THE DEVELOPMENT OF ASSESSMENT MODEL ON THE SUSTAINABLE DEVELOPMENT AND ITS APPLICATIONS : THE CASE OF ULSAN METROPOLITAN CITY

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Introduction

East-Asian countries have experienced rapid economic growth, industrialization, and urbanization. However, this rapid economic growth also has created several environmental problems in local, national, and even global level. And then, the current economic growth policy reaches some limitations environmentally in sustaining economic growth. It is necessary to search a new growth paradigm for the sustainable development economically, socially, and environmentally in this area. Korea has influenced the economic growths of East-Asian countries because she is one of the most successful countries in the economic development during the last forty years. In another way she has been experiencing serious environmental problems due to negative impacts of a rapid economic growth. She, especially Ulsan

Metropolitan City (UMC), which is one of the most representative cities in terms of economic growth and environmental pollution, paid lots of costs to cure these environmental problems and still is suffering from the environmental damages. And then she changed recently a growth strategy from an economic growth-oriented policy to a sustainable development in order to solve environmental problems. These changes result in the slight improvement in the environments. Therefore, Korean experiences, especially UMC's ones, will be helpful to solve environmental problems of other Asian cities.

In order to get the new policy alternatives for the sustainable growth, this study reviews the Korean economic growth policies and environment policies, especially the economic development and environmental policies of Ulsan Metropolitan City. The objectives of this paper are to present innovative ideas and models to guide urban environmental management policies in the sustainability urban development. More specifically, it develops the assessment model for the sustainable development and it applies to the Ulsan Metropolitan City. For this objective, this paper develops the Driving Force - Environmental Pressure – Environmental States - Its Effects–Government Response (DPSER Model), following development stages. And using this model it also assesses economic growth and environmental policies of Ulsan Metropolitan City (UMC) in order to draw the sustainable development policy and get some lessons to apply to other developing cities.

Sustainable Development and Development of Analytical Model –DPSER Model

Literature Reviews on Sustainable Development

Anticipating and preventing problems is often better than trying to react and fix them after they occur. One way to this approach is through sustainable development, which has recently become one of the most popular concepts in development economics. Since the United Nations' Conference on

Humans and the Environment in 1972, the international concern surrounding sustainable development has increased (Korea Environmental Technology Research Institute, 1993). The concept of sustainable development is suggested as an alternative approach to solving the conflict between economic growth and environmental preservation.

Sustainable development can be defined in several ways. The following are some common descriptions:

"Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs." (United Nations World Commission on Environment and Development, 1987).

"Sustainability refers to the ability of a society, ecosystem, or any such ongoing system to continue functioning into the indefinite future without being forced into decline through exhaustion . . . of key resources." -- Robert Gilman, President of Context Institute (www.sustainable.doe.gov, 1998).

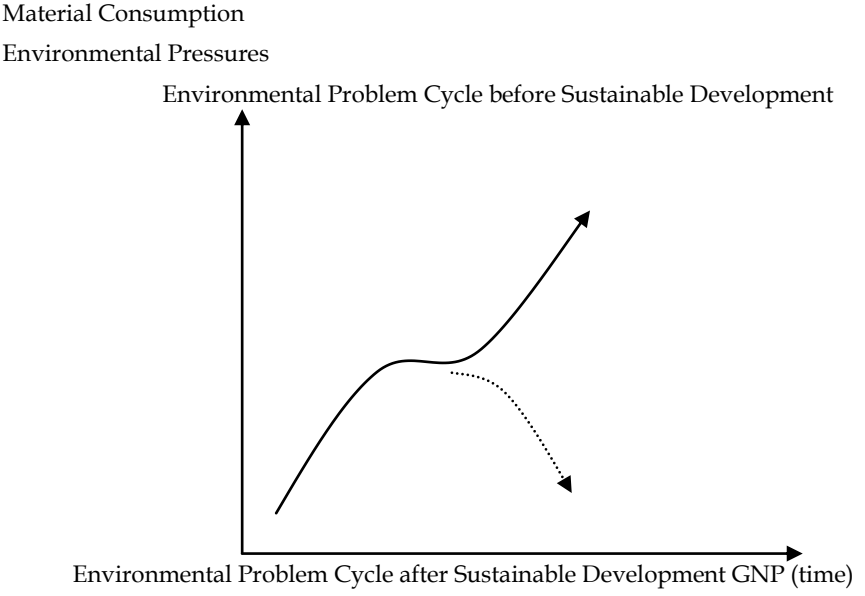
"It is the emerging doctrine that economic growth and development must take place, and be maintained over time, within the limits set by ecology in the broadest sense. It means that environmental protection and economic development are complementary rather than antagonistic processes." (Ruckelshaus, 1989).

Economic Growth and Environmental Degradation

Economic growth is closely related to the pressures on the environment in the industrial society because it causes several kinds of industrial wastes which are externalities of industrial development (Tisdell, 1993). The relation between economic growth and pressures on the environment are, in a broad sense, be illustrated in Figure 1 (Vellinga, 1998). As a country develops from a mainly agriculture economy to an industrialized economy, its gross national product (GNP) grows, while the use of environmental resources simultaneously increases along with environmental pollution. Most of the developing countries experience growing environmental problems as their economy expands, following the left side of the bell-shaped curve in Figure 1. Industrialized countries have followed that path until about 1970. Meanwhile,

social basic needs such as food and housing have been meted and the quality of life gradually has improved. However, in many cases, the environmental problems have grown worse. In order to solve these problems, human, financial and technical resources were invested in transforming industrial structure from the heavy-chemical industry to information technology and cleaning up of polluted industrial sites. And several environmental governance policies have also been adopted. As a result, the urban environment of some developed countries has significantly improved, moving downward along the right hand side of the bell-shaped curve, because the services and information economy requires less environmental resources and consumes less materials (IHDP, 1998).

Figure 1. Economic Growth and Environmental Problems



Source: Velliga, Pier (1998), Industrial Transformation Research, p. 2, Figure 2. Economic Growth and Resource Use (revised by author).

However, Korea – a semi-developed country – is still on an increasing path of environmental resource use and materials consumption. If she does not change its industrial structure from heavy-chemical industry to high technology or does not take environmental governance policy, the environmental problem cycle will move upward along the right hand side of the bell-shaped curve. Currently, Korea is located at the turning point of the bell-shaped curve. Depending upon the adjustment of industrial structure or the adoption of environmental governance policies, its curve can move either upward or downward. Very recently, the UMC has especially been following the downward slope of the curve because she has successfully began to transform her industrial structures and has implemented environmental governance policies (Ulsan, 1997).

Sustainable development stresses active planned-regulation in the level of local governments at the time of city development. This kind of bottom-up development strategy necessitates conceding the decision-making right to the level of local governments in establishing and implementing public policies. Accordingly, in the principle of sustainable city development, there have been growing and successful efforts made by local governments. The concept of sustainable city development can be defined in various dimensions and is determined comprehensively by various factors. The concept of sustainable development should be considered comprehensively with various aspects from ecological, social, and economic views so that it can be applied to all fields of policies, planning, programs, and particular projects.

With consideration of previous studies, this paper hereby defines the concept of sustainable city more precisely: sustainable city is the one that has accomplished ecological diversity, circularity, self-reliance, and stability. It is a city that allows both humans and nature to cohabit, decreases environmental load, and at the same time enhances the quality of life. On the basis of the concept of sustainable city defined here, this study is going to develop an assessment model for sustainable city.

