

Audit Workshop Paper on **“Environmental Auditing”**

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The Board of Audit and Inspection (BAI) of Korea

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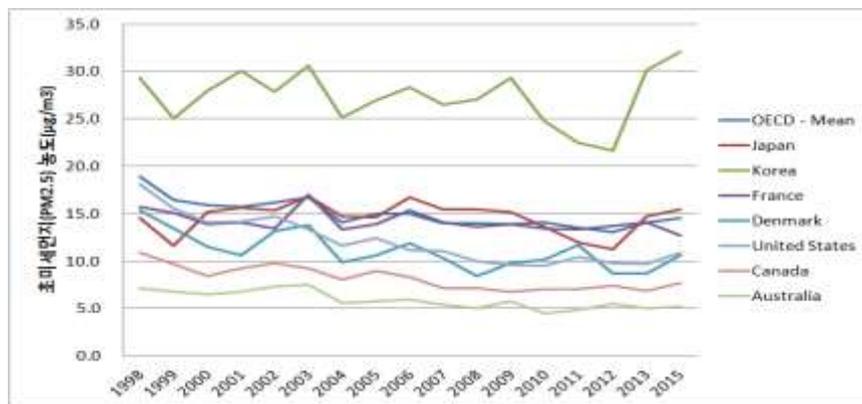
1. Background

After ‘The Rio Declaration on Environment and Development’ at the United Nations Conference on Environment and Development (UNCED) in 1992, the ‘environmentally sound and sustainable development’ has emerged as one of the most important tasks in the international community. In particular, sustainability has been reflected in the national policy until now as a critical value to minimize environmental degradation. In line with the global trend toward sustainability, Korea has also pushed forward to various policies for sustainable development, including the full implementation of the environmental impact evaluation system with the revised ‘Environmental Impact Evaluation Act’ in 1993.

Despite such efforts, however, Korea ranked only 36th out of total 38 members in the OECD’s Better Life Index¹⁾ in 2017, raising the question of the effectiveness of its environmental policies.

Against this backdrop, among other environmental factors, the air quality issue has recently been the most serious social issue in Korea as it faced double, sometimes even quadruple concentration of fine dust (PM-2.5²⁾) compared to other OECD member countries (refer to Picture 1).

[Picture 1] Changes in PM 2.5 concentration of Korea and other OECD members



Source: <http://stats.oecd.org/>

To tackle this issue, the Korean Ministry of Environment (MoE) has steadily increased the budget for improving the air quality from a mere 7.4% out of its total project budget in 2016 to 13% (about 633 million USD) in 2018 as seen in Table 1.

1) OECD Better life index: a tool designed to measure the quality of lives by evaluating 11 key factors such as environment, health, and safety that have impacts on well-being of people in 38 OECD member countries

2) Particulate Matter smaller than 2.5 μm

[Table 1] Project budget of MoE by area for the past 3 years

(Unit: 100 million KRW, %)

Category	2016		2017		2018	
	Budget	Weight	Budget	Weight	Budget	Weight
Sewage-water quality	34,488	62.2	32,664	58.6	30,034	55.3
Atmospheric environment	4,115	7.4	5,276	9.5	7,043	13
Resource recycling	3,477	6	3,492	6	3,106	6
Natural environment	5,680	10	5,832	11	5,732	11
Others	7,709	14	8,510	15	8,377	15
Total	55,469	100	55,774	100	54,292	100

Meanwhile, the Board of Audit and Inspection (BAI) of Korea also tried to meet the growing demands of the Korean people on clean air, and therefore conducted the audit on the Improvement Project for Air Quality in Metropolitan Areas in 2015, focusing on Seoul, Incheon, and Gyeonggi Province.

In this regard, among the various environmental areas such as atmospheric environment, water environment, marine environment, soil environment and resource recycle, this report introduces the Korean government policies with the main focus on the biggest environmental issue in Korea, namely the atmospheric environment, and shares relevant audit cases.

