



Characteristics of Naturalized Plants in Hadong Traditional Tea Fields as GIAHS

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1. Background and purpose
2. Method
3. Results
4. Conclusions

I . Background and purpose



- The Globally Important Agricultural Heritage Systems(GIAHS) do not mean just the production activities of crops. They include the agricultural ecosystem, which is combined based on the production activities of the crops, and also include agricultural customs, land use systems, and biodiversity.
- The goal of protecting the GIAHS is to maintain the ability of the agricultural ecosystem in the region to provide sustainable ecological services.
- Naturalized plants are plants that come in artificially or naturally and do not get caught in a natural ecosystem, but live in coexistence with self-indulgence.

I . Background and purpose

- A naturalized plant is not necessarily a harmful plant, but it is a factor that has an unstable disturbance effect on any native species, populations, or ecosystem. Thus, the status of the distribution of naturalized plants in determining the stability of the ecosystem of an agricultural heritage is one of the important indicators to be considered.
- This study was conducted to identify the characteristics of the distribution of naturalized plants at the traditional tea fields as GIAHS site in Hadong.



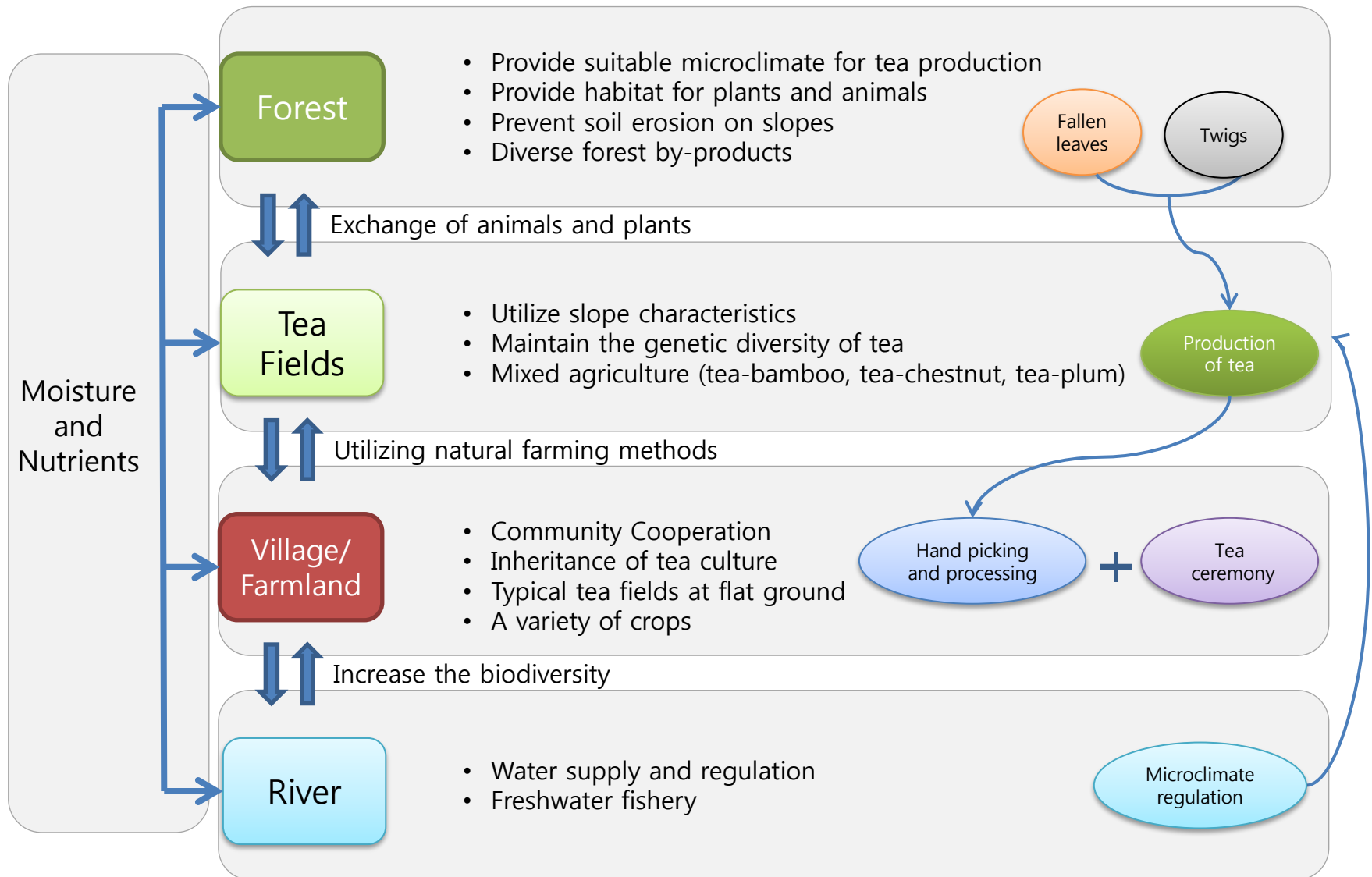
II. Method

1. Research area

- Hadong Traditional Tea Field is located mainly in Hwagae-myeon, located at the northwest end of Hadong County in South Gyeongsang Province. Hwagae area is located on the banks of the Seomjin River, where has an environment suitable for tea growth : fog and sandy loam
- This agricultural heritage has been passed down for 1,200 years through the rational use of natural resources even in the barren mountainous area in Mt.Jiri.
- Hwagae residents have been growing and maintaining tea through traditional natural farming methods that do not seriously damage the natural environment.
- The tea fields around the river and the mountains blend with the surrounding environment to form a beautiful landscape.