Development of the Assessment Model for a Sustainable City

The concept of sustainability this paper deals with is quite broad and abstract. Considering that the structure of a city is closely related with every element of a society, it could be very hard to assess a certain city's sustainability through the process of systematizing and modeling. Thus, this study intends to develop a more precise and practical city assessment model, using the Driving Force -Environmental Pressure –Environmental States -Its Effects –Government Response process (DPSER) for the environmental sustainability. DPSER Module views a city as a systematic structure. In this module a city is understood as it responds to various factors like human activities, the amount of environmental load derived, environmental conditions due to the environmental load, the influence of changed environment, and human response to the change. To do that, several indicators will be adapted or developed.

The Development of DPSER Module

DSPER Module takes the most fundamental part of city development assessment model. It is not long since indexes consisting of assessment models began to be used as effective standards and criteria for public policies. In the Conference of Environmental Ministries at the beginning of 1990s, in the common approach to human-environment relationship, Organization for Economic Cooperation and Development (OECD) and United Nations Commission Sustainable Development (UNCSD) suggested systematizing Core-Set of Indicators taking PSR structure. PSR represents: first, pressure on the environment from emitted pollutants and dried up natural resources, second, change of state that such pressure causes, and third, response against all these. This has been the groundwork for the following index development projects worldwide.

Since the necessity of index development was clarified on the chapter 40 of agenda 21 in Rio Summit in 1992, practical work was under way by Control Sustainable Development (CSD) and Policy Control Sustainable Development

(PCSD). Especially the term Pressure in PSR was changed into Driving Force in order to properly institute indexes, taking society, economy, and institute all into consideration.

DSPER structure this study suggests adds Effect to the DPSR system. While index represents the present situation, model helps to predict the future and change direction. In the sustainable assessment model, comprehending the effect of environmental changes is necessary to predict changes in the future.

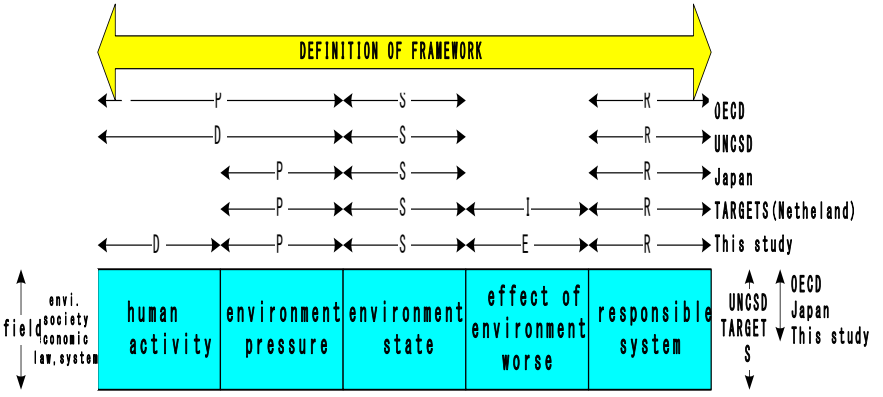
In other words, to assess sustainability of a city, it is necessary to understand the effects on the urban environment but those on the global environment are also beginning to be discussed. The IPCC (International Panel on Climate Change) has three working groups (WG): WG1 to study present situation of climate change, WG2 to study effects from climate change, and WG3 to study about alternatives to reduce climate change. Here again the analysis on the Effect as well as on the State of the present environmental situation is to make sure of policies which will reduce green house effect in the international level and to draw attention to climate change. Among DPSER Modules, this study contains Effect, in that it is necessary for modeling the assessment system and also in that effects should be grasped to predict future changes and to build policies for the changes.

However, the study can be inconsistent because effects can hardly be calculated, existent study is quite limited, a huge number of data are needed, and the methods are varied. Even though it has limitation of time, labor, and data, not only national but beyond national level, this study had to embrace Effect, since it is necessary to comprehend the effect in the assessment of city sustainability.

As a result, instead of traditional assessment system which vertically discusses individual environmental elements like pollution, national environment, and agreeableness, this study centers around ecological aspects, that is the relationship between "inherited natural environment", and "human beings taking its advantage." In other words, it is based on the DSPER structure which here can represent human activities under the social economic background (Driving Force), environmental load from those

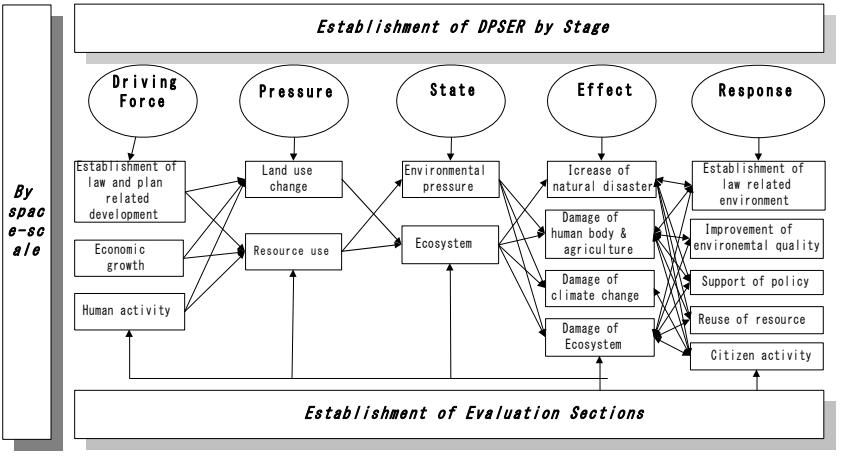
activities (Pressure), environmental State these cause, and the Effect due to environmental changes, and Response from human beings (see Figure 2). Each factor contains several indicators (see Table 1).

Figure 2. Development Framework of DPSER Module



As for the contents of the assessment sections, the driving force is related laws and plans, economic development, and human activities, all of which cause increasing use of energy and natural resources, and the change of land use. The environmental conditions are accordingly changed resulting in increased environmental load, deteriorated ecological system, and depleted natural resources. This changed environment and in return inflicts a blow on human life and ecosystem on the whole globe. As a result, it will naturally increase natural disasters. As a reaction we institute environment-related laws, provide support through policies and administration, and make efforts for better environmental quality and recycling (see Figure 3).

Figure 3. Relationship between assessment sections and their contents



Source: Institute of Global Environmental Strategies (2000), Urbanization, Industrialization and Sustainable Development in Korea –The Case of Study on Ulsan and Ansan Cities-, Korean IGES members (unpublished).

Table 1. Components of environmental indicators in study areas

Category	Intermediate Indicators	Individual Indicators	Indicators
Driving Force	Human Activities	Population	Population Density
		Transportation	The Number of Automobile
	Policy and Finance	Socio-Economic Policy	Change of Socio-Economic Policy
		National Development Policy	Change of national development policy
		Land use policy	Land use change
		Industrial policy	Change of industrial policy
		Resource and energy policy	Change of Resource and energy policy
Pressure	Land use change	Urbanization rate	Urbanized area/ urban areas
		Land use change by category	Land use change by category
	Resource use	Amount of energy consumption	Amount of Gasoline and Petroleum
		Water resource use	Pipe line water
	Productivity	Manufactural products	Manufactural productivities

Tqble 1. Continue.

