댐상류지역 하수도사업의 WTP추정을 위한 편익전환기법 적용

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발표순서

- 댐상류지역 하수도사업이란?
- CVM을 이용한 WTP추정
  - 안동/임하댐지역 하수도사업을 중심으로
- WTP추정을 위한 BTM 적용

댐상류 하수도시설 확충사업 진행경과

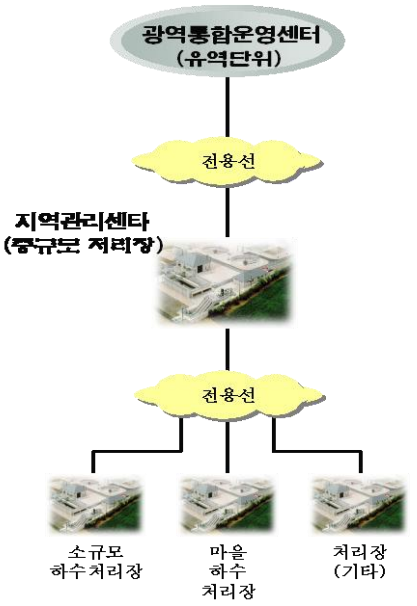
- 2002년: 다목적댐 상류지역에 대한 하수처리장 확충사업 추진계획을 수립
- 2003년: 이를 민간투자사업으로 추진하기 위한 협약을 체결
- 2005년: 이에 대한 타당성조사와 기본계획을 수립.
- 2005년 3월: 감사원의 ‘SOC 민간투자제도 운영실태’ 감사
  - 사업추진방식이 민간투자사업에서 재정사업으로 변경
- 2005년: 7개댐 9개 권역에 대한 설계시공일괄입찰공고
- 2006년: 착공
- 2011년: 준공
- 2012년: 통합관리시스템 운영 개시
- 대상지역:
  - 소양강댐 등 7개 다목적댐 상류지역의 28개 시군이 포함,
  - 총사업비: 약 14,001억원
  - 하수처리시설 463개소(개량/신설포함), 오수처리시설 11개소, 하수관거정비 64개소로 총 사업대상시설 532개소
- 특징
  - 상수원의 수질 조기개선, 하수도 보급률 향상을 도모
  - IT(정보기술)와 ET(환경기술)을 접목한 통합하수관리체계 구축
  - 하수처리 시설의 운영 및 운전 효율성 증대 도모
  - 하수처리장의 최적관리를 위한 무인 자동화 및 원격제어 통합관리 시스템 도입
  - 모니터링, 제어.계측 및 환경공학이 함께 접목된 기술 도입

댐상류 하수도시설 확충사업 개요

사업의 개요				
사업기간	2004~2010년	대상지역	소양강댐 등 7개 다목적 댐 상류지역(28개 시·군)	
총 사업비	14,001억원	사업추진방식	설계·시공일괄입찰(턴키)	

사업대상시설										
구 분		사업비 (억원)	합계 (개소)	하수처리장		마을하수도		오수 처리 시설	하수 관거 정비
				신설	개량	신설	기존		
계		14,001	538	25	18	267	153	11	64
대청댐	1권역	1,478	66	-	6	43	6	-	9
	2권역	1,839	46	2	2	33	9	-	5
충주댐	1권역	1,675	67	8	2	24	20	-	13
	2권역	3,030	65	2	1	35	19	-	8
소양강댐		1614	116	4	3	28	59	11	11
안동·임하댐		1,501	52	3	-	39	15	-	5
합청댐		1,054	36	2	1	26	7	-	3
남강댐	1권역	890	43	2	2	25	10	-	6
	2권역	921	42	2	1	26	7	-	2

