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Economical Valuation of Hypothetically Constructed Washland Around A Wetland

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Abstract: *This study performed the economic value analysis based on flood damage reduction, water quality improvement, ecological effectiveness, and sociocultural effect for the washland construction plan in Topyouncheon basin in Changyeonggun,Gyeongnamdo, Korea. The results of economical value analysis showed that we can have economical benefit of about 74 million USD and this could contribute to the realization of the effect and importance of washland construction.*

Keywords: *economic valuation; washland; wetland*

Introduction

Recently, in Korea, we have a growing interest in the washland construction as a measure of flood control and as a wetland with ecological function in the river. However, previous researches on washland construction have focused on the flood control effect or flow discharge change. In spite of the previous studies, the washland construction has lacks in representing its reasonable value and effects. In this study, we performed the economic value analysis to quantify the economic benefit based on flood damage reduction, water quality improvement, ecological effectiveness, and socio-cultural effect for the washland construction plan in Topyoun-cheon basin in Changyeong-gun,Gyeongnamdo, Korea.

Study Area and Hypothetical Washland Constructions

Upo wetland is located in near to Topyoungcheon steam which is a tributary of the Nakdong river, Korea. The Topyoungcheon tributary is about 27 km long and flowing through the Upo wetland. We have the plan of the washland constructions around Upo wetland for the aim of flood damage reduction. Besides Upo wetland there are two more wetlands of Sajipo and Mokpo in Topyungcheon stream. We have three candidate areas for the washland constructions of Daedae, Sejin, and Mogok(see Figure 1). These areas are divided into two cases which are residential and nonresidential(or outside) areas. Then we categorize washland construction in 5 cases shown in Table 1. This study will quantify the economical value for the cases of hypothetical washland constructions which we planned.

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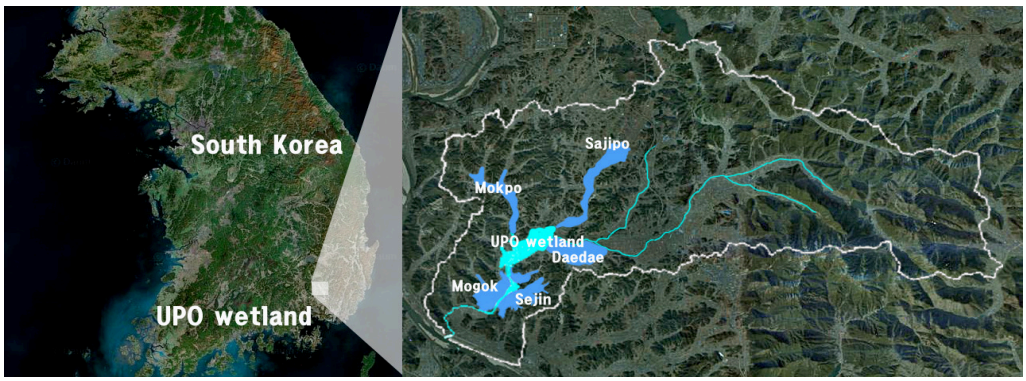

Fig. 1. Study Area and constructed washland

Table 1. Cases of washland construction

Cases of washland construction		Construction Area ($1,000m^2$)
case 1	Daedae(outside) + Sejin(all) + Mogok(all)	3,137
case 2	Daedae(all) + Sejin(all) + Mogok(all)	3,778
case 3	Daedae(all) + Sejin downstream + Mogok(outside)	2,875
case 4	Daedae(outside) + Sejin(all) + Mogok(outside)	2,528
case 5	Daedae(outside) + Sejin(upstream) + Mogok(outside)	1,866

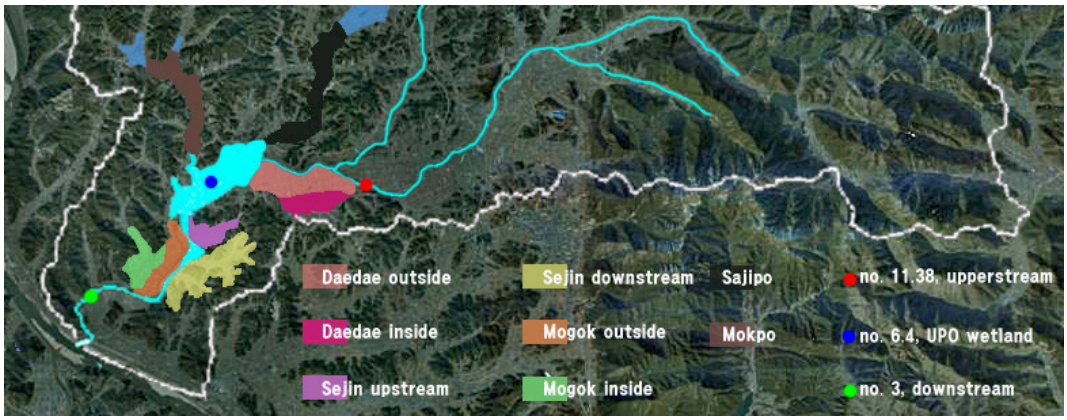

Fig. 2. Locations of hypothetically constructed washlands

Flood damage reduction by hypothetically constructed washlands

Here we estimated the flood damage reduction for each washland construction shown in Table 1 and used "Multi Demension Flood Damage Analysis(MDFDA)" (Minsistry of Construction and Transportation, Korea, 2004) for the flood damage estimation. This method is based on flood frequency and inundation analysis. So if we construct washland the inundation will be reduced and flood damage is also reduced. The results are shown in Table 2.