2. Korea's Atmospheric Environment Policy

2. 1. Atmospheric Environment Management Condition

Korea has structural weaknesses such as the effects from neighboring countries (e.g. yellow dust), weather conditions, and concentration of population and industry, which serve as limitations in the management of atmospheric environment.

Geographically, it is located in the area of westerlies, and therefore prone to be affected by its neighboring countries. Korea also has unfavorable weather conditions. For example, since Korea has most of its rainfall during the summer and little precipitation in the winter and spring, it is hard to expect the cleaning effect of rain as in Europe that would remove micro dust from the air. In particular, frequent continental high pressure causes frequent air stagnation, inducing high concentration micro dust.

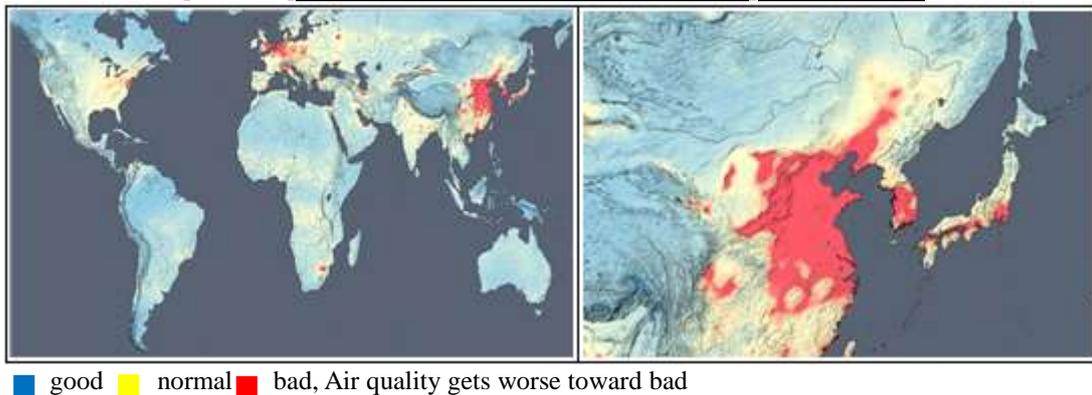
On top of geographical and meteorological conditions as fixed constant values for managing micro dust, other factors were combined to increase micro dust emission per unit area such as the world's third highest population density, urbanization resulted from concentration of both population and cars in the capital area, and industrialization

focusing on manufacturing industry.

2. 2. Air Pollution and Public Recognition

According to the analysis of the air population level measured by the satellite of the National Aeronautics and Space Administration (NASA), the concentration of NO_2 , which generates O_3 and PM-2.5 in the air, has decreased, compared to 2005 in Japan and Europe, but increased in China and Korea. As seen in Picture 2, by country, Korea ranked 2nd in the world's worst air pollution level, following China, while ranking 5th out of 195 cities in the world following Beijing, Guangzhou, Tokyo, and Los Angeles.

[Picture2] Air pollution level in 2014 (based on NO_2 concentration)



Korea has continuously strengthened the management of gas emission from automobiles and workplaces. In particular, it pushed forward to the 1st Air Improvement Measure in Metropolitan Area (2005~2014) for the last decade. As a result, the micro dust level has significantly improved from the past 10 years. For example, $\text{PM}_{10}^{3)}$ of Seoul stood at $76\mu\text{g}/\text{m}^3$ in 2002. However, in 2014 when the 1st Air Improvement Measure in Metropolitan Area ended, it improved by 40% to reach $46\mu\text{g}/\text{m}^3$. With a low of $41\mu\text{g}/\text{m}^3$ in 2012, the level has been back and forth by recording around $45\sim 46\mu\text{g}/\text{m}^3$ from 2013.

Korea has managed the concentration of PM-2.5 from 2015 by adding the related criteria to the atmospheric environment standard. The level of PM-2.5 reached $26\mu\text{g}/\text{m}^3$ nationwide and $23\mu\text{g}/\text{m}^3$ in Seoul alone, which are more than double the WHO standard ($10\mu\text{g}/\text{m}^3$).