1. Research area



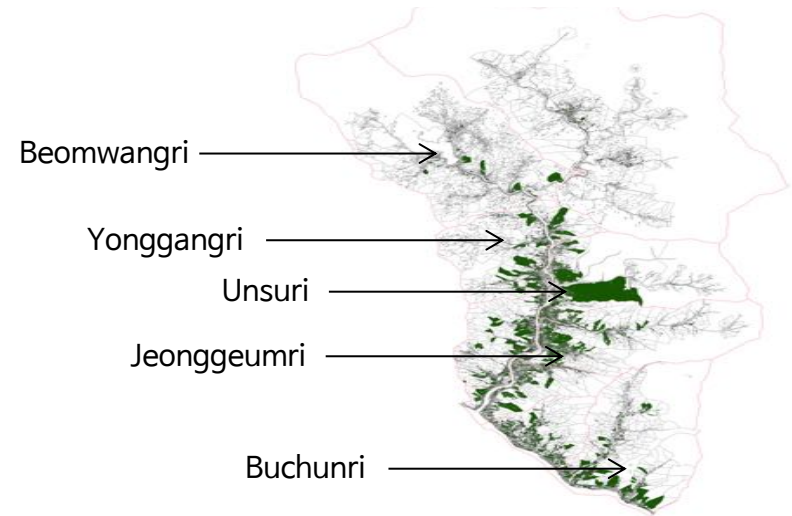
2. Scope of the survey

- Temporal range

April ~ November, 2016

- Contents range

- Current status of flora and naturalized plants
- Characteristics of the naturalized plants in traditional tea field
- Distribution characteristic of naturalized plants by position of traditional tea fields



〈Traditional Tea Field Distribution〉



〈Study Area〉

II. Method

Traditional tea fields position distribution patterns



3. Method

- The flora in the districts were studied by researchers walking the designated path, who investigated accessible areas from the path
- The investigation was conducted using Braun-Blanquet Method (Braun-Blanquet, 1913)
- When possible, plants were identified on site, and those that could not be identified were collected and later identified using literature by Lee Wu-cheol (1996), Lee Chang-bok (2003), and Lee Yeong-no (2006)
- The arrangement of the plants and the publishing of their academic names were done so in accordance with Korea Plant Names Index by the Korea National Arboretum and the Korean Society of Plant Taxonomists, as well as Engler System of Classification (Melchior, 1964)
- Life form was analyzed with Numata and Asano (1969), which is a detailed expression of Raunkiaer (1934)'s life form
- Naturalized plants were identified 321 Classification by Lee Yu-mi et al (2011)
- To analyze the Importation timing, apply the 3-time division method of Park Soo-hyeon (1994) and the level of naturalization distribution by Park Soo-hyun (2002) based on the 5th grade criteria.
- Naturalization rate (NR) was calculated by Numata (1975) method.

$$NR = \frac{n_n}{N_t}$$

n_n : The number of naturalized plant species;

