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Sino-British cooperation for urban environmental enhancement and sustainable development

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Abstract—This paper gives an overview of the presentations and discussions at the Sino-British Workshop on Urban Environmental Enhancement and Sustainable Development held in Beijing from September 9—11, 1998. It summarises the contributions from both the Chinese and British sides to the four major themes of urban sustainability: integrated environmental assessment, water pollution and management, urban transportation and its impacts on air quality, and environmental technology. It also identifies many areas of common interest for further collaboration.

Keywords: urban sustainability, environmental enhancement, environmental management, sustainable development.

1 Introduction

It has been argued that China has pressed against or exceeded the limits of sustainable development on many occasions over the past 3000 years with serious consequences for the environment (Elvin, 1993). Hence China's current environmental problems are not a new constraint to development. What is new, however, is the rapid rates of environmental degradation; the greater diversity of pollutants because of China's transformation from an agricultural to an industrial based economy; and the fact that the most serious environmental pressures are now urban rather than rural based. However, on a more positive note, there are the new opportunities for overcoming these problems stemming from international co-operation and the sharing of experience between nations and communities. Thus, one of the major problems facing China is that of the rapid degradation of the urban environment. This was a problem that the United Kingdom and some other developed countries started to experience over 100 years ago in the early days of the industrial revolution. Although they commonly did not address these problems through environmental protection legislation until the 1950s and 60s, this prior experience gives China the opportunity of benefiting from the successes and avoiding some of the failures of developed country responses.

The rapid expansion of Beijing, like that of many other towns and cities in China, is a threat to long-term sustainable development and to human well-being. For example, urban expansion in China since the early 1980s has caused the loss of some 1.5 million hectares of high quality farm land which is in very short supply (Ash, 1998) and essentially irreplaceable by direct means. Though such losses have occurred around London and other UK urban areas they are not an appreciable problem because their loss has been balanced by high agricultural productivity growth and food imports. In China, however, such responses may not be so easy and will require a greater degree of integrated problem assessment and policy planning than that prevailing at the current time. Yet in other problem areas like urban air pollution, London and Beijing face similar problems, that is, without major steps to limit traffic emissions it will be very difficult in the long-

run to prevent further urban environmental degradation. Moreover, co-operation in such areas of common interest could have global benefits in that they relate to the issue of climate change and to compliance with international undertakings like the Framework Convention on Climate Change.

It was thoughts like these that led to the Sino-British Workshop on Urban Environmental Enhancement and Sustainable Development held in Beijing in September 1998*, and to this special issue of the Journal of Environmental Sciences. The Workshop had three main objectives: to bring together scientists, engineers and officials from the United Kingdom and China to share technological and policy planning experience on the urban environment; to promote collaboration between the Chinese Academy of Sciences (CAS), the Chinese Academy of Engineering (CAE) and University College London (UCL)** and to develop an international consortium for the promotion of research on urban environmental enhancement and sustainable development.

The Workshop discussions ranged widely from the use of ecological concepts in urban planning to the application of advanced technologies to wastewater treatment. It focused, however, on four main areas: integrated environmental assessment; water pollution and management; urban transportation and its impact on air quality and human health; environmental technology.

2 Integrated environmental assessment

Two dimensions of integrated assessment were considered: the analytical dimension as advanced by Rotmans (Rotmans, 1998) and applied to the UK by John Murlis, and the urban ecosystem dimension advanced by Wang Rusong.

Historically, environmental problems have been monitored and treated in a piecemeal manner. Pollutants were tackled individually as an outcome of an industrial process, for example, with little thought of how their levels relate to the driving forces of pollution, to the multiple impacts they may have, or how they may react with other pollutants with greater or lesser consequences. John Murlis outlines how the weaknesses of such approaches are leading to greater emphasis on integrated environmental assessment for urban environmental issues which requires multi-pollutant impact and response option analysis. He stresses the need to structure the information so as to support the production and implementation of viable solutions and to translate research information into forms that different stakeholders can understand.

Wang Rusong brakes new ground by presenting a holistic view of urban structure and development founded on ecosystem concepts. Like John Murlis he stresses the need to avoid placing too much emphasis on the visible symptoms of urban degradation and not enough on the underlying causes. He describes a systematic framework in which to consider the problems, options and solutions.

Mark McCarthy adds a further dimension by considering the public health aspects of sustainable urban development. He argues for research agenda to shift from technologies for specific environmental areas (water, air, etc.) to investigations on how complex urban environmental structures like housing and transport systems enhance or diminish social patterns and both physical and mental health. He describes how research at UCL is addressing these issues.