Furthermore, fine particle pollution has become so exacerbated that Korean citizens have sensed its seriousness. Recently, the frequency of yellow dust in Seoul has increased from 1 time per 1 day in 2012 to 8 times per 15 days in 2015, reducing visibility and increasing the inconvenience to public's senses. Not only the inconveniences, does the fine dust also pose a health threat. Fine particles are micro-

3)Particulate Matter smaller than $10\ \mu\text{m}$

sized, so they cannot be filtered through nose, mouth, and bronchial tubes and infiltrate to internal organs of our body. As a result, they cause allergic rhinitis, bronchitis, asthma, etc. and increase the rate of premature mortality. In this regard, the International Agency for Research on Cancer (IARC) newly designated the fine dust as a group 1 carcinogen in 2013 while the World Health Organization (WHO) announced that the premature deaths from fine dust reached 7 million in 2014. As such, public concerns and attention to the fine dust have escalated. According to the survey on 3,317 adults conducted by the Korean Medical Association (KMA) in May 2016, the Korean people recognized the fine dust as the most terrified risk in public health than other factors such as smoking and cerebrovascular diseases.

2. 3. Comprehensive Measures to Improve Atmospheric Environment

The MoE, which is in charge of atmospheric environment, has made efforts to improve air quality in the Metropolitan area. For example, it established the 1st Basic Plan on Atmospheric Environment Management in the Metropolitan Area in 2005, in accordance with the Special Act on the Improvement of Air Quality in Seoul Metropolitan Area legislated on Dec. 31st, 2003. Also, from 2015, the MoE has implemented the 2nd Basic Plan with a target year of 2024.

However, it has been raised publicly that there are limitations in the MoE-centered measures. Therefore, in June 2016, the related Ministries including the Ministry of Strategy and Finance (MOSF), the Ministry of Trade, Industry and Energy (MOTIE), and the Ministry of Land, Infrastructure and Transport (MOLIT) actively participated in jointly establishing ‘Special Measures on Fine Dust Management.’ With a growing public demand on improving air quality, the ‘Comprehensive Measures on Fine Dust Management’ was established in Sep. 2017 (as seen in Picture 3) by making up for the weaknesses of the previous measures, and shifting to a new paradigm.

[Picture3] Paradigm shift in fine dust management

(Category)	(Past paradigm)	(New paradigm)
Target areas	Metropolitan area and large cities	Severely hit area in the nation
Mgmt. methods	Focusing on individual pollutants	Promoting integrated management
Int'l cooperation	Cooperation in research	Practical cooperation for pollution reduction
Key policy	Focusing on general air pollutants	Focusing on reducing hazards to human health
Base for Response	Individual, decentralized research	Structural, integrated research

Looking into details of the abovementioned Comprehensive Measures on Fine Dust Management, the Korean government plans to achieve 30% reduction in domestic pollutants emission by 2022, while reducing the PM-2.5 level in Seoul to $18\mu\text{g}/\text{m}^3$. As for domestic emission reduction, it divides the categories into power generation, industry, transport, and living sectors and establishes the strategy to achieve the reduction goal by intensively reducing large sources of emission. As seen in Table 2 in the power generation sector, Korea plans to reduce the importance of coal-fired power generation by reconsidering the construction of a coal power plant with a lower processing rate. Also, the share of renewable energy will be increased up to 20% of the total electric power supply by 2030. As for the industrial sector, the target regions for emission credit will be expanded from metropolitan areas to major industrial areas nationwide. In the transport sector, old and worn diesel vehicles will be gradually forced out while in the living sector, the number of street sweepers to be provided will be increased.