댐상류 하수도시설 통합관리시스템 구축

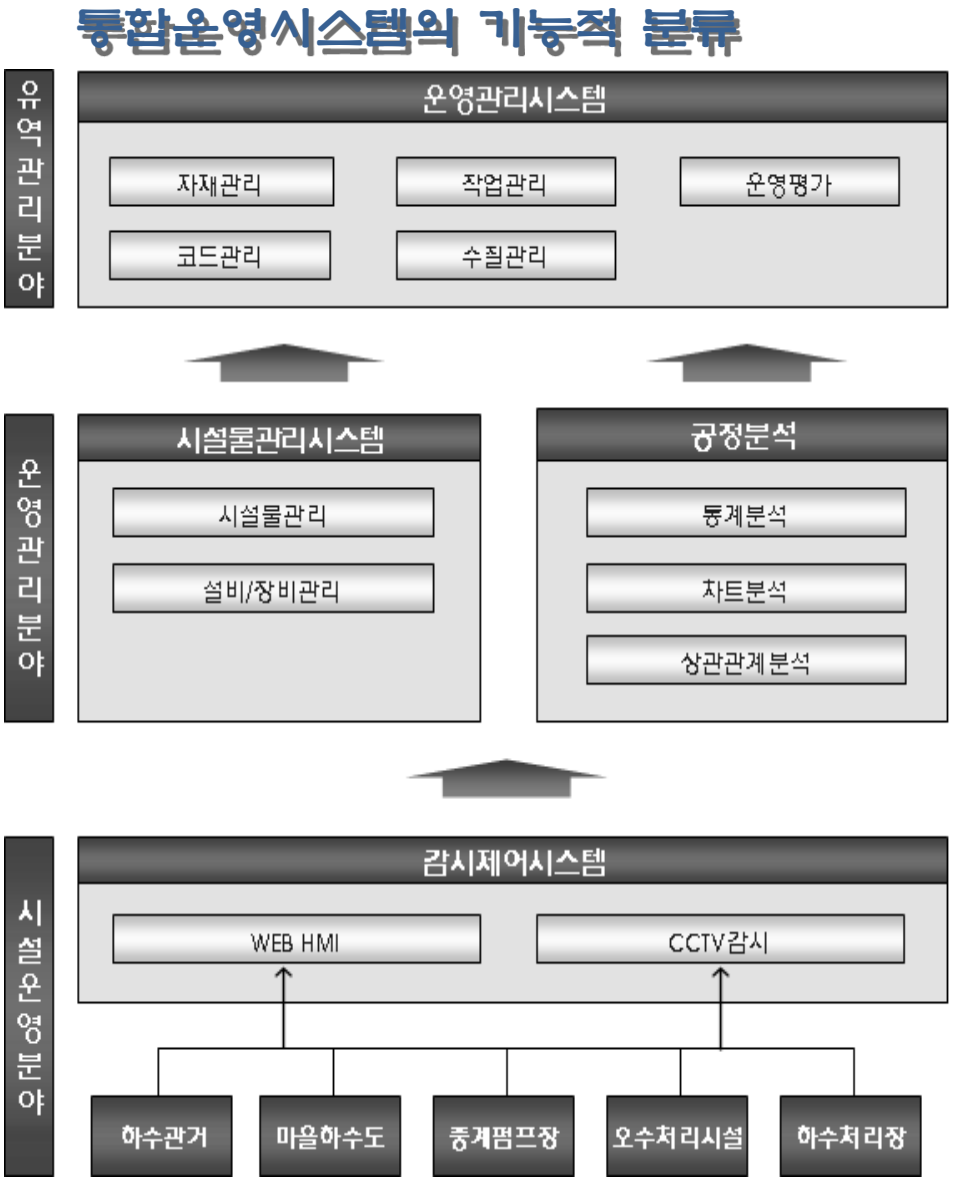


통합운영관리 기본 개념도

통합운영관리 계통별 주요기능

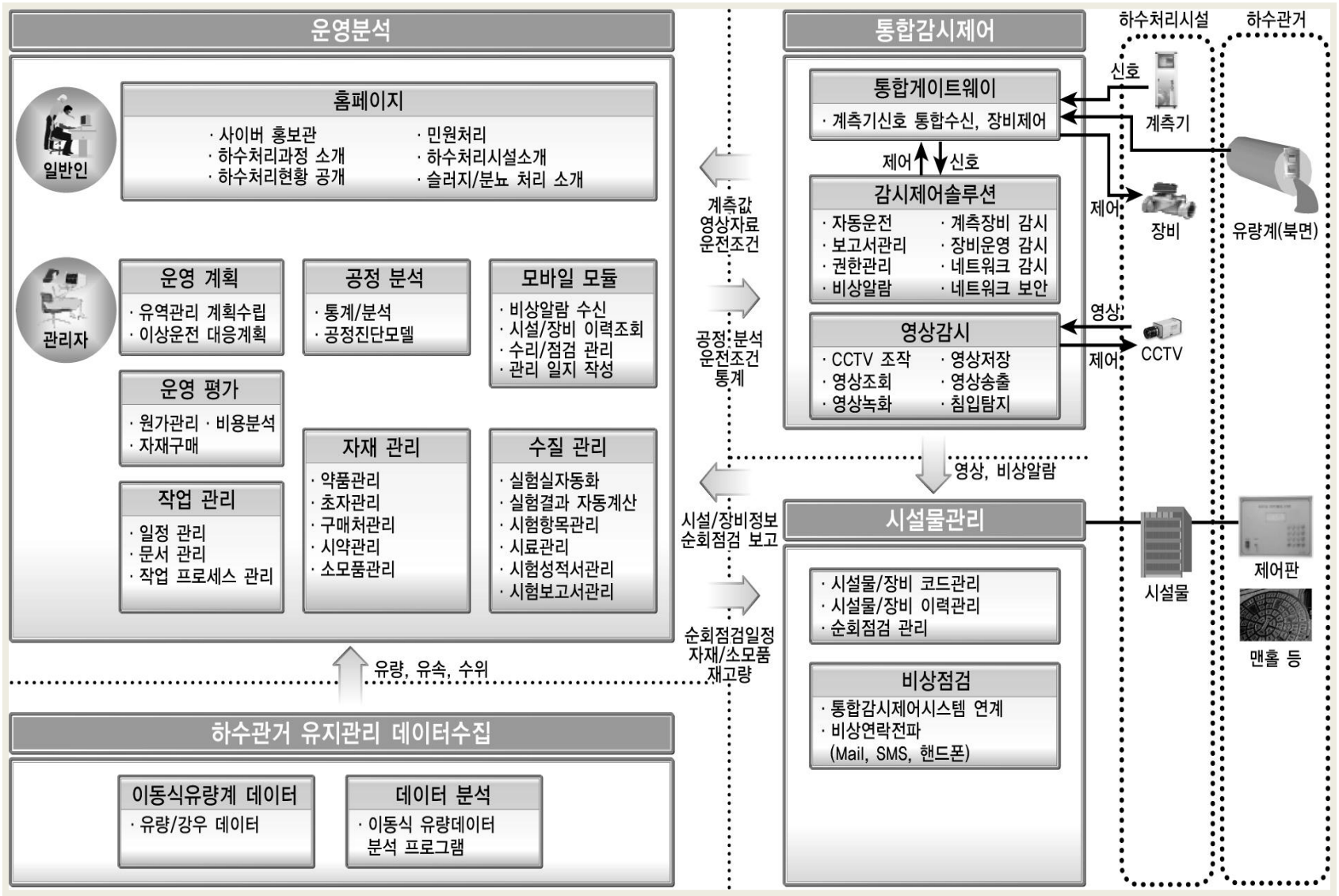
구분	시스템	시스템
광역통합운영센터 (유역 중심처리장)	운영분석	• 처리장 운영상태 및 처리효율 분석 • 처리장 운영개선 방안 수립
	정책지원	• 각종 정책 지원자료 생성 및 관리방안 수립 • 수질향상 및 수자원 이용방안 수립
지역관리센터 (시·군별중심처리장)	자동운전 원격감시제어	• 하수처리장 등 환경기초시설의 자동운전 • 단위 환경기초시설의 원격감시.제어 • 시스템 분석결과에 따른 설비제어
	정보관리	• 각종 운영자료의 수집.보관용 DB • 각 설비의 유지보수이력관리 • 운영정보 분석 및 효율 향상 방안 수립
단위 처리장	자동운전 원격감시제어	• 하수처리장 등 환경기초시설의 자동운전 • 운전상태 전송 및 원격제어명령 수행

댐상류 하수도시설 통합운영시스템의 기능적 분류



구분	적용대상
감시제어 시스템	·통합관리센터 ·지역관리센터
시설물관리 시스템	·통합관리센터
수질관리	·통합관리센터
작업관리	·통합관리센터
자재관리	·통합관리센터
운영관리분석	·통합관리센터

댐상류 하수도시설 통합관리시스템 기능 구성



Estimation of WTP using CVM in planning construction project of the integrated sewerage system

