscape Architecture, Pusan National University

PARK, Jin-Wook Department of Landscape Architecture, Keimyung University

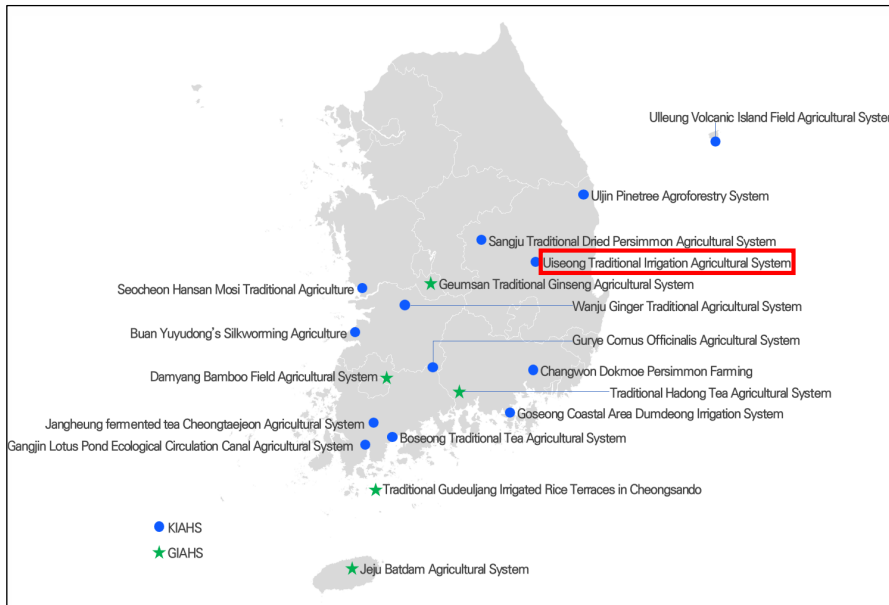
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I . Introduction

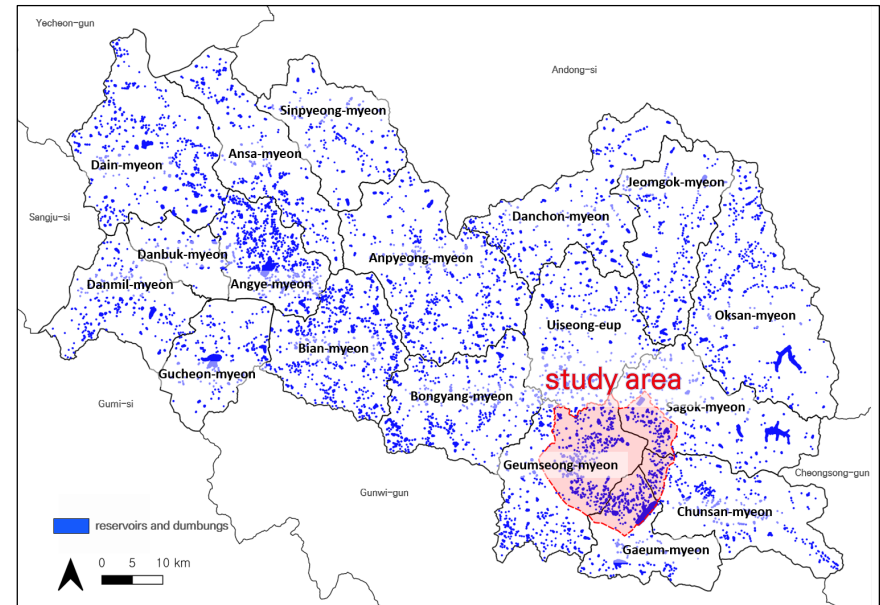
KIAHS No.10 Uiseong Traditional Irrigation Agricultural System

- Uiseong-gun, Gyeongsangbuk-do, was designated as 'The Korea's Important Agricultural Heritage System(KIAHS)' No.10 in 2018
- This system is an agricultural system that contains the traditional knowledge, history and agricultural culture created by local residents for over 2000 years.
- To overcome the unfavorable environment in volcanic and least rainy area, about 1,500 large and small reservoirs were built in scattered areas.

IAHS Site in Korea



Distribution of Irrigation Facilities in Uiseong and study area

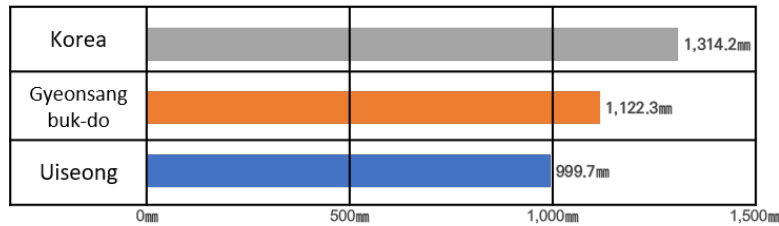


I . Introduction

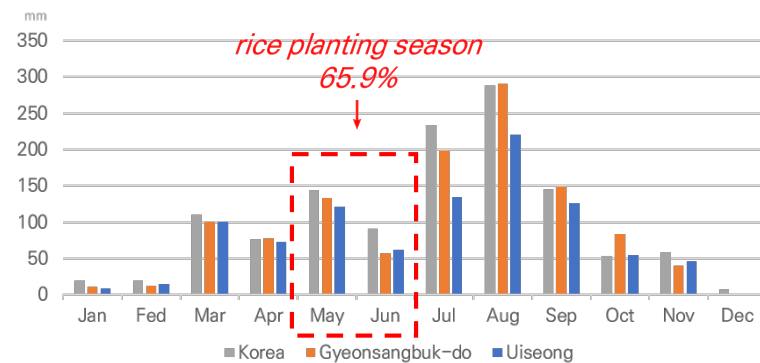
Environmental and Topographical Conditions unfavorable to agriculture

- Uiseong is low rainfall area, and the average annual rainfall is only about 76.1% of the national average during the same period.
- Geumseong-mountain, Korea's first volcano, is located in the east, making the terrain unfavorable for agriculture due to shallow soil depth and deep drainage(LEE at al, 2022).

