Experience of Yokkaichi City: Forerunner of air quality management in Japan

Noriko Kono

Institute for Global Environmental Strategies

1. Introduction

This paper presents on the experience of Mie Prefecture and Yokkaichi City titled; Experience of Yokkaichi city: Forerunner of air quality management in Japan. The experience of Yokkaichi city is one of the four biggest environmental pollutions in Japan along as two Minamatas and Itai-itai disease, and has been known the name not only domestically but internationally. Here the paper will explain its chronological outline and socio-economic background in 1960s, its urban environmental management capacity, its adaptability to developing country in Asia-Pacific.

This presentation consists of five sections: Outline of the Yokkaichi /City's Air Pollution Experience, Analysis of the City's environmental management capacity, Comparison with the successor cities in Japan, Adaptability to Asian developing countries, and Conclusion.

2. City's Air Pollution Experience

First outline of the Yokkaichi will be explained. Japan is using prefecture system and there are 47 prefectures in Japan and Yokkaichi is situated in Mie prefecture, close to Osaka and the city is in the north of Mie Pref. During the WWII, city's Shiohama area was put a large navy's fuel storehouse. After the war, the area was operating as the heavy chemical industrial site. In 1955, then cabinet decided to put a large industrial complex in further developmental stage. In 1959, the largest industrial complex in Asia had appeared in the site. At that time, while most other Japanese area was using coal, In Yokkaichi, oil fuel from Middle-East Asia was used in 95 % of the site. That oil consisted of a lot of sulfur. The rapidest shift of energy source in Japan ironically caused the tragedy of Yokkaichi.

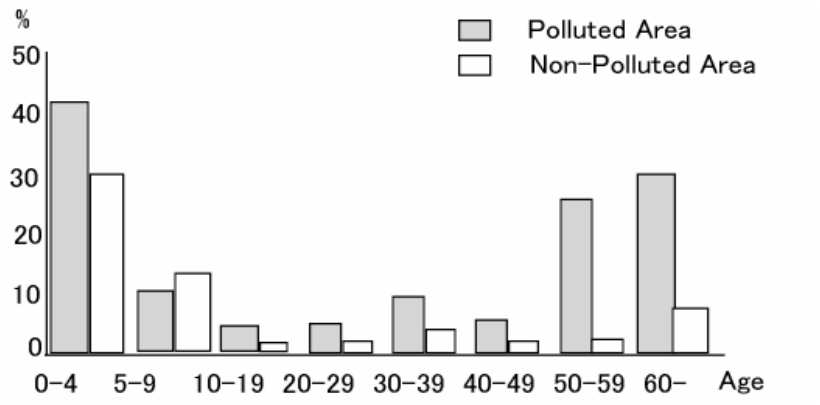
Fig. 1 Yokkaichi City's petrochemical complex in 1950s.

Obviously, the air pollutants exist in the black smoke in the picture and it contains not only smoke and soot, but also sulfur dioxide.

Source: ICETT

Around the late 1950s, people started to suffer bronchial diseases, especially conspicuous in elder citizens. The diagram shows the incidence rate in age bracket. Polluted area is showing the whole city of Yokkaichi area while the non-polluted area shows the Tsu City, Mie-prefecture's capital.
Medially speaking, asthma is not occurred in older people and rather an infancy disease, however, the area where the largest industrial complex was put suffered from outburst of new asthmatic patients year by year, and local academia began to doubt something from the smokestacks affects their health.

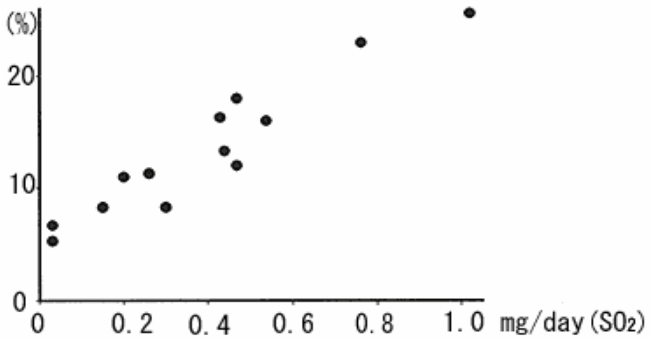
Fig. 2 Bronchial Asthma by Age Bracket in Yokkaichi (1960)



Source: Labor Science Volume 28 Number 1

In 1960, local university professor announced the correlation between sulfur dioxide emission and asthma patients, especially in the old. The diagram shows the annual patients of asthma in age over 50s.