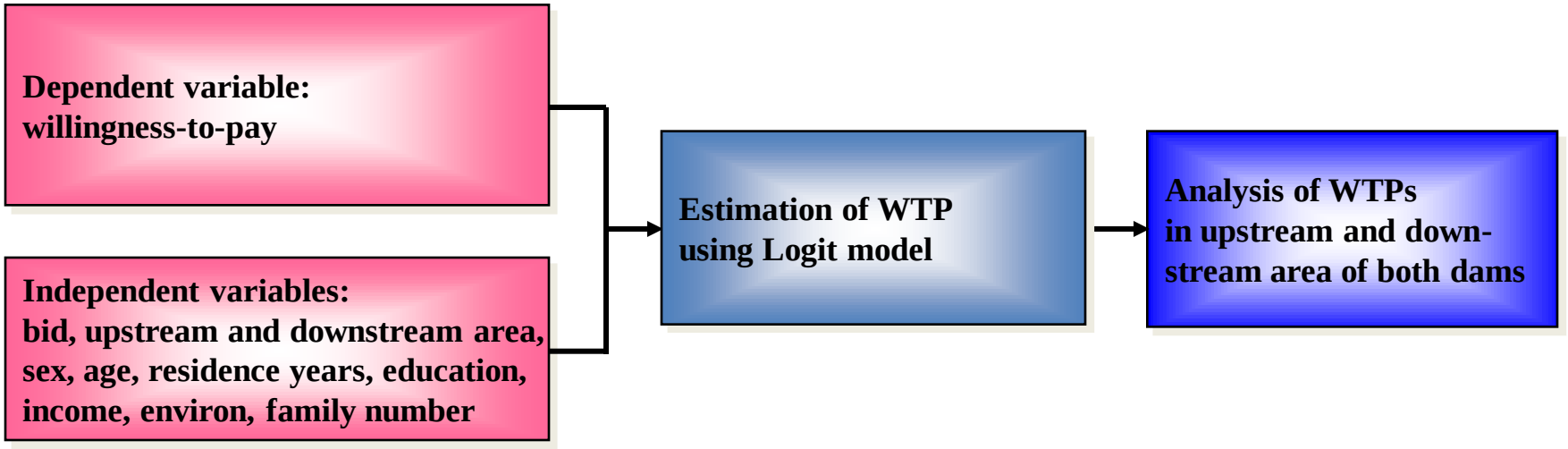
Introduction

❖ Backgrounds and objectives

- To estimate the willingness-to-pay (WTP) using contingent valuation method as a tool of the analytical model of economical feasibility in implementing the construction project of integrated sewerage system in the watershed of dams Andong and Imha.

- To analyze the difference of WTP estimates in the upstream area and the downstream area of dams Andong and Imha.

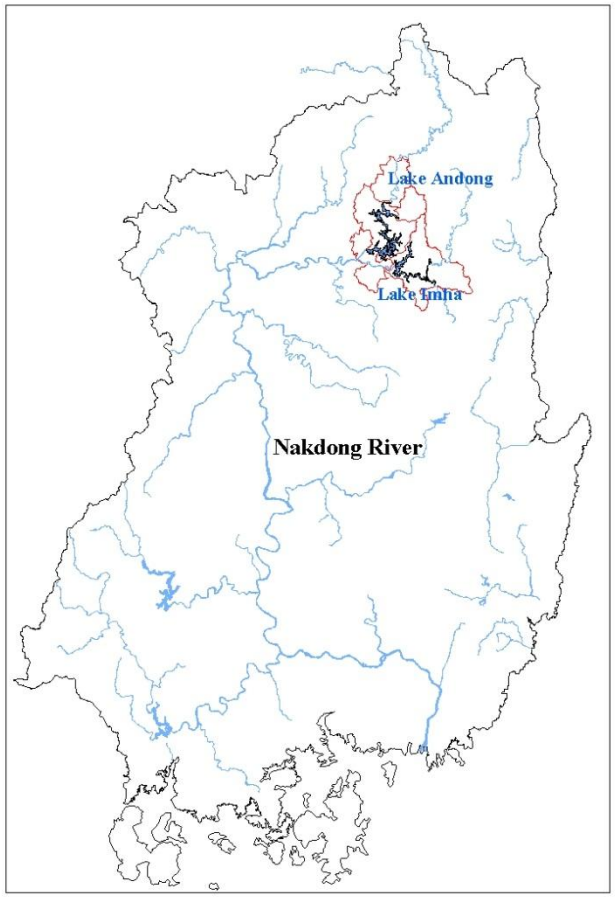
❖ Research approaches



Materials and Methods

❖ Study area(1)

● **Administrative district of the catchment of dams Andong and Imha**



Classification	Province City·Gun	Eup·Myun	Tributary
Andong dam	Gyungbuk Youngyang Gun	Youngyang Eup, Ipam Myun, Subi Myun	Banbyun stream, Sinsa stream, Jangsupo stream
	Gyungbuk Bonghwa Gun	Seokpo Myun, Socheon Myun, Jaesan Myun, Myungho Myun, Beopjeon Myun, Chunyang Myun	Seokpori stream, Hyundong stream, Jaesan stream, Changri stream, Ungok stream, Beopjeon stream
	Gyungbuk Andong city	Dosan Myun, Yean Myun, Waryong Myun, Imdong Myun, Imha Myun, Nokjeon Myon	Togye stream, Donggye stream, Waya stream, Daegok stream, Banbyun stream, Yukgye stream
Imha dam	Gyungbuk Cheonsong Gun	Pacheon Myun, Cheongsong Eup, Budong Myun, Bunam Myun, Jinbo Myun	Yongjeon stream, Singi stream, Gupyung stream, Jusan stream
	Gyungbuk Andong city	Gilan Myun, Imha Myun, Imdong Myun	Gilan stream, Yonggye stream, Banbyun stream, Imha stream, Daegok stream
	Gyungbuk Youngyang Gun	Ipam Myun, Seokbo Myun, Cheonggi Myun, Ilwol Myun, Subi Myun, Youngyang Eup	Banbyun stream, Songha stream, Dong stream, Janggun stream, Jangpa stream

Materials and Methods

❖ Study area(2)

- **The service ratio of sewerage system in the catchment of dams Andong and Imha (March 2003)**

Classification	Area of watershed (㎢)	Populations (capita)			Service ratio of sewage treatment system(%)	
		Administrative residents	Residents serviced		2001	2007
			2001	2007		
Andong dam	1,584	93,734	38,352	65,531	40.9	69.9
Imha dam	1,361	48,473	1,028	32,709	2.1	67.5

- **Construction plan of the integrated sewerage system in the catchment of dams Andong and Imha (March 2003)**

