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The Developmental Stages of the Circumstances and Characteristics in Wentland

- In the Gyunggi Do Mountains -

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Abstracts : This Study is about the wetlands in the GyunggiDo Mountains. It is written in the point of the hydrogeomorphology, geology, and soil. And it has accessed to ecological environment. Wetlands are divided into mountain wetlands and river wetlands by location, relief, processes, hydrology, and the type of inlet and outlet of water in wetlands. Mostly mountain wetlands are formed by the process of destruction of mountain slope. So they are to be located in the knickpoint. Therefore the underground surface is visible and underground water is rising or leaking. At this process, the environment forming wetlands are made by soil that was influenced by geology and composed by fine and very fine granules.
key word : Mountain Wetlands, Slope type, Basin type, knick point

Ⅰ. Introduction

Today wetlands are very interesting. In our country, the interest began from 1990s and then wetlands has been studied. In the results, it is thought to be 'the habitat of fowls' or 'living stock of water plants', and mostly its concepts and studies have gone there. But, recently the study is beginning to have the viewpoint of environment or ecology, because wetlands are very important for environment or reservation of ecology.

The surface is the environment that has differences by the region in geography. Because the region differ in geology·geomorphology·climate · hydrology · and the human's activity. These factors are the environment in geography. Therefore, wetlands are influenced by geographic environment through its lifetime. Especially wetlands are influenced by hydrogeomorphology and soil.

1. The studied area is Gyunggi-Do.

And, the studied aims are how the geomorphology and hydrology act in wetlands formation process. This is what the characteristics and circumstances are in wetland developmental stages. These are geology, geomorphology, hydrology, and soil.

But this study has a limit on the scale, boundary, the relation of geology and the water quality, the stages of wetlands in times and vegetation in wetlands. These will be studied in the near future.

2. The study method

It is studied in the indoor and outdoor fields. This field study was on 2002~2005.

In geomorphology, they studied the profile from hilltop to wetlands, seepages, the relations of wetlands, runoffs, and the geological process near

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wetlands. Through the analysis of water of wetlands, it got the value of COD, T-N, T-P.

Through the analysis of characteristics of soil, it got the value of the organic matter, CEC, pH and granule size.

3. The studied areas

In our middle country, GyunggiDo has the character of old stages in geomorphology. For a long time, this country had erosion and denudation.

Mostly in GyunggiDo, geology is Gyunggi metamorphic complex. It has the longest metamorphic rock. Gyunggi gneiss complex has been the processes of metamorphose and granitization.

GyunggiDo is sited near Seoul and Incheon, and has the core of function and population. So that was occupied by human environment for growing our country's economy, education, culture etc.

As the results, nature was replaced by cultural environment in GyunggiDo. But, these day many people see it in a new light, and change modes of living. These phenomena, even so small scale, look better in agriculture. A lot of cultivated land was used with a rice paddy from 1960's to 1980's. Today it has returned the nature for the shortage of labor and the dropping of consumption of rice. Wetlands have developed in such areas. Wetlands are typically restored landscape. After entering local self-government, there argue between development and reservations.

This study are from these six areas. These areas are Gobongsan in Goyang, Chilbosan in Ansan, Dajang Dong in Sungnam, Seunsan in Ansung, Chunggyesan in Ewang and Undusan in Gapyong.

These wetlands were intervened by man activity. But lately, they are the restoration of nature. Because they have seepages or discharges, they are called 'wetlands'.

Ⅱ. Classifications of Wetlands

Wetlands are classified by hydrogeomorphology that the location, the source of water, the water inflow and outflow, and the duration of inundation. But this classification is located on the geomorphology and climate.

The studied wetlands are classified by geomorphology and hydrology in this study.

The first condition is the location of wetlands. The locations have the relief on the spot, the relief is the result from the structure and the process of this area. The mountain and river is the concept of its geographic location and the index of the variation in relief. Therefore, wetlands can be divided into the Mountain wetlands and the River wetlands.

The second condition is the geomorphic process that has been developed by erosion and sedimentation. In mountains, the erosion makes slope types, and in the plains makes valley or sedimentary plains.