N_t : the number of total plant species found in the studied area

1. Current status of flora and naturalized plants

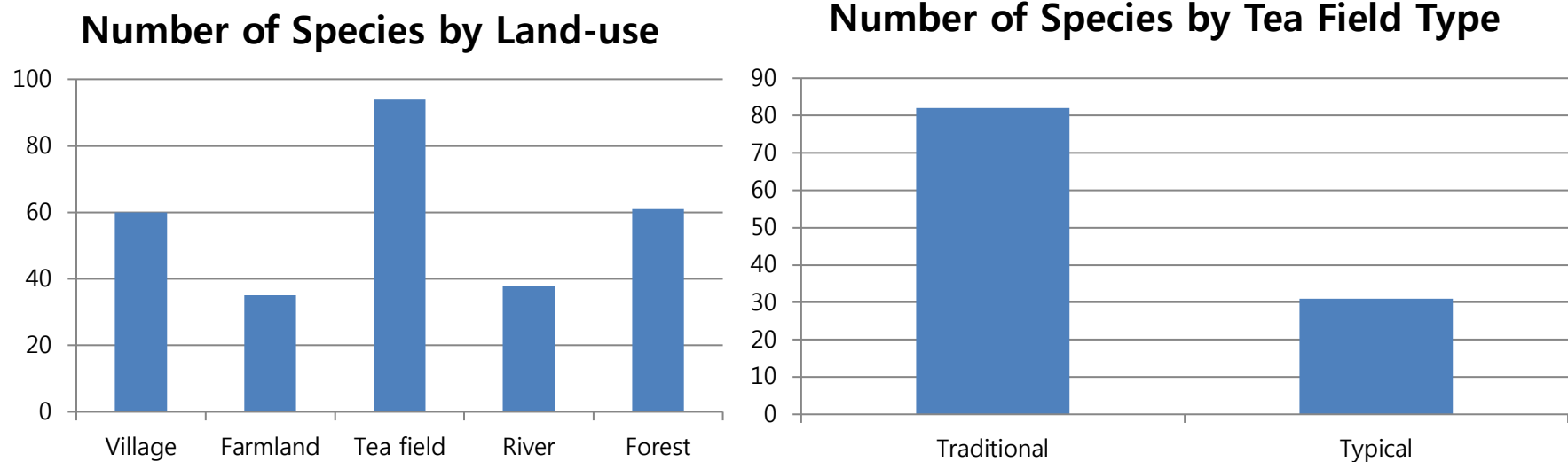
1) Flora

- Flora of two villages were a **total of 176 taxa** in 67 families, 131 genera include 142 species, 10 subspecies, 22 varieties and 2 forma.
- Most plant species were found in tea fields.
- Plants in the forest and villages were relatively diverse, meantime the diversity of plants is low in the river and farmland areas.
- As a results of the research on the flora in different land use, the most diverse range of plants was in traditional tea fields located on the slopes and around forests.



1. Current status of flora and naturalized plants

1) Flora



Land use		Results
Village		31Families 54Genus 53Species 7Varieties 60Taxa
Farmland		17Families 31Genus 31Species 4Varieties 35Taxa
Tea field	Subtotal	47Families 81Genus 79Species 13Varieties 2Forma 94Taxa
	Traditional	43Families 72Genus 68Species 12Varieties 2Forma 82Taxa
	Typical	19Families 27Genus 28Species 3Varieties 31Taxa
River		21Families 32Genus 32Species 6Varieties 38Taxa
Forest		32Families 50Genus 45Species 10Subspecies 10Varieties 61Taxa
Total		67Families 131Genus 142Species 10Subspecies 22Varieties 2Forma 176Taxa

III . Results

1. Current status of flora and naturalized plants

2) naturalized plants

- There were 9 Families 14 Genus 14 Species 2 Varieties , **total 16 Taxa** of naturalized plants founded in the research area
- As a results of the research on the naturalized plants in different land use, the tea fields had the most diversity of plants and the most naturalized plant species as 10.
- There were also a relatively large number of naturalized plants in the villages and farmland, but forest has the lowest number of naturalized plants.

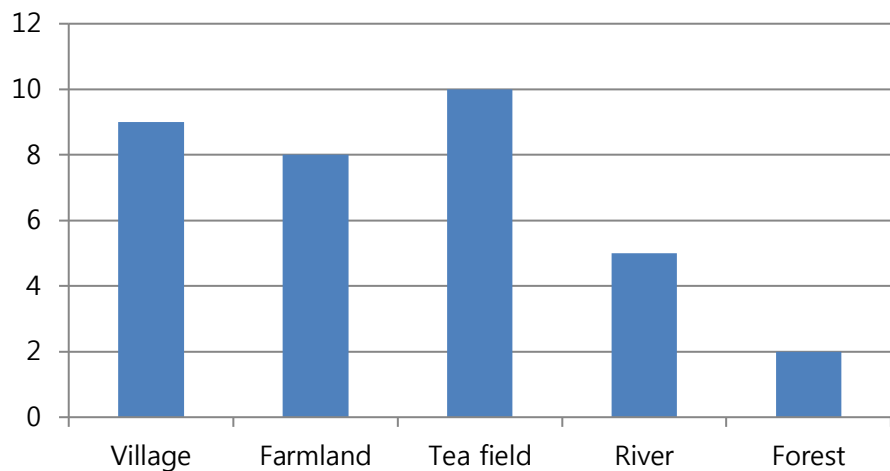


III. Results

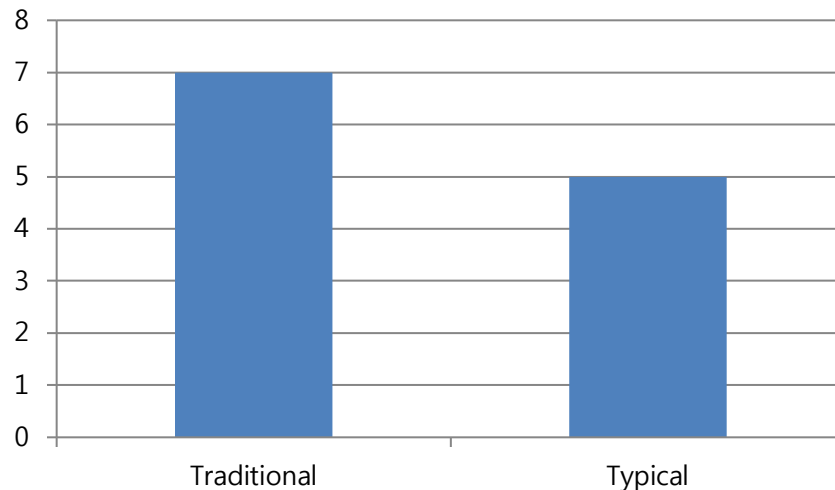
1. Current status of flora and naturalized plants

