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ENVIRONMENTAL ISSUES AND ENVIRONMENTAL IMPACT ASSESSMENT IN HIGH GROWTH REGIONS
—— The Situation and Practice in Guangdong Province of China and Southeast Asia Region

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Abstract The history and current situation of environmental issues in rapid economic growth regions are stated, with emphasis on Guangdong Province of China and some Southeast Asia countries and regions. The methods and processes of environmental impact assessment (EIA) employed in these countries and regions are introduced. The experience of EIA studies conducted by the Institute of Environmental Science, Zhongshan University are presented on the basis of over 10 years work and research in the EIA field. Problems in EIA theory and current practice are also discussed.

Keywords environmental impact assessment, economic growth and environmental issues, Guangdong, Southeast Asia Region

1 Environmentnal Problems behind the High Growth of Economy

1.1 The economic growth and environmental problems in Guangdong province

Guangdong, the southern province in China, has experienced rapid growth in its econmomy since the reform and opening up policy was launched. From 1978 to 1993, the average GDP growth rate of the province was 13% . It hit a record of 18.24% from 1990 to 1993. Many companies from foreign countries and Hong Kong, Macao and Taiwan invested much capital in building up their manufacture plants. In 1993, the number of foreign capital enterprises accounted for 19.25% of the total number of enterprises in the province, and the output value accounted for 33.21% . Of these enterprises, most are labour-intensive type industries. Some of them, such as textile dyeing, electroplating, chemical engineering, food processing, heavy oil power plant and toy making, may cause heavy pollution. Although these industries have been restricted or even prohibited by laws in the original countries or regions of the investors, they are still accepted in

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Guangdong. During the same period of time, the township enterprises also mushroomed in the province. Most of them are manufacturing plants of cement, ceramics, metal materials, paper, food and household electrical appliances. In the meantime, large and regional central cities of the province focused on the development of basic and heavy chemical industries, including transportation, energy and power, raw materials, electronics, automobiles, petrochemistry, metal materials and shipbuilding, so as to support the rapid growth of the manufacturing industries.

The high speed development of industries and urbanisation have caused serious environmental problems in Guangdong. In 1994, the quantity of industrial wastewater discharged into public waters was $1.315\times 10^9 m^3$, of which less than 50% was treated. The quantity of domestic wastewater amounted to $2.057\times 10^9 m^3$, with more than 90% untreated. This has resulted in serious water pollution in rivers and estuaries near the cities. The water in some reaches of the polluted rivers has appeared black colour and emitted offensive odour. Because of this, the so called "quality-restricted water shortage" has happened in some cities.

Air pollution is also in critical situation in Guangdong. The industrial exhaust air amounts to $6.5\times 10^{11} m^3/a$. Sulphur dioxide emitted amounts to 581.4kt/a, while only an amount of 113.3 kt is removed. The emission of sulphur dioxide has caused serious acid rain problems in some areas of the province: the frequency of acid rain is 50%; it is estimated that acid rain incurs an economic lose of more than 2×10^9 yuan a year. Rapidly increased automobiles exhaust large amount of nitrogen oxides, carbon monoxide and hydrocarbon. In large cities such as Gauangzhou and Shenzhen, the nitrogen oxides contents have exceeded the environmental standard for the second class air quality.

There are also noise pollution problems in the urban areas. According to statistics, noise pollution accounts for most of the complaints by the residents. Solid waste is another increasingly serious problem. At present, most cities are using simple landfill to treat solid waste. This have caused sanitary problems and surface water pollution in areas near the sites.

1.2 The economic growth and environmental problems in Hong Kong, Taiwan and Southeast Asia countries

Hong Kong, Taiwan and Singapore have enjoyed a high growth period since the middle of 1960s with a GDP growth rate between 8% and 13%. The average growth rates in 1970s and 1980s were 9.2% and 8.7%, respectively. They still maintained a high growth of 6.3% in 1991.

The economic boom in Thailand, Malaysia, Indonesia and the Philippines brought an average growth rate of 7.9% in 1970s. It maintained at the level of 5.4% in 1980s. In 1991, it was 6.5%.

The old economic structures in these regions were single-product economy. In 1952, agriculture accounted for 35.7% of Taiwan's economy, while industry merely 17.9%. The economy of Singapore and Hong Kong was concentrated on entrepot trade. Singapore's manufacturing industries only had a share of 9.1% in the country's GDP in 1960.

The proportion of exported goods value of entrepot trade to the Hong Kong-made products was 7: 3 in early 1950s. During the recent 20 years, they first developed their light and textile industries and changed the economic structure. On the basis, they built up their heavy and chemical industries as well as energy and power industries, together with port, financial business and service trade. New industries, such as electronic engineering and computer, were also developed quickly. At present, their industries are experiencing transition from a labour-intensive type to a technology-intensive one.

