

Environmental Impact Assessment and Environmental Monitoring in Korea

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Abstract

Environmental Impact Assessment (EIA) is composed of various procedures, such as screening, scoping, inventory survey, prediction, assessment, alternative assessment, mitigation measures, and post management. Environmental monitoring data for air quality or water quality, etc. is applied in the EIA process, especially in prediction and post management. As an effective tool of environmental monitoring, the remote sensing method, introduced recently, was used in collecting nationwide data concerning ecosystem and land use.

This article explains the current monitoring status in Korea. Monitoring factors include air quality, water quality, soil, ocean, odor, noise, and ecosystems. This report explains the organization of the environmental monitoring system managed by the Ministry of Environment in Korea. Furthermore, it shows the environmental criteria and environmental policies applied to EIA in Korea.

keywords: environmental monitoring, EIA

I. Introduction

Environmental Impact Assessment (EIA) is composed of screening, scoping, inventory surveys, prediction, assessment, alternative assessment, mitigation measures, and post management. Particularly, EIA must be monitored and managed systematically by environmental factors to assess environmental impact faithfully and to manipulate environmental data effectively. However, we spend much of our budget and time on the monitoring process in EIA because we still have problems in collecting data from monitoring agencies. We don't have reliable model applications because of insufficient environmental data. As environmental factors and stations continue to en-

large, we need to understand the status of monitoring and managing of environmental factors.

The Ministry of Environment has a major role in monitoring the environment, as does the National Institute of Environmental Research (NIER), the Regional Environmental Administration, as well as city and provincial Environmental and Health Research Institutes.

In this article, we introduce mainly status and criteria monitored by the Ministry of Environment.

II. Contents of Monitoring and Management

1. Air Quality

(a) Monitoring and Management

Generally, air pollution stations can be classified as stationary and mobile. The stationary ones consist of automatic stations and acid monitoring stations. Automatic stations monitor 6 items of TSP (PM 10), SO₂, NO₂, CO, O₃, Pb. There are 84 monitoring stations in 35 cities which consist of 74 stations set up by the Ministry of Environment and 10 stations set up by the Seoul Metropolitan Government. Data monitored in these stations are sent to regional environmental administrations and the Ministry of Environment by Telemetering System (TMS) (see Table 1). 45 automatic stations in 32 cities monitor acid rain (see Table 2).

Mobile stations, defined as monitoring units placed on automobiles are managed by regional environmental administrations. They monitor polluted sites where automatic stations are located. Microclimatic factors are used in monitoring wind direction, wind velocity and temperature. NIER monitors the status of the ozone layer with RASS (Radio Acoustic Sounding System) as a warning system.

(b) Automatic Stack Monitoring

Automatic stack monitoring has monitored 41 industrial cases since January of 1990. These monitoring data are networked with the city and provincial computer centers.

(c) Environmental Standards

Environmental standards of air quality are described in Table 3. Recently, PM 10 was included.

Table 1. Automatic Monitoring Network for Air Quality

Environment Management Office	Number	City
Total	84	35 cities
Han River	38	Seoul(2), Incheon(3), Suwon(2), Anyang(2), Songnam(2), Kwangmyong(1), Ansan(2), Puchon(2), Gwachon(1), Uijongbu(1), Chuncheon(1), Kuri(1)
Naktong River	17	Pusan(7), Ulsan(4), Ulsangun(3), Changwon(2), Masan(1)
Kum River	5	Taejon(3), Chongju(1), Chonan(1)
Yongsan River	9	Kwangju(3), Yochon(1), Chonju(1), Tongkwangyang(1), Kunsan(1), Iri(1), Yosu(1)
Taegu Regional Environment Office	10	Taegu(5), Kumi(2), Pohang(2), Kimchon(1)
Wonju Regional Environment Office	5	Wonju(2), Chungju(1), Chechon(1), Kangnung(1)