There are two types in the mountain wetlands, 'the slope wetlands type' and 'the basin wetland type', are from the eroding process. But there are wetlands in the river by sedimentation more than

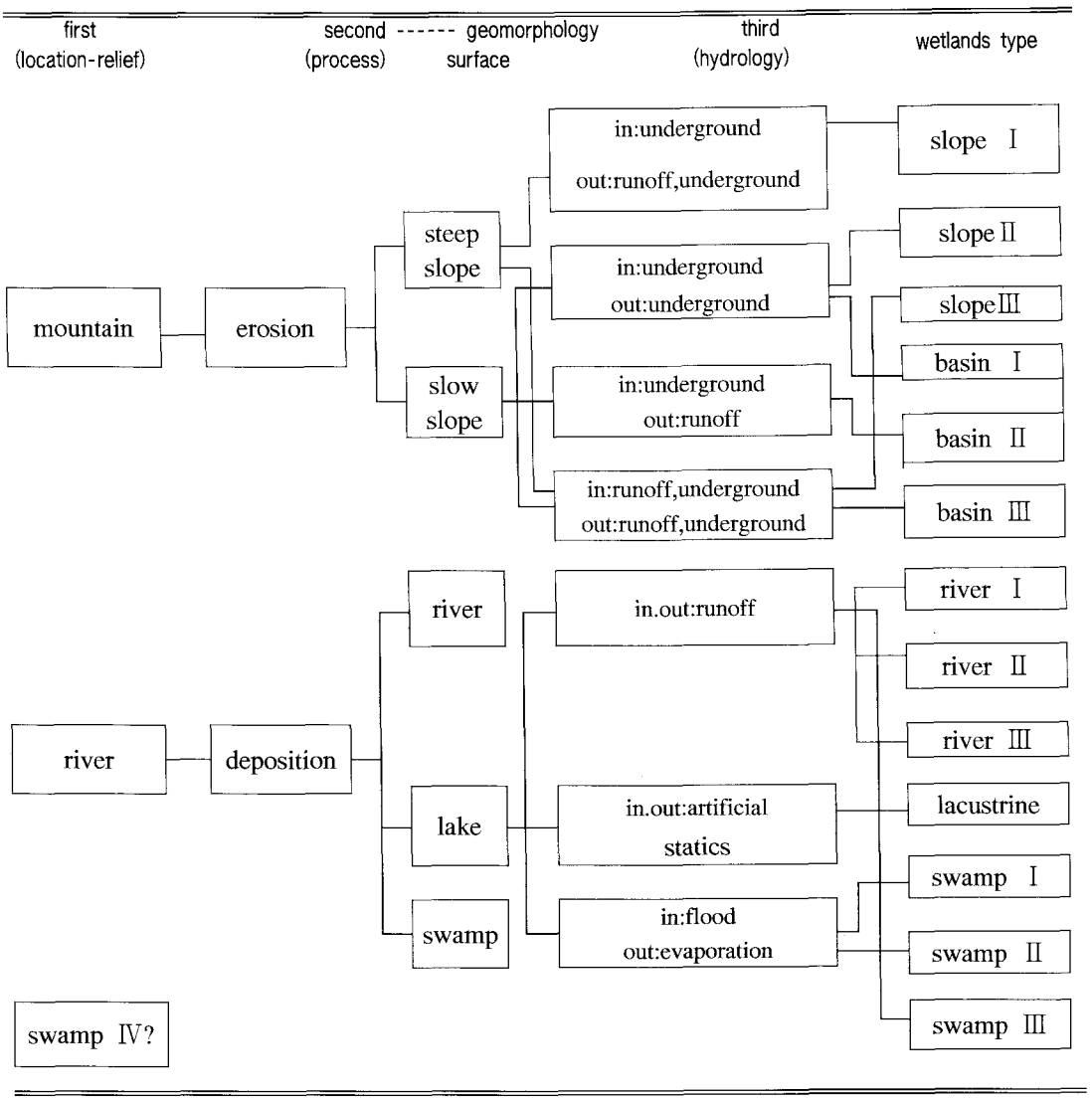

Table 1. The wetland classification by geomorphology and hydrology

erosion. Especially it develops at the spot meeting a small river, riverine being higher depositional landform than the channel floor, the bar that the water speed is slowed down or in braided channel and lively deposited, the slip off slope, the lakeside, flood plain, oxbow lake, and old river channel. These wetlands are called 'River type wetland', 'Lacustrine type wetland 'and 'Swamp type wetland'.