Fig. 3 Relation between SO2 and the annual patients of asthma (age group over 50) in FY1963



Source: Labor Science Volume 28 Number 1

To combat the air pollution, K-value method or K-value control was used. It represents a regulatory

model incorporating sulfur oxide emission standards into the Air Pollution Control Law. Determined by effective chimney height (He), it tolerates the limits of pollution per hour among facilities generating smoke and dust and they are calculated based on the formula.

Fig. 4 K-Value Method Formula

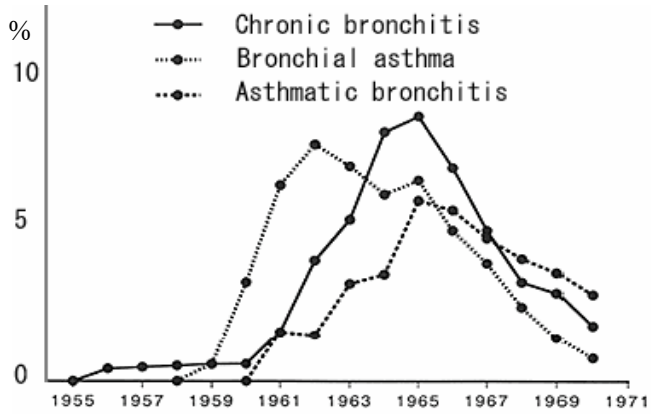
$$Q = K \times 10^{-3} \times He^2$$

Q: Amount of sulfur dioxide (Nm^3/hour)
K: Constant stipulated in the Air Control Pollution Control Law
He: Effective smokestack Height (m)

Because the K varies from area to area, emission standard levels also vary accordingly. In determining "He," modification factors based on the rising momentum of exhaust gas and temperature differences with the air calculated and added to the actual height of chimney.

This K-Value control, then common method of dealing with air pollution, was countered the outbreak of new patients. The graph shows the newly found patients with three typical diseases in the area: chronic bronchitis, bronchial asthma, and asthmatic bronchitis. We can see the peak of bronchial asthma in 1961, chronic bronchitis and asthmatic bronchitis in 1965. They decreased to fewer than 5 % in the late 1960s.

Fig. 5 Variation in the concentration of sulfur dioxide after smokestacks became higher (Isozu area)

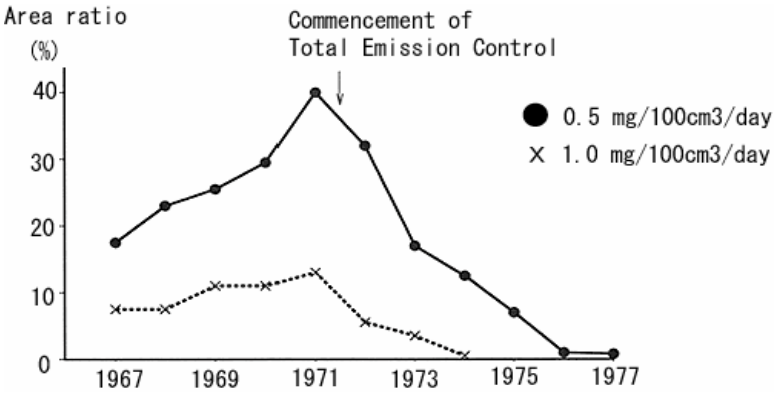


Source: Labor Science Volume 28 Number 1

The method was effective in mid-sized or small industrial areas when the flue gas desulfurization process was not yet gained. However, in Yokkaichi, where a large number of facilities emitting smoke and soot, the high chimney diffusion approach was criticized that it did not reduce total pollutant load. Eventually, K-value method increased the area of SO2 polluted area.