Annual Rainfall (As of 2021)



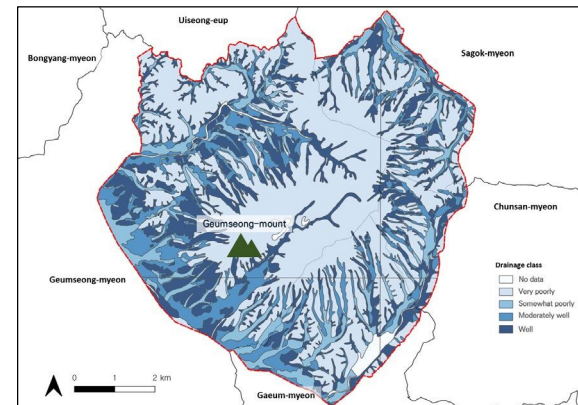
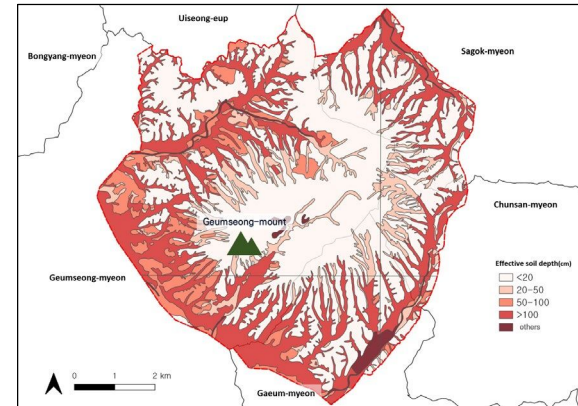
Monthly Rainfall (As of 2021)



Source : Korea Meteorological Administration.

In particular, the rainfall during the rice planting season, which requires a lot of water, is only 65.9% of national average.

Effective Soil Depth, Drainage Class of study area



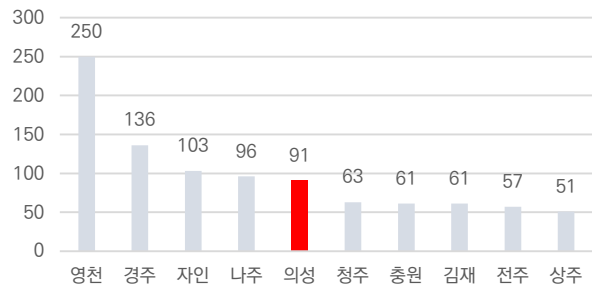
Source : National Institute of Agricultural Science and Technology, Korea Rural Development Administration.

I . Introduction

Development of Irrigation Facilities in Uiseong

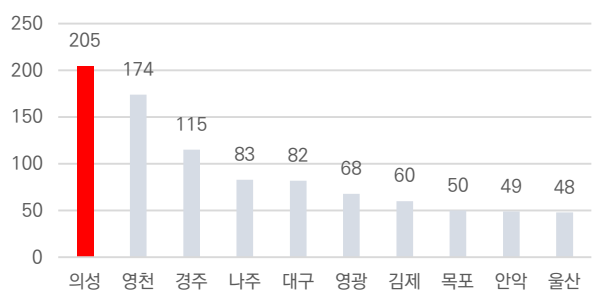
- Although the area was unfavorable for agriculture, agriculture began in the past, and irrigation facilities were introduced and developed to supply water for agriculture.
- As of 2021, It was found that are 6,277 reservoirs and dumbungs distributed in Uiseong.

Number of reservoirs nationwide in Korea (As of 1757)



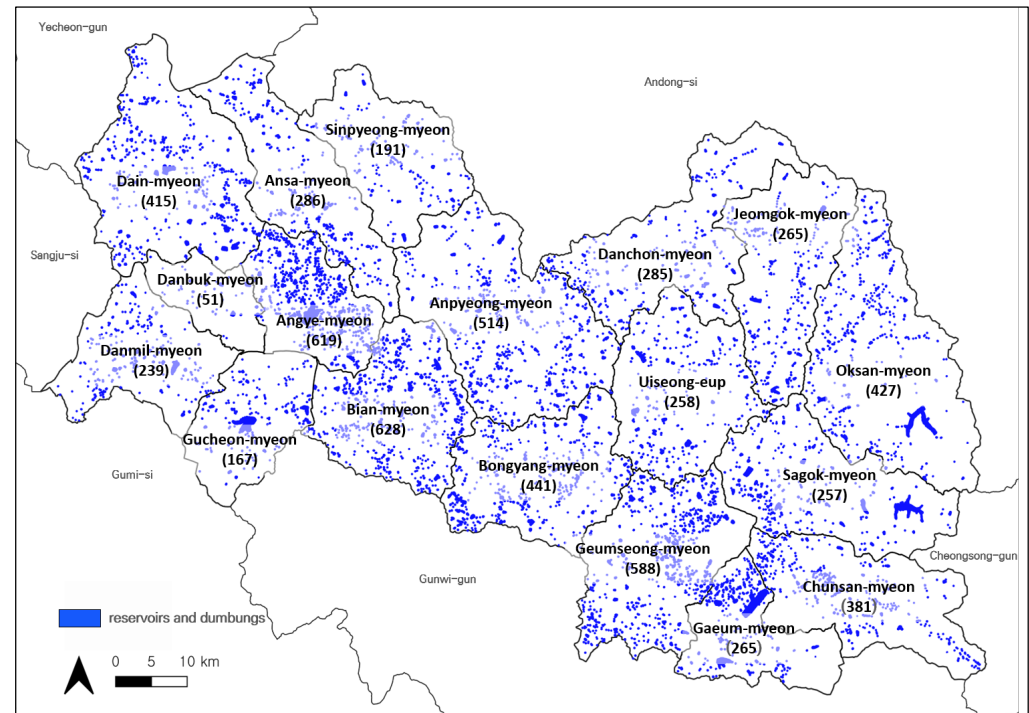
Source : Jung, Chi-Young (2008).

Number of reservoirs nationwide in Korea (As of 1918)



Source : Kim, Hyun-Hee, Choi, Ki-Yeop (1990).

Irrigation facilities by administrative district in Uiseong (As of 2021)

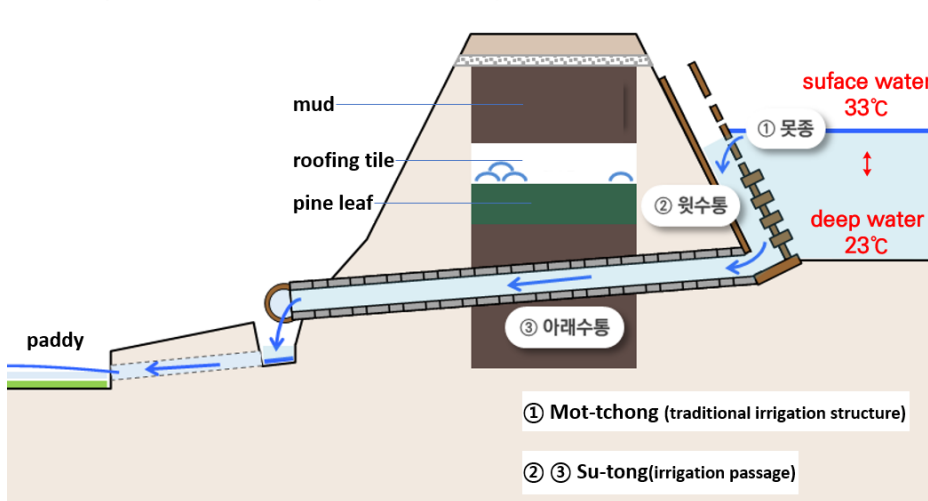


I . Introduction

Efforts to manage insufficient water

- Uiseong-gun maintain a traditional agricultural knowledge system that precisely controls the amount of water through a traditional irrigation structure consisting of 'Su-tong' and 'Mot-tchong'.
- There is 'Water Management Organization(水利契)' for the use and management of irrigation facilities and distribution of agricultural water.