Classification	Andong dam			Imha dam		
	Total	Under construction	Planning construction	Total	Under construction	Planning construction
Sum	19	1	18	18	3	15
Sewage treatment plant	5	-	5	4	1	3
Sewage treatment plant of small community	14	1	13	14	2	12

Materials and Methods

❖ Survey and principle of Logit model

- **Survey number in the catchment of dams Andong and Imha**

Classification	Total numbers of survey		Survey sites
Andong-Imha dam	800	Upstream area(394)	Upstream site of Andong dam(269), Upstream site of Imha dam(125)
		Downstream area(406)	Andong city(252), Youngyang Gun(99), Bonghwa Gun(190), Gumi city(259)

- **Logit model and WTP estimate**

$$\ln\left(\frac{p}{1-p}\right) = \alpha + \beta x = f(bid, ws, year, sex, age, edu, income, environ, family) \quad (1)$$

$$= f(\text{Independent variables with significance below 10\% level at Equation(1)}) \quad (2)$$

$$Mean\_WTP = -\frac{1}{\beta}\ln\left(1+e^{\alpha}\right) \quad (3)$$

Results and Discussion

❖ Statistical characteristics of survey (1)

Classification	Total respondents		Respondents in the upstream area of dam		Respondents in the downstream area of dam	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Number of samples	800		394		406	
Willingness to pay	0.27	0.44	0.21	0.41	0.32	0.47
Bid(1,000won)	4.870	3.053	4.883	3.062	4.857	3.048
Upstream(1) and downstream(0) area	0.49	0.50	-	-	-	-
Residence years	24.72	16.92	30.69	17.29	18.92	14.37
Sex	0.50	0.50	0.50	0.50	0.50	0.50
Age(year)	41.62	12.10	47.06	10.84	36.34	10.86
Education level	2.61	1.43	2.31	1.52	2.89	1.28
Income level	3.22	1.52	2.83	1.53	3.61	1.40
Environmental education	0.53	0.50	0.48	0.50	0.57	0.50
Family number	3.68	1.46	3.71	1.56	3.66	1.37

※ S.D.: Standard deviation

Results and Discussion

❖ Statistical characteristics of survey (2)

- ‘Yes’ respondents : 27%
  (upstream area of dam : 21%, downstream area of dam : 32%).
- Resident year of all respondent is mean 24.7 year
  (upstream area of dams : 30.7 year, downstream area of dams : 18.9 year).
- Average age of all respondent is 41.6 year
  (upstream area of dams : 47.1 year, downstream area of dams : 36.3 year).
- Education level of all respondents ≈ above graduation or dropout of high school.
  Residents in the downstream area of dams is nearly above graduation of college.
- Income level of respondents is 0.5~1 million won every monthly.
  (upstream area of dams : 0.5~1 million won, downstream area of dams : 1~2 million won)
- Ratio of respondents receiving an environmental education : 53%.

Results and Discussion

❖ Estimation of WTP in the watershed of dams Andong and Imha(1)

Classification	Total respondents		Respondents in the upstream area of dam		Respondents in the downstream area of dam	
	Equation(1)	Equation(2)	Equation(1)	Equation(2)	Equation(1)	Equation(2)
Number of samples	800		394		406	
Bid(1,000won)	-0.178*	-0.177*	-0.140*	-0.140*	-0.211*	-0.209*
Upstream and downstream area	-0.132	-	-	-	-	-
Residence years	-0.007	-	-0.005	-	-0.007	-
Sex	0.25	-	0.530***	0.558**	-0.008	-
Age(year)	-0.012	-	-0.029***	-0.036*	0.001	-
Education level	0.034	-	0.011	-	0.007	-
Income level	0.313*	0.365*	0.323*	0.361*	0.274*	0.238*
Environmental education	0.081	-	0.37	-	-0.157	-
Family number	-0.024	-	0.024	-	-0.12	-
Constant	-0.751	-1.468*	-0.828	-0.449	-0.241	-0.721**
χ^2	94.729	82.711	52.26	50.165	43.426	40.12
-2Log likelihood	830.426	842.445	356.052	358.148	462.655	465.962
α	-0.312	-0.2927	-0.8751	-0.8425	0.1395	0.1382
β	-0.178	-0.177	-0.14	-0.14	-0.211	-0.209
Mean WTP estimate(won)	**3085.9**	**3149.5**	**2488.8**	**2557.9**	**3627.1**	**3658.5**
Ratio of WTP [{E(2)-E(1)}/E(1)] (%)	2.1	-	2.8	-	0.9	-

* **Significance at the 1% level,** ** **Significance at the 5% level,** *** **Significance at the 10% level**

Results and Discussion

❖ Estimation of WTP in the watershed of dams Andong and Imha(2)

- To estimate WTP of watershed residents, watershed attribute variables such as whether or not residing in the upper area of dams and resident year, social attribute variables such as income level, the number of family and environmental education, and personal attribute variables such as sex, age and education level are considered.
- For the equation (1), mean WTP estimates of all residents, the upstream and the downstream area residents are 3,086 wons, 2,489wons and 3,267wons, respectively.
- For the equation (2), mean WTP estimates of all residents, the upstream and the downstream area residents are 3,150 wons, 2,558wons and 3,659wons, respectively.
- The ratio of difference between equation (1) and equation (2) is the range of 0.9 to 2.8 %.
- Reasons of considerable difference between the upstream and the downstream area mean WTP are education level, income level, environmental education, age and so on.

Conclusion

- The WTP estimate of residents in the catchment of dams Andong and Imha was investigated by single-bounded dichotomous choice method and the two regression parameters were estimated using the logit model of SPSS.

- Willingness to pay of 800 respondents was relatively low as 27%. It seemed that residents of dams Andong and Imha have feeling of being victimized since two adjacent dams was constructed in this area, the upstream area was designated as drinking water source protection zone, and thereafter their economical actions have been restricted.

- Mean WTP estimates for logit model function using all variables of all residents, the upstream area and the downstream area residents are 3,086 wons, 2,489 wons and 3,267 wons, respectively. Also, mean WTP estimates for logit model function using variables below 10% significance of all residents, the upstream area and the downstream area residents are 3,150 wons, 2,558 wons and 3,659 wons, respectively.