Table 2. Automatic Monitoring Network for Acid Rain

Environment Management Office	Number	City
Total	45	32 cities
Han River	16	Seoul(10), Incheon(1), Suwon(1), Ansan(1), Songnam(1), Gwachon(1), Uijongbu(1)
Naktong River	7	Pusan(2), Ulsan(1), Ulsangun(1), Changwon(1), Masan(1), Jinju(1)
Kum River	5	Taejon(3), Chongju(1), Chonan(1)
Yongsan River (include Chonju)	7	Kwangju(1), Yochon(1), Chonju(1), Kunsan(1), Iri(1), Yosu(1), Tongkwangyang(1)
Taegu Regional Environment Office	5	Taegu(2), Antong(1), Kumi(1), Pohang(1)
Wonju Regional Environment Office	5	Wonju(1), Chungju(1), Taebak(1), Kangnung(1), Chechon(1)

Table 3. Environmental Standards of Air Quality

Classification	Standards
SO ₂	Annual Average : below 0.03 ppm 24 hour Average : below 0.14 ppm 1 hour Average : below 0.25 ppm
CO	8 hour Average : below 9 ppm 1 hour Average : below 25 ppm
NO ₂	Annual Average : below 0.05 ppm 24 hour Average : below 0.08 ppm 1 hour Average : below 0.15 ppm
Total Suspended Particulates(TSP)	Annual Average : below 150 $\mu\text{g}/\text{m}_3$ 24 hour Average : below 300 $\mu\text{g}/\text{m}_3$
PM-10 (below 10 μm)	Annual Average : below 80 $\mu\text{g}/\text{m}_3$ 24 hour Average : below 150 $\mu\text{g}/\text{m}_3$
O ₃	8 hour Average : below 0.06 ppm 1 hour Average : below 0.1 ppm
Pb	3 month Average : below 1.5 $\mu\text{g}/\text{m}_3$

2. Water Quality

(a) Monitoring and Management

The monitoring data of water quality are taken from major

watersheds around rivers and lakes nationwide. Monitoring items are defined by living environmental criteria and health protection criteria ; the former are pH, BOD, COD, SS, DO, and coliform and the latter Cd, As, CN, Hg, organic phosphorus, Pb, Cr⁺⁶, PCB, and ABS. Water quality has been monitored in city and provincial health environmental research institutes since 1974. These monitoring tasks were transferred to regional environmental administrations in July of 1983 for more effective management.

There are 572 monitoring stations in rivers, 134 in lakes, 480 in drinking water reservoirs, and 50 in agricultural areas, totalling 1, 348 stations (see table 4).

(b) Automatic Monitoring Network

To analyze the water quality and various accidents quickly and precisely, we have biomonitoring the Paldang lake since September of 1992. Also, we have plans to build stations in major drinking water reservoirs and industrial complexes.

Table 4. Monitoring Network for Water Quality by River System

Classification	Total	River & Stream			Lakes	Drinking Water	Agriculture	Others
		Sum	Ministry of Environment	Others				
Total	1,348	572	324	248	134	480	50	112
Han River	362	208	118	90	31	105	8	10
Naktong River	266	103	65	38	18	102	11	32
Kum River	160	91	54	37	10	45	7	7
Yongsan River	53	20	15	5	11	16	2	4
Somjin River	47	18	10	8	10	17	2	—
Mankyong River	35	11	9	2	5	10	2	7
Ansong Stream	44	22	9	13	8	8	4	2
Sapgyo Stream	28	12	7	5	6	7	2	1
Tongjin River	13	9	4	5	—	4	—	—
Tamjin River	6	4	2	2	—	2	—	—
Taehwa River	22	13	4	9	4	3	1	1
Hyongsan River	19	8	3	5	3	5	2	1
Others	293	53	24	29	28	156	9	47

(c) Environmental Standards

Environmental Standards are based upon pH, BOD, SS, DO and MPN levels as well as the health protection criteria mentioned earlier. COD instead of BOD, total-P, and total-N are included in the environmental standards of lakes. SS values of rivers are higher than that of lakes (see Table 5).