State	Ecosystem	Quantity	Green area in urban area
		Quality	Plants Density of plants
		Distribution	Isolation
			Continuity
	Environmental Pressure	Air quality	NO2
			SO2
		Water Quality	BOD
		Rain (water)	Surface Water
		Ocean	Ocean pollution
		Hazard waste	Amount of Solid and hazard waste
		Global worm	CO2
		Soil	Cu
			Pb
	Quality of Life	Amenity	Beautiful District
			History and Culture
	Awareness on environment	Citizen	Citizen's awareness on environment
		Government	Government's awareness on environment
Effect	Effect on human	Disease	Disease Causes
	Material Damage	Natural damage	Flooding
	Deterioration of living conditions	Deterioration of amenity	Districts
			History and Culture
	Damage on ecosystem	Load on environment	Extermination of wild amimals
	Climate change	Acid rain	Acid rain days/ raining day
Response	Resources recycling	Waste recycling	Rate of waste recycling
		Water recycling	Water recycling
		Energy recycling	Heating system
	Improvement of environment	Plant space	Green protection
		Green area	Park
	Environment management	Law, control and regulation on Environment	Environmental law and system
		Environment education and information	Environment education
		Environment organizations	Environmental officials
	Environmental technology	Domestic environmental technology	Environmental technology
	Environmental facilities	Water	Pipe line water and waste water
		Solid waste	Waste treatment to the energy consumption
	Policy and planning on environment	Land use	Land use related policy
		Air quality	Clean air quality policy
		Transportation	Transportation related policy
		Clean water	Clean water related policy
	International cooperation	International cooperation on technology	International cooperation
		Exchange of technology	Environmental technology cooperation

DPSER Processes in the Ulsan Metropolitan City

Ulsan is the seventh large city in Korea, which has about one million inhabitants with one thousand and fifty-five square kilometers of total area, and eighty seven point two percent of financial self-support rate. The fertile land was created across the Tae Hwa River, Ulsan. On-san and Bang-o-jin ports are connected with Ulsan Bay and the industrial site that is formed on the hilly districts covers around nineteen million Pyong (3.3 square meter) area where all of them became the foundation of the development of Ulsan as an industrial city (the UMC, 1999).

The city of Ulsan is divided into new and old sections, and suburban area. And suburban area is divided into farming and fishing villages with a green belt. This city was a typical fishery village until 1960. However, the UMC is one of the fastest industrialized cities within the country or in the world since 1962 when she became a city[1)]. She had become a symbolic city of Korean economic development in terms of industrialization, urbanization, and even environmental problems. The Korean government nominated Ulsan as a special industrial area and established an industrial center by the 'Special Law of National Industry Site Development' (Corporation of Industry Site Development, 1987) in 1962. Based upon this law, Ulsan National Industry Complexes were constructed.

At the initial stage of industry complex development, its population and size were respectively 85 thousands and 176.04 km^2. However, its population and size are separately 991 thousands and 1,055.55 km^2 in 1996. The number of population has increased about 12 times and urban size six times during 34 years. She also has grown to the seventh largest city and is well known to all over the nation and the world for its petrochemical and heavy industries and became one of the important nucleus cities in the Pacific Rim areas of the World (UMC, 1997). Especially, the development of UMC has been lined up with that of the heavy-chemical industrial complexes. Therefore, the UMC has experienced the serious environmental problems since 1970s. And then, the UMC has paid attention on the improvement of urban environment. These

[1)] A city is a town where more than 50 thousand peoples live.

concerns has contributed the improvement of urban environment and in a broad sense, urban environment improved since 1995.

Environment indicators are signposts that can point the way to sustainable development. While there is still no precise definition of sustainable development, environmental indicators can help to show whether we are moving in the right direction. Unifying economics and environment in decision-making may be the key to understanding how well we are navigating the course to sustainable development. To move to sustainable development, decision-makers need several informations on environment indicators as follows: They need information about where they are at the moment and on developing trends and pressure points. They also need information about the impacts or effects of interventions or policies put into place. Moreover, they need feedback on which adjustments to make to speed up or slow down the effects of their interventions and about milestones achieved or about failures that frustrate progress.

Indicators are useful because they point to trends and relationships in a concise way. They provide meaning beyond the attributes directly associated with them. In this sense, they are different from primary data or statistics, providing a bridge between detailed data and interpreted information. Indicators have been used for many years and are common in planning and economics where indicators such as GDP, the unemployment rate, the literacy rate and the population growth rate are widely monitored. Indicators can be used for many purposes such as measuring progress towards pre-established targets and goals or simply getting a picture of where things stand at a particular point in time. They can help to guide national policies for sustainable development and facilitate national reporting on measures to implement sustainable development (http://www.un.org/esa/sustdev/indi6.htm).

In this section, this study intends to find the way for the sustainable urban development, based upon the DPSER framework. The Korean economic growth has mainly been led by the strong central government since the military coup in 1961. The economic growth of UMC is not an exception. Therefore, the driving force was originated from the economic growth policy

of the central government. Therefore, the UMC driving force should focus on the economic growth policies of the central government.

Driving Force of the UMC

Indicators of driving force include the population, transportation, policies and planing for the economic growth. However, it is very difficulty to distinguish the national indicators from the local indicators because most of policies and planning were initiated by the central government. Local governments had just implemented the central government policies.

Growths of local population

The population of UMC had increased about five times from 1962 to 1997. Population density also increased around five times during the same period. However, the number of households had increased about ten times during the above period (see Table 2). It means that the UMC had processed the urbanization for that period like other cities. Rural populations had migrated to the UMC to get jobs. The UMC provided lots of job opportunities because two national industrial and several local industrial complexes were established in that city. The increasing rate of population in the UMC was shown high from 1972 to 1982 when the economic effects of industrial complexes were presented.

The total number of cars increased around 13 times during 13 years from 20,373 in 1986 to 262,294 in 1997. Automobiles increased about 25 times for the same period. Especially, the numbers of trucks for the delivery of industrial products increased around 36 times for the same period The acute increase of number of cars created several environmental problems such air pollution, noise, and car accident (see Table 3).

Table 2. The Change of Population and Area of the UMC

Year	Populations	Increasing Rate(%)	Population	Households	Area (㎢)
1962	211235	1	209.5	32238	1008.32
1965	222965	1	221.1	38123	1008.32
1968	249131	2.1	247.1	44916	1008.32
1972	275355	5.9	274.2	53704	1004.22
1975	368612	4.6	366	76738	1007.18
1978	482150	4.3	476.6	99930	1011.58
1982	593042	4.5	585.5	130964	1012.82
1985	670358	1	638.4	163443	1050.08
1988	743184	3.9	705.8	184974	1050.92
1992	898630	5.1	854.4	262970	1051.81
1995	969196	2.4	918.4	289295	1055.35
1997	1013070	2	959.6	309945	1055.7

Source: Department of Information Management in the UMC.