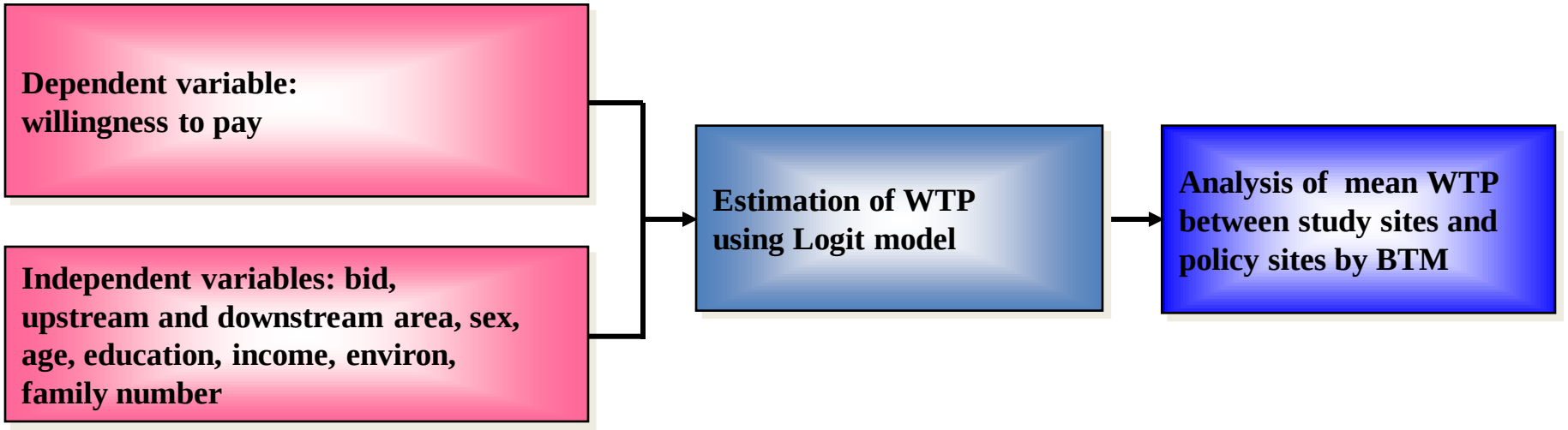
Estimation of willingness-to-pay and application of benefit transfer method in planning construction project of the integrated sewerage system

Introduction

❖ Backgrounds and objectives

- To estimate the willingness-to-pay (WTP) using contingent valuation method as a tool of the analytical model of economical feasibility in implementing construction project of the integrated sewerage system in the watershed of multi-objective dams(study sites).
- To estimate WTP estimates using benefit transfer method (BTM) at study sites, and compare the estimates with WTP estimates at policy sites.

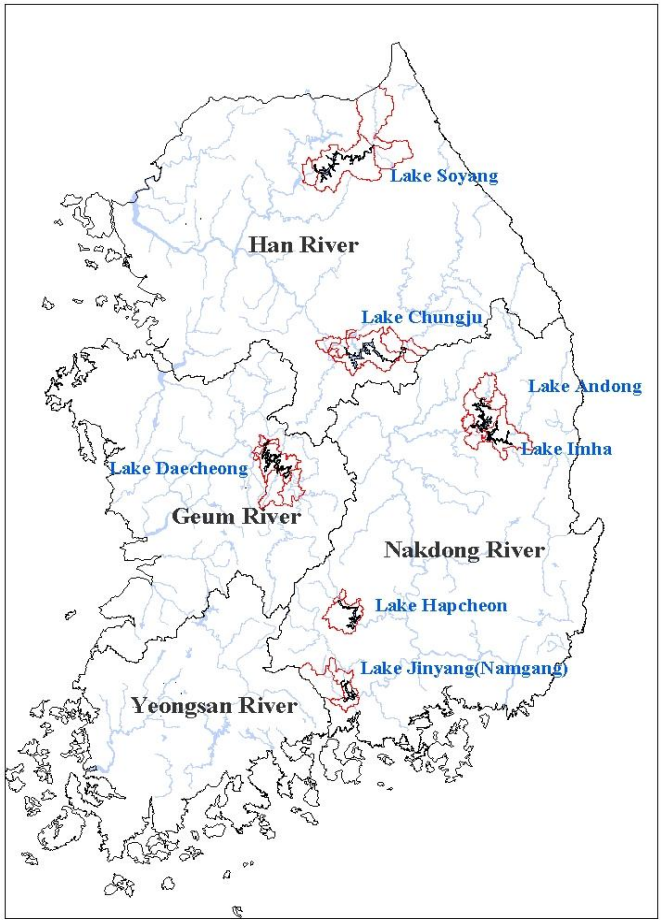
❖ Research approaches



Materials and Methods

❖ Study area(1)

● **Administrative district of the watershed of multi-objective dams**



Classification	Province	City·Gun	Eup·Myun
Dam Andong	1	3	15
Dam Imha	1	3	14
Dam Soyang	1	4	12
Dam Daecheong	3	5	45
Dam Namgang	2	7	34
Dam Hapcheon	1	2	15

Materials and Methods

❖ Study area(2)

- **The service ratio of sewerage system in the catchment of multi-objective dams (March 2003)**

Classification	Area of watershed (km^2)	Populations (capita)			Service ratio of sewage treatment system(%)	
		Administrative residents	Residents serviced			
			2001	2007	2001	2007
Dam Andong	1,584	93,734	38,352	65,531	40.9	69.9
Dam Imha	1,361	48,473	1,028	32,709	2.1	67.5
Dam Soyang	2,703	70,468	4,597	55,330	6.5	78.5
Dam Daecheong	4,134	330,634	93,410	239,140	28.3	72.3
Dam Namgang	2,285	139,551	26,723	98,574	19.1	70.6
Dam Hapcheon	925	77,605	43,283	62,467	55.8	80.5

Materials and Methods

❖ Study area(3)

● **Construction plan of the integrated sewerage system in the catchment of multi-objective dams (March 2003)**

Classification		Number of sewerage facilities		
		Total	Under construction	Plan of construction
Dam Andong	Sum	19	1	18
	Sewage treatment plant	5	-	5
	Sewage treatment plant of small community	14	1	13
Dam Imha	Sum	18	3	15
	Sewage treatment plant	4	1	3
	Sewage treatment plant of small community	14	2	12
Dam Soyang	Sum	20	11	9
	Sewage treatment plant	11	6	5
	Sewage treatment plant of small community	9	5	4
Dam Daecheong	Sum	89	14	75
	Sewage treatment plant	35	8	27
	Sewage treatment plant of small community	54	6	48
Dam Namgang	Sum	38	2	36
	Sewage treatment plant	15	2	13
	Sewage treatment plant of small community	23	-	23
Dam Hapcheon	Sum	13	-	13
	Sewage treatment plant	1	-	1
	Sewage treatment plant of small community	12	-	12