'Su-tong' and 'Mot-tchong' structure diagram



Source : Uiseong-gun (2021).

Source : [www.youtube.com/@uiseong_agriculture\(L\)](http://www.youtube.com/@uiseong_agriculture(L)), [www.idaegu.co.kr\(下\)](http://www.idaegu.co.kr(下))

I . Introduction

Maximization of land use and agricultural landscape through Two-crop system

- The Geumseong mountain area began Two-cropping to increase agricultural production, and generates income and maintains a livelihood by sowing garlic after the fall harvest, irrigating the rice fields after harvesting the garlic the following year, and growing rice.
- It has an agricultural landscape that changes from fields to rice paddies in a week through irrigation facilities.

Agricultural landscape of Uiseong



Landscape of garlic harvest season



Landscape of rice planting season



Source : Uiseong-gun (2018).

I . Introduction

Risk of loss of functionality of traditional irrigation facilities

- It surely expected that irrigation facilities will be neglected or lost in function as changes in land use, land area reduction, and modernization of irrigation facilities have occurred due to the recent decline in the agricultural population as well as industrialization and urbanization.

Landuse and Agricultural Population of Uiseong-gun

Year	Landuse(m ²)			Agricultural Population	
	Field	Rice Paddy	Orchard	Household	Population
1990	87,765,194.0	133,803,026.0	8,604,028.0	20,886	66,892
2000	82,422,905.0	135,729,792.4	10,086,821.0	16,133	39,379
2010	78,463,227.0	135,336,246.0	10,894,966.0	12,495	26,860
2020	77,817,252.0	133,007,302.0	13,584,872.2	8,494	16,803

Source : KOSIS.

The rice paddies and fields in Uiseong are being converted into orchards with relatively low need for irrigation facilities.

The agricultural population also decreased by 37.4% in the past 10 years.

Changes in irrigation facilities of reservoirs in Uiseong



Samidwit reservoir



Seolmul reservoir



Source : Uiseong-gun (2021).

Traditional irrigation facilities are being replaced by modern facilities due to the convenience and safety of modern irrigation facilities such as 'Spindle' or 'pumps'

I . Introduction

Research purpose and content

- Therefore, this study was conducted for the purpose of examining the characteristics of traditional irrigation agricultural system of Uiseong.
 - In order to achieve the purpose of the study, the current status of irrigation facilities and characteristics of water systems were examined in the Geumseong Mountain area, and a comprehensive review was conducted through a field survey on the characteristic village.
-
- **First, analysis of type and distribution status to determine the status of irrigation facilities.**
 - **Second, hydrological analysis to identify rivers and water system.**
 - **Third, comprehensive review was conducted through a field survey on the characteristic village.**

II. Research method and procedure

2.1 Irrigation facility type division

- The types of irrigation facilities within the agricultural heritage area were classified into 'reservoir', and 'dumbung' based on the presence or absence of water gate.
- Reservoirs were divided into the traditional 'Su-tong and Mot-tchong' method and the modern 'Spindle' method depending on the irrigation method.

Type of irrigation facilities

Type		Water gate	Irrigation method
Reservoir	① Traditional	O	Su-tong, Mot-tchong
	② Modern		Spindle
③ Dumbung	-	X	Pump, Natural drainage

Dumbung is a water pond built by individuals within agricultural land to assist in the supply of agricultural land to assist in the supply of agricultural water.

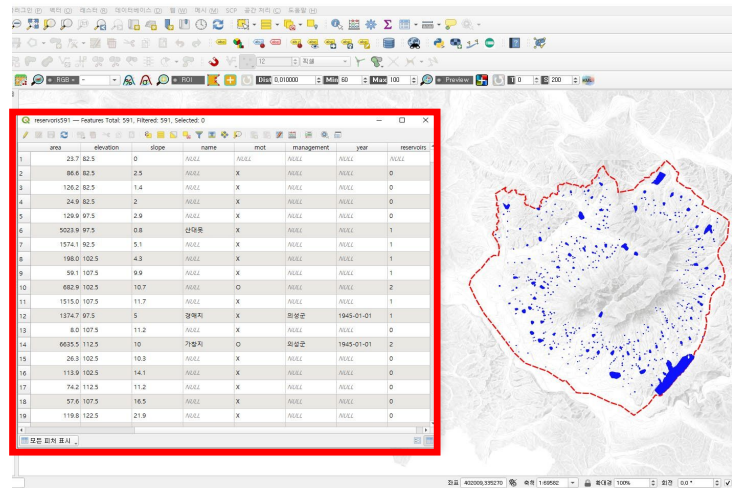
Type of irrigation facilities in Uiseong



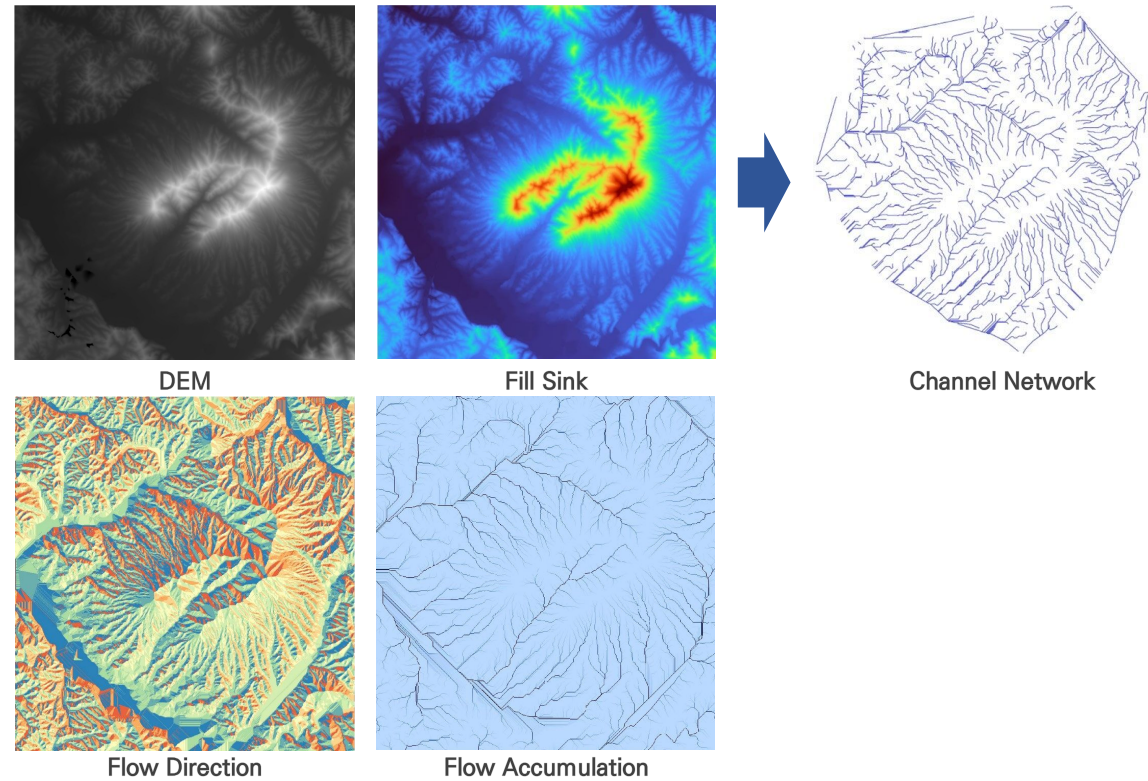
2.2 Distribution status of irrigation facilities / Hydrological analysis