2) naturalized plants

Number of Naturalized Species by Land-use



Number of Naturalized Species by Tea field type



Land use		Results
Village		5 Families 9 Genus 9 Species 9 Taxa
Farmland		4 Families 7 Genus 7 Species 1 Varieties 8 Taxa
Tea field	Subtotal	5 Families 10 Genus 10 Species 10 Taxa
	Traditional	4 Families 7 Genus 7 Species 7 Taxa
	Typical	2 Families 5 Genus 5 Species 5 Taxa
River		3 Families 5 Genus 4 Species 1 Varieties 5 Taxa
Forest		2 Families 2 Genus 2 Species 2 Taxa
Total		9 Families 14 Genus 14 Species 2 Varieties 16 Taxa

III. Results

1. Current status of flora and naturalized plants

2) naturalized plants

Families	Genus	Species
Madiaceae	Rumex	<i>Rumex obtusifolius</i> L.
Myelonaceae	Chenopodium	<i>Chenopodium album</i> L.
Viliaceae	Amaranthus	<i>Amaranthus lividus</i>
		<i>Amaranthus retroflexus</i> L.
Petraceae	Phytolacca	<i>Phytolacca americana</i>
Pollaceae	Trifolium	<i>Trifolium repens</i>
Euphorbiaceae	Euphorbia	<i>Chamaesyce supina</i> MOLD.
Centriaceae	Ipomoea	<i>Ipomoea hederacea</i> var. <i>integriuscula</i> A. Gray
		<i>Ipomoea hederacea</i> Jacq.

Families	Genus	Species
Archaelidae	Bidens	<i>Bidens frondosa</i> L.
	Conyza	<i>Erigeron canadensis</i> L.
	Crassocephalum	<i>Crassocephalum crepidioides</i> (Benth.) S. Moore
	Erigeron	<i>Erigeron annuus</i> (L.) Pers.
	Glinzoga	<i>Galinsoga ciliata</i> (Raf.) Blake
	Tataxacum	<i>Taraxacum officinale</i>
Salaceae	Panicum	<i>Panicum dichotomiflorum</i>

III. Results

1. Current status of flora and naturalized plants

2) naturalized plants



Erigeron annuus (L.) Pers.



Chenopodium album L.



Amaranthus lividus



Amaranthus retroflexus L.



Phytolacca americana



Trifolium repens

III. Results

1. Current status of flora and naturalized plants

2) naturalized plants



Chamaesyce supina MOLD.



Ipomoea hederacea var.
integruscula A.Gray



Ipomoea hederacea Jacq.



Bidens frondosa L.



Erigeron canadensis L.



Crassocephalum crepidioides (Be
nth.) S. Moore

III . Results

1. Current status of flora and naturalized plants

2) naturalized plants



Erigeron annuus (L.) Pers.



Galinsoga ciliata (Raf.) Blake



Taraxacum officinale



Panicum dichotomiflorum

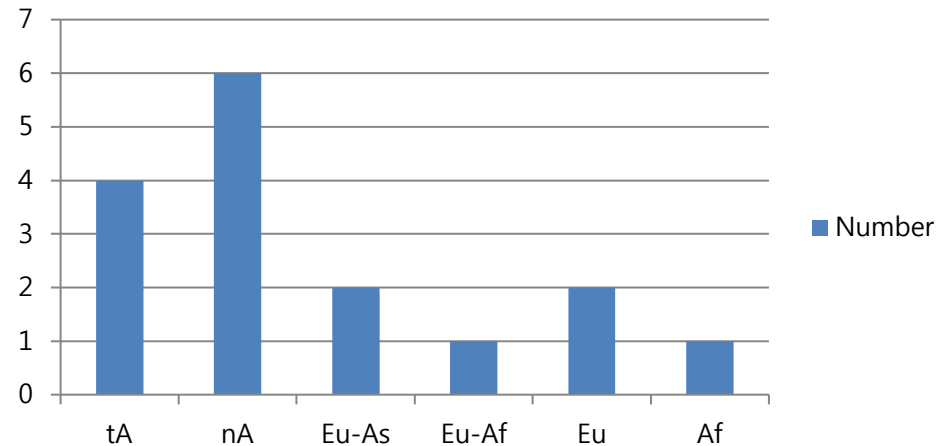
2. Characteristics of the naturalized plants in traditional tea field

