

**A Study on Strategic Pollution Management:  
Towards Enhanced Policy Outcomes for Sustainable  
Development**

January 2019

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## **ABSTRACT**

Pollution has become a leading cause of death and illness worldwide and continues to worsen as more pollutants are emitted and accumulate in the environment. Many developing countries, particularly middle-income nations experiencing vigorous economic growth, lack sufficient environmental management capacity to mitigate pollution and protect public health. Thus, they are the main producers and victims of severe pollution. Countries are achieving higher income levels through diversified development patterns and increased material consumption, which accompany equally diversified and intensified pollution. To effectively manage these, pollution management needs to become both systemic and systematic, and policy should lead this process. Specifically, policymaking should address the underlying behaviours and values that lead to pollution, and ways to alter them.

There has been increased focus on the policymaking process in order to enhance or achieve the desired policy outcomes. Key examples include studies on co-benefits and optimal combinations of policy measures. In the climate mitigation argument, the ancillary benefits or ‘co-benefits’ of addressing climate change and air pollution together are emphasised. It takes common emission sources and chemical interplay into account, thus making a strong case for integrated policymaking. Similarly, studies on optimal choice of policy instruments explores the possibilities in terms of making policy more cost-effective and cost-efficient to address various pollution challenges. While these studies are important for incentivizing political action, the arguments and quantitative estimations developed are not well-utilised in actual environmental policymaking. Studies argue that there is a fundamental gap between academic investigations and real-world applications, which indicates a dire need for empirical studies and closer interactions between science and practice in order to align collective efforts and achieve tangible pollution reduction. In this regard, several key concepts have appeared in the literature, including ‘adaptive policymaking’ and ‘policy analytics’. This study attempts to combine these systematic ideas to develop a more comprehensive framework for pollution management.

Past studies have linked policy success and technological innovation to the design of policy intended to address systemic problems. Previously, the author investigated a policy process that generated climate co-benefit by conducting a retrospective case study in Kawasaki, Japan. The city-level analysis of air pollution control policy found that municipal actions had positively contributed to improvements in both ambient air quality and industrial energy efficiency between the 1960s and the 1990s. The introduction of an environmental assessment ordinance was associated with these improvements, suggesting an unintentional policy effect born besides the direct, end-of-pipe mitigation measures. The Kawasaki case demonstrates the importance of local government’s capacity to adequately identify and respond to locally-unique challenges. Such policy planning capacity needs to be strengthened in developing countries.

This study focuses on the policy planning stage, as a first step towards developing a policymaking framework for pollution management. It proposes ways to utilise rapidly advancing analytic tools to effectively strengthen policymaking processes in these countries. Based on an analysis of the varying development patterns and economic structures that characterise the middle-income country group (Chapter 3), three case studies are developed (Chapters 4, 5 and 6).

The first case study (Chapter 4) addresses industry-driven development. It investigates China's ambient air pollution control efforts as an example and discusses how policy concerning industrial pollution can be designed in a more cost-effective manner. Using scenario-based modelling and comparing the results thereof for five mega-cities in China, it finds large regional disparities in pollution mitigation potential and the associated costs, which facts are not sufficiently taken into account in the existing national-level policy. This chapter concludes that policy design should be more sensitive to 'local reality' by considering varying development stages and socio-economic characteristics across regions when identifying targets and establishing enforcement mechanisms.

The second case study (Chapter 5) focuses on services-driven economies, which include many small island developing states (SIDSs). As these countries are more consumption-driven rather than production-driven, addressing this behaviour is a priority target for policymaking, and public environmental education is a key strategy. This chapter uses Saint Lucia, a Caribbean SIDS, as an example to demonstrate how the application of geographic information system (GIS) would enable incorporation of geospatial perspectives into the design of environmental education policy.

The third case study (Chapter 6) addresses countries with highly complex pollution patterns due to a mixed composition of industries, both formal and informal. These trends are particularly pronounced in South Asian and African countries that are vigorously growing, accompanying rapid and haphazard urban growth. The chapter addresses land pollution, which is a growing threat in these countries, and discusses integrative approaches to this under-addressed pollution challenge. Using Ghana as an example, it demonstrates that improved access to global-scale data would provide better understanding of local pollution impacts in areas where data collection has proven challenging.

This study represents an early effort to contribute to improved knowledge base for systematic policymaking, with the goal of achieving better pollution management. Building upon several existing concepts, it proposes a strategic pollution management framework as a more comprehensive approach to policymaking. It also attempts to characterise developing countries' challenges with pollution management by distinguishing among various development patterns. Three case studies are developed to provide insights into how policy planning capacity may be strengthened in specific development contexts. Throughout, this study argues that incorporating geospatial perspectives would facilitate advanced characterisation of both problems and solutions. Under complexity and uncertainty, policy must be continuously optimised as new evidence becomes available, and such efforts should be supported by the analytical capability that is evolving. Future work must evaluate components of the proposed framework other than policy planning, which would include implementation and evaluation processes. Improving policymaking and shifting humanity's development path towards a more sustainable direction is an urgent but achievable task.

**Keywords:** Policy planning; strategic framework for pollution management; middle-income countries; sustainability transition; systemic approach; development pattern; geospatial; GIS