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** The Chinese Academies of Sciences and Engineering play a major role in national research policy formulation and have some one hundred research institutes. University College London was the first university institution to be established after Oxford and Cambridge and is grouped with them in the top rank of multifaculty universities for research quality. It is the oldest and largest College of the University of London, is the fifth largest university in the UK.

IEA, however, should not be restricted to urban planning. Cai Shuming shows that it can be equally important in other areas of natural resource planning like the conversion of wetlands to cropland where the failure to identify the long-term cross-sectoral consequences of wetland drainage has led to very serious economic losses. Drainage of lakes in the middle basin of the Yangtze River has greatly reduced the natural storage capacity for heavy rains and river flows. Consequently the incidence of severe flooding has increased and the economic losses in the area in bad years are now around 90 billion RMB Yuan.

China has made a number of changes favourable to IEA, such as the adoption of the county as the basic planning unit so that urban development is considered in relation to surrounding rural areas. Lu Yonglong presents general principles and procedures that have been developed for IEA in China, and outlined a number of possibilities for their improvement. One unique aspect is the development of the eco-county approach. Li Wenhua describes how this approach is being developed for strategic planning. It is based on system engineering principles and involves all the main stakeholders in the development of locally appropriate and ecologically sound production and management systems.

Gao Qingxian introduces a national and global dimension to integrated assessment by placing China's pattern of ozone release into the global framework. He pinpoints to a possible problem in relation to the Qinghai-Tibetan Plateau where ozone concentrations are high and still rising, in contrast to the global decline. He stresses the need to consider tropospheric as well as stratospheric ozone, and ecosystem as well as human health impacts.

3 Water pollution and water management

These two issues are closely related with each other and with urbanization. Rapid urban and industrial development are increasing the competition between domestic, industrial and agricultural consumers for water and lowering its quality. A number of urban areas are suffering from serious water shortages which could be reduced if better water treatment permitted reuse of the large volumes of water used by industry. Zou Ji examines the supply and demand for urban water resources and discusses how institutional changes in water management including changes in water pricing and the greater use of other economic instruments could help to overcome the problem.

Swanson also takes up the issue of economic valuation and the deterioration of water quality. He describes the use of contingent valuation with regard to river water quality in a number of areas near Beijing. People were asked how much they would pay to prevent further deterioration. The total cost of further deterioration in the survey area was estimated to be US $ 60 million and people were willing to pay about 1.3% of their income to prevent it. Such valuations can help guide policy makers as to the support for and acceptable costs to consumers of better water pollution control.

China is experiencing many of the water pollution problems that the UK faced some 20—30 years ago, with both biological and chemical threats to human health. The required responses involve technological and economic changes. The Workshop focused primarily on the technological responses, which need to cover regulatory as well as pollution control options. The latter point is illustrated by Wang Zijian and his co-workers in their paper on developing sediment quality criteria for rivers contaminated by heavy metals.

John Gregory emphasises the need for technological improvements in both the clean up process itself and the monitoring of process performance e. g. to ensure that pathogens are effectively removed from drinking water. He describes a simple optical technique for achieving these aims.

Chinese scientists have been actively addressing one of the major water pollution problems

namely heavy metals. As in the UK, where this pollution commonly used to come from very small metals finishing factories, so in China an important current source are the small township and village enterprises (TVEs) which are less able to adopt capital intensive modern technologies. Li Fude describes a new technology to treat electroplating wastewater, which uses a specially selected mixture of bacteria to achieve almost complete recovery of the metals and permit reuse of the wastewater. It is cheap to build and operate and hence appropriate for the TVEs. Zhang Yi outlines another innovation for the co-treatment of electroplate sludge and stainless steel pickle waste liquid to recover the metals for recycling without the production of any harmful slag.

4 Urban transportation and its impact on air quality

In major Chinese cities like Beijing, Shanghai and Wuhan high consumer preference for private car ownership, rising incomes and insufficient investment in public transport are rapidly leading to the human health problems, traffic congestion and urban environmental degradation common to many cities of developed countries including London. Roger Mackett points out that it is not simply a question of greater investment in cleaner car engines or greater investment in public transport. Even with these measures there could be further environmental deterioration. It is a major dilemma for senior policy makers throughout the world with no easy solution, and difficult trade-offs between policy areas, for example, the energy efficiency gains from diesel engines and their high emissions of particulates.