Table 3. The Number of Cars of the UMC

(Unit: Cars)

Year	Total	Automobile	Trucks	Buses	Special Cars
1986	20,376	8,896	8,510	2,091	879
1987	26,803	12,204	10,567	3,040	992
1988	37,275	18,878	12,770	4,521	1,106
1989	53,002	30,335	16,112	6,115	440
1990	70,877	43,097	19,443	7,775	562
1991	94,515	62,540	22,303	8,835	837
1992	11,9357	82,446	25,230	10,006	1,675
1993	144,705	104,078	28,375	10,612	1,640
1994	174,642	132,598	28,727	11,630	1,688
1995	209,803	160,752	35,303	12,054	1,694
1996	241,600	188,845	38,141	13,038	1,576
1997	262,394	207,053	39,938	14,053	1,350

Source: Department of Information Management in the UMC.

Development Process of Industrial Complexes in the UMC

The economic growth of the UNC is directly related with the development of industrial complexes because the central government utilized the Ulsan industrial complexes as an engine of the Korean economic growth. The stages of development of industrial complexes are as follows: the Port of Ulsan was originally called "Yeomp'o", one of 3 P'os (*P'o means harbor in old Korean) which were opened for the foreign trade in 1426 in the era of the King Sejong of Lee Dynasty. In 1963, it became the first industrial port in support of the economic growth of Korea. Following the major construction of wharves in 1966, Onsan and Mipo Port were added to the boundary of Port of Ulsan in 1976, to facilitate the port development in the region.

The first stage (1962-1966) focused on the building of an industry site and infrastructure such as port, road, and water provisions for the Ulsan Industry Site. The second (1967-1971) made an effort to construct the heavy chemical industrial complex. A refined oil industry along with chemical fertilizer industries was built in the water front areas such as Jangsengpo and Yeochun. In order to support these facilities, social overhead capital such as port, road, and steam power plant also was installed in this era. The third period (1972-1976) was a leaping stage in the development of Ulsan industry. Ulsan's representative industries such as automobile and shipbuilding were constructed in Yumpo and Mipo industry complexes during this period. In the fourth stage (1977-1981), agglomeration and scale effects of these industries was gradually generated and several industries such as iron, automobile, and lumber were located in order to enjoy these side effects. An industry belt was established in the fifth period (1982-1986) because existing industry complexes were continuously grown in terms of productivity and scale, and new industry complexes like Unyang and Yongyun were built.

And then Ulsan has grown the biggest heavy-chemical industry complex city in South Korea in terms of amount of products and scale. In another aspect, Ulsan has tried to reduce environmental problems through changing the structure of industrial base from petroleum chemical plants to automobile and shipbuilding plants, which are relatively a low pollution industry.

Eventually, main industries gradually has changed from the petroleum chemical industry to the automobile and shipbuilding since 1987 (UMC, 1997).

As a result, two national industrial complexes and several local industrial complexes were located in UMC as the Figure 4. The productivity is corresponded to 18.9 percent in that of nationwide manufacturers and 21.1 percent in amount of nationwide export customs (UMC, 1997). Finally, Ulsan was eventually grown to the symbol of Korean economic development

Figure 4. Locations of Ulsan Industry Complexes

Source: The Figure on Locations of Industry Complexes in http://www.ulsancci.or.kr. It is revised by authors.

Environmental Pressure in the UMC

Environmental pressure indicators represent the pressure on the environment that affects sustainable development. As the above description, the environmental pressure of the UMC was initially begun by the central government in order to promote the economic growth through the building of heavy-chemical industry complexes but their results were shown in the local area. Two main components of environmental pressures are the increase of GDP and energy consumption. Figure shows the growth pattern of GDP and energy consumption since 1971. Both factors has maintained 5-10 percent growth rate during the same periods. These have contributed to deteriorate the environmental problems of the UMC and Korea. Environmental Pressures in UMC are summarized at Table 4-8. Urban areas, urbanization rate, land use change, the increase of oil consumption, the change of industrial structure effect on the local environmental pressures. Especially, oil consumption increased three times for 5 years from 1992 to 1997.

Table 4. The Population Increase and Urbanization Rate in Korea and 7 Large Cities

	Total Pop	Urban Planning Area		Administration Area		Urbanization Rate(%)	
						Urban Planning Area	Administration Area
		Urban Pop	Non-Urban Pop	Urban Pop	Rural Pop	Criteria	Criteria
Yea	(A)	(B)	(C=A-B)	(D)	(E=A-D)	(B/A*100)	(D/A*100)
Seoul	10,389	10,389	-	10,389	-	100.0	100.0
Busan	3,865	3,865	-	3,840	25	100.0	99.4
Taegu	2,502	2,534	-32	2,483	19	101.3	99.2
Inchon	2,446	2,403	43	2,378	68	98.2	97.2
Kyongju	1,324	1,340	-16	1,324	-	101.2	100.0
Taejun	1,323	1,329	-5	1,323	-	100.5	100.0
Ulsan	1,013	898	115	910	103	88.6	89.8

Furthermore, three industrial complexes were established in 1997. Local government tried to promote the local economy after the introduction of local autonomy.

Table 5.Land Use by Land Category in the UMC

(Unit: m^2)

Year	Residential Land	Industrial Site	School Site	Road	Rail Site	Mineral Spring
1992	17,038,608.9	20,904,979.8	1,759,584.6	10,136,320.6	1,127,808.9	
1993	17,728,857.9	22,157,958.5	1,828,071.7	10,666,393.7	970,257.0	
1994	18,693,527.3	22,538,706.5	1,885,437.2	11,189,996.5	981,885.4	
1995	32,407,211.8	34,211,758.0	2,589,016.2	27,883,555.2	1,907,667.1	6.0
1996	33,053,219.3	36,023,164.7	2,646,916.2	28,153,278.1	1,919,436.1	6.0
1997	34,287,932.7	38,205,124.0	2,668,356.5	28,545,551.1	1,918,853.1	6.0

Table 6.Oil Consumption in the UMC

(Unit: ton)

				Distillate		Bunker C	
	Total	Gasoline	Kerosene	Fuel Oil	Heavy Oil	Oil	Others
1992	327,434	80,093	39,745	207,596	-	-	-
1993	349,350	96,881	42,665	209,804	-	-	-
1994	392,088	121,658	41,135	229,295	-	-	-
1995	447,623	147,920	41,852	257,851	-	-	-
1996	785,101	257,805	86,874	440,422	-	-	-
1997	927,593	265,344	203,503	458,746	-	-	

Source: Department of Regional Economics of the UMC in 1997.

Table 7. Status of Mining and Manufacturing in the UMC

(Unit: number, person, million won, ㎡)

	No. Of Establishments	Monthly Average No. of Workers	Wage & Salary	Gross Output
1992	359	104,685	1,642,011	20,751,803
1993	606	116,981	1,931,132	23,298,222
1994	578	117,4	2,301,767	26,941,919
1995	978	145,139	3,084,911	41,658,414
1996	1,017	144,886	3,445,551	45,537,812
1997	1,004	138,217	3,165,397	53,297,019

Source: Department of Regional Economics of the UMC in 1997.