- Topographic information on area, altitude, and slope was constructed based on the location information of irrigation facilities distributed around Geumseong mountain.
- In addition, hydrological analysis using GIS was conducted to confirm the water system.

Calculate area, altitude and slope using GIS

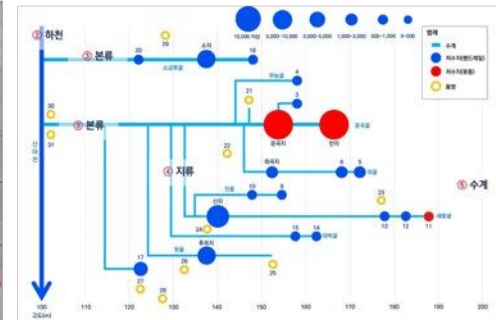
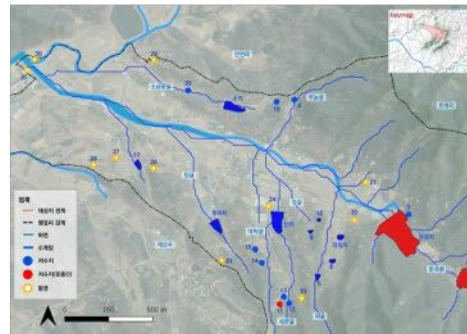
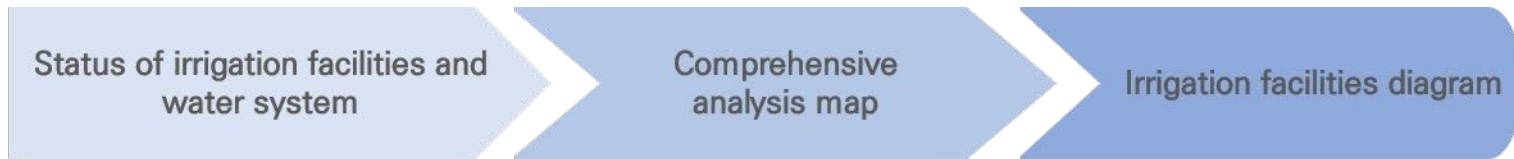


Hydrological analysis process



2.3 Create a irrigation facility system diagram

- A comprehensive status map was created by overlapping the analyzed distribution status of irrigation facilities and the water system, and this was diagrammed.
- Analysis was conducted by creating a system diagram for each 17 administrative districts.

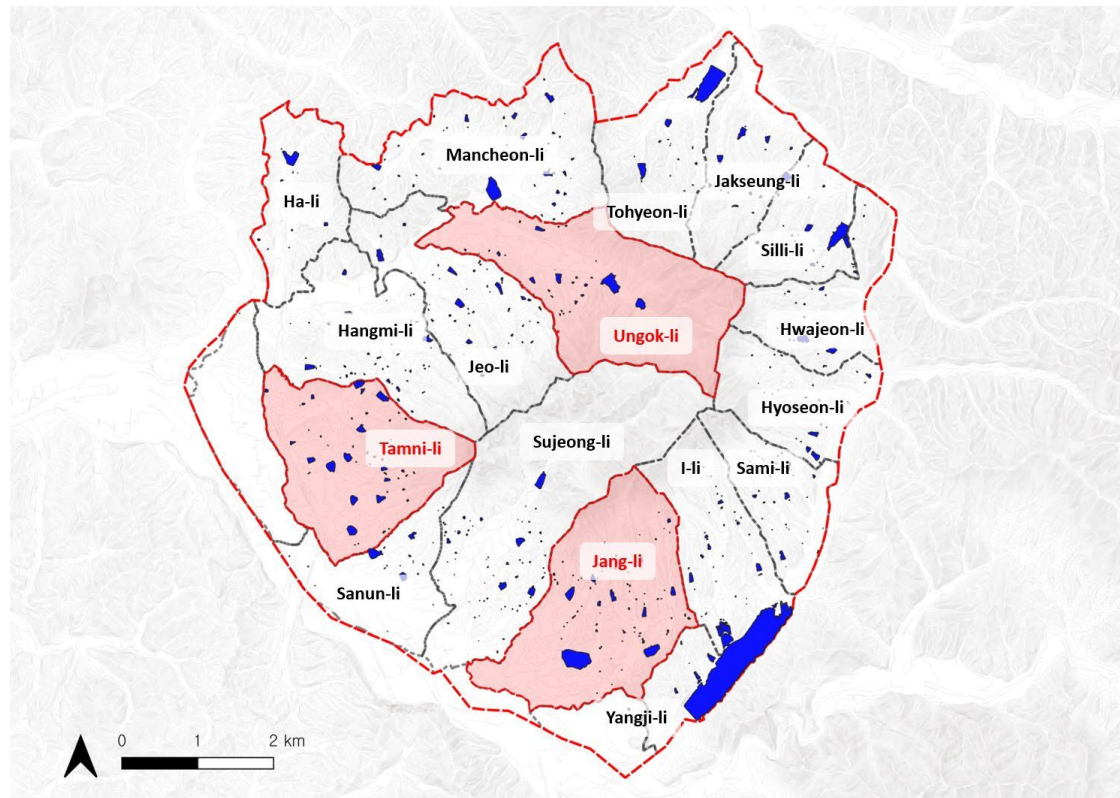


Expression of type, area, altitude, and connected tributaries for each irrigation facilities.

2.4 Field survey

- Based on the analysis, a field survey was conducted on Tamni-li, where the largest number of reservoirs are distributed, Jang-li, where the largest number of dumbungs are distributed, and Ungok-li, where the largest number of reservoirs in one water system are distributed.