Table 2. Flood damage reduction by washland construction

(unit: million USD, duration: 50 years)

Item	Flood damage reduction in each case				
	case 1	**case 2**	**case 3**	**case 4**	**case 5**
Damage reduction	7.65	10.57	11.80	11.92	9.46

Water quality improvement by hypothetically constructed washlands

We assumed that the wansland can provide flood control function in flood season, in nonflood season, the washland can provide the functions of water quality improvement or purification and ecological benefits(Bennett et al, 2001). This could be possible when we consider the washland as a wetland which can purify water pollution and have ecological benefits. Therefore if we construct washland, the wetland will be enlarged and as the area of wetland is increased, the benefit will be also increased(Birol et al, 2005).

This section treated the washland can purify water pollution and estimated its benefit. Therefore we estimated the benefit by converting washland's purification ability of polluted water to economical value. We used the replacement cost method(RCM) for the estimation of economical value by water quality improvement of the washland using Equation (1) and the results are shown in Table 3.

$$Washland \quad annual\, BOD \quad Treatment = \frac{Sewage \quad Plant \quad Operation \quad Cost \quad / \quad ton}{Sewage \quad Plant \quad BOD \quad Treatment \quad / \quad ton} \tag{1}$$

Table 3. Water quality improvement value by washland

(unit: million USD, duration: 50 years)

Cases	Water quality improvement value (annual mean value)	Water quality improvement value (mean value of rainy season)
case 1	1.59	4,669
case 2	1.91	5,603
case 3	1.46	4,284
case 4	1.28	3,750
case 5	0.94	2,772

Nonuse value of washland construction

The economical value from washland construction can be divided into use value and nonuse value. Use value is the value that can obtain directly from washland function such as flood prevention or water quality improvement and nonuse value is the nonmarket value that can appear from the ecosystem of washland(Louviere et al, 2000). Therefore we used questionnaire survey to estimate the economical value of the ecosystem in washland.

This study used Choice Experiment(CE) to estimate the value about various functions and services of washland ecosystem. To use CE we performed the questionnaire survey in seven metrocities including Seoul capital city of Korea then we did economical valuation of washland construction. The collected data was analyzed by using a logit model in Equation (2) by LIMDEP 8.0 NLOGITs 3.0 that is favorite program for econometric analysis(Kuhfeld, 2005)

$$\begin{aligned} V_{ij} = {} & \beta_1 Wetlands + \beta_2 Birds + \beta_3 \,\mathrm{Pr}\, ogram + \beta_4 Fund + \alpha_1 Wetlands \times city \\ & + \alpha_2 Birds \times city + \alpha_3 \,\mathrm{Pr}\, ogram \times city + \alpha_4 Fund \times city + \alpha_5 Wetlands \times kids \\ & + \alpha_6 Birds \times kids + \alpha_7 \,\mathrm{Pr}\, ogram \times kids + \alpha_8 Fund \times kids \end{aligned} \quad (2)$$

Total value of hypothetically constructed washland

The estimated total value of the hypothetically constructed washland is in the range of 54 million USD and 88 million USD according to the construction cases. The estimated values are summarized in Table 4. According to Table 4, nonuse value shows more bigger than use value. This represents the effectiveness of flood control and water quality improvement is less than that of ecological function and service.

Table 4. Economica value of hypothetically constructed washland (unit: million USD)

Cases	Area of washland (ha)	Use value		Nonuse value	Total Value
		flood damage reduction	water quality improvement value (annual mean value)		
case 1	314.04	7.65	1.59	63.74	72.98
case 2	376.86	10.57	1.91	76.45	88.93
case 3	287.60	11.80	1.46	62.93	76.19
case 4	251.23	11.92	1.28	54.05	67.25
case 5	185.12	9.46	0.94	43.89	54.29

CONCLUSIONS

Previous researches on washland construction in Korea have focused on the flood control effect or flow discharge change. Because of this, the washland construction has lacks of representing its value and effectiveness. This study performed the economic value analysis based on flood damage reduction, water quality improvement, ecological effectiveness, and socio-cultural effect for the washland construction plan in Topyoun-cheon basin in Changyeong-gun,Gyeongnamdo, Korea. As the result, economical value of washland showed that we can have economical benefit of about 74 million USD and this could contribute to the realization of the effectiveness and importance of washland construction.

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