The last condition is hydrology. It is the inflow and outflow of wetland water. In the mountains, the hydrologic condition, which is the water source, is the one between the underground and the runoff. In the river, the types of inflow and outflow are among the running water, still water, or flood. Of course, in the river wetland, wetland

develops into a habitable condition to water plants. This is developed when the variation of the water level is being between high and low. That means the wetland grows in some environments, the fluctuations of the amount of flowing water, the speed, the type of moving materials, and the condition of sedimentation.

Figure 1, figure 2 are drown on the ground at table 1. This shows how the wetlands are developed and classified by the geomorphology and hydrology in the land space.

In the mountains, the wetlands are classified by the geomorphologic process. If the erosion process is strong the slope will be steep. This is called 'the slope type wetlands'. And if the moving materials from the slope are sediment at the nickpoint, the wetlands will grow and have two types of wetlands near the nickpoint. One is 'the slope type', 'the other is the basin type'. These are broken into 3 parts - the slope type Ⅰ'·'the slope type Ⅱ'· 'the slope type Ⅲ' and 'the basin type Ⅰ'· 'the basin type Ⅱ' and 'the basin type Ⅲ' are from the wetland water hydrology that is the inflow and outflow.

If the slope surrounding the wetlands does instead of being developed, it is called 'The slope type Ⅰ'. Because the wetland is located on the steep slope, the water source is the seepages and the water is difficult to be contained at wetlands. So, the water outflows into underground, like sheetflow or gully on the surface. If the water source is in underground and it outflows into the underground, it will be called 'The slope type Ⅱ'. In this case, backslope retreats, and the slope is slow in speed. If the backslope is broken by the denudation or erosion, the slope will be slow. And it will be called 'The slope type Ⅲ' The water source is almost in underground like seepages, the water outflows into the underground or run on the surface. The slope surrounding these wetlands donit take so long to develop..

If the water source is the seepage and the water recharge in underground, it is called 'The basin type Ⅰ', but when the water comes out of the seepage too much, the water speed will be rapid, and the water will run through the channel, this is called 'The basin type Ⅱ'. If the water source is the seepage and the runoff, the water recharges underground, this is called, 'The basin type Ⅲ'. 'The basin type wetlands' are developed after the nickpoint on the slow slope. And it is surrounded by three slopes, so the water supplies sufficiently go into the wetlands by seepages. The water recharges into the underground or runs through the channel.

Therefore, the seepages are good condition that 'the basin type wetlands' and 'the mountain type wetlands' are developed.

Generally speaking, the river wetlands are classifiepd by the landform and location for deposition and hydrology. It is included by the channel and the floodplain. In relation with the river channel, running water supplies water wetlands in and out. The wetlands develop at the channel bed, and the river in the .junction of two small streams. These ares called 'the river type Ⅰ'· 'the river type Ⅱ'· 'the river type Ⅲ'.

If men make a dam, the wetland develops on the lakeside, it is called 'the lacustrine type'. But If the wetlands develops in the floodplains, these

are called 'the swamp type Ⅰ', 'the swamp type Ⅱ', and 'the swamp type Ⅲ'. When the water inflows by flood in wetlands, and outflows by the transevaporation, it is called 'the swamp type Ⅰ'. During the flood, the plains are inundated and the fine materials are deposited like the fine sand, silt, and clay. Because these deposits have a homogeneity of materials, the layer gathering these materials gets the character of aquiclude layers. This is just the backmarsh. In the flood plains, there is an oxbow lake, this is 'the swamp type Ⅱ'. This is one of the relict landform. Or, for some reasons if the water gathers in some hollow, this case also calls for the same type. Knowingly, the water inflows by flood and outflows by transevaporation or recharges into the underground. 'The swamp type Ⅲ' is also relieved from landform, but in an old stream channel, the water supplies from the present stream through the old channel for high water level, and flows out to the present stream.

Except for this type, this is 'the swamp Ⅳ'. It is separated without the river. But the water table near the ground exposes in convex landform by some reasons like structure, and climate.

Ⅲ. The six wetlands in the studied areas

1. The characteristics of environment in the wetlands developmental stages

A. geology and geomorphology

This studied area has figures of Gyunggi metamorphic complex in geology. It composes lots of the mica, especially biotite. And It has weathered deep for a long time. This series of phenomena have given the influence of the developmental stages in wetlands.

The wetlands make it a condition that mica is in the deep weathering and the landscape is in dissection of mountain slope. These conditions make the land to be a slow slope. On time, the slope having the nickpoint is broken by erosion and dissection, so the underground water leaked through the seepage, and the land inundated in the water become the wetland.