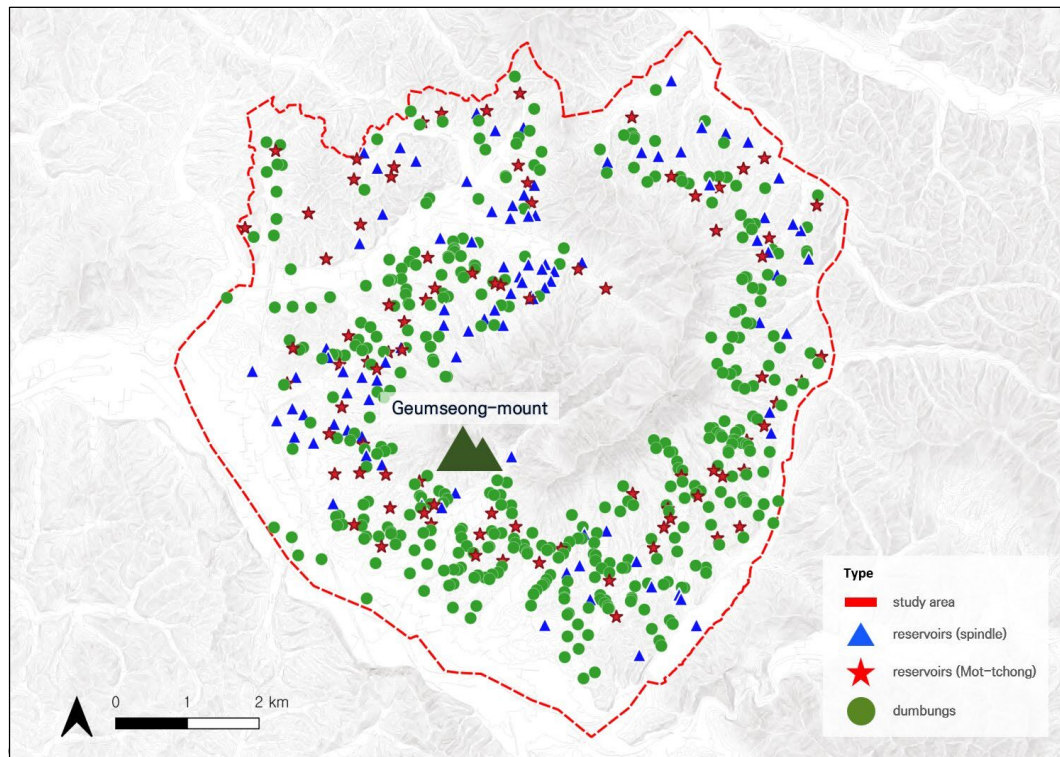
Target site of field survey



3.1 Type of irrigation facilities

- There were 591 irrigation facilities distributed in the study area. By type, there were 183 reservoirs and 408 dumbungs.
- And the reservoirs had 86 'Su-tong and Mot-tchong' structures and 97 'Spindle' structures.

Distribution of irrigation facilities in the study area by type



unit	reservoir			dumbung	total
	Mot-tchong	spindle	sum		
Number	86	97	184 (31.0%)	408 (69.0%)	591 (100.0%)

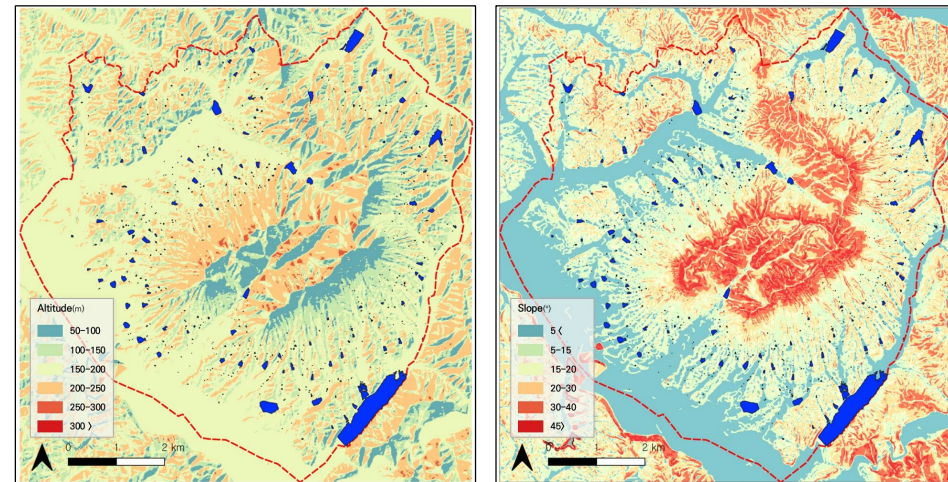
3.2 Location characteristics of irrigation facilities

- The average altitude of each reservoir in the Geumseong mount area was 143.0m, the average slope was 9.8 degrees, and the average area was 7,557.4m², and dumbing was located at 148.4m and 10.7 degrees, with an average area of 168.9m².
- Of the 591 facilities, 531(76.8%) were small of less than 500m², and 531(89.9%) were concentrated at altitudes 100~150m, There were 459(70.6%) locations with a slope of 15 degrees or less.

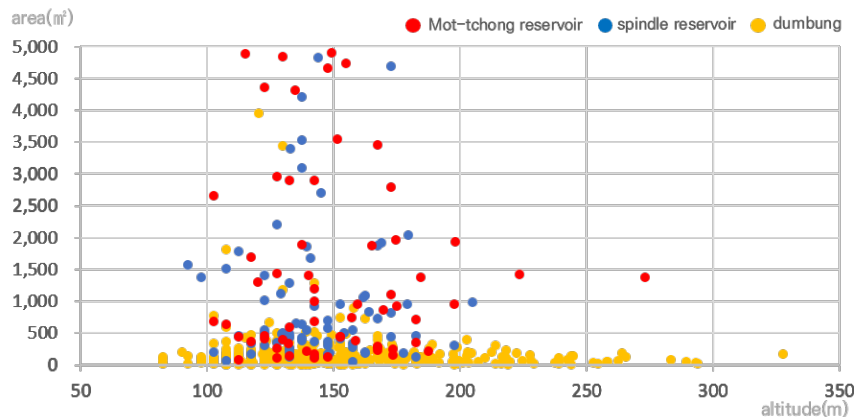
Location characteristics by type of irrigation facilities

unit	reservoir			dumbung
	Mot-tchong	spindle	sum	
average area (m ²)	3,609.5	10,907.1	7,557.4	168.9
average altitude (m)	144.3	141.7	143.0	148.4
average slope (°)	10.1	9.6	9.8	10.7

