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Urban Air Pollution

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Urban Planning and Air Quality

The role of urban planning is to manage the spatial organization of cities for efficient allocation of urban infrastructure and land use. Depending on how it is applied, urban planning can improve air quality in the long run by strategic location of polluting sources and exposed population, and encouraging a city structure that would minimize pollution emissions and build-up. Unfortunately, urban regulations in South Asia have historically contributed to misallocation of land use and growth of urban shapes that are not necessarily conducive to economic development or air quality improvement. Taking careful account of market forces and allowing demand-driven solutions rather than the current administrative allocation of resources could bring considerable benefits, if closely coupled with other sector policies—most notably in transport.

The shape of a city and distribution pattern of land use affect air quality and its health impact. The urban shape determines locations of emission sources and where people spend their time, as well as emission levels by influencing the amount of polluting activities. This briefing note focuses on the potential impact of different spatial structures on air quality, and options for improving air quality through modifying the urban spatial structure in urban planning.

Objectives of Urban Planning Policy

Urban planning has four primary objectives:

1. to promote efficient provision of urban infrastructure and allocation of land use, thereby contributing to economic growth,
2. to manage spatial extension while minimizing infrastructure costs,
3. to maintain or improve the quality of the urban environment (including the quality of the housing stock), and
4. to preserve the natural environment immediately outside the urban area.

Different strategies adopted to reach each objective may work against one another. For example, facilitating economic growth (objective 1) might entail clearing more land for development, thereby clashing with objective 4. The problem of potentially inconsistent objectives of urban planning is compounded by the fact that planners can influence the urban shape only indirectly through land use regulations, primary infrastructure investments, and taxation. To be effective, the use of these instruments

should be harmonized to achieve the same overall objectives. In practice, the fragmentation of jurisdictional responsibility and the difficulties of changing or repealing regulations in force make it difficult to implement an efficient policy.

Historical Approach to Urban Planning

Historically, urban planning in South Asia has tended to stress compliance with the legal requirement to update a city's physical development plan at specified time intervals without much consideration of the infrastructure cost implications—notably transport—and without taking into account how urban planning may be used to mitigate urban air pollution or water pollution and depletion.

Experience to date also suggests that inappropriate or misguided land use regulations can lead to serious problems in city development. One example is the tendency in South Asia to limit the floor space index (FSI)—the ratio of the maximum total floor area permitted to the area of the plot of land—to a very low value in central areas, or even impose a uniformly low FSI throughout the city, to “avoid congestion”. Many cities in India have limited FSI to 1, whereas typical FSI in other Asian cities can fall between 5 and 15. As a result, demand for land has far outstripped supply, pushing up the price of land to the point where in some cities the ratio of the price of land to income ranks among the highest in the world.

If FSI is set at a level that makes the development of commercial real estate financially uneconomic, then the private sector will not invest, or else will try to get around the regulations by paying bribes. The adverse investment climate in turn reduces government revenue in taxes and

user fees which could otherwise finance the much needed upgrading and expansion of the city's infrastructure.

Multiple and confusing land development regulations result in a significant fraction of land parcels under dispute as in India, and discourage long-term investments on the disputed land. This in turn severely constrains economic development. Land developers are deterred from investing in retailing and housing, reducing employment and better housing opportunities. If urban land is under-used because of low FSI, unnecessary extension of urban areas ensues, increasing demand for private motorized transport and hence emissions. Such a city shape could also isolate the poor by placing them far away from areas of potential employment—already lower than what it could have been because of poorer investment climate—and deprive them of employment opportunities if they lack access to mobility.

The remainder of this note discusses the impact of land use policy on mobile and stationary sources of emissions.

Land Use Policy and Transport Emissions

The amount of air pollution generated by urban transport depends on the length, speed and number of motorized trips and the type of vehicles. For a given urban population, the length and number of daily trips are closely correlated with the average population density in built-up areas, and the spatial distribution of trip destinations and origins [1].

Factors affecting transport emissions

Population density

Population density affects motorized trips for two reasons. First, for a given population, the higher the density, the shorter the distance between two points in general, and the higher the number of people who can walk to work or shopping areas (see Box 1). Second, the higher the density, the easier it is to provide frequent and easily accessible public transport services, thereby reducing demand for private motorized transport. However, this trend is true only for contiguous urban areas. Where built-up areas are spatially fragmented, average density becomes a poor indicator of trip length.

Predominance of the central business district

It is easier to operate an efficient public transport system when the destination of the majority of trips is concentrated

within the central business district (CBD) area. As a consequence, in cities that are predominantly “monocentric” (most jobs and retail concentrated in the CBD), the share of trips using public transport tends to be higher than in “polycentric” (no dominant center) cities where the CBD contains only a small fraction of the total number of jobs and retail shops. In reality, no city is purely monocentric or polycentric but lies somewhere along the continuum. In mixed mode cities, a large share of the trips to and from the CBD are likely to be by public transport, while those from suburb to suburb are likely to be by private transport. As a broad guide, maintaining contiguous urbanization and a high density CBD is not feasible for cities with more than 5 million people. Therefore, a degree of polycentricism should be allowed in mega cities while maintaining the primacy of the CBD to reduce trip length and to maintain a high share of public transport.