Table 2 shows the landscape of the six studied wetlands. In the mountain, the wetlands has two groups, the one is the basin type, the other is the slope type. The former has not or just a little the surrounded slope, the latter has been surrounded with 3 slopes and supplied lots of water from slopes into the wetlands. There are five slope types of wetlands except Gobongsan wetlands.

Almost all the location of wetlands are at the nick point in the mountain regardless of wetlands type except Undoosan and Seownsan.

The nick point is in relations with the dissection of mountain by river and not relations with river. It explains that the nick point is connected with the slope retreated by the deep weathering, sheetfloow, and undergroundwater. As the result, the mountain wetlands is sited on a nick point or a slow slope.

The development of slopes that has gathered at the wetlands and supplies of the water in wetlands makes the growth of wetlands.

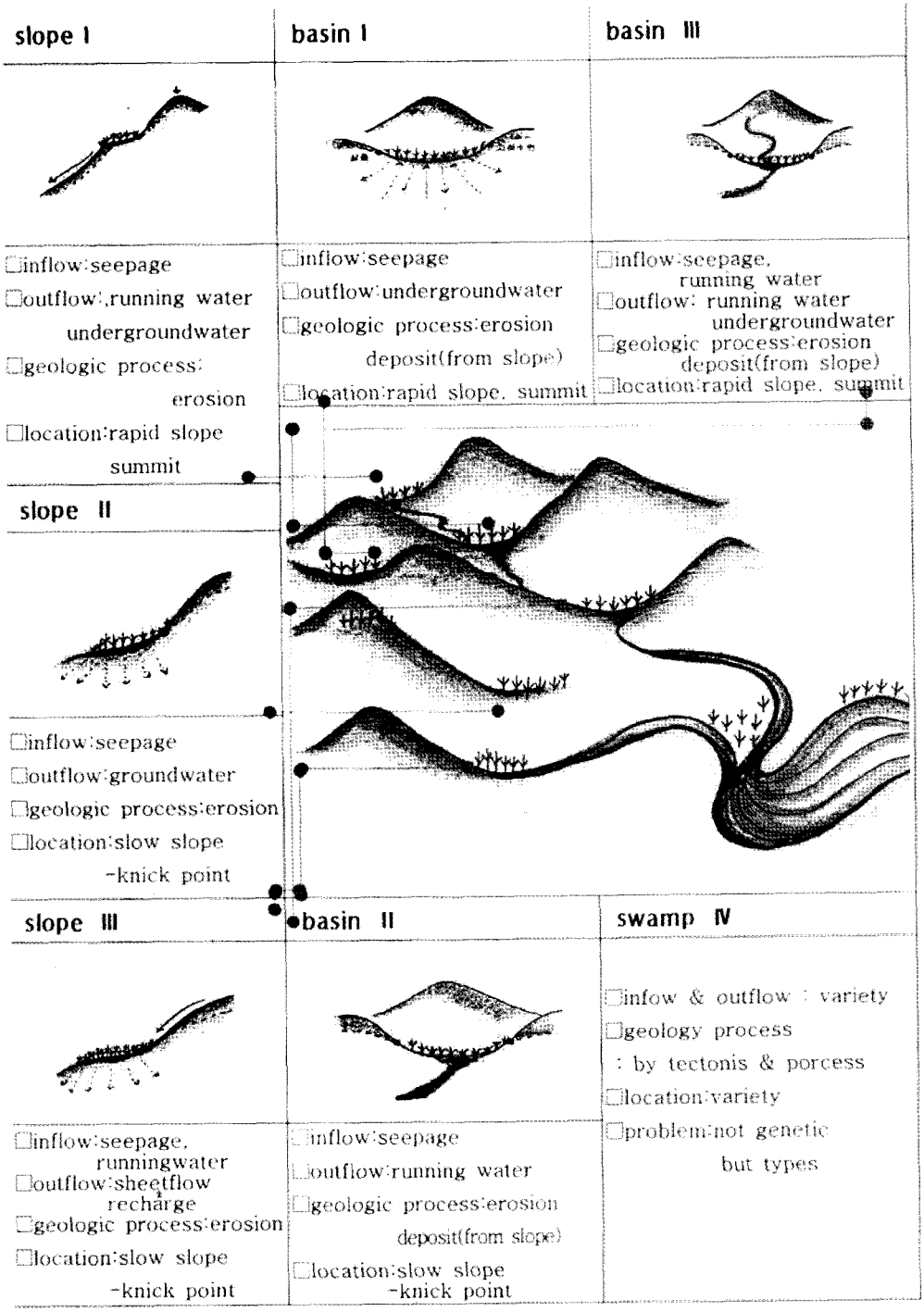

Figure1. The classification of wetlands by geomorphology and hydrology I .