Table 8.Industry, Agriculture and Industry Complexes in the UMC

	Number of Complex	Total Area	Number of Establishments	Number of Workers
1992	2	261	13	1,200
1993	2	261	17	1,744
1994	2	261	20	1,950
1995	3	332	22	2,176
1996	3	332	27	2,223
1997	6	71,335.2	583	114,944
Ulsan·Mipo National Industry Complex	1	46,222	421	102,437
Onsan National Industrial Complex	1	24,518	135	10,184
Songbuk Agriculture and Industrial Complex	1	138.5	9	1,189
Tuso Agriculture and Industrial Complex	1	122.6	14	850
Tudong Agriculture and Industrial Complex	1	69.7	4	284
Dalchon Agriculture and Industrial Complex	1	264.4	Incompleted	

Environment States of the UMC

These explosive urbanization and industrialization however created several environmental problems such air quality, sewage water, soil, and river and ocean pollution in UMA. Especially, Ulsan's environmental problems are serious more than that of any other city because most manufacturing plants are pollution-related industries such as petroleum-chemical or automobile and shipbuilding industries. At the initial stage of development of industry complex, there was no consideration on its environmental impacts (Department of Environmental Protection of UMC, 1998).

Moreover, the characteristics of environmental problems are that its impacts slowly show up and last for the long time. Heavy chemical industry complexes were usually constructed in the 1960s but environmental problems actually were generated in the 1980s. Moreover most industrial complexes were located in the water front area. This resulted in the pollution of river and coastal water. Detrimental smog of manufacturing plants moved to the residential area from the spring to the fall, following the direction of the southeast wind (see Figure 4). More specifically, source industries of environmental pollution are like Table 9.

Table 9. Source Industries of Environmental Pollution in 1998

Number of Source industries					Dust	Bad Smell	Poison	Soil	Automobiles
Sub Total	Air	Water	Noise	Specified Waste Materials					
2,018 (616)	770 (330)	791 (286)	209	248	289	35	170 (122)	448	262,394

Note: ( ) is the number of source industry of two national industry complexes (Ulsan and Onsan).

Source: This data is provided by the Department of Environmental Protection in UMC in 1998.

As the Table 10, one-third (616) of total pollutant factories (2,018) is located in two national industry complexes. Main pollutants of national complexes are air and poison pollution because major factories in these areas are petroleum chemical or heavy industries. More specifically, two major environmental problems in the UMC are air quality and water pollution.

Air Pollution

Air pollution in UMC had been very serious because most of industrial complexes were related with heavy-chemical industries like figure 4. Eventually, UMC was one of most polluted cities in Korea. It resulted in the serious environmental damages. Civilians who lived in the outskirts of industrial complexes were relocated to other places (see environmental effect section). However, central and local government had made an effort to change local industrial structure from heavy chemical industrial industries to automobile or high tech-oriented ones. Due to these efforts and civilian awareness on the environments, air quality has been gradually improved in 1990s.

Table 10. Air Pollution (SO_2) by the Metropolitan City

	Standard	1993	1994	1995	1996	1997
Seoul	0.03	0.023	0.019	0.017	0.013	0.011
Pusan	0.03	0.028	0.023	0.023	0.022	0.018
Taegu	0.03	0.035	0.038	0.031	0.023	0.016
Inchon	0.03	0.021	0.022	0.023	0.012	0.013
Kyongju	0.03	0.014	0.013	0.010	0.008	0.009
Taejun	0.03	0.020	0.021	0.017	0.015	0.011
Ulsan	0.03	0.032	0.030	0.028	0.022	0.019

Table 11. The Circumstance of Air Pollution in UMC

Category	Unit	Criteria	Average Levels of Air Pollution by Year							
			1991	1992	1993	1994	1995	1996	1997	1998.4
SO_2	PPM/Y	0.03	0.038	0.031	0.032	0.031	0.028	0.022	0.018	0.016
TSP	μ g/m_3/Y	150	96	95	97	95	98	106	75	69
O_3	PPM/8h	0.06	0.013	0.012	0.014	0.013	0.015	0.015	0.015	0.017
NO_2	PPM/Y	0.05	0.022	0.027	0.028	0.026	0.023	0.023	0.023	0.022
CO	PPM/8h	9	1.7	1.3	1.4	1.2	1.3	1.0	0.9	0.8
Acid Rain	P.H	5.6	5.5	5.7	5.3	5.4	5.4	5.6	5.7	5.9

Source: Department of Environmental Protection in the UMC (1998.5), Circumstances of Environmental Preservation in the UMC.

Water Pollution

The most serious environmental problems in Ulsan are water pollution. The quality of drinking water or pipeline water is not good because the lake for the pipeline water is polluted. Moreover, the volume of water which people use has been continuously increased. In terms of water problems, Ulsan met two problems. One is a shortage of total water volume and another is a low quality of water.

Water quality can be noted in Table VI-15. Water pollution exceeds the environmental criteria in most areas except coastal water. In other words, the UMC is experiencing serious water pollution. However, water quality has improved since the middle of the 1990s due to the same reason why accounts for the improvement of air quality. Other environmental problems such as noise, soil, and poison also became better as the result of the effort of the local government and the public (UMC, 1997). In a broad sense, the environmental quality of the UMC has been improved but that of specific industrial complexes is still deteriorating.

Table 12. Generation of Waste Water and Household Waste Water per Day

	Unit	1993	1994	1995	1996	1997
Household Waste Water	1 Thousand㎥/ Day	13,972	15,976			
Per Capita	ℓ /Person, Day	314				
Industrial Waste Water	1 Thousand㎥/ Day	6,412	7,259	8,741	8,926	4,874
Discharge Amount	1 Thousand㎥/ Day	2,093	2,316	2,375	2,511	2,618
Livestock Waste Water	1 Thousand㎥/ Day	170,138	175,669	168,370	197,017	199,917
BOD Discharge	1 Thousand㎥/ Day	470	403	455	541	547

Source: National Statistics Organization.

Table 13. The Circumstances of Water Pollution in the UMC

Location		Cate-gory	Criteria	Average Levels of Water Quality by Year (ppm)							
				1991	1992	1993	1994	1995	1996	1997	1998.4
Taewha River	Upper	BOD	1	1.2	1.2	1.2	1.5	1.5	1.8	1.3	2.0
	Lower	BOD	3	11.7	6.4	6.9	9.7	9.8	11.3	10.7	7.4
HeiYa River		BOD	3	6.6	3.5	3.3	4.2	3.8	2.8	3.5	2.5
Coastal Water		COD	4	2.0	1.7	1.3	1.9	1.9	1.3	1.3	-

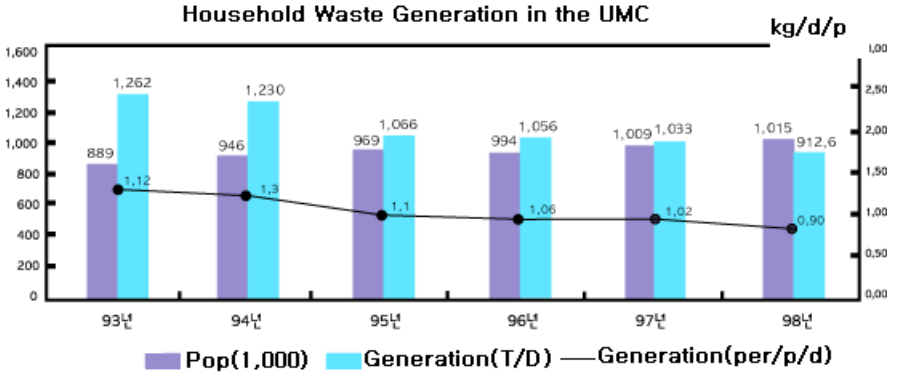
Source: Department of Environmental Protection in UMC (1998.5), Circumstance of Environmental Preservation in UMC.