The Ministry of Environment has operated the soil monitoring system, consisting of 2,610 points in 522 areas, of mining, smelting, agriculture sites, and sediment collection areas throughout the country biennially. We monitor soil acidity (pH) and heavy metals such as Cd, Cu, As, Hg, Pb and Zn (see table 6).

3. Soil Pollution

Table 5. Environmental Standards of Water Quality

(1) River

Category	Class	Application by Use	Standards				
			Hydrogen Ion Concentration (pH)	Biochemical Oxygen Demand(BOD) mg/ ℓ	Suspended Solids (SS) mg/ ℓ	Dissolved Oxygen (DO) mg/ ℓ	Coliform (MPN/100mℓ)
Living En- vironment	I	Portable Supply Class I Natural Environment Preservation	6.5-8.5	1 or less	25 or less	7.5 or less	50 or less
	II	Portable Supply Class II Fisheries Class I Swimming	6.5-8.5	3 or less	25 or less	5 or less	1,000 or less
	III	Portable Supply Class III Fisheries Class II Industry Supply Class I	6.5-8.5	6 or less	25 or less	5 or less	5,000 less
	IV	Industry Supply Class II Agriculture	6.0-8.5	8 or less	100 or less	2 or less	
	V	Industry Supply Class III Living Environment Conservation	6.0-8.5	10 or less	No refuse etc. floating on surface	2 or less	
Human Health Protection	All water	Cadmium : 0.01 mg/ ℓ or less Mercury (Hg) : None detectable Hexachrome (Cr ⁺⁶) : 0.05 mg/ ℓ or less Polychlorinted bipheny1 (PCB) : None detectable			Cyanide (DN) : None detectable Lead (Pb) : 0.1 mg/ ℓ or less Arsenic (As) : 0.05 mg/ ℓ ABS : 0.5 mg/ ℓ		

(2) Lakes

Category	Class	Application by Use	Standards						
			Hydrogen Ion Concentration (pH)	Chemical Oxygen Demand (COD) mg/ℓ	Suspended Solids (SS) mg/ℓ	Dissolved Oxygen (DO) mg/ℓ	Coliform (MPN/100 ml)	Total-P (mg/ℓ)	Total-N (mg/ℓ)
Living Environment	I	Portable Supply Class I Natural Environment Preservation	6.5-8.5	1 or less	1 or less	7.5 or less	50 or less	0.01 or less	0.2 or less
	II	Portable Supply Class II Fisheries Class I Swimming	6.5-8.5	3 or less	5 or less	5 or less	1,000 or less	0.03 or less	0.4 or less
	III	Portable Supply Class III Fisheries Class II Industry Supply Class I	6.5-8.5	6 or less	15 or less	5 or less	5,000 less	0.05 or less	0.6 or less
	IV	Industry Supply Class II Agriculture	6.0-8.5	8 or less	15 or less	2 or less	—	0.1 or less	0.1 or less
	V	Industry Supply Class III Living Environment Conservation	6.0-8.5	10 or less	No refuse etc. floating on surface	2 or less	—	0.15 or less	1.5 or less
Human Health Protection	All water	Cadmium : 0.01 mg/ℓ or less Mercury (Hg) : None detectable Hexachrome (Cr ⁺⁶) : 0.05 mg/ℓ or less Polychlorinated biphenyl (PCB) : None detectable				Cyanide (DN) : None detectable Lead (Pb) : 0.1 mg/ℓ or less Arsenic (As) : 0.05 mg/ℓ ABS : 0.5 mg/ℓ			

4. Marine Pollution

(a) Monitoring and Management

The role of monitoring stations for marine pollution began with 270 stations of 70 seashore areas in 1992 and was enlarged to 294 stations to increase reliability in 1993. Samples

are taken 6 times per year for monitoring (see table 7). Regional environmental administrations have monitored marine pollution with the help of the National Fisheries Research and Development Agency.