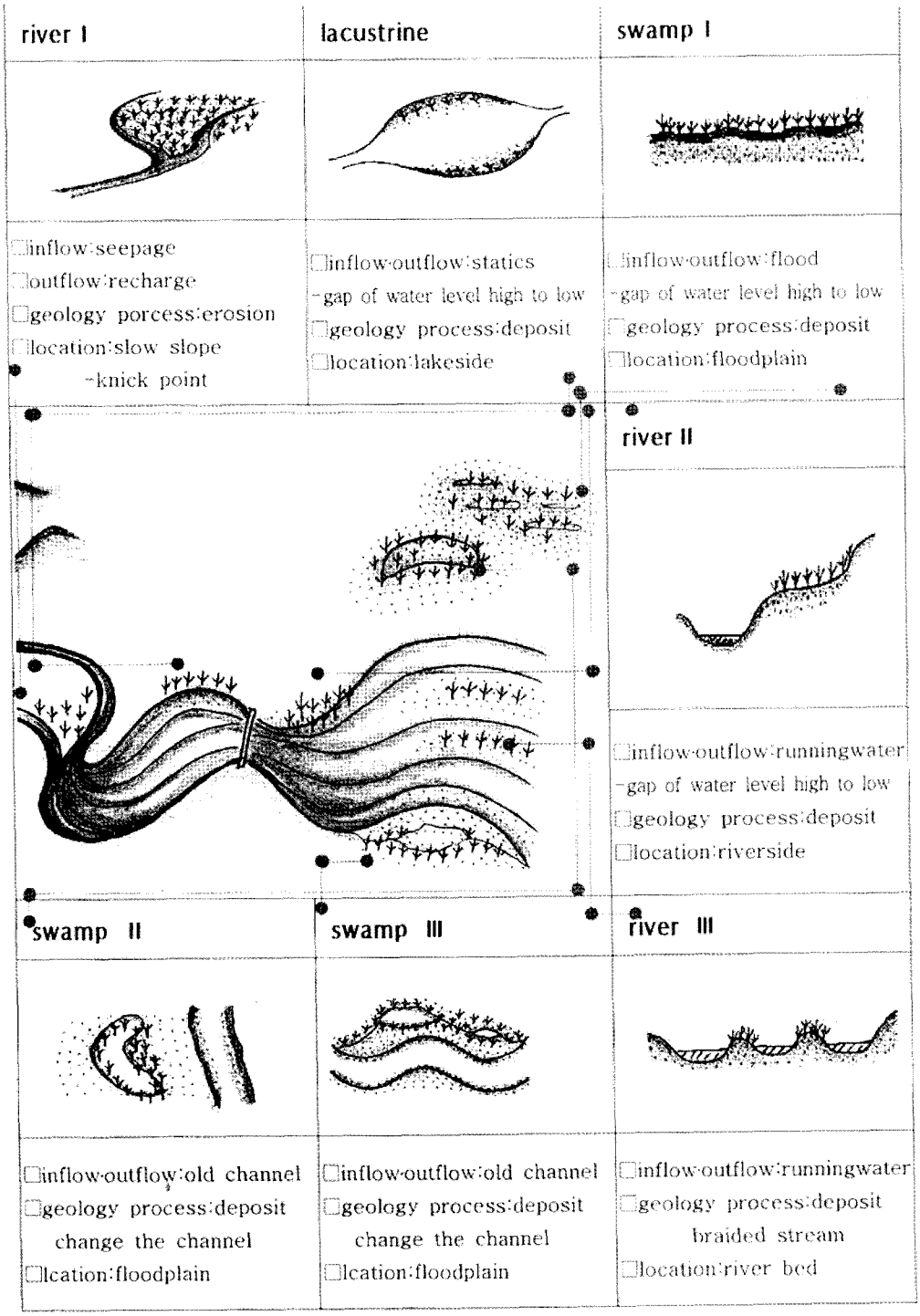

Figure 2. The classification of wetlands by geomorphology and hydrology II.