Materials and Methods

❖ Status of Survey

● **Survey numbers in the catchment of multi-objective dams**

Dams	Survey method	Survey term	Bid(won)	Survey number		Ratio(%)
Andong-Imha	Individual interview	2004	10000, 8000, 6000, 4000, 2000, 1000, 500	800	Upstream area(394)	49
					Downstream area(406)	51
Soyang	〃	2003	8000, 4000, 2000, 1000, 500	980	Upstream area(480)	49
					Downstream area(500)	51
Daecheong	〃	2004	8000, 7000, 6000, 5000, 4000, 3000, 2000, 1000, 500	990	Upstream area(552)	56
					Downstream area(438)	44
Namgang	〃	2003	8000, 4000, 2000, 1000, 500	875	Upstream area(615)	70
					Downstream area(260)	30
Hapcheon	〃	2003	8000, 4000, 2000, 1000, 500	465	Upstream area(205)	44
					Downstream area(260)	56

Materials and Methods

❖ Principle of Logit model and BTM

- **Logit model and WTP estimate**

$$\ln\left(\frac{p}{1-p}\right) = \alpha + \beta x = f(bid, ws, sex, age, edu, income, environ, family) \quad (5.1)$$

$$= f(\text{Independent variables with significance below 10\% level at Equation(1)}) \quad (5.2)$$

$$= f(bid, ws, edu, income, environ) \quad (5.3)$$

$$= f(bid, edu, income) \quad (5.4)$$

$$Mean\_WTP = -\frac{1}{\beta}\ln\left(1+e^{\alpha}\right) \quad (5.5)$$

- **Types of benefit transfer model for WTP estimate**

Classification	Study sites	Policy sties
Model 1	Dam Soyang, Dam Daecheong, Dam Namgang, Dam Hapcheon	Dam Andong-Imha
Model 2	Dam Daecheong, Dam Namgang, Dam Hapcheon	Dam Soyang
Model 3	Dam Namgang, Dam Hapcheon	Dam Daecheong
Model 4	Dam Namgang, Dam Hapcheon	Dam Andong-Imha
Model 5	Dam Andong-Imha	Dam Soyang

Results and Discussion

❖ Statistical characteristics of the watershed of multi-objective dams (1)

Classification	Dam Andong-Imha		Dam Soyang		Dam Daecheong		Dam Namgang		Dam Hapcheon	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
wtp	0.27	0.44	0.48	0.5	0.4	0.49	0.38	0.49	0.45	0.5
bid	4.87	3.053	3.106	2.734	4.056	2.501	3.119	2.73	3.123	2.751
ws	0.49	0.5	0.49	0.5	0.53	0.5	0.7	0.46	0.44	0.5
sex	0.5	0.5	0.51	0.5	0.52	0.5	0.5	0.5	0.51	0.5
age	41.62	12.1	44.19	10.59	45.79	11.28	53.77	14.36	50.51	13.59
edu	2.61	1.43	2.2	1.1	2.35	1.22	1.46	0.73	1.73	0.79
income	3.22	1.52	3.48	1.33	3.15	1.44	2.47	1.26	3.09	1.37
environ	0.53	0.5	0.33	0.47	0.33	0.47	0.17	0.38	0.21	0.41
family	3.68	1.46	3.72*	1.23	3.79	1.22	3.12	1.48	3.5	1.4
N	800	-	980 (*977)	-	990	-	875	-	465	-

※ **wtp**: yes(1) or no(0) of willingness to pay, **bid**: bid(1,000 won), **ws**: residence in the upstream area(1) or the downstream area(0), **sex**: man(1) or female(0), **age**: age(years), **edu**: education level, **income**: income level per house, **environ**: yes(1) or no(0) on experience to receive an environmental education, **family**: number of family members, **N**: number of survey household

Results and Discussion

❖ Statistical characteristics of the watershed of multi-objective dams(2)

- ‘Yes’ respondents : residents of dam Soyang 48%, those of dam Andong-Imha 27%.
- Income level of respondents is investigated 1~2 million won every monthly in watershed of dams Andong-Imha, Soyang, Daecheong and Hapcheon, 0.5~1 million won in that of dam Namgang.
- Age of residents is mean 41.6~45.8 years in watershed of dams Andong-Imha, Soyang & Daecheong, mean 50.5~53.8 years in that of dams Namgang & Hapcheon.
- Education level of residents is above high school graduation in watershed of dams Andong-Imha, Soyang & Daecheong, but below high school graduation in that of dams Namgang & Hapcheon.
- Number of family is about 3.7 people in watershed of dams Andong-Imha, Soyang & Daecheong, 3.1~3.5 people in that of Namgang & Hapcheon.
- Residents receiving an environmental education is mean 0.53 in dam Andong-Imha, 0.33 in dams Soyand and Daecheong, 0.17 in dam Namgang, 0.21 in dam Hapcheon.

Results and Discussion

❖ Estimation of WTP in the watershed of multi-objective dams (1)

Variables	Dam Andong-Imha		Dam Soyang		Dam Daecheong		Dam Namgang		Dam Hapcheon	
	Eq.(5.1)	Eq.(5.2)	Eq.(5.1)	Eq.(5.2)	Eq.(5.1)	Eq.(5.2)	Eq.(5.1)	Eq.(5.2)	Eq.(5.1)	Eq.(5.2)
bid	-0.179*	-0.179*	-0.240*	-0.242*	-0.229*	-0.231*	-0.279*	-0.279*	-0.295*	-0.286*
ws	-0.15	-	-0.359**	-0.338**	-0.409*	-0.395*	0.828*	0.866*	-0.162	-
sex	0.23	-	0.141	-	-0.051	-	0.325**	0.366**	0.221	-
age	-0.017**	-0.020*	-0.002	-	0.008	-	-0.009	-	0.002	-
edu	0.033	-	0.408*	0.434*	0.145**	0.111***	-0.035	-	0.142	-
income	0.315*	0.337*	0.139**	0.138**	0.268*	0.270*	0.376*	0.412*	0.319*	0.375*
environ	0.081	-	0.078	-	0.392*	0.398*	0.324	-	0.196	-
family	-0.032	-	-0.023	-	0.025	-	-0.044	-	-0.023	-
constant	-0.662	-0.543	-0.468	-0.595**	-1.076**	-0.576**	-0.767	-1.535*	-0.684	-0.533**
χ^2	93.741	89.977	172.601	172.451	143.993	142.67	120.023	115.188	81.625	77.706
-2Log likelihood	831.414	835.178	1181.062	1185.199	1186.931	1188.255	1040.61	1045.445	558.243	562.163
α	-0.3009	-0.2903	0.6611	0.6744	0.4561	0.4573	0.2866	0.2718	0.6505	0.6258
β	-0.179	-0.179	-0.240	-0.242	-0.229	-0.231	-0.279	-0.279	-0.295	-0.286
WTP(won)	**3094.7**	**3120.2**	**4489.1**	**4488.3**	**4135.2**	**4102.8**	**3034.7**	**3004.6**	**3628.4**	**3686.0**
Eq.(5.2)/Eq.(5.1) (%)	0.82		-0.02		-0.78		-0.99		1.59	