[Table2]Key measures to reduce domestic emissions

Power generation	<ul style="list-style-type: none"> → reducing the weight of coal power generation (reconsidering the construction of coal power plant with low processing rate, and so forth) → expanding the share of renewable energy (up to 20% by 2030) → considering adjustment of tax rate for electricity-generating energy (LNG, soft call)
Industry	<ul style="list-style-type: none"> → expanding target regions and sources for emission credit system → strengthening emission standard and imposing NO_x tax → monitoring workplaces and supporting funds for SMEs in improvement efforts
Transport	<ul style="list-style-type: none"> → Forcing out old diesel vehicles gradually (expanding target of early escaping, limiting driving such cars, etc.) → Expanding provision of environmentally friendly vehicles such as LPG and electric vehicle → Strengthening management of vessels (elevating the standard on sulfur content of fuel) and construction machinery (making 31,000 low-pollution units)
Living sector	<ul style="list-style-type: none"> → Doubling the number of street sweepers (2016: 1,008, 2022: 2,100 units) → Strengthening management of dust scattering in construction site (monitoring and guiding) → Strengthening support measures to prevent illegal incineration in farming areas (supporting crushing agricultural residues, and so on)

In addition, the Korean government has strengthened international cooperation while promoting policies to protect pollution-sensitive groups by establishing the standard on indoor facilities for children. The government has also exerted efforts toward reinforcing measuring, forecasting, and alerting systems by using environmental satellites.

2. 4. Progressing Systems

The MoE is the control tower of the atmospheric environment management. The MoE establishes and amends concerned laws, manages budgets, and consults with related departments. Its affiliate agency, the “Seoul Metropolitan Atmospheric Environmental Agency (SMAEA),” formulates the basic plan to manage and evaluate work performance. And, it also receives technical supports from the National Institute of Environmental Research (NIER) and the Korea Environment Corporation (KECO), which have high levels of professionalism in the atmospheric environment.

In order to achieve the atmospheric environment management goals, the Basic Plan calculates the environmental capacity by regions and then allocates the allowable total amount of emission by each respective region. Accordingly, each city and province (municipality) devises investment plans for reducing emissions, and establishes specific implementation plans for realizing the basic plans to promote reduction projects and to enforce regulations on risk factors.

3. Audit Case Study for Improvement of the Atmospheric Environment

Since auditing on the status of “Diesel Emission Reduction Project for Diesel Vehicles” in 2007, the BAI has not been able to conduct audits on the atmospheric environment improvement, whereas the BAI focused on auditing major issues such as forest conservation (2013), improvement of river water quality (2013), and hazardous chemical management (2014).

However, taking the opportunity of the completion of the 1st Basic Plan for Seoul Metropolitan Atmospheric Environment Management (hereinafter referred to as the “1st Basic Plan”) in October 2015, and the start of the 2nd Basic Plan for Seoul Metropolitan Atmospheric Environment Management (hereinafter referred to as “the 2nd Basic Plan”), the BAI conducted an atmospheric environmental audit entitled “Atmospheric Environmental Improvement Project in Seoul Metropolitan Area.”

3. 1. Audit Background and Purpose

In accordance with the 1st Basic Plan, the MoE promoted the improvement of the atmospheric environment in the Seoul metropolitan area as one of the large-scale projects. After ten-year implementation of the 1st Basic Plan, however, the progress of the project in 2014 did not achieve its planned goals that the actual concentration of PM-10 and NO₂ fell behind the targeted concentration. Although there was no proper evaluation for the 1st basic after its completion, the 2nd Basic Plan reflected similar projects just like the previous ones. It was noted by the BAI that there might be a possibility of encountering problems in formulating policies. Thus, it was necessary to check the appropriateness of the new policy directions by evaluating the project performance of the 1st Basic Plan. In addition, people were experiencing pollution from fine dust directly and indirectly, and the demand for improvement of the atmospheric environment was increasing day by day.

To this end, the BAI considered that it was the right time to inspect atmospheric environment areas even though there were risk factors of audit failure, such as a lack of expertise in the atmospheric environment and difficulties in proving scientific causalities. Therefore, the BAI conducted an audit on the 2nd Basic Plan, which was established and carried out by the Korean government during 2015, and made recommendations to contribute to the improvement of the atmospheric environment of the Seoul metropolitan area.