1) Importation

- Origin area:

America 10 Taxa (North America 6, Tropical America 4), 63% of the total

Origin Areas of Naturalized Species



Origin Area	Species	Number
tA	<i>Ipomoea hederacea</i> var. <i>integriuscula</i> A.Gray, <i>Ipomoea hederacea</i> Jacq., <i>Galinsoga ciliata</i> (Raf.) Blake, <i>Amaranthus retroflexus</i> L.	4
nA	<i>Erigeron annuus</i> (L.) Pers., <i>Erigeron canadensis</i> L., <i>Bidens frondosa</i> L., <i>Panicum dichotomiflorum</i> , <i>Phytolacca americana</i> , <i>Chamaesyce supina</i> MOLD.	6
Eu-As	<i>Rumex obtusifolius</i> L., <i>Chenopodium album</i> L.	2
Eu-Af	<i>Trifolium repens</i>	1
Eu	<i>Amaranthus lividus</i> , <i>Taraxacum officinale</i>	2
Af	<i>Crassocephalum crepidioides</i> (Benth.) S. Moore	1

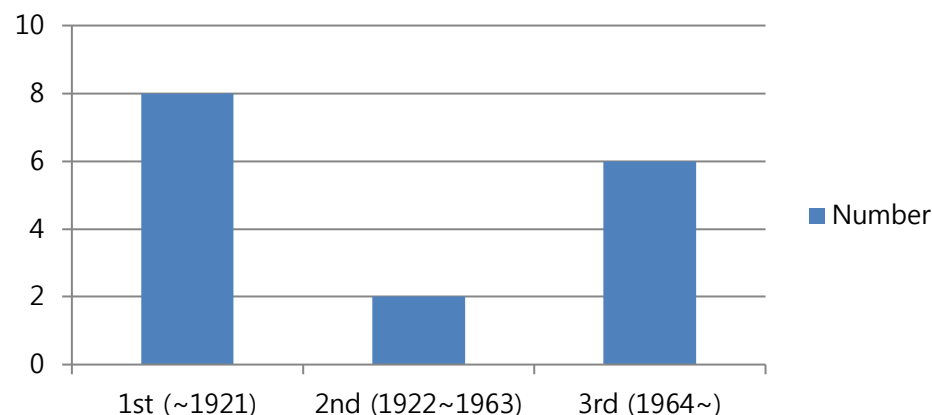
2. Characteristics of the naturalized plants in traditional tea field

1) Importation

- Importation timing:

8 taxa of naturalized plants are imported before 1921, 6 taxa are imported after 1964

Importation Timing of Naturalized Species



Importation Timing	Species	Number
1st (~1921)	<i>Amaranthus retroflexus</i> L., <i>Erigeron annuus</i> (L.) Pers., <i>Erigeron canadensis</i> L., <i>Chamaesyce supina</i> MOLD., <i>Chenopodium album</i> L., <i>Trifolium repens</i> , <i>Amaranthus lividus</i> , <i>Taraxacum officinale</i>	8
2nd (1922~1963)	<i>Panicum dichotomiflorum</i> , <i>Rumex obtusifolius</i> L.	2
3rd (1964~)	<i>Ipomoea hederacea</i> var. <i>integriuscula</i> A.Gray, <i>Ipomoea hederacea</i> Jacq., <i>Galinsoga ciliata</i> (Raf.) Blake, <i>Bidens frondosa</i> L., <i>Phytolacca americana</i> , <i>Crassocephalum crepidioides</i> (Benth.) S. Moore	6

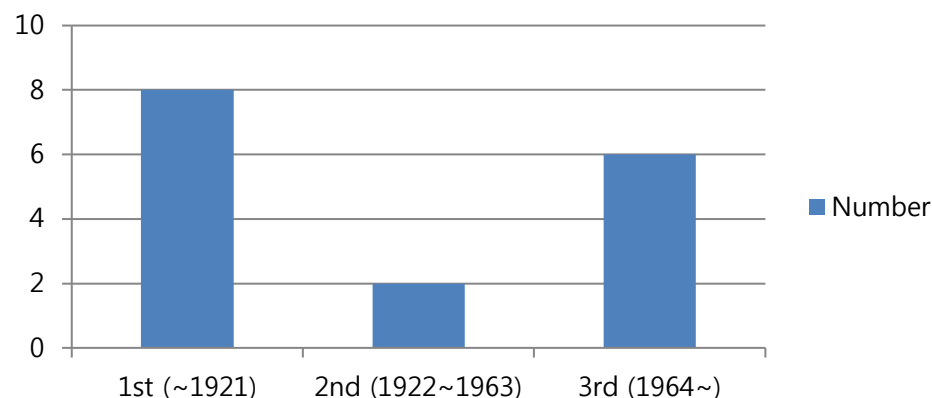
2. Characteristics of the naturalized plants in traditional tea field