Distribution of irrigation facilities in the study area by altitude and slope



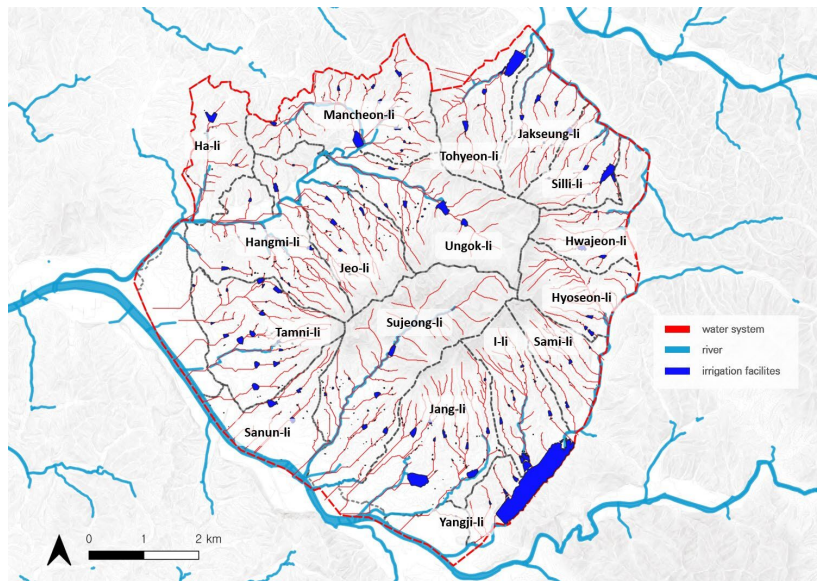
 Reservoirs and Dumbungs



3.3 Water system

- There were an average of 3 water systems for each administrative districts(called Li), an average of 7 branch were connected to one water system, and 3 and 7 reservoirs and dumbungs, respectively. In addition, there were an average of two or more reservoirs connected within one tributary.

Distribution of water system network and irrigation facilities



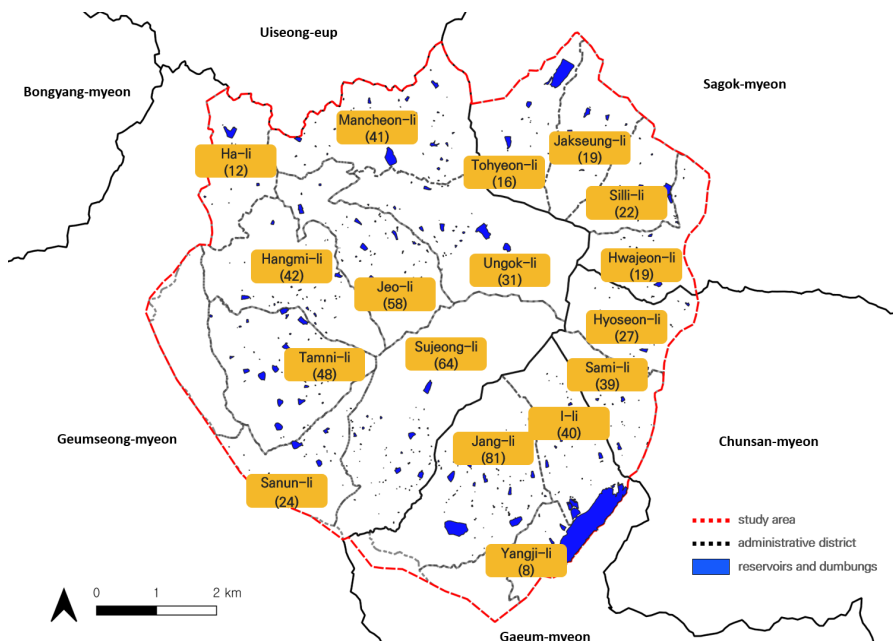
Water system by administrative district

administrative district	water system	tributary	number of reservoirs connected to tributaries			
			four	three	two	one
Mancheon-li	2	46	0	0	3	14
Sanun-li	3	11	0	1	0	1
Sujeong-li	3	38	0	0	1	9
Ungok-li	2	22	1	2	3	4
Jeo-li	5	38	0	2	4	5
Tamni-li	5	32	0	3	3	9
Ha-li	1	15	0	0	0	3
Hangmi-li	5	26	0	1	2	6
Yangji-li	3	5	0	0	0	2
I-li	4	19	0	1	2	2
Jang-li	3	43	0	1	3	4
Silli-li	4	17	0	2	2	2
Jakseung-li	5	22	0	0	3	3
Tohyeon-li	1	23	0	1	2	0
Hwajeon-li	2	15	0	0	1	3
Sami-li	5	20	0	0	1	3
Hyoseon-li	5	26	0	0	1	5
total	58	418	1	14	31	75
average	3	7				2

3.4 Characteristics of village

- An average of 11 reservoirs and 24 dumbungs were distributed by administrative districts. The village with the most reservoirs distributed was Tamni-li with 26, and Jang-li was the most dumbing, with 68. On the other hand, the village showing the most reservoirs in one system of water supply was Ungok-li.

Distribution of irrigation facilities by administrative district



Distribution of irrigation facilities by administrative district

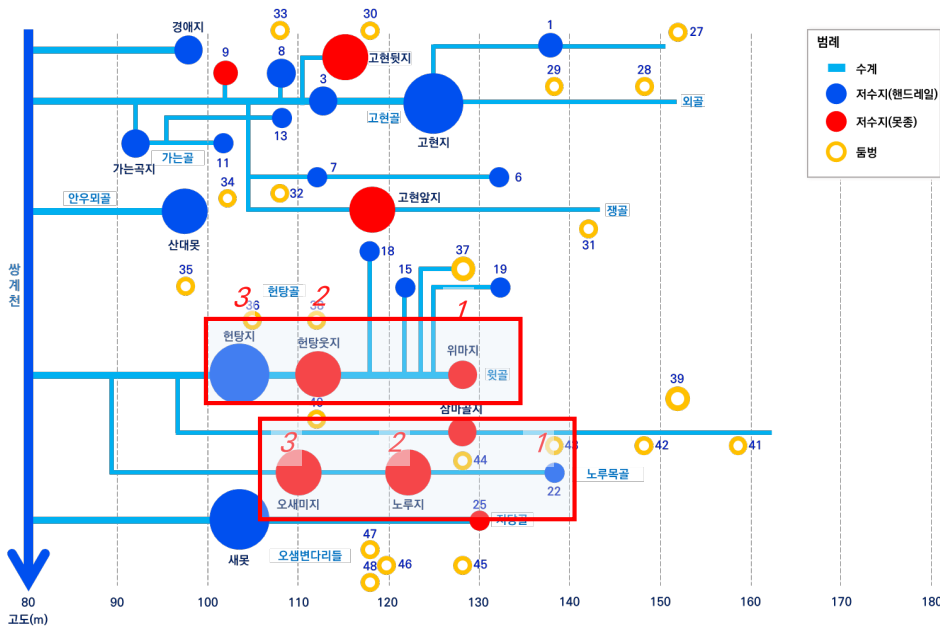
administrative district	reservoir			dumbung	total
	Mot-tchong	spindle	sum		
Mancheon-li	11	11	22	19	41 (6.9%)
Sanun-li	4	-	4	20	24 (4.1%)
Sujeong-li	8	4	12	52	64 (10.8%)
Ungok-li	3	17	20	11	31 (5.2%)
Jeo-li	7	11	18	40	58 (9.8%)
Tamni-li	7	19	26	22	48 (8.1%)
Ha-li	3	-	3	9	12 (2.0%)
Hangmi-li	9	4	12	29	42 (7.1%)
Yangji-li	-	2	2	6	8 (1.4%)
I-li	7	2	9	31	40 (6.8%)
Jang-li	5	8	13	68	81 (13.7%)
Silli-li	4	7	11	11	22 (3.7%)
Jakseung-li	4	5	9	10	19 (3.2%)
Tohyeon-li	1	4	5	11	16 (2.7%)
Hwajeon-li	1	3	4	15	19 (3.2%)
Sami-li	5	-	5	34	39 (6.6%)
Hyoseon-li	5	2	7	20	27 (4.6%)
total	84	99	183	408	591
average	5	6	11	24	35