Table 6. Monitoring Network for Soil Quality

Source	Area Characteristics	Number (Total : 522)
Agriculture	Exclusive Agriculture Water	80
	Fruits and Vegetable Production	20
Water	Extremely Polluted	42
	Industrial Complex	40
	Stream	40
	Special Water Use	20
Air	Road	30
	Smelting	16
Waste	Domestic Landfill	84
	Industrial Wastes Landfill	12
	Mining	50
	Nightsoil Treatment	20
Others	Public Health Survey	24
	Park & Recreation	20
	Playground	12
	Golf	12

Table 7. Monitoring Station by Ocean Area(1993)

Classification	Ocean area		Class		
	No. of coast	No. of investigation	I	II	III
Total	63(7)	254(40)	111	81	62
West sea	16(2)	65(17)	31	21	13
South sea	29(2)	124(10)	53	40	31
East sea	18(3)	65(13)	27	20	18

(b) Environmental Standards

On the coast, 11 items from the living environment such as pH, DO, COD, SS, coliform, normal hexane extractable substances, total-N, total-P, water temperature, salinity, transparency and 10 items of health protection such as Cr⁶⁺, As, Cd, Pb, Cu, Zn, CN, total-Hg, PCB, organic phosphorous are monitored bimonthly (PCB are monitored once per year), and items for the protection of health on the seashore are monitored once per one year except PCB and organic phosphorous (see Table 8).

5. Odor

Odor is considered as malodorous gaseous substances such as H₂S and NH₃. It is characterized by multiple sources and difficult mitigation measures and the impact of laundromat, slaughterhouses, and factories on households. Odor has been managed and controlled since the Air Environment Conservation Act promulgation of 1991 (see Table 9).

Table 9. Management of Offensive Odors Discharge Facilities

Organizations	Number of offensive odors facilities						
	1987	1988	1989	1990	1991	1992	1993
Total	268	292	300	361	397	414	421
Regional Environment Office	161	182	183	188	136	—	—
City & Province	107	110	117	173	261	414	421

6. Noise Vibration

(a) Monitoring and Management

28,365 noise pollution sites are monitored and managed by the Ministry of Environment as well as 3,176 sites that produce excessive vibration. Major cities are monitored quarterly (see table 10). Aircraft noise is monitored in Kimpo, Cheju, and Kimhae.

Table 10. Noise Discharge Facilities

Province & city	Total	Seoul	Pusan	Kwangju	Taegu	Taejon	Wonju	Chunchon
Total	64	10	10	9	10	9	8	8

(b) Environmental Standards

Environmental standards of noise are classified by area and time (see Table 10).

Table 8. Environmental Standards of Sea Waters

Class	Standard								
	Hydrogen Ion Concentration (pH)	Chemical Oxygen Demand (COD) (mg/ℓ)	Dissolved Oxygen (DO) (mg/ℓ)	Suspended Solids (SS) (mg/ℓ)	Coliform Group (MPN/100 ml)	Normal Hexane Extractables Substances (mg/ℓ)	Total-N (mg/ℓ)	Total-P (mg/ℓ)	Inorganic Materials
I	7.8-8.3	1 or less	Saturation 95 or more	10 or less	200 or less	Non Detectable	0.05 or less	0.007 or less	Hexachrome (Cr ⁺⁶):0.05 mg/ℓ or less
II	6.5-8.5	2 or less	Saturation 85 or more	25 or less	1,000 or less	Non Detectable	0.1 or less	0.015 or less	Arsenic (As):0.05 mg/ℓ or less
III	6.5-8.5	4 or less	Saturation 85 or more	—	—	—	0.2 or less	0.03 or less	Cadmium (Cd):0.01 mg/ℓ or less Lead (Pb):0.1 mg/ℓ or less Zinc (Zn):0.1 mg/ℓ or less Copper (Cu):0.02 mg/ℓ or less Cyanide (DN), Organic phosphorus, Mercury(Hg), Polychlorinated biphenyl (PCB):None detectable