1) Importation

■ Naturalization level

Most of the naturalized plants (8 taxa) are grade 5 which are widely distributed throughout the country

Importation Timing of Naturalized Species



Naturalization Grade	Species	Number
2	<i>Amaranthus retroflexus</i> L., <i>Ipomoea hederacea</i> var. <i>integriuscula</i> A. Gray, <i>Crassocephalum crepidioides</i> (Benth.) S. Moore	3
3	<i>Amaranthus lividus</i> , <i>Rumex obtusifolius</i> L., <i>Ipomoea hederacea</i> Jacq., <i>Galinsoga ciliata</i> (Raf.) Blake, <i>Phytolacca americana</i>	5
5	<i>Erigeron annuus</i> (L.) Pers., <i>Erigeron canadensis</i> L., <i>Chamaesyce supina</i> MOLD., <i>Chenopodium album</i> L., <i>Trifolium repens</i> , <i>Taraxacum officinale</i> , <i>Panicum dichotomiflorum</i> , <i>Bidens frondosa</i> L.	8

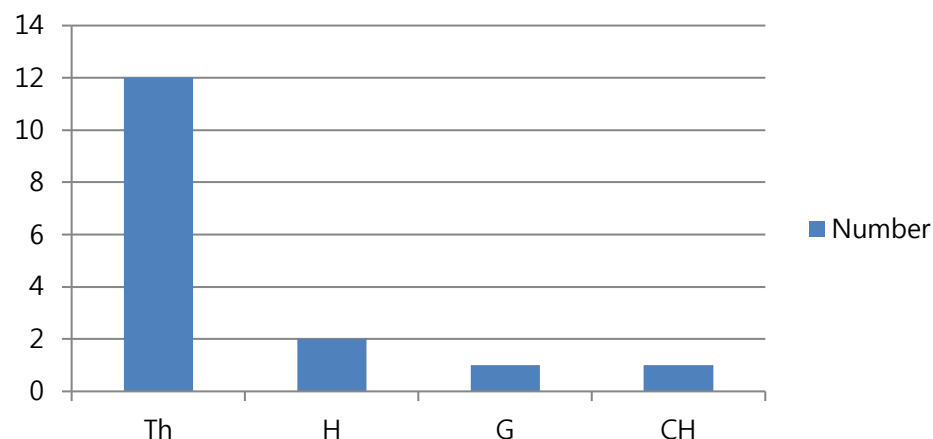
2. Characteristics of the naturalized plants in traditional tea field

2) Ecological characteristics

- Dormancy form:**

There are 12 taxa of annual herbs accounting for 75%, and 4 taxa of perennial herbs.

Hypopus of Naturalized Species



Dormancy form	Species	Number
Th	<i>Erigeron annuus</i> (L.) Pers., <i>Amaranthus lividus</i> , <i>Ipomoea hederacea</i> var. <i>integriscula</i> A.Gray, <i>Erigeron canadensis</i> L., <i>Bidens frondosa</i> L., <i>Panicum dichotomiflorum</i> , <i>Ipomoea hederacea</i> Jacq., <i>Chamaesyce supina</i> MOLD., <i>Crassocephalum crepidioides</i> (Benth.) S. Moore, <i>Galinsoga ciliata</i> (Raf.) Blake, <i>Amaranthus retroflexus</i> L., <i>Chenopodium album</i> L.	12
H	<i>Rumex obtusifolius</i> L., <i>Taraxacum officinale</i>	2
G	<i>Phytolacca americana</i>	1
CH	<i>Trifolium repens</i>	1

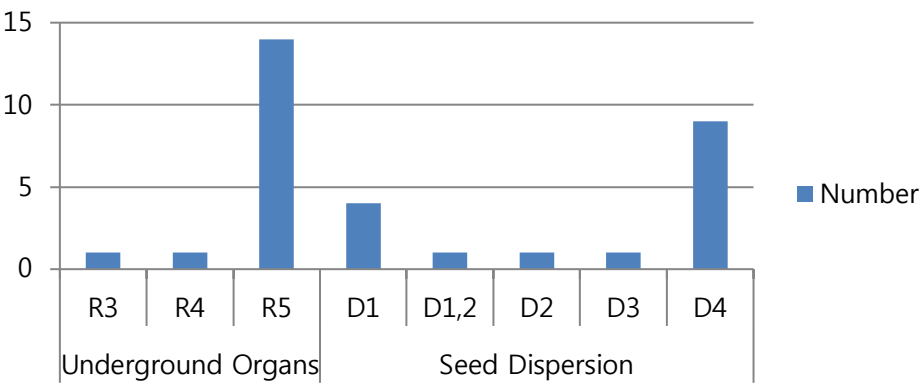
2. Characteristics of the naturalized plants in traditional tea field

2) Ecological characteristics

▪ **Vegetation Form:**

Most of the emerging naturalized plants are monopartite and seeding by gravity.