However, the environment in these areas has had a period of serious pollution or is still in critical situation. In Taiwan, 42.3% of its 21 first rank rivers and 24 second rank rivers have medium or heavy degree pollution, 57.7% of them have slight or light degree pollution. Few of the rivers are suitable for drinking water sources. Of the 37 reservoirs on the island, 85% are polluted in varying degrees.

The coastal waters of Hong Kong are undergoing heavy organic pollution. Up to 50% of the quantity of wastewater discharged from the region is untreated at present. 40% of it is treated with primary treatment processes. And merely 10% of it meets the requirements of effluent standards. This has caused the marine biological pollution in the waters and high contents of heavy metals in the marine sediments.

Serious water pollution also occurred in Singapore during the period of rapid industrialisation and urbanisation of the country. In order to change the situation, a comprehensive plan for river pollution control and management was launched and carried out from 1977 to 1987. The river quality was recovered after 10 years of hard work.

The air quality in Taiwan still gives no grounds for optimism. More than 10 million motor vehicles are running on the crowded roads of the cities and exhausting large amount of carbon monoxide, hydrocarbon and nitrogen oxides, while the industrial areas are emitting large amount of suspended particles and dust. According to the data observed by Taiwan's air quality monitoring stations, 80% of the cities have medium degree air pollution and 15% have heavy pollution.

In Bangkok, Thailand and Manila, the Philippines, the contents of sulphur dioxide and suspended particles in the atmosphere are 10 times higher than those in the American and Canadian cities. The air-born lead pollution in Bangkok has resulted in high lead concentration in the blood of its residents: it is 4 times of that in the blood of the American urban residents.

Solid waste is another big environmental issue. In Taiwan, the annual amount of solid waste has hit 30 million tons. At present, most of it is treated with landfill. Two third of the villages, towns and cities are faced with the problem of waste treatment: there are few places for landfill sites. In Hong Kong, the daily amount of solid waste is 15 kt. Most of it is treated with landfill, while a small part (9%) is incinerated. Like Taiwan, Hong Kong is also faced with the problem of solid waste treatment.

2 Environmental Impact Assessment(EIA) in Hong Kong and Thailand

2.1 The EIA process in Hong Kong

The EIA process for a major development project focuses on siting, construction and operational phases. The need for, and scope of, the process is determined by an initial review. Formal government administrative procedures apply to public work projects, and provide for an environmental review (ER) by the Environmental Protection Department (EPD). The ER will result in the project falling into one of the following categories of potential environmental impact: (1) minor or negligible impacts (no need for special attention to environmental matters); (2) limited impacts (normally addressed in project development through standard technical measures); (3) significant impacts; or (4) serious and complex impacts.

If a project falls into either of the last two categories, formal EIA procedures are invoked. If the preliminary design is not available, an environmental planning assessment study is undertaken. If the preliminary design concept is available, either an environmental assessment (EA) study (for projects with impacts of limited scope or complexity) or a full EIA study (for the study of serious or complex impacts) will be required. The procedures vary to meet the demands of each type of assessment.

These types of studies are usually conducted in two stages. The initial evaluation identifies key issues which are then subject to detailed, quantitative evaluation. The detailed study is typically based on preliminary design concepts for the development. Study outputs normally include mitigation methods to render the environmental impacts acceptable. These methods may include: process design modification; environmetnal protection and pollution control equipment or systems; and particular specifications and special conditions of contract.

2.2 The EIA process in Thailand

The EIA system in Thailand is established for reducing the adverse influence or damage of a development project on the environment. It requires that the environmental impacts should be considered at the initial, construction and operational stages, and regular monitoring should be conducted after the completion of the project. For those projects which an EIA study is required, a project application, associated with an EIA report, must be submitted to the National Environment Committee Office in the preparatory stage to obtain the permit for starting the next stage of the project of activities. The report is required to study the adverse influence on the environmental quality and to propose measures for its prevention and remedy.

The laws authorise the officials of the National Environment Committee Office to examine the EIA reports and to issue the project permits. If the project application is approved by the Office, a permit is issued. Otherwise, it is postponed until the applicant submits a proposal to the Office with measures for the prevention and remedy of the environmental impacts.

The National Environment Committee has the right to authorise experts to conduct an EIA study, and propose measures for the prevention and remedy of the adverse influence and submit a study report.

3 The Substance of EIA

The Environmental Protection Law of China stipulates that attention must be given to the prevention of environmental pollution and damage when siting, design, construction and production are carried out for an enterprise or institution. A proposed project of new construction, upgrade or expansion must be associated with an EIA report. Only after the EIA report is approved, can the design of the project start. Following the above stipulation, the planning, economic and environmental management departments of the country have made EIA an important part of the feasibility study for all development and construction projects.