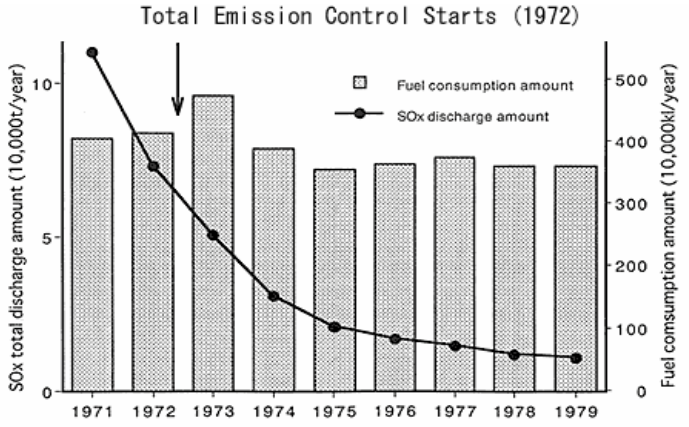
Total emission control includes air diffusion simulation modeling and exhaust gas desulfurizer at each factory and the introduction of this system finally solved the problem. The figure below shows the ratio of the area affected by sulfur dioxide in the city. The bar shows the amount of fuel consumed and the line shows the total SO_2 consumed. After the method introduced in 1965, the polluted area continued to increase until in 1971, when the total emission control was introduced. The total emission control included air diffusion simulation and exhaust gas desulfurizer at the factories

Fig. 6 The transition of area affected by sulfur dioxide emission in the City of Yokkaichi (1967-1977)



Source: Labor Science Volume 28 Number 1

Fig. 7 SOx emission total and Fuel consumption (1971-1979)



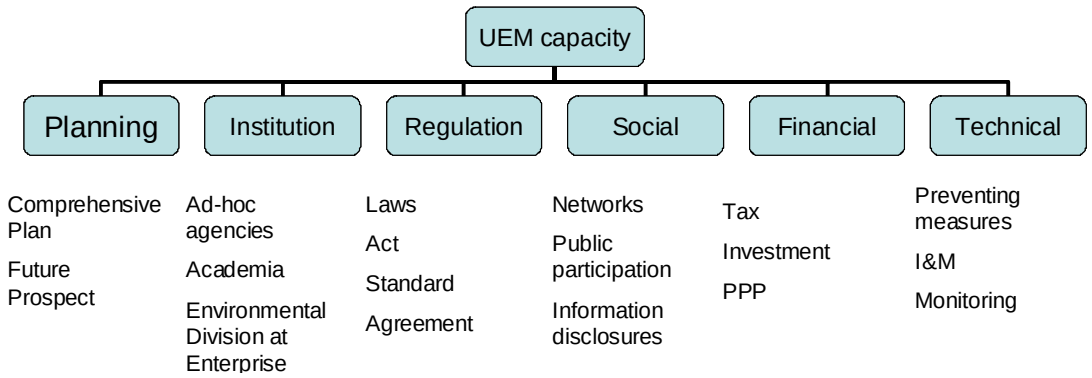
Source: Labor Science Volume 28 Number 1

3. Urban Environmental management Capacity of the City

IGES is creating the urban environmental management (UEM) capacity assessment system and capacity development program for developing countries of the Asia Pacific region. The diagram is

the framework made by team members and here the analysis will be done with this framework. The figure will show the framework of the analysis. There are six components: Planning, Regulatory, Institutional, Social, Financial, and Technical. Here the latter five will be in the focus.

Fig. 8 IGES' s Urban Environmental Management Capacity Components



Source: Created by author from Memon, Imura & Hitsumoto (2003)

Regulatory capacity was very poor in Japan as a country at that time. The city started to suffer when there were no laws on environmental pollution prevention in Japan, along with other big cities such as Osaka and Yokohama. In 1962, Smoke and Soot Act was enacted by the national government and in 1964, Yokkaichi was designated as the "designated area" of this law. In 1965, Yokkaichi Ordinance was enacted and medical expenses needed for the patients were covered by the city. This was an innovative ordinance in Japan. In 1972, the polluting enterprises lost the lawsuits occurred from 1960 and it recognized the legal responsibility of the polluters.