Rreproduction Type of Naturalized Species



Vegetation Form		Species	Number
Radicoid Form	R3	<i>Taraxacum officinale</i>	1
	R4	<i>Trifolium repens</i>	1
	R5	<i>Erigeron annuus</i> (L.) Pers., <i>Amaranthus lividus</i> , <i>Ipomoea hederacea</i> var. <i>integriuscula</i> A.Gray, <i>Erigeron canadensis</i> L., <i>Bidens frondosa</i> L., <i>Panicum dichotomiflorum</i> , <i>Ipomoea hederacea</i> Jacq., <i>Chamaesyce supina</i> MOLD., <i>Crassocephalum crepidioides</i> (Benth.) S. Moore, <i>Galinsoga ciliata</i> (Raf.) Blake, <i>Amaranthus retroflexus</i> L., <i>Chenopodium album</i> L., <i>Rumex obtusifolius</i> L., <i>Phytolacca americana</i>	14
Disseminule form	D1	<i>Taraxacum officinale</i> , <i>Erigeron annuus</i> (L.) Pers., <i>Erigeron canadensis</i> L., <i>Crassocephalum crepidioides</i> (Benth.) S. Moore	4
	D1,2	<i>Bidens frondosa</i> L.	1
	D2	<i>Phytolacca americana</i>	1
	D3	<i>Chamaesyce supina</i> MOLD.	1
	D4	<i>Trifolium repens</i> , <i>Amaranthus lividus</i> , <i>Ipomoea hederacea</i> var. <i>integriuscula</i> A.Gray, <i>Panicum dichotomiflorum</i> , <i>Ipomoea hederacea</i> Jacq., <i>Galinsoga ciliata</i> (Raf.) Blake, <i>Amaranthus retroflexus</i> L., <i>Chenopodium album</i> L., <i>Rumex obtusifolius</i> L.	9

2. Characteristics of the naturalized plants in traditional tea field

3) Total

- Importation

Most of the naturalized plants which emerged in the tea field of Hadong, are common species to reproduce nationwide before 1921. There are also a variety of naturalized plants have been imported since 1964 due to the growing international exchange. Especially most of the 3rd period plants are imported from the Americas.

- Ecological characteristics

Most naturalized plants that emerged from the tea fields of Hadong, are monopartite-root or seeding by gravity which are easy for management. However, the species that can reproduce in its roots such as *Trifolium repens*, or can spread their seeds with wind such as *Taraxacum officinale*, *Erigeron annuus* (L.) Pers., *Erigeron canadensis* L. will have a lasting impact on the surrounding ecosystem. So continuous monitoring and management is required.

III. Results

3. Characteristics of Naturalized Plant Distribution by land-use

- Naturalization rate of the whole area is calculated as **9.1%**

- **Naturalization rate by land-use type**

Farmland 22.9% . Village 15%, River 13.2%, Tea field 10.6%, Forest 3.3%

- **Naturalization rate by tea field type**

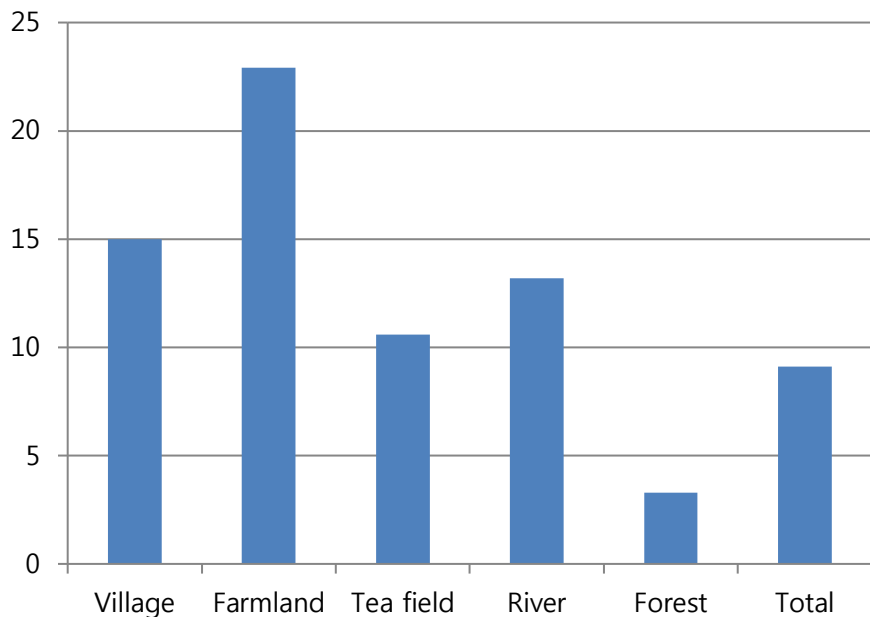
Typical tea field 16.1%, Traditional tea field **8.5%**