* **Significance at the 1% level,** ** **Significance at the 5% level,** *** **Significance at the 10% level**

Results and Discussion

❖ Estimation of WTP in the watershed of multi-objective dams (2)

- To estimate WTP of watershed residents, watershed attribute variable such as whether or not residence in the upstream area of dams, social attribute variables such as income level, the number of family and environmental education, and personal attribute variables such as sex, age and education level are considered.

- For the equation (5.1), WTP estimate of dam Namgang is the lowest 3,035 won and that of dam Soyang is the highest 4,489 won.

- The ratio of difference between equation (5.1) and equation (5.2) is the very low range of –0.99 to 1.59 %.

Results and Discussion

❖ Statistical characteristics of the study sites

Classification	Data set excluding dam Andong-Imha (Model 1)		Data set excluding dams Soyang and Andong-Imha (Model 2)		Data set of dams Namgang and Hapcheon(Model 3 & 4)		Data set of dam Andong-Imha (Model 5)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
wtp	0.43	0.49	0.4	0.49	0.4	0.49	0.27	0.44
bid	3.396	2.701	3.518	2.701	3.12	2.736	4.87	3.053
ws	0.55	0.5	0.58	0.5	0.61	0.49	0.49	0.5
sex	0.51	0.5	0.51	0.5	0.5	0.5	0.5	0.5
age	48.09	12.92	49.73	12.92	52.64	14.18	41.62	12.1
edu	1.98	1.08	1.89	1.08	1.55	0.76	2.61	1.43
income	3.06	1.4	2.88	1.4	2.69	1.33	3.22	1.52
environ	0.27	0.44	0.25	0.44	0.18	0.39	0.36	0.47
family	3.55*	1.39	3.48	1.39	3.25	1.46	3.68	1.46
N	3310(*3307)	-	2330	-	1340	-	800	-

- Willingness to pay : data of Model 1 43%, data of Model 2~4 40%, data of Model 5 27%.
- Age of respondents is the range of 41.6 to 52.6 year.
- Education level of residents at the site of dam Andong-Imha(Model 5) is the highest as 2.61, also income level is the highest as 3.22.

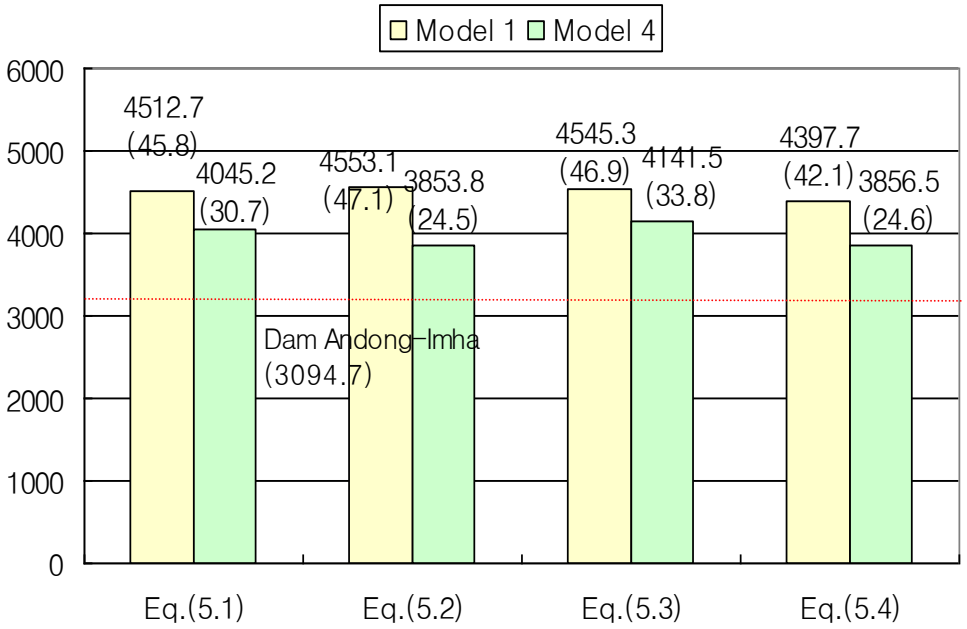
Results and Discussion

❖ Estimation of WTP using BTM in the policy sites (1)

Classification	Equation (5.1)		Equation (5.2)		Equation (5.3)		Equation (5.4)		WTP estimate by CVM (won)
	Estimate (won)	Error(%)	Estimate (won)	Error(%)	Estimate (won)	Error(%)	Estimate (won)	Error(%)	
Model 1	4512.7	45.8	4553.1	47.1	4545.3	46.9	4397.7	42.1	Dam Andong-Imha (3094.7)
Model 2	4213.1	-6.1	4195.7	-6.5	4184.6	-6.8	4160.1	-7.3	Dam Soyang (4489.1)
Model 3	3807.2	-7.9	3682.8	-10.9	3863.1	-6.6	3745.5	-9.4	Dam Daecheong (4135.2)
Model 4	4045.2	30.7	3853.8	24.5	4141.5	33.8	3856.5	24.6	Dam Andong-Imha (3094.7)
Model 5	3117.4	-30.6	3207.7	-28.5	3155.1	-29.7	3258.2	-27.4	Dam Soyang (4489.1)

Results and Discussion

❖ Estimation of WTP using BTM in the policy sites (2)