3.4 Characteristics of village

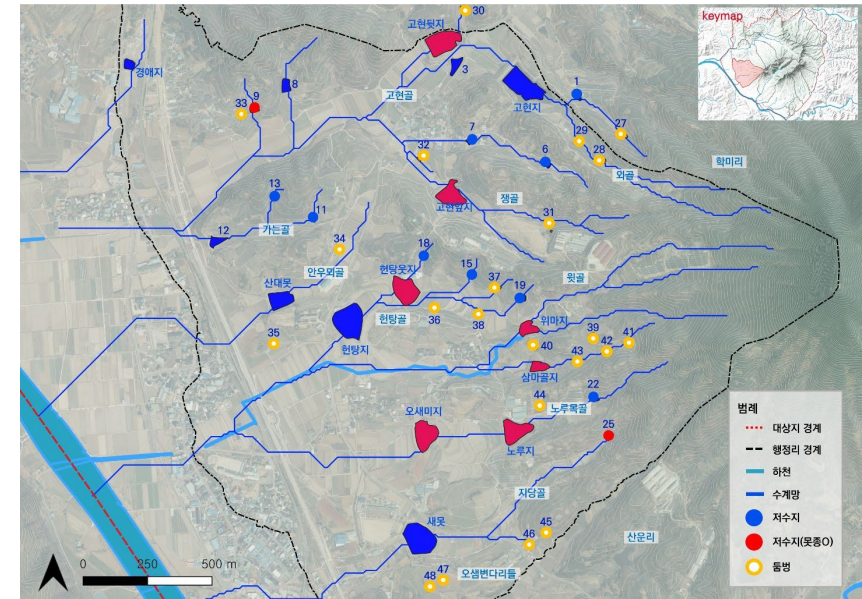
1) Most reservoirs distributed : Tamni-li, Geumseong-myeon

- Tamni-li has 26 reservoirs distributed in 5 water systems.
- The tributaries where 'Huntang reservoir' and 'Ohsemi reservoir' are located each have three reservoirs connected to them.

Tamni-li irrigation facility system diagram



Tamni-li comprehensive status map

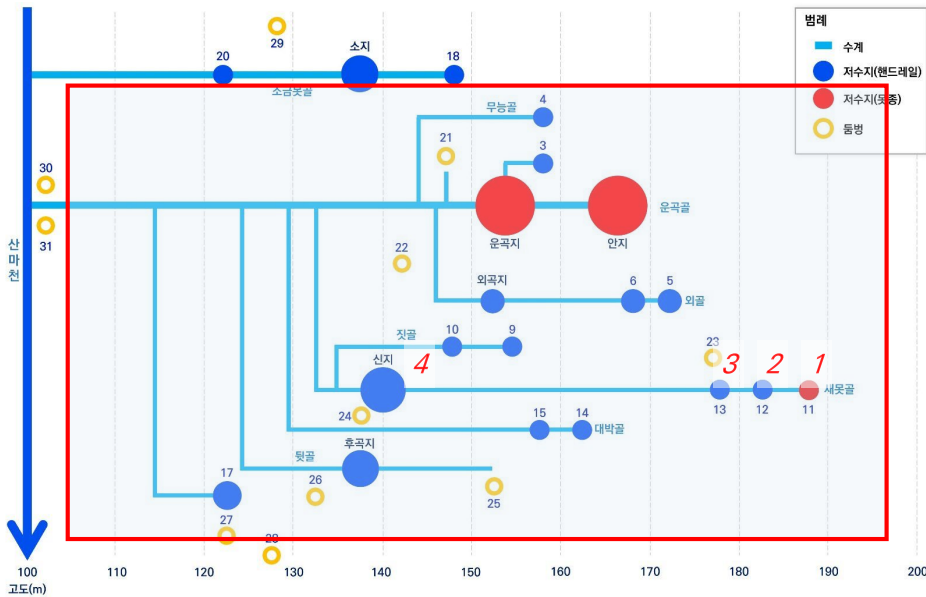


3.4 Characteristics of village

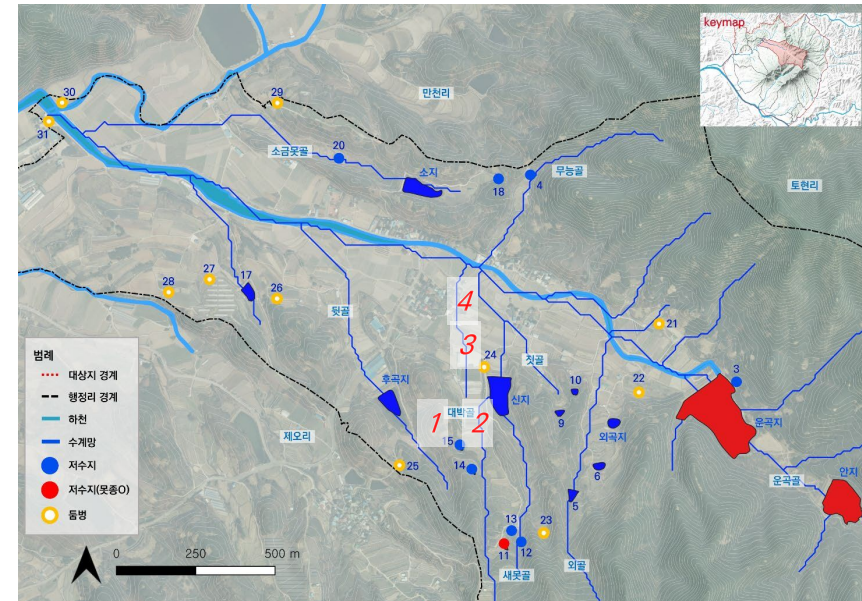
2) Most reservoirs distributed in one water system : Ungok-li, Geumseong-myeon

- The water system containing 'Ungok reservoir' included 17 reservoirs, making it the area with the most reservoirs in one water system.
- In addition, 4 reservoirs are connected in a row in a tributary containing 'Sin reservoir'.