Table 2. The geomorphology of six studied wetlands

landscape		Gobong	Chilbo	Daejang	Seown	Chunggye	undoo
dip of slope		6~9°	7~8°	12~19°	19~23°	16~21°	14°
hight(m)		25~45	40~80	150~200	280~330	120~130	500~650
knick point		○	○	○		○	
classification		basin	slope	slope	slope	slope	slope
river	inflow	○					
	outflow				○	○	○

Generally speaking, the large boundary that gathers the water from the slope are good for the wetlands.

The wetland's water is supplied from the seepages in this slow slope after the knickpoint. All the seepages have the head erosion on the point. But the erosion rate of the slope has differences by vegetation around the wetlands. For example, Chilbosan's Wetlands have the badland and the dry stream by sheetflows, because it doesn't have enough vegetation and are developed in the terrible deep weathering.

B. Hydrology

In these studied areas, the hydrology points is very important.

In the mountain slope, the wetlands are developed by seepages which the groundwater is leaky over the ground. Table 3 tells us the circumstances of wetland water -inlet and outlet, the relations of the stream. The seepage is the most important factor of the wetlands watersource in the slope. If the slope has the channel, the wetlands are developed by the stream with the seepages.

Table 3. the Hydrology of Six Studied Wetlands

index		Gobong	Chilbo	Daejang	Seoun	Chunggye	Undoo
in flow	seepage	○	○	○	○	○	○
	spring	○			○		?
	stream	○					
the relantion of the stream		○					
out flow	under ground		○	○	○		
	stream			○	○	○	○
	artificial channel	○					
wetlands type		basin I	slope II	slope I	slope I	slope I	slope I

Generally speaking, these cases are 'the basin type wetlands' not 'the slope type', because there is a relation of the velocity of water and the angle of the slopes.

In another general way, the wetland outflowing makes the 1st stream, having the sheetflood or recharge from underground.

There are classified study area by the hydrologic conditions - inflows and outflows. Gobongsan wetlands are classified by 'the basin type', but Chilbosan wetlands belong to 'the slope type II' because underground water come in and go out. Except these wetlands, all belong to 'the slope type I'.

C. Soil

Soil is inundated for a long time, so it is gray and unaerobic. It has red spots of the oxidated Fe in all of the studied areas.

The analysis of particle separates soil by 0~30 ㎝, 30~50㎝, and 50~80㎝ shows the deposits from the mountain slope for being poor sorting and having rectangular gravels that is larger than 2㎜.

As the result of the soil analysis, there are a lot of sandy, and little or no clay in the outer layer of soil, and the deeper soil layer has increased the quantity of silt and clay, so it has an index of 2~69.5%. It is the reason of this phenomena that leaching and siallitization of silt and clay. As the result, silt and clay makes the soil conditions to rise of being waterable to 10~45㎝ through the capilarization of the soil water.

So the soil water stays in the ground for a long time and the soil is inundated.

Table 4 shows the soil texture of the studied wetlands.

Fig 3 shows the soil texture in triangular diagram. Generally speaking, there are high percentages in sandy loam

Table 5 shows the chemical features of wetlands soil. All the studied wetland's soil have the value of acid soil, pH 4.47~5.13.

It has the value of CEC 8.49~33.4. Chunggye is low, Undoo is the highest value of all. The value of Al_2O_3 reaches 11.7~19.2. It has very high figures. This shows the active CEC. Undoo is the lowest, Gobong is the highest. The rates of MgO, Na_2O, K_2O in the wetlands soil are comparatively higher than in the parents soil forming minerals. Specially, the rates of MgO,

Table 4. The Texture of Six Wetlands

index (㎝)	Gobong	Chilbo	Daejang	Seoun	Chung-gye	Undoo
0~30	sandy loam	sandy loam	sandy loam	loamy sand	loamy sand	sandy loam
30~50	silt loam	loam	loamy sand	sandy loam	sandy loam	sandy loam
50~80	silt loam	silt loam	sandy loam	sandy loam	sandy loam	sandy loam