Land use		Results of Flora	Results of Naturalized Plants	NR%
Village		31Families 54Genus 53Species 7Varieties 60Taxa	5 Families 9 Genus 9 Species 9 Taxa	15
Farmland		17Families 31Genus 31Species 4Varieties 35Taxa	4 Families 7 Genus 7 Species 1 Varieties 8 Taxa	22.9
Tea field	Subtotal	47Families 81Genus 79Species 13Varieties 2Forma 94Taxa	5 Families 10 Genus 10 Species 10 Taxa	10.6
	Traditional	43Families 72Genus 68Species 12Varieties 2Forma 82Taxa	4 Families 7 Genus 7 Species 7 Taxa	8.5
	Typical	19Families 27Genus 28Species 3Varieties 31Taxa	2 Families 5 Genus 5 Species 5 Taxa	16.1
River		21Families 32Genus 32Species 6Varieties 38Taxa	3 Families 5 Genus 4 Species 1 Varieties 5 Taxa	13.2
Forest		32Families 50Genus 45Species 10Subspecies 10Varieties 61Taxa	2 Families 2 Genus 2 Species 2 Taxa	3.3
Total		67Families 131Genus 142Species 10Subspecies 22Varieties 2Forma 176Taxa	9 Families 14 Genus 14 Species 2 Varieties 16 Taxa	9.1

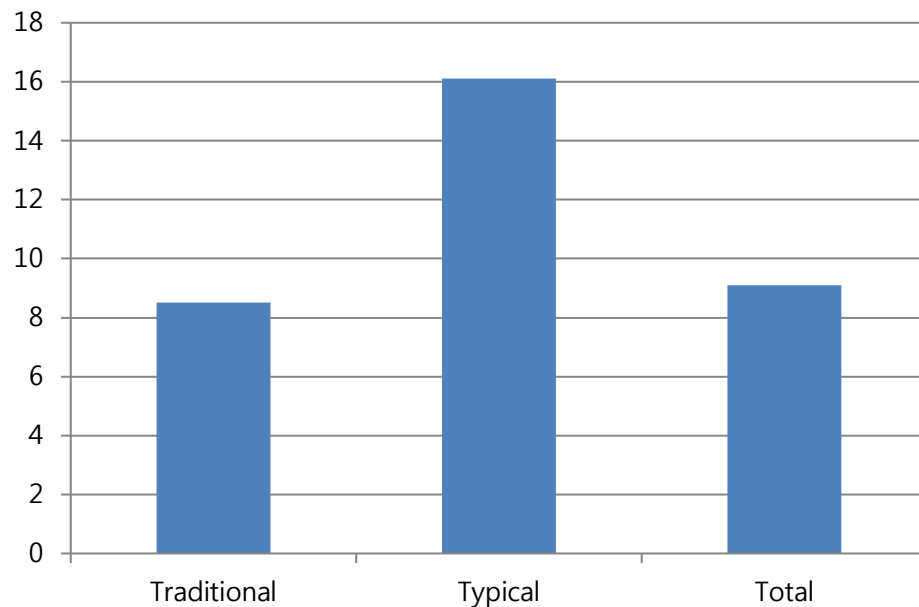
III. Results

3. Characteristics of Naturalized Plant Distribution by land-use

NR(%) by Land-use Type



NR(%) by Tea Field Type



IV. Conclusions

- A study of the site flora found that in two villages, there were a total of 176 classifications in 67 families, 131 genera include 142 species, 10 subspecies, 22 varieties and 2 forma. Among them 9 families, 14 genera, and 2 varieties, total 16 taxa of naturalized plants were founded.
- Naturalized plants by land use type showed the highest number of naturalized plant species in the tea field, but the naturalization rate was very low compared to farmland and residential area.
- The most prevalent species of naturalized species have been imported to Korea before 1921, and many species have been distributed since 1964. Most of the 3-grade naturalized species are imported from the Americas.
- Naturalized plants in Hadong traditional tea field were most monopartite and seeding by gravity which can be easily managed. So it seems that naturalized plants are not the main threat factors in traditional tea fields. However monitoring of naturalized plants in agricultural heritage sites is needed for maintaining biodiversity.

IV. Conclusions

- The naturalization rate of the research site was calculated as 9.1%. The naturalization rate by land-use type was the highest in farmland. Next was in residential areas and rivers. On the other hand, naturalization rates of traditional tea fields and the forests on the slope were low
- The flora results, the imported or the ecological characteristics of naturalized plants , naturalization rates by land-use type in this study can be used as basic data for future vegetation management in traditional tea fields.
- In order to sustain the agricultural ecosystem and biodiversity of the traditional tea fields as GIAHS site, research on the characteristics of the whole agricultural ecosystem such as animal, inorganic environment field as well as vegetation is required.
- In the future, it is necessary to conduct surveys of naturalized plants in all of the GIAHS sites. Through some comparative analysis we will find the laws and causes as meaningful reference information for the management and poeration of the GIAHS sites.



Thanks for your attention!