3. 2. Audit Focus and Target

This audit focuses on examining the appropriateness of the Basic Plans and individual projects, promoted by the MoE to improve the atmospheric environment. For the systematic audit, the BAI divided the audit into three sectors as shown in [Table 3] and the three sectors set two specific focuses, thus having a total of 6 specific focuses.

[Table3]Detailed focuses on the audit by sector

Establishment of Basic Plan for Metropolitan Atmospheric Environment Management	(1) Is the formulation of the Basic Plan and the implementation performance appropriate? (2) Is the establishment of countermeasures to reduce air pollution in the metropolitan area appropriate?
Management on Air Pollutant Sources	(1) Has the management on air pollutant sources been carried out properly? (2) Are other air pollutant sources, such as business sites and so on, managed properly?
Forecast and Air Quality Management	(3) Have the management systems for the forecasting and cautionary operation been done properly to prevent any damages from air pollution? (4) Are the operation and the management of the monitoring networks appropriate to secure a basis for the air quality measurement and forecasting?

Finally, the BAI audited the MoE and the SMAEA (the organizations responsible for establishing the Basic Plan and performance evaluation), the metropolitan local authority in charge of air pollutant source management, the Korea Automobile Environmental Association (AEA), KECO and NIER, which is responsible for managing air quality and forecast.

3. 3. Audit Methodologies

Prior to the audit, the BAI gathered and analyzed related materials such as media reports and discussions of the National Assembly on the environmental management measures in the metropolitan area.

However, since the process of establishing the Basic Plan requires professional expertise and has complex relations with many stakeholders by its nature, such as figuring out the actual state of emission sources and its emission amount, and estimating the target emissions by using forecast modeling, it was necessary to secure

professionalism and objectivity. For this reason, the BAI collected advice and opinions from the Korean Society for Atmospheric Environment, Car Safety Research Center of Korea Transportation Safety Authorities, etc., on any problems regarding the establishment of the Basic Plans and their processes. The audit was conducted with 23 auditors, including one expert in the field of automobile inspection and two experts in forecast modeling.

In order to identify problems by sector and recommend ways to improve, audits were conducted in the following ways.

First, in order to secure professionalism and objectivity of the audit results, the BAI conducted an evaluation on the performance of the 1st Basic Plan, an error analysis of the air pollution automatic recording data, and case studies of advanced foreign policies. Moreover, the BAI conducted research services through KAST (Korean Academy of Science and Technology) to review the recommendations for the 2nd Basic Plan, and was advised on the overall audit process by operating a specialist advisory group composed of professors of air environment management, such as forecast modeling and atmospheric environment policies.

Second, in order to identify the problems in the projects for attaching the Diesel Particulate Filter (DPF), which is one of the major reduction measures against mobile pollution sources, the BAI detected suspicious cases by comparing the data between the Vehicle Inspection Management System (VIMS) in the MOLIT and the system called “the Ministry of Environment Car (MECAR)” in the MoE so as to identify cases of duplicate executions of subsidies and illegal removal of DPFs. Then, the BAI conducted on-site inspections.

Third, in order to check the management status of other pollutant emission sources such as business sites, the BAI conducted on-site inspections of air pollutant emission facilities at 438 sites in the metropolitan areas and 98 cars with DPF during the audit period, in cooperation with local governments and the MoE. This inspection revealed 41 violations.

Fourth, in order to draw up a reasonable improvement plan, the auditors communicated closely with the relevant organizations, such as holding meetings with the auditees once every week under the supervision of the Director General, for this audit.

3. 4. Audit Results

As a result of conducting the audit, 4 cases were found inappropriate in the sector of “Establishment of Basic Plan for Metropolitan Atmospheric Environment Management”, 11 cases in the “Management on Air Pollutant Sources”, and 3 cases in the “Forecast and Air Quality Management”. In total of 18 illegal and irregular activities and problems to be revised were found. Main audit results by sector are as follows.