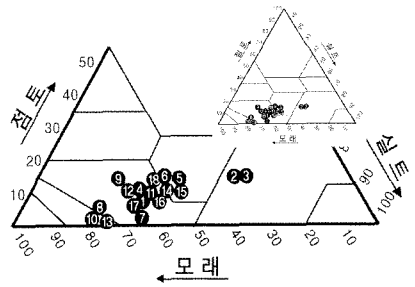

Fig 3. the Texture in Triangular Daiagram

Table 5. the soil characteristics in six studied wetlands

index	Gobong	Chilbo	Daejang	Seoun	Chunggye	Undoo
organism	5.42	4.11	5.08	5.03	3.35	11.8
pH	5.12	4.47	4.63	4.70	5.13	4.65
CEC	15.3	9.11	15.5	13.5	8.49	33.4
Al_2O_3	19.2	15.0	12.6	15.0	13.7	11.7
MgO	1.33	0.39	1.21	2.02	0.85	1.28.
Na_2O	0.38	1.99	0.50	1.25	1.50	0.87
K_2O	2.64	3.40	2.10	2.44	3.88	2.50

K_2O show that the bedrock having many mica is being weathered for a long time, and as the results, mica is distributed in the soil fill the role of making the wetlands.

In this case the volume of the organization of clay is not enough. If the volume of clay in soil is 0~15%, organization has to get to 3.35~11.8%. So, all the studied soil is the inorganic soil

2. The developmental Processes of Wetlands in Mountain.

Any developed wetlands have the adequate environmental factors in landform, hydrology, habitate, soil. But it is a point to be considered where the wetlands water sources start in the case of the developed wetlands in mountatain. Generally it is clean enough to be developing process of 'Inland Wetlands', what we call, though all wetlands have the essential conditions of the exposure of underground water table. For example the wetlands in old river channel, in back marsh, lakeside or riverside, and the deposit in river with slow water speed.

However, the reason of the mountain wetlands depend upon the outcrop of water table, the weathering of the bedrock or soil, and the impermeable layer.

All of the landforms are built on the geology that is bedrock, structure line, and geologic history.

The wetlands are built on the impermeable geology or soil. The underground water on the impermeable layer is leaky on the ground, this is the seepages or spring, flows into the depression or flows continually on the mountain slope having impermeable layer just below the soil for high water table. So, the wetlands are formed permanent or temporary in the slope.

Mostly the wetlands in the mountains begin at the seepage or spring. The outflow of the wetlands water begin from the 1st channel for example gully and it grows actively the head weathering, sometime turn into the sheetflood. But the temporary wetlands are influenced by the rainy season or by having a little tranevaporations on the near surface. As the result the soil is saturated with soil water, and has the strong erosion in the massmwasting forms. And this case has not been cleaned by outlet and inlet on the surface.

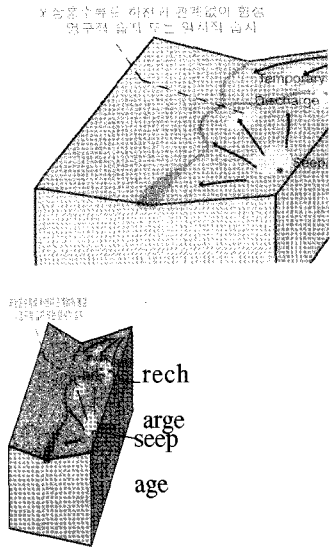

Fig 4. the Typical Type of Developmenatal Process of Wetlands in Mountain

Table 6. The developmental circumstances in the mountains wetlands

type	permanent wetlands	temproary wetlands	impossible
geology	impermeable layer	impermeable layer	permeable layer
landforms	depression, slope(rapid,slow)		not relation
slope	slow rapid-vegetables	slow rapid-vegetables	
water source	undergroundwater, runningwater, precipitation	undergroundwater, runningwater, precipitation	not relation
runoff of undergroundwater	seepage spring	seepage high watertable	not
outflow	channe. sheetflow	sheetflow recharge	not relation

The figure of the process types of wetlands in the mountains. Table 6 shows the developmental processes and circumstances of the wetlands in the

mountains. And Fig 4 arranges table 6.

It is important factor in developmental processes of wetlands that the surface has the impermeable layer in geologic and soil conditions. This is from the parents soil. This study shows the relation to the geology of the bedrock, especially the mica. With the geologic factor, the depression front the knickpoint is good conditions of permanent wetlands. Despite of the inclination, the impermeable layer develops the wetlands permanent as well as temporary without the depression. This condition is filled up only to the soil. As the soil consist of the particles of the silt and clay it becomes impermeable layer, and retains the wetland water.

Therefore it is very important conditions of wetlands development to leak underground water like the seepages and springs. At this time, the wetlands water outflows with channel or sheetflood. But, in temporary wetlands the way of outflows is usually the sheetflow and rechange rather than the running water for a little discharge.