In line with the requirements of the related laws and ordinances, EIA studies have been conducted in Guangdong Province mainly for individual construction projects and regional development projects while taking account of the regional characteristics. Since 1980, the Institute of Environmental Science of Zhongshan University has carried out a number of EIA studies which include energy, transportaion, chemical engineering, petroleum, textile and raw material industries, water conservancy facilities, harbours and ports, agriculture and tourism.

An EIA report should include the following substance: (1) project analysis— The name, character, scale, technological process, and the way and quantity of pollutants discharged by the proposed project are stated in this part; (2) investigation of the present situation of the local natural and social environment; (3) investigation and evaluation of the present local environmental quality; (4) analysis of main environmental problems— This is to find out the main environmental pollution problems and determine the focal points for the assessment and the major targets for protection; (5) environmental impact assessment for the project— The impacts of the proposed project on the atmosphere, water, soil, sound and ecosystem are assessed in this part. For some projects, impact assessment of social environment, such as social economy, health, landscape and cultural and historical relics, are also required. Environmental impact assessment is to predict the potential impacts of major pollution factors on the environment, and to check whether the environmental quality meets the requirements of the related standards after the background values are taken into account; (6) environmental cost and benefit analysis; (7) pollution control and protection measures and assessment conclusions— Pollution control and protection measures are suggested after the analysis and evaluation of the major pollution factors and their impacts. The assessment report is concluded in terms of the environmental feasibility of the project.

4 Some Experience of EIA Practice

4.1 Siting and short EIA time requirement of the project

The construction site of a project is often determined by the owner and local government on the basis of the social economic benefit and engineering conditions of the

project, without sufficiently analysing and expounding the environmental impacts. Some projects will cause serious pollution, resulting in the violation of local environmental quality standards. Under these circumstances, it is necessary to consult with the environmental management department, the owner and the design institute to increase site alternatives. The EIA institute then conducts assessment for each alternative respectively, and recommends a best alternative. We employed this method to the EIA study of a 400kt triple superphosphate plant in Yunfu city, a 200kw power plant in Luoding city and a 200kw oil shale power plant in Maoming city, and the results were good.

It is also very often that the owner and local government require the EIA institute to complete the EIA study within a short period of time to push the project starting at early time. This kind of requirement can be met when the project is small, the pollution factors are few and the present environmental quality data of the proposed site are available. However, when the project is large with complex pollution factors and poor environmental quality survey data, it is necessary to conduct detail and systematic field survey and monitoring before the EIA study starts. In this case, it is important to keep contact with the environmental management department. On one hand, the basic work of EIA study is started as soon as possible. On the other hand, in order to make the project application go smoothly, a preliminary EIA report is submitted to the government department concerned, or the environmental management department identifies that the EIA study is in progress.

4.2 Project engineering analysis should be done by an institute having intimate knowledge of the project

Project engineering analysis is an important fundamental part of an EIA study. It provides the following information: Is the technological process adopted in the project an advanced and rational one? Does the project owner provide the correct pollutant items and the discharge quantity? The information is essential for the prediction of pollution level and range caused by the project, and for the suggestion of pollution control countermeasures.

In China, institutes granted with EIA certificates are from various trades. It is difficult for an EIA institute to do project engineering analysis when it is not familiar with the project. For small and simple projects, the problem can solved by analogy and/or by consulting experts. For large projects with complex technological processes, it is necessary to entrust an institute which is familiar with the project for the engineering analysis so as to ensure the quality of the EIA study. So far, we have employed this method to the EIA studies for the Yunfu 400kt triple superphosphate plant, the Leizhou 50kt eucalyptus paper mill, the Nanhai petrochemical project, and the Taiwan Qimei engineering plastic plant whose EIA study is still in progress. The results are satisfied.

4.3 Policy co-ordination in EIA studies for large projects

Large projecs are usually restricted by various conditions even by laws. For example, the Nanhai Petrochemical Complex Project, a joint venture of Shell and China Petrochemical Industry, selected a plant site at the north bank of Daya Bay which is a aquatic

resources protected zone in Guangdong Province. After the plant goes into operation, it is inevitable that considerable quantity of pollutants is discharged to the Bay, which is against the regulations for the aquatic resources protected zone. Because the project will bring large economic and social benefit to the region and the province, the concerned department of the province decided to support the construction of the plant by loosing the restrictions. They agreed to give a discharge zone to the plant if its impact on the aquatic resources in acceptable. In the EIA study, we conducted detail investigation and simulation. A conclusion based on sceientific research was obtained for the pollution level and range of the discharge. With the EIA study results, the Standing Committee of the Guangdong Province People's Congress imposed higher standards for the plant's discharge, and gave a discharge zone which may be better for the Daya Bay's aquatic resources protection.