- (Note) 1. DO concentrations may also be shown as follows: Class I : 6 mg/ℓ, Class II and Class III : 5 mg/ℓ or more, respectively
 2. Class I shall mean the water quality suitable for habitation, culture and spawning of aquatic organisms
 3. Class II shall mean the water quality suitable for swimming, sightseeing and leisure activities in the marine waters and for habitation of the species of aquatic organisms other than those in Class I
 4. Class III shall mean the water quality suitable for such other use as for industrial water supply, anchorage of ships, etc.
 5. Total-N is summation of NO₂-N, NO₃-N, and NH₃-N
 6. Total-P means PO₄-P

Table 11. Environmental Standards of Noise

in Leq dB(A)

Area Classification	Subject Area	Standards	
		Day (06 : 00—22 : 00)	Night (22 : 00—06 : 00)
Ordinary Area	Area "A"	50	40
	Area "B"	55	45
	Area "C"	65	55
	Area "D"	70	65
Road Vicinity	Area "A" and "B"	65	55
	Area "C"	70	60
	Area "D"	75	70

(Note) (1) Area "A":Residential area

- nature environment preservation area, resort and recreational area, and community area
- open spaces
- exclusive residential area
- area within 50 meters from the boundary of a general hospital site
- area within 50 meters from the boundary of a school site

(2) Area "B"

- area other than the residential area in the community areas
- residential area and the semi-residential area

(3) Area "C"

- commercial area
- semi-industrial area and the exclusive industrial area
- industrial area and the exclusive industrial area

(4) Area "D"

- industrial area and the exclusive industrial area
- industrial area

7. Hazardous Chemicals

Chemicals which are newly formulated or imported need the approval of the Ministry of Environment, especially some 23 chemicals which are considered more hazardous to human health and the environment than others.

8. Solid Waste

Solid waste treatment facilities are composed of 590 sites in landfills including 4,089,000m² at the Kimpo landfill, and incineration facilities, including one located in Mokdong (where 150 tons are incinerated per day), Euijungbu (50 ton/day), Taegu (200 ton/day), Sungnam (100 ton/day), and Pyungchon (200 ton/day). There are hazardous waste treatment sites which are located in Hwasung, which is 49,180 m² and one in Onsan which is 29,630m².

9. Ecosystem

The Ministry carried out the first national survey of natural ecosystems from 1986 to 1990 and published a map which ranks the degree of green naturalness map of 1km x 1km grid with the results of this survey. Remote sensing techniques were recently used to calculate these ranks.

III. Organizations of Monitoring

1. Ministry of Environment

The Ministry of Environment makes general guidelines of monitoring, creating a standard and overseeing equipment development. It has 4 river regional environmental administrations and 3 regional offices. These agencies also have major roles in monitoring. Recently, the experiment analysis division employed more researchers for greater reliability.

2. National Institute of Environmental Research (NIER)

There are 137 researchers at NIER. The division of micro-substance analysis and 4 river water quality research institutes, which were established recently have important roles in monitoring and analyzing the environment. Also, NIER monitors the QC (quality control) of monitoring agencies of 15 cities and provincial health environmental research institutes, regional environmental administrations, and 21 wastewater treatment facilities, etc. (see Table 12)

Table 12. Organizations of River Water Research Institute

Name	Total	Senior Researcher	Researcher	Officer	Technician
Han River	23	4	8	3	8
Naktong River	17	4	9	2	2
Kum River	12	4	5	1	2
Yongsan River	12	4	5	1	2

IV. Recommendations

High quality data in EIA must be used effectively for reliable prediction. Projects based on monitoring are important in formulating predictions and in post management. Most of all,

various errors in monitoring, such as instrument error, human error, systematic and sampling should be minimized. Data monitored will then be utilized for interpreting environmental pollution levels systematically with the Environmental Information System (EIS).

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