Waste Generation

Solid wastes are composed of household and industrial wastes. Since 1960s when the industrial complexes were established, both household waste and industrial waste has been continuously increased. However, the generation of household waste decreased since 1993 in terms of both total

amounts and amounts per caper and day due to the volume based-collection policy and recycling policy.

Figure 5. Household waste generation in the UMC



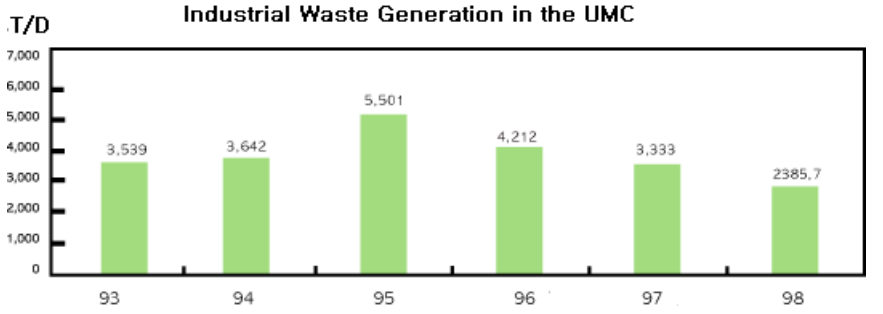
Industrial waste decreased since 1995 when the local autonomy was adopted. Local government made an effort to reduce the generation of industrial waste. Before the local autonomy, central government did not pay much attention to reduce the local waste. Moreover, people concerns on the qualities of environment and life because the UMC is one of the most polluted cities in Korea. Efforts of the local government and citizens resulted in the reduction of both household and industrial wastes from the mid-1990s.

The Environmental Effects on UMC

Since 1962 when the First Five Years Economic Development Plan was established, a top priority of government policy has been a focus on development-oriented economic growth to escape from absolute poverty. In the early stages of economic development, the smoke of a chimney was a symbol of economic development. Especially, the smoke of Ulsan national industry complexes played the role of engine for Korean economic growth.

Most people were happy when they saw the smoke of an industry chimney because they believed that it could relieve them from the desperation of poverty.

Figure 6. Industrial waste generation in the UMC



This policy eventually brought material affluence. However, the environment problems became serious from the middle of the 1980s. Particularly, the environmental problems of heavy industry cities like Ulsan and Ansan have become serious social issues. The central government opened an Environment Administration (EA) in 1980 in order to consider the environmental problems.

It surveyed the environmental damage caused by Ulsan and Onsan national industry complexes in 1984. Based upon the results of this survey, the government compensated citizens influenced by the environmental damage and made a plan to force them to move to other areas (Kim and Hong, 1997). Total numbers of households that had to be relocated were 8,138 and relocations are still not completed due to an insufficient budget (Department of Environmental Protection of UMC, 1998).

Moreover, the relocation also must be implemented continuously because the spatial range of the environmental damage becomes larger. The central government designated the Ulsan industry complexes as a special

management district of air quality in 1986. In spite of these governmental efforts, the environmental problems of other large cities including Seoul continuously worsen.

The Environmental Response in the Ulsan Metropolitan City

Until the last chapter, DPSE processes in the UMC have been assessed. In this section, overall environmental responses of UMC will be identified. The UMC government like other local governments has implemented the environmental policies of central government since 1961. However, after the local autonomy in 1995, the role of local government has increased in the local environmental governance. In order to challenge the national environmental problems, including Ulsan's problems, the Ministry of Environment was opened in 1994.

In the local government level, Ulsan opened the department of environmental management in 1987. Local government approached more positively these environmental problems because they are directly related with the quality of life for citizens. At first, the local government employed a monitoring system to note the circumstances of the pollution on air and water, smoke, noise, poison, coastal water, and so on.

Based upon the survey on the environmental pollution, she made a mid-term implementation plan for the environment improvement in 1997. Especially, this plan focused on the improvement of quality of life for the Ulsan citizens but the environmental policies of central government mainly emphasized the compensation to the damaged citizens and their relocations to the other place.

The basic principle of this plan is that the emission of pollutants should be "Zero Base." Based upon this principle, the local government controls the environmental pollution as follows: 1) In order to construct a new factory, it must produce the environment-friendly goods or recycle the waste. 2) In order to increase the scale of existing factory, total amount of pollutant emission should be less than that of the existing plant. Following an officer of Ulsan, he argues that if this plan is implemented successfully, Ulsan will be

changed from the symbol of polluted city to a clean city environmentally in 2002. In this section, this paper notes the local environmental response of Ulsan Local Government.

Economic Instruments for the Environmental Response

Following the national guideline on the environmental responses, based upon the "Green Ulsan 21," the UMC has adopted the following instruments to save the local environments.

Firstly, the Emission Charge System was put into effect in 1983, in order to prevent damage to the environment due to pollutants discharged in excess of the specified emission standards and to ensure that firms would actually observe the permissible limits. If permit holders are caught violating the conditions of their permits, the system imposes charges on the emissions or discharges of certain pollutants that are in excess of emission limits.[2] The emission charge system was modified in 1997 to include volume or discharge based charge (the Basic Emission Charge[3]).

Secondly, the Deposit-Refund System for Waste Disposal went into effect in 1992. To promote recycling, the MOE has the authority to collect deposits from producers and importers of easily retrievable and recyclable products. When pollution is avoided or reduced by returning the products or their residuals, a refund follows. In 1999, twelve items among six products, including beverage containers, tires, the lubricating oil, are liable to the deposit-refund system.

Thirdly, the Waste Treatment Charge System was introduced in 1993 to

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[2] Ten air pollutants, including SOx and TSP, and seventeen water pollutants, including BOD, COD, and suspended solids, are subject to the charge.

[3] The change occurs in parallel with modifications to the permit system; emission and discharge permits stipulate an upper limit for the amount of pollutants that can be emitted. The emission charge will then become payable on all discharges and emissions in excess of 30 percent of this maximum amount, thus creating an incentive to permit holders to reduce emissions to below 30 percent of the maximum allowed.

promote waste reduction and resource conservation. This system charges producers or importers of 29 items of 10 products which use materials and containers that contain harmful substances or that are difficult to collect or recycle.

Fourthly, the Environmental Improvement Charge was levied on the owners of commercial buildings and on diesel-powered vehicles in order to curb increasing pollution from commercial and consumption sectors and in order to raise funds for environmental investment. The major objectives of the charge are to foster pollution reduction and to secure funds for environmental investment. The rate of charge for commercial buildings is on the amount of fuel and water used, and that for diesel-powered vehicles is on the age of the vehicle and the estimated volume of exhaust.

Fifthly, the Volume-Based Collection Fee System for Domestic Wastes went into effect in 1995. Its objectives include reducing the volume of domestic wastes generated by households and promoting recycling by imposing collection fees according to the volume of wastes generated.

To efficiently promote the financial investment on the environmental improvement and secure new revenue sources, the government introduced the Special Account for Environmental Improvement in January 1995. Financial resources secured through economic instruments are deposited in the Environmental Improvement Special Account to pay for the construction of basic environmental facilities, such as sewage treatment plants and waste treatment facilities. Revenue sources include various charges imposed on polluters, transfers from general and other accounts, loans from the National Bond Management Fund and foreign loans (MOE, 1997 and 1999).