R. Battarbee highlights this latter point in relation to traffic pollution in London. His research group has shown that there is a high correlation between traffic density and atmospheric concentrations of particulates strongly implicated in greater urban morbidity and mortality. They underline the importance of characterising urban air particles rather than monitoring their total mass. Ultra-fine particles can account for 90% of the total load coming from vehicles and these pose the greatest risk to human health. Standard monitoring techniques, however, do not estimate them and thus account for little of the total mass.

One of the solutions to the pollution arising from vehicles and traffic congestion is the adoption of high speed transport systems including rail, metro and freeway systems for vehicular traffic. The latter, however, involve trade-offs between travelling time and pollution, in that they can speed up traffic movements but transfer traffic congestion from one area to another and raise pollution. Jin Fenjun presents such issues in the context of an urban high-speed transport development strategy for China.

These contributions point to the need for a holistic approach to the control of transport related urban air pollution and the application of advanced multi-dimensional analytical methods. There are, for example, a range of mathmatical modelling tools available to anticipate the environmental problems that can arise from traffic growth. Wang Jinfeng presents a spatial interaction model for traffic planning which could be integrated with urban environment models. It can be used for forecasting traffic problems and the impact of shopping centres and industrial parks on traffic flows. Bill Hillier takes such thinking a stage further by presenting arguments for an approach called space syntax research. It aims to reduce the apparent complexity of cities to a number of key parameters that represent their basic structure and function. He describes its application to London and Santiago, Chile.

Zhuang Yahui introduces another analytical tool to support the holistic approach namely life cycle analysis. After reviewing transport related air pollution he argues for the application of life cycle analysis to motorway construction, the disposal of scrapped cars and tyres, and to the

selection of cleaner fuels and "green" vehicles.

5 Environmental technology

Science and technology play an essential role in environmentally sound urbanization in China but are also the source of many urban pollution problems. Liu Jian gives an overview of the main issues involved and of the steps China and it's Academy of Sciences has been taking since the early 1970s to promote environmental R&D and provide its own technological solutions to the main urban pollution problems. Consequently, the environmental protection industry is now composed of nearly 9000 enterprises and employs some 1.8 million people. None the less, not all of the old problems have been overcome, such as acid precipitation and groundwater contamination, and new challenges exist.

One such challenge is the build up of persistent organic pollutants (POPs) which are a very serious threat to human health and natural ecosystems. Xu Xiaobai describes the use of very advanced trace organic analysis to assemble one of the most comprehensive databases in the world on the distribution and environmental behaviour of certain polycyclic aromatic hydrocarbons.

China has been very active in improving access to foreign information and hardware for environmental technology and in promoting its own R&D. Since 1978 it has launched a series of R&D programmes to promote environmental science and technology development. Lu Yonglong and Wang Guilian outline the major opportunities for further progress: (a) enhancing the environmental R&D component of the national sustainable development strategy; (b) greater enforcement of environmental laws and regulations; (c) strengthening environmental management and (d) expansion of the national technical innovation system.

One of the common environmental problems associated with urbanization is the safe disposal of large quantities of solid wastes. China has a long tradition of small-scale recycling of organic wastes but the present demand is for the treatment of larger volumes. Liu Xiaofeng describes an environmentally and economically sound process developed in Chengdu, Sichuan for the fermenting amounts of upto 200 ton of organic wastes to generate energy and fertiliser.

6 Conclusions

Since the 1950s a number of major environmental policies have been developed and implemented in the UK and these have had substantial benefits for urban environmental quality. Policy development has been underpinned, if not driven, by advances in fundamental scientific understanding of the environment. Through engagement in this process, environmental scientists at UCL and in the UK generally have acquired valuable insights into the methodology of dealing with problems of the urban environment which could be applied in Beijing and elsewhere in China.

Current environmental problems in China provide many opportunities for collaborative research on the processes involved in urban degradation and the options for sound urban management and sustainable development. Such research will give Chinese policy makers a more complete assessment of urban environmental problems and of appropriate solutions than is presently possible.

The Workshop identified many areas of common interest with wide scope for fruitful collaborations at both individual and institutional levels. Specific areas of collaboration which are being explored include the following: environmental impacts of energy conversion in urban areas; industrial discharges and their pathways through the urban environment; sustainable urban transport; urban form and its relationship to sustainable urban development, including impacts on human interaction with the environment and social behaviour; impacts of environmental quality on public and personal health; sustainable ecotourism and methods of economic evaluation of

environmental goods; transnational environmental research focused on the requirements for scientific knowledge to support national and local policy on urban development; links between urban and rural environmental problems including lake sedimentation and the impact of nitrous oxides and ozone on rural ecosystems.

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