Social capacity includes public participation, informal networks or norms, customs and habits, those common senses which are not written. In Yokkaichi, some local academia was interested in the local air pollution problems. Especially epidemiological study by Professor Yoshida at Mie University meant importance to the further movement. Then the mass-media and citizens began to realize the co-relation of the asthma and SO_2 emissions.

Institutional Capacity includes governmental organizations or agencies which deal with the problems, academic institutions, private sector's environmental divisions. As for this capacity, the Kurokawa investigation Group organized by Ministry of International Trade and Industry & Ministry of Health and Welfare is significant. It advised not only the mere betterment of condition in environment, but also the drastic innovation of Urban Environmental Management in the area such as urban redevelopment, healthcare system, labor problem, and financial mechanisms. Moreover, Mie Prefecture's Environmental Bureau was founded for dealing with environmental pollution.

Financial Capacity includes the mechanism involving money for the environment. In 1965, Yokkaichi ordinance medical expenses borne by the city should be noticed. Also, in 1970 Remedial

act applied at city and succeeding in 1972, compensating by polluters applied at city

In fact, in 1973 National government enacted Japanese Pollution-Related Health Damage Compensation Law modeling the Yokkaichi Ordinance, forerunner of the compensation system.

4. Comparison with the successor cities in Japan

Everything was a first experience for Japan, so the drastic measure is only taken in 1972, more than 10 years after the major complaints. National government followed the experience. In 1970, Yokkaichi applied remedial ordinance and in 1973 national government applied the similar thing. In 1972 Yokkaichi adapted total emission control and in 1974 national government made the similar law. Yokkaichi had to suffer a longer time than other cities because of poor Japanese UEM capacity at that time.

Secondly, compared to the other pollution from water, such as Minamata or Itai-itai disease, bronchitis was a traditional disease and hard to prove the epidemiological cause and effect. Therefore, it took longer time to come to use the drastic measure than the other cases.

5. Adaptability to Asian Developing Countries

Here we seek the adaptability to Asian developing countries from the environmental capacity assessment system we saw in the previous section. There are mainly two important lessons from the City.

First, Kurokawa Investigation Group at the institutional capacity is important since it shows the prototype as assessment system. First environmental assessment law dates back in 1966 by the US House of representative so the Kurokawa's attempt was exceptionally visionary. Nowadays there are already many developing countries that have executed the environmental assessment laws in Asia-Pacific, modeling those of developed countries. However, sometimes these laws are becoming rather routine and not appreciated fully from its raison-d'être. The struggle of Yokkaichi gives occasion for those countries to pause to realize the importance of holistic approach of environmental assessment.

Secondly, academia cooperation shown at the social capacity is also important. Local university was interested in the local environmental problems and results were shown to the public. This helped the local consensus in Yokkaichi case. Developing countries should use this lesson. At Surabaya, Universities such as ITS, State University of Surabaya and University of Airlangga, are eager to tackle local environmental problems. Seemingly this is helping the city's ongoing air quality control program by local government.

6. Conclusion:

The Experience of Yokkaichi can be described as the incunabula of Japanese Environmental Pollution Management. The struggle of the city was one of the hardest in then economy-prioritized

society and compared to other cities, the city took longer time to get to the drastic countermeasure. Despite numerous disadvantages, some experiences are still important as lessons for developing countries. Cooperation by academia and information disclosure is a practical lesson for other suffering cities. The prototype of environmental assessment should be fully introduced to developing countries as the underlying principle of environmental assessment law.

Bibliography:

1. ICETT. 1994. The History of Pollution and Environmental Restoration in Yokkaichi –For the sake of Global Environment--.
2. Committee on Japan's Experience in the Battle against Air Pollution. 1997.Japan's Experience in the Battle against Air Pollution.
3. Mushtaq Armed Memon, Hidefumi Imura, and Reiji Hitsumoto. 2003. Urban Environmental Management: Local Capacity Building though International Cooperation. Japan Society for Civil Engineers
4. Mie Prefecture homepage: http://www.eco.pref.mie.jp/english/
5. ICETT homepage: http://www.icett.or.jp/