In 1996, the central government adopted a National Action Plan for Agenda 21. Moreover, the MOE is also responsible for the policies relating to Environmental Impact Assessments (EIA). In order to ensure the objectivity of the EIA, Central and Regional Committees for EIA, which consist of professors, engineers, and specialists, review the assessment. Residents are invited to the hearing process of EIA. Those who plan to carry out projects that are subject to EIA must prepare draft assessments, which are made public, and hold a public hearing on the proposed project (MOE, 1997; Jeong

and Cheong, 2000).

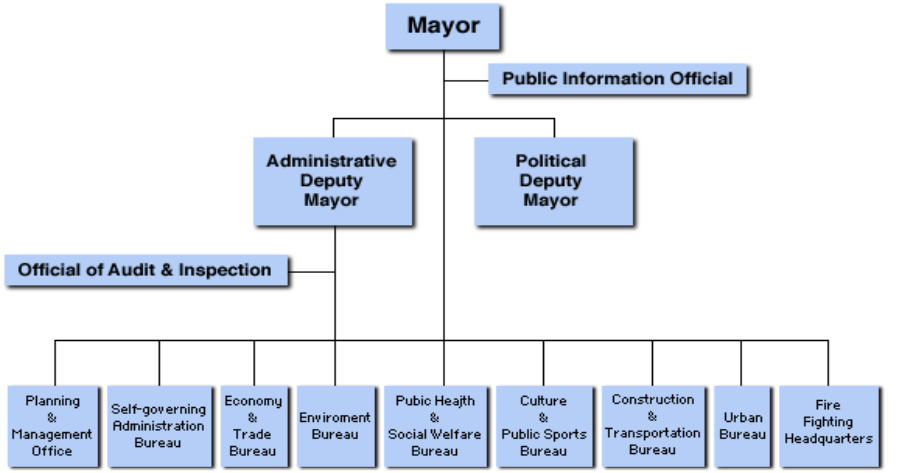
In summary, on the early stage of the Ulsan development, the central government did not consider environmental problems. In the middle stage, environmental policy focused on moving of affected people after the fact instead of directly preventing environmental pollutants. Finally, environmental problems have taken on a great urgency in Korea. Moreover, by their inherent nature, they cannot be solved in a short period of time.

Political and Administrative Organizations in Ulsan Metropolitan City

As the above description the right and responsibility of local government on the environmental governance have been significantly increased after the local autonomy. And then UMC government enlarged the organization and the number of officers on the environmental governance since 1995. Basically, UMC is composed of 7 bureau, 2 offices, 1 headquarters, and local assembly. Each community has its own administrative organization. Moreover, the citizens elect a mayor and local assembly. And then they have to consider local environmental problems which local citizens have been concerned.

Environment Bureau is composed of three sections. Environment Protection Section covers the environmental policy, water quality management, and air quality Management. Scavenger Section charges scavenger administration. Sewerage Management Section takes the work on the waterworks management, sewerage administration, and sewerage facilities. Forestry & Park Section had a responsibility on the management of green tract of land and administration of park & forestry. In addition, there are several environment-related organizations that are belonged to other sections.

Figure 7. The Organization of Administrative Structure in Ulsan Metropolitan City



Source: http://www.metro.ulsan.kr.

Figure 8. The Environmental Section of Ulsan Administrative Organization

Source: http://www.metro.ulsan.kr.

The Decision-Making Processes for the Environmental Response

Actually urban environmental problems are closely related with the local people's thinking and activity because the lives of local people as both consumers and producers of infrastructure services influence the nature, quality and flow of environmental infrastructure. Therefore, they have to be

actively involved throughout the project cycle from the formulation of goals and policies to its implementation. There often are conflicts between the policy preferences of different sectors of society (Mangal, 1998). For example, industries benefit from lax water standards but they externalize the burden to downstream populations who are likely to want stricter standards. Local community and citizens facet the environmental problems due to lax pollution standards but industrial sectors can benefit from them. However, the industrial sectors also can face the environmental problems in the long terms. Because of these conflicts, all stakeholders participate in formulating the environmental policy or suggest their opinions to the policy building in order to ensure that the goals of environmental governance are consistent with the broader values and goals of society as a whole.

Since the adoption of local autonomy, the UMC made the municipal codes on the principles of environmental preservation and the role and duty of local government, industry, and citizens in 1997. Based upon this code, eventually Ulsan Metropolitan City established the Mid-term plan on the UMC environmental improvement (1998-2002) in 1997. It is actually the first comprehensive plan for the improvement of local environment. Before this plan, the local government only had implemented the environmental plan of central government. This plan contained 10 sections and 103 projects on the environmental management, the preservation of natural resources, air and water quality, and pipeline water (http://www.metro.ulsan.kr).

Furthermore, in order to promote the citizen's participation in building the environmental policies, Environmental Committee, Environmental Preservation Consulting Committee, and Environmental Conflict Coordinating Committee were established in 1997. The first covers the environmental education for the public and consulting on the environmental policies and alternatives. The second consults the environmental preservation and environmental plan. The third charges the consulting of environmental conflicts among agents and between the public and the private sectors. All committee are composed of governmental officers, professors, and NGO groups. The UMC also established the "Green Ulsan 21 Promotion Committee in order to implement efficiently the "Green Ulsan 21 Plan." Its members are

composed of the education, broadcasting, police, NGOs, and citizen organizations (http://www.metro.ulsan.kr).

Environmental Responses of NGOs

Due to the increased public awareness of environmental preservation, environmental NGOs have been more active in their activities. Environmental NGOs are engaged in diverse activities, such as keeping up public relations on environmental preservation, conducting campaigns, surveys and research on environmental issues, and holding seminars on environmental policies. Moreover, most of NGOs have their own local branches. Therefore, the roles of NGO in central government are similar with those of local government. The roles and activities of the NGOs are as follows:

First, the Korea Environmental Preservation Association and the Toxic Chemical Management Association were established in accordance with the Basic Environmental Policy Act and other relevant laws. The Associations were formed to conduct inspections and research, develop environment-related technology, promote education and training, and improve public relations.

Second, organizations that are similar to research institutes include the Korea Action Federation for the Environment, the Baedal Eco-Society, the Environment & Pollution Research Group, etc. These organizations, consisting of environmental experts and social leaders, hold seminars, conduct academic studies and research on environmental policies, and exchange environmental information with both national and international organizations.

Third, with the environmental movement developing into a kind of civic movement, various civic groups, including religious groups and women's groups, are staging campaigns for environmental preservation under diverse themes. For example, campaign titles such as "Let's reduce food wastes," "Let's use public transportation," and "Let's save water," have become common slogans for many environmental groups. On February 1, 1996, representatives from six major religious groups met together to declare the

"Declaration of the Greening of Our Society" and to start an aggressive campaign for environmental preservation.

Fourth, there are many regional organizations represented by local residents, such as Earth and Eco-friends. These organizations are involved in the environmental preservation of the local community. They hold seminars on local environmental issues and conduct activities to protect water supply resources.