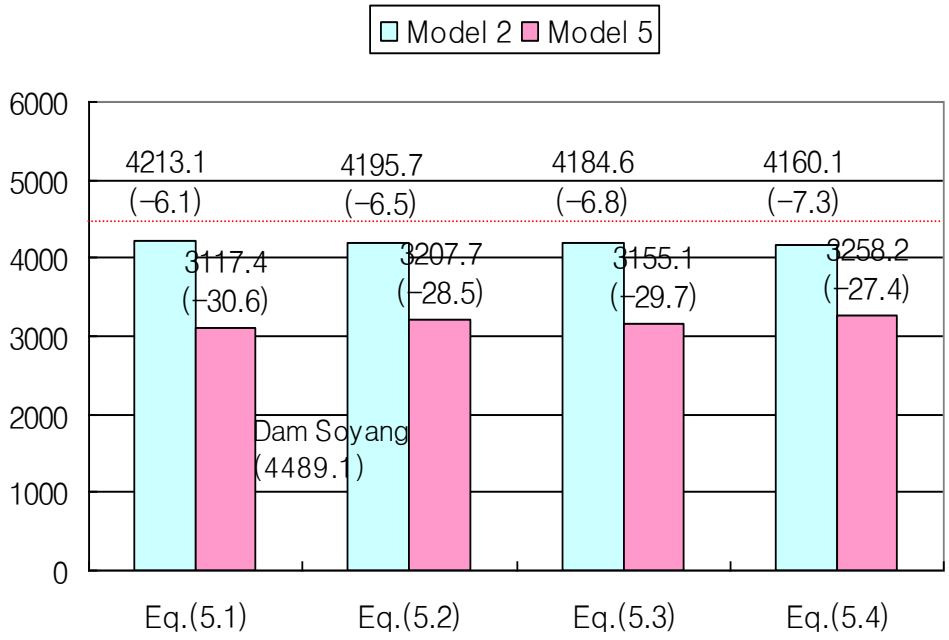


Classification	Model 1	Model 4	Dam Andong-Imha
wtp	0.43	0.4	0.27
bid	3.396	3.12	4.87
ws	0.55	0.61	0.49
sex	0.51	0.5	0.5
age	48.09	52.64	41.62
edu	1.98	1.55	2.61
income	3.06	2.69	3.22
environ	0.27	0.18	0.53
family	3.55*	3.25	3.68
N	3310(*3307)	1340	800

※ Watershed status of dams Andong and Imha

Results and Discussion

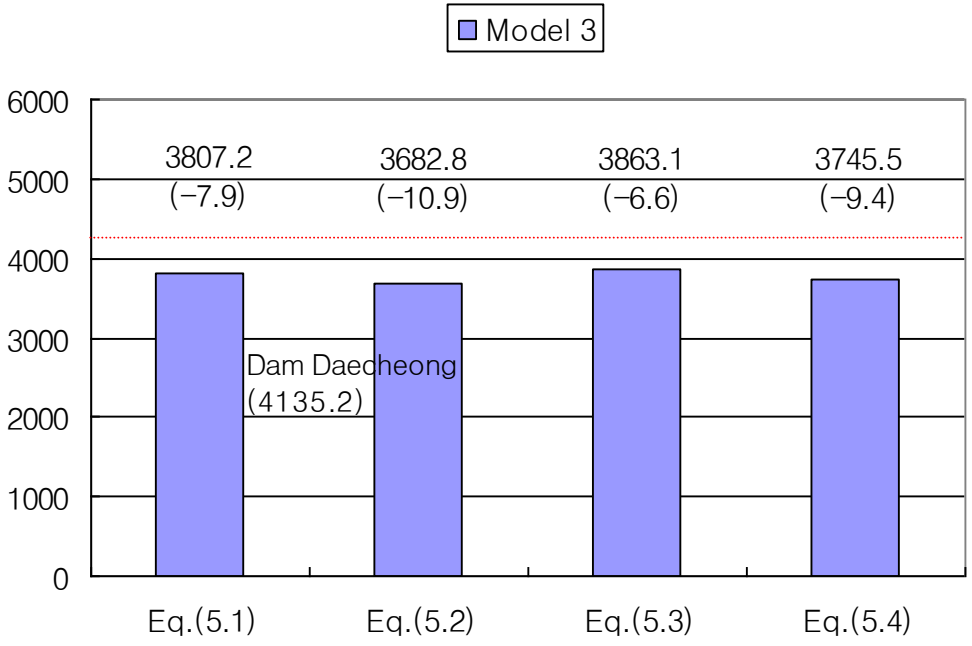
❖ Estimation of WTP using BTM in the policy sites (3)



Classification	Model 2	Model 5	Dam Soyang
wtp	0.40	0.27	0.48
bid	3.518	4.870	3.106
ws	0.58	0.49	0.49
sex	0.51	0.50	0.51
age	49.73	41.62	44.19
edu	1.89	2.61	2.20
income	2.88	3.22	3.48
environ	0.25	0.36	0.33
family	3.48	3.68	3.72*
N	2330	800	980(*977)

Results and Discussion

❖ Estimation of WTP using BTM in the policy sites (4)



Classification	Model 3	Dam Daecheong
wtp	0.40	0.40
bid	3.120	4.056
ws	0.61	0.53
sex	0.50	0.52
age	52.64	45.79
edu	1.55	2.35
income	2.69	3.15
environ	0.18	0.33
family	3.25	3.79
N	1340	990

Results and Discussion

❖ Estimation of WTP using BTM in the policy sites (5)

- **Comparison of results between this study and other studies**

Study	Environmental goods	Transfer error[a)] (%)
Bergland et al.(1995)	Water quality improvements[b)]	25~45 18~41
Downing and Ozuna(1996)	Saltwater fishing	1~34 -
Kirchhoff et al.(1997)	White water rafting	24~56 6~228
Brouwer and Spaninks(1999)	Biodiversity on agricultural land	27~36 22~40
This study	Construction project of the integrated sewerage system	- 6.1~47.1

a) Minimum-maximum transfer errors found in the studies. The upper range refers to the absolute transfer errors based on unit value transfer and the lower range to the absolute transfer errors based on value function transfer.

b) Primarily for use by local residents, such as recreation

Conclusion

- The WTP estimate of residents using benefit transfer method in the catchment of multi-objective dams was investigated by single-bounded dichotomous choice method and the two regression parameters estimated using the linear logistic model of SPSS.

- Mean WTP estimates of benefit transfer in dam Andong-Imha were overestimated as 42.1~47.1% on Model 1 and 24.5~ 33.8% on Model 4. Also, those of benefit transfer in dam Soyang were underestimated as 6.2~7.4% on Model 2 and 27.4~ 30.6% on Model 5. That of benefit transfer in dam Daecheong was underestimated 6.6~ 10.9% on Model 5.

- It is available to apply benefit transfer method to estimation of WTP using CVM, which we are known to apply simple type of equation (5.4) to BTM.

경청해 주셔서
감사합니다.