Ungok-li irrigation facility system diagram



Ungok-li comprehensive status map

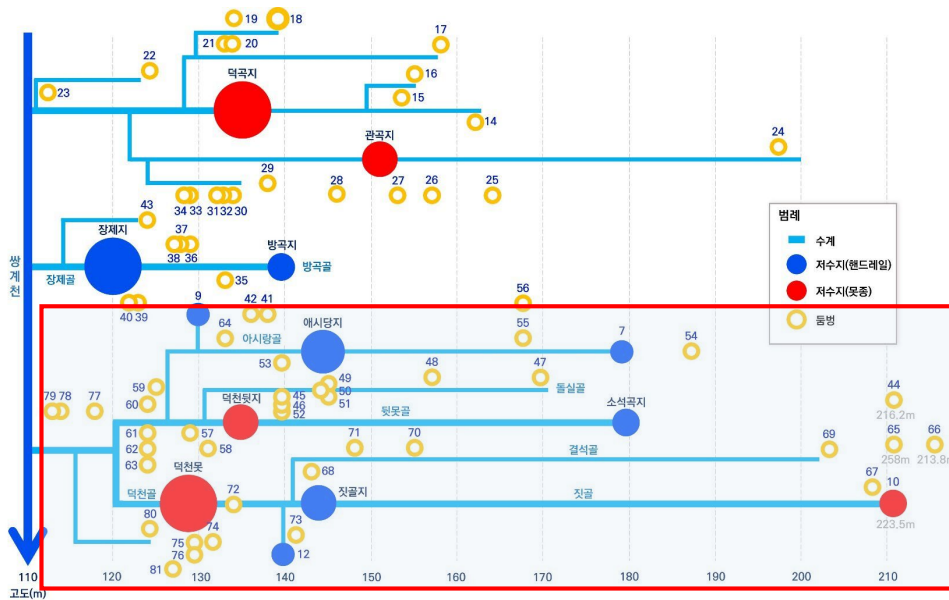


3.4 Characteristics of village

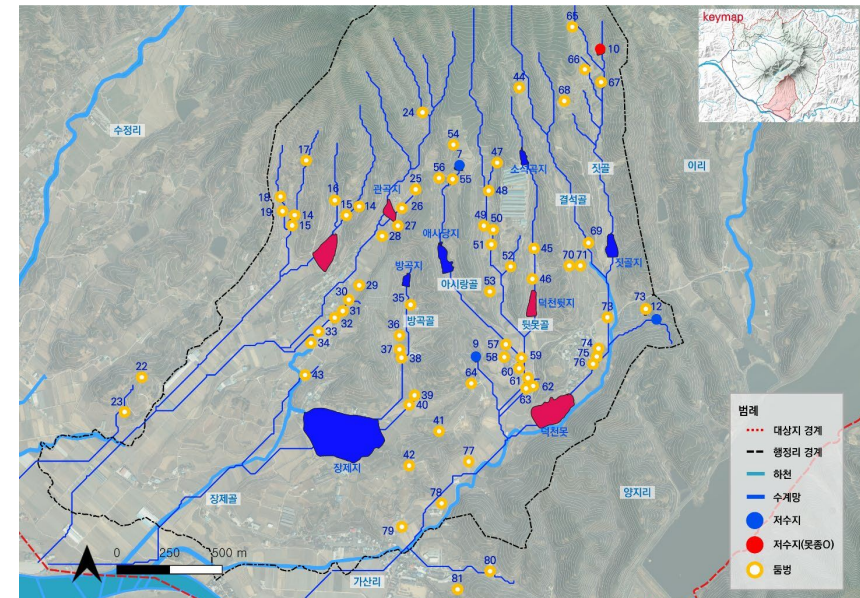
3) Most dumbung distributed : Jang-li, Gaeum-myeon

- There are 68 dumbungs distributed in Jang-li. In particular, there are 40 dumbungs located in the water system that includes 'Deokcheon reservoir' alone.

Jang-li irrigation facility system diagram



Jang-li comprehensive status map



3.5 Field survey results

- As a result of the field survey of Tamni-li, Ungok-li, Jang-li, it was found that 31(19.4%) of the 160 irrigation facilities had lost their function.
- By usage situation, 16 (10.0%) were reclaimed, 10 (6.2%) were waterlessned, and 5 (3.1%) were water polluted.
- By type of irrigation facility, it was found that 6 (10.2%) reservoirs and 25 (24.8%) dumbungs had lost their functions, resulting in more changes in use in small dumbungs.

Status of irrigation facilities as a result of field survey

type	as of 2021	field survey in 2024			
		reclaimed	waterlessned	water polluted	sum
reservoir	59	2	4	-	6
dumbung	101	14	6	5	25
total	160	16	10	5	31

3.5 Field survey results

- The reasons for changes in the use of irrigation facilities in agricultural heritage area are as follows.
- First, it is change in land use. The land use of the study area is changing to orchards, which require relatively less water than rice paddies and fields.
- In addition, solar power generation facilities and livestock farms are being built around Geumseong mount. not only is the land use changing, but the agricultural land is also decreasing.

Changes in land use of the study area



Orchards



Solar power generation facility



Livestock farm

3.5 Field survey results

- The reasons for changes in the use of irrigation facilities in agricultural heritage area are as follows.
- Second, with the modernization of irrigation facilities, the importance of small-scale facilities decreased and they were being reclaimed to expand agricultural land.
- And the traditional system was decreasing due to reasons such as convenience and safety.

Modernization of irrigation facilities



Abandoned traditional irrigation facilities



Replaced with modern facilities

3.5 Field survey results

- The reasons for changes in the use of irrigation facilities in agricultural heritage area are as follows.
- **Third, this is a case of landfill due to landscape obstruction and water surface contamination due to agricultural waste and various pollutants generated from surrounding farmland or livestock farms.**

Water polluted dumbungs



In summary, the traditional irrigation agricultural system in Uiseong has the following implications.

- First, the irrigation facility in Uiseong is a representative example of a traditional irrigation agricultural system that responds to the topography and environment unfavorable to agriculture.**
- Second, reservoirs and dumbungs formed a network with waterways to efficiently supply water to farmland. also, many reservoirs were connected up and down the water system, and together with the dumdung, agricultural water was used as efficiently as possible.**
- Third, the sustainability of traditional irrigation agricultural system in Uiseong is threatened by changes in land use and the modernization of facilities, so continuous monitoring and preservation activities are considered to be necessary.**

THANK YOU

hh7667@pusan.ac.kr

CHO, Hyeon-Ho