3. 4. 1. Audit Results on “Establishment of Basic Plan for Metropolitan Atmospheric Environment Management”

Taking note of not having management measures for pollutants outside the Seoul metropolitan area, the BAI notified the MoE to prepare measures to make up for inadequacies of the 2nd Basic Plan, such as the Chungnam thermal power plant, which has up to 28% effect on the concentration of PM-2.5 in the metropolitan area and so forth.

In addition, even though the results of the emission reduction fell behind according to the 1st Basic Plan, the reduction was over-estimated to be up to 87.4% p due to calculation errors. Likewise, the evaluation of the performance was revealed as as being inaccurate. The BAI recommended the MoE to pay closer attention to accuracy so that the over-estimation on the performance should not happen again.

3. 4. 2. Audit Results on “Management on Air Pollutant Sources”

In relation to the mobile pollution sources, the MECAR (designed to manage low emission projects of vehicles) contained multiple errors in data input and system management, thus not being properly used. There were additional problems in that the subsidies of low emission projects for vehicles were calculated and granted as the maximum of 112% of its allowance without excluding self-burden charges. Therefore, the BAI recommended the MoE to periodically check the input data of the MECAR and to improve the errors in information. In the mean time, the BAI advised the MoE to prepare a plan to reasonably adjust the subsidy payment standards when the subsidies were spent on the DPF attachment projects or on relevant projects, such as the exemption of self-burden charges.

In terms of the pollution sources in the business sites, the BAI recommended Incheon Metropolitan City to pay attention to manage and supervise the selection of exemplary business sites where regular inspection is exempted. There were detected cases that good business sites were wrongly selected or were self-measured for the selection.

3. 4. 3. Audit Results on “Forecast and Air Quality Management”

The accuracy of the air quality measurement was deteriorated due to the lack of accuracy in 35 out of 65 sites, which is 54% of PM-2.5 measurement sites installed across the metropolitan area. The data analysis function of the air quality integrated management system was insufficient to operate the air pollution forecasting, but the system was operated nevertheless. The BAI notified the NIER to devise necessary measures to improve the accuracy of measurement networks and the information of the management system.

3.5. Implementation of Audit Follow-up Measures

The BAI conducted an audit on the “Atmospheric Environmental Improvement Project in the Seoul Metropolitan Area” from November 26 to December 13, 2015, for 20 days.

Followed by the internal review process and the decision of the Audit Committee (April 2015), the results were officially announced in May, 2016. Since then, the BAI has continuously monitored the status of fine dust generation and whether the audit results were reflected or not.

Soon after the audit results were released, the Korean government announced special measures for reducing fine dust in June, 2016. The 2nd Basic Plan, established in December 2013, was revised and re-notified in three years by reflecting the BAI's audit recommendations.

However, according to the survey results conducted by the Korean Center for Social Conflict Resolutions in March, 2017, 95.6% of the total respondents perceived fine dust to still be a serious issue. 91.5% of the respondents stated that they were not satisfied with fine dust management policies. Likewise, the negative perception on the fine dust remains the same.

Accordingly, the BAI will include "Audit on the Air Quality Improvement Projects" in the 2018 annual audit plan and will conduct the audit in the second half of 2018.

4. Conclusion

This paper elaborated on the atmospheric environmental policies of the Korean government and the corresponding audit case by the BAI.

The world has been facing the inevitable task of sustainable development due to the development in science and technology, an increase in population, and the environmental damages caused by industrialization. In recent days, there has been great interest from the public in environmental issues, as they directly affect the public's health and serenity. In this circumstance, the functions and roles of the BAI are becoming more important in enhancing the quality of citizens' lives and securing their health and safety.

However, as described above, the environmental factors surrounding the public consist of wide and diverse characteristics, such as atmospheric environment, soil, water, ocean, hazardous materials, resource circulation, etc.

Therefore, in order to perform SAI's duties properly in the environmental field, the SAI should set clear targets and conduct audits systematically and actively by setting up roadmaps. It is also necessary to monitor the governmental policies and provide them with feedback. In doing so, the SAI's sustainable monitoring function will enable promotion of the sustainable development of the nation.