5 Problems in EIA Practice

5.1 Unripe and imperfect theory and methodology of environmental benefit estimate

Environmental benefit analysis is indispensable to an EIA study. In practice, however, because the index and method of estimate are not determinate, the results of the analysis are lack of convincingness and operability. Usually, it is very difficult to convert the environmental benefit to monetary value in the environmental investment and benefit analysis.

5.2 The indirect pollution of the project

Indirect pollution is a big issue in an EIA study. It is usual that the project itself is environmentally acceptable, while its products may cause pollution.

For example, a chemical plant producing detergents such as washing powder and shampoo may be environmentally acceptable if the pollutants discharged from the production processes are treated. Its products, however, have considerable content of phosphoreted substance which may cause eutrophication problem when it is discharged with domestic wastewater into public water bodies. In developed countries, tough restrictions of using phosphoreted brightening agent have been imposed on these kind of plants to prevent eutrophication. Under the pressure, they abandoned the production lines in their countries and shifted them to China. Their products are superior to the same kind of products made in China. Since China has no restriction on the use of phosphoreted brightening agent, many plants invested by foreign companies started to produce phosphoreted detergents in large quantity. The sales of this kind of products imply water pollution. Indirect pollution resulting from the use of products should be taken into account in EIA studies. To do so, related evaluation standards must be set up.

5.3 Environmental impacts due to the economic promotion effect of the project

The effect of the proposed project to promoting the regional economic development is usually neglected in EIA studies. In some new development areas, this effect is very important. When an EIA study is conducted for such a project, attention should be paid

to the following matters.

(1) The downstream and deep-processing industries brought along with the project

Some basic industries bulit up in a new development area provide many other industries with raw materials. The products of petrochemical industries, for example, are raw materials of chemical fibre, textile, fine chemical as well as mechanical industries. In order to reduce the transport cost and lose, these downstream industries often tend to set up their plants near the raw material supplier. Therefore, when a basic industry project is to set up, the EIA report should consider the potential pollution caused by the future development of its downstream industries.

(2) The increase of basic facilities and population brought along with the project

Setting up a project in a new development area means to employ a certain number of workers, engineers and administrative personnel. For the convenience of these people's life in the area, it is necessary to complete the service facilities for food, entertainment, shopping and housing. The employees of service facilities also result in the population increase. This in turn causes the increase of the basic facilities in terms of the scale and number. The service facilities, such as transportation, telecommunicatin, commerce, school and environmental protection, will eventually reach a level matching the scale of the economic development in the area. Therefore, the increase of population and service facilities should be taken into account in the EIA of an individual project.

5.4 The neglect of review and post audit of EIA

Experience and lessons can be obtained and learnt from the review and post audit of an EIA work done in past. The feedback of review provides information which is useful for the improvement of EIA methods which lead to the improvement of the EIA quality. The following issues should be further discussed for the review and post audit of EIA.

(1) The object of review and post audit

A development area usually have a certain number of projects. Since EIA is carried out for an individual project, it is necessary to know its actual weight of impact on the environment of the whole area after operation and to compare this with that in the EIA report. On one hand, the theory and technique for EIA review and post audit are incomplete at present. More effort should be done in this field. On the other hand, there will be obstruction from the reviewed enterprise if it is a heavy pollution one.

(2) The conclusions of review and post audit

When the review reaches a conclusion that is significantly different from that of the EIA report, it is easy to amend the contents of the report. For the environmental management of the reviewed enterprise, however, this change may raise many issues such as the increase or upgrade or pollutant treatment facilities and the adujstment or change of the technological process.

(3) The cost of review and post audit

The cost for review and post audit is different from that for the project's EIA. The project owner will not pay the whole expense incurred. It can even refuse to pay anything for the review. From the viewpoint of beneficiaries pay principle, it is suggested

that the project owner, the EIA reviewer and the environmental management organisation should share the expense, because each of them will be benefited from the results of review. For the project owner, it has an opportunity to have further understanding of environmental pollution caused by the enterprise, and this will help it to improve the management of production and pollution control. For the EIA reviewer, the feedback from the review is important information for the improvement of EIA work in the future. With the review results, the environmental management organisation can make adjustment to the pollution control policy, so that it has more definite targets for management.

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经济发展迅速地区的环境问题和环境影响评价
—— 以广东省为例兼谈东南亚有关地区

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摘　要　综合论述了广东省与东南亚有关地区的经济高速发展所引起的环境问题，并介绍了一些国家和地区的环境影响评价方法与实施程序. 在此基础上，着重介绍了中山大学环境科学研究所十多年来在广东省从事环境影响评价工作的体会和经验，并就当前环境影响评价的理论和实践中发现的一些存在问题提出了探讨性意见和建议.

关键词　环境影响评价，经济发展与环境问题，广东省，东南亚地区

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