Actually 10 NGOs participate in the environmental movements for the Ulsan local environment improvements such as the public awareness, environment watch, and preservation of eco-system. The Green Environment Conservation, the Korea Environment Movement Federation, and some other NGOs are Ulsan Branches of national-wide organization. Onsan Complex Environment Management Committee, Community Countermeasure Committee on Onsan Pollution Problems, Taewha River Conservation Committee, and some other NGOs are working for the local specific environmental problems. The Ulsan Natural Environment Preservation Committee, Onsan Environment Preservation, and Environment Preservation Committee of Ulsan Local Prosecution Attorney are on action for the local natural environment and eco-system. Total 80 plants and more than 3000 personals including university, government officers, and professionals are participated in the above NGOs' activities (http://www.metro.ulsan.kr). Actually, 9 factories are certified as the "Environmentally Friendly Plants" in the UMC. Local government supports these factories with the financial, technical, and other incentives (http://www.metro.ulsan.kr).

The Public and Private Partnership for the Environmental Responses

Local environmental problems are closely related with the local people's lifestyle, awareness, and participation. Therefore, the success and failure of environmental governance are highly depended upon the public and private partnership on the local environmental issues. As the above descriptions, UMC environmental problems are significantly different from those of other cities. Especially, UMC was the origin of the Korean urban environmental

problems because where was the heavy-chemical industry-oriented city. Therefore, the concern on environmental governance in UMC is higher than any other city in Korea. The "Campaign-Oriented Culture", which is probably a result of military dictatorship culture, encourages the partnership between the public and private sectors. There are several environmental governance activities by the public-private partnership.

First, the Green Ulsan 21 will be developed into the citizen movement on the environmental preservation. This program has its own community organizations for stimulating the citizen participation in the Green Ulsan Network. It charges the citizen education and public awareness on the environment preservation.

Second, the Environmental Technology Development Institute was established in 1998. The Ministry of Environment, local municipal, Ulsan University, Industry, and citizen including NGOs were involved in this program. This institute charges the environmental technology development, survey on the natural resources and environmental pollution, and water quality management system. Its total budget was 1.35 billion Korean Won. Its budget came from 50% in central government and 50% in local government.

Third, in order to improve the local environmental quality, local environmental standards will be reestablished in the near future. This project is on processing. A new standard will be higher than that of central government (SO2: 0.030 PPM/year; TSP, 150 ㎍/㎥/year) and World Health Organization (SO2: 0.015~0.023 PPM/year; TSP, 60 ㎍/㎥/year).

Fourth, the Ulsan Health and Environment Institute is establishing in order to study the relationship between the public health and environmental problems. It will be opened in July 2000. In addition, several environmental governance programs are implementing and are scheduled. As the above description, the effects of these environmental governance programs, however, are not clear or very small because most of programs were established very recently or are at the beginning stage now. In spite of these problems, the public concerns on the environmental governance, including housewives, have been largely increased due to the implementation of local autonomy and NGO's activities. Moreover, the central and local governments

also begin to recognize the importance of the local environmental governance. Therefore, we can have the optimistic view on the improvement of Ulsan environmental problems.

Lessons and Policy Implications of the Ulsan Economic Growth and Environmental Policies

East Asian rapid economic growth, urbanization, and industrialization have placed increasing demands on air, water, and land resources. Much of the region, particularly major urban areas, is plagued with unacceptably high air and water pollution levels. Land degradation and deforestation are acute problems in heavy-chemical industry cities. Urgent steps are needed to reverse this trend and to foster a more efficient and environmentally friendly growth in years ahead.

Because of rising of income levels, the public concern on a clean environment is increasing. In order to challenge this demand, East Asian countries must prepare a new paradigm on the economic development strategy. A new policy approach is clearly needed in order to handle the global environmental issues and challenges posed by rapid changes in social structure. The government must accordingly develop environmental technologies to match those of advanced nations, take immediate action to cope with environmental problems, and take an initiative in solving global environmental problems. An environmentally friendly consumption patterns and business management system must be fostered. The ideal of "Environmentally Sound and Sustainable Development (ESSD)" for the economic growth must be promoted.

All these challenges make environmental governance system in Korea and especially UMC much more sophisticated. However these does not mean that the environmental governance system in UMC is very effective to meet the sustainable development requirement. There are several tasks and strategies to improve efficacy of the environmental governance system. Accepting these changes of Korean society, this paper suggests some policy implications on

the environmental governance for other developing country and Korea itself. Based upon the DPSER assessment model on the Ulsan Metropolitan City, this paper summarizes the conclusion for the sustainable development.

Firstly, the administrative paradigm in the progressive era should be replaced by "governance" paradigm, especially environmental governance for the sustainable development. Based on this new paradigm, key themes of administrative reform should be to reduce organizational hierarchy, empower local communities, promote task-centered management, and apply multi-media approaches including the public-private partnership and citizen participation.

Secondly, local governments need to build up expertise in implementing and enforcing environmental protection measures to tackle compliance problems involving small local factories and enterprises. Policy measures currently discussed to improve the capacity of local governments include the privatization of environmental service provisions, promotion of citizens'participation (of course NGOs) in environmental management, and development of Local Agenda 21 and comprehensive regional environmental plans, community partnership with industries, etc.

Thirdly, restoration and fortification of environmental capacity is needed. It is a prerequisite to have a margin within the limits of environmental capacity to continue economic growth without, however, compromising environmental quality. Furthermore, investment should be enlarged for fortification of sewage treatment plants, solid waste treatment installations, fostering environmental industries, and technology development for environmental improvement. Land use planning and industrial policy should maintain harmony with environmental policy.

Fourthly, it is urgent to develop new methods and techniques to solve and reduce regional conflicts. Some scholars suggest that the Polluter Pays Principle must be emphasized more. Others believe the Beneficiary Pays Principle should be adopted as a way of settling regional disputes. Still others recommend the use of a community fee system regarding NIMBY facilities. However, the most important thing, I think, is to design a "principled negotiation" mechanism to solve the increasing environmental conflicts and

disputes.

Fifthly, the promotion of public participation is encouraged. Environmental policy cannot be successfully implemented without the cooperation of the public. Recognizing these facts, the role of non-governmental organizations (NGOs) is becoming more important in Korea and increasing number of NGO leaders actually participate environmental policy formulation and implementation. Moreover, environmental education for students and the provision of suitable environmental information for the general public should be strengthened and enhanced to promote public participation.

Sixthly, to help promote voluntary environmental management and clean technology development, government should provide more flexible environmental regulatory system. Industries, which had paid little attention to voluntary environmental management, began to realize the importance of environmental management to survive in the high competition system of the global economy. Therefore, it is necessary to develop much more voluntary programs to help such positive business's attitudes. Moreover, it will be helpful to improve industrial environmental practices, if Korea can introduce the environmental accounting system for individual industry and bank loan system based on industries' environmental performance.

The developing countries must consider the environmental issues and their governance when they establish economic development strategies, considering the Korean environmental governance experiences. They must induce low-pollutant factories. Moreover, in order to solve local environmental problems, each local government must make a plan on the protection of urban environments and implement it, considering socio-economic situations of planned areas. Her citizens and organizations also must voluntarily participate in protecting urban environments. If other Asian developing countries obtain lessons from the Korean experiences, they can get away from the Korean terrible experiences and a sustainable economic growth can be maintained. They also can save the East Asian and global environments.

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