Ⅳ. Conclusion

The purpose of this study is to examine the characteristics of wetlands and the processes of their formation by the hydromorphology in Gyunggi-do. Six areas were studied - Gobongsan at Goyang, Chilbosan at Ansan, Daejangdong at Sungnam, Seounsan at Ansung, Chunggyesan at Euwang and Undoosan at Gapyun. This study analyzes the circumstances of the wetlands-geology, geomorphology, hydrology, water quality, soil texture, soil characteristics, and researched six small wetlands in Gyunggi-do Mountains.

The results are as follows :

1) The weathering of many granules of moscovite or mica in bedrock is made to help the wetlands in geology. The areas that included many granules of mica(specially biotite) in bedrock is adapted to the wetlands.

2) The wetlands located at the nick point is that the mountains exchange the plains through the process of dissection of mountains. Long-termed denudation has made the nick point. If these areas were cut by any reasons, the groundwater leaks on the earth through the seepages, and the water flows the earth and joins in the wetlands.

3) The wetlands in the mountains have two types : 1. The slope-type: that develops in the slopes not having surrounded the hill slope that have the flowing water(surface or ground water) from the mountains. 2. The basin-type: that have three hill slopes, and join the water(surface or ground water) from hill slopes. This area have the wet soils. If the series of these processes were steadied, this becomes the permanent wetlands

Anywhere the water was not supplied steadily, the soil becomes temporary et. This is the temporary wetlands.

These areas have a basin-type wetlands (Gobongsan wetlands) and the five slope-type wetlands (Chilbosan wetlands, Daejanddong wetlands, and Seounsan wetlands Chunggye wetlands, and Undoo wetlands).

4) Six wetlands are the 'muknon' wetlands and restored wetlands on the nick point, the basis of mountains.

5) Six wetlands, all the two types of wetlands, have the seepage that was squeezed through the broken slopes. This seepage is the spot of the surface water that started from the ground water table. And these wetlands are almost not related with the river.

Therefore the water source of the wetlands are formed in the groundwater more than the river or precipitation.

6) Anyway, the wetlands water is sucked, and recharged. Sometimes the recharged groundwater makes another wetlands blow the slopes. Or the wetlands water change the little first river.

7) The slope-type wetlands are tend to make the sheetflow, on the other hands, the basin-type wetlands tend to make the first stream of river on the earth.

8) The soil texture are composed the sand and silt. Six wetland soil texture have the ratio of sand 75 to silt 25. It has no clay. It shows the A horizon of soil profile, and the strong zone of eluviation. X90 is from fine sand to middle sized sand. These characteristics show the evenness of the soil texture.

10) The value of CEC(cation exchange capacity) is different by the wetlands, but Al_2O_3 value of the study of wetlands is higher than others. Therefore it is doing cation exchange steadily in the soil.

11) The value of pH is very low from 4.47 to 5.13. It shows that the soil of the studied area is strong acid soil. The acid soil is anaerobic soil. Because the water table is very high, and the A horizon of soil is inundation, its color becomes grey.

12) O horizon of soil has much humus and its depth reaches from 10~30㎝, and A horizon is located below the O horizon, that is grey and has spot of red oxidatized Iron.

13) By 1)~13) we get the mechanism of the wetlands on the mountain slope.

13-1) Generally the process of wetland formation is said that the seepage of water table on the slope, bedrock, the weather of the soil, and impermeable layer. The basis of many landforms is geology. Geology - the bedrock, structures, the geology history is one of factors of landforms processes. Generally speaking, it makes the wetland that the geology has characteristics of impermeable layer and so have the soil characteristics and texture. The groundwater on impermeable layer leak on the earth(seepage or discharge), this process makes the hollow. But If the groundwater moves steadily under the earth on the hill slope, it makes the permanent or temporary wetlands.

The permanent wetlands is adapted to begin from seepage on the hill slope or the spot of seepage makes the headward erosion, and moves toward the upper stream. The seepage or discharge is unique, the slope is slow, and the hollow by the seepage makes a very little channel. Sometimes, the soil water in company with the first channel flows by the sheetflows.

In the temporary wetland, if the wetlands become for rainy seasons or for low evaporations, the water flow just beneath the surface. As the result, these flows becomes sheetfloods, not a very little channel. And it has not an inlet and an outlet.

* This study sumed up the doctoral thesis of writer.