Even if a city moves towards the “right” structure, however, if traffic is poorly managed in the CBD, air quality may not improve, or may even worsen. High densities and monocentric city planning require a high degree of infrastructure investments, management and traffic law enforcement than in lower density and more dispersed cities. Poor traffic management in dense CBD results in low vehicular speed, which in turn increases exhaust emissions (see Briefing Note No. 5 in this series [2]).

Policy for controlling transport emissions

Re-suspension of road dust contributes significantly to elevated ambient concentrations of particulate matter, the pollutant of concern in South Asia [3]. This is something that can be directly and easily addressed by simple urban designs and landscaping. Whenever these urban design features have been implemented, local air quality improves markedly as a result of smoother traffic flows and dramatically lower dust re-suspension. Unfortunately, scant attention has been paid to these effective measures to date because they are perceived as “luxuries” that only high-income countries can afford. In practice, they can be implemented at a small incremental cost in many road projects, bringing significant environmental benefits.

To help control transport emissions, it would be helpful to develop a policy that increases, or at least maintains, the population density and that favors the concentration of employment and retail in a centrally located CBD. The

Box 1. Walking trips in high density cities

A person walking up to 12 minutes can easily reach any point in an area of 100 hectares (ha). As a consequence, a job or a shop located in an area with a density of 10 people per ha (typically density of a US suburb) can be reached by 1,000 people without requiring motorized trips, but 30,000 people can reach the same job within the same walking time if the density is 300 people per ha (typical density in Asian city central business districts).

important questions are then what type of land use legislation, infrastructure investments and fiscal policy are likely to achieve these outcomes, and what potential negative consequences might be.

Land use legislation

Increasing or maintaining residential densities. Regulations can allow high densities but they cannot increase density if there is no demand. Most land use regulations in South Asia—for the minimum plot size or the maximum FSI—have tended to lower density below the market-determined level, leading to an imbalance between supply and demand and pushing up land prices. Land markets are often more influential and more efficient than regulations at setting the level of residential densities.

Increasing density by restricting land supply, on the other hand, increases housing prices and reduces housing for the poor. Planners sometime take measures to reduce land supply in order to curb urban “sprawl”. The most common legal tools used to curb sprawl are green belts and urban growth boundaries. They result in acute housing shortages and high land prices, as in Seoul. In turn, the lack of developable land may curtail the creation of new businesses and may have a negative effect on the city’s economy.

Maintaining a dominant CBD. Regulations limiting FSI in the commercial areas in the CBD should be regularly reassessed. At the same time, the impact of increasing FSI on air quality in South Asia has not always been positive because of inadequate handling of traffic management. The number of two- and three-wheelers often increases appreciably because of their maneuverability in congested traffic following increased density. On account of the large number of operators involved, these vehicles in turn are difficult to control for emissions as well as traffic management. This points to the close linkage between transport and urban policies. Higher FSI requires much better traffic management, stricter enforcement of parking laws and capital investments in sidewalks and pedestrian overpasses. But dispersing business outside of the CBD primarily to save expenditures on traffic management is not cost-effective. Box 2 gives an example of successful integration of sector policies.

Infrastructure investments

Managing high densities requires adequate infrastructure investments. But these investments are not necessarily

higher and in many cases are actually lower than those required to accommodate an equivalent growth at low density in the periphery. A network of public transport should also be developed to serve the CBD adequately and to maintain speed in the downtown area. To maintain the primacy of the CBD, the reinforcement of radial services (particularly public transport) should have priority over the construction of multiple ring roads, although at least one ring road is required to prevent truck traffic from crossing the CBD.

Taxation

A standard ad valorem property tax is probably the best fiscal tool to promote contiguous and dense development. In addition, impact fees could be imposed on new business construction for high FSI values. The impact fee should cover the cost of improving the downtown infrastructure. Confiscatory capital gains taxes on real estate, while appearing equitable as they concern “unearned income,” in fact have a disastrous effect on land use efficiency. Increasing capital gains tax increases the threshold for the profitability of land conversion, and as a result obsolete, inefficient and low intensity land uses are prolonged for a much longer time than in the absence of such tax.

Land Use Policy and Fixed Sources

Land use legislation and fiscal policy are again the main tools to address industrial and residential sources of air pollution.

Industrial pollution

Although industrial activities in cities have been declining in the last several decades, the selection of the optimal location for polluting industries in metropolitan areas must balance locating factories as far away from population centers as possible and maintaining good access to labor. The failure to strike the right balance can result in a high concentration of air pollution next to densely populated areas, or increased traffic demand and high daily transport costs for workers. Often, workers try to compensate by creating dense squatter settlements around polluting factories in isolated locations, thereby increasing their exposure level to air pollution.

The dynamics of land markets would ideally push obsolete and land-intensive industries toward the periphery of the

Box 2. Getting the private sector to invest in road and air quality improvement

Along the five-kilometer-long C.G. Road in Ahmedabad, India, a very simple road cross-section design has dramatically improved through-traffic flows by separating through-traffic and service lanes. At the same time, the amount of managed parking space was increased, and simple paving and landscaping reduced dust re-suspension [4]. All this was funded by a consortium of private firms that were given advertising rights in return.

city. Government regulations should allow and facilitate such moves by permitting factory closures and financing of their move by land sale at the market price. If it is illegal, or very costly (because of legal requirements), to close down factories, as in some South Asian cities, plant owners are forced to keep obsolete and non-profitable plants running, or else to abandon the plants altogether. This creates severe problems of brown fields within city boundaries, increasing pollution levels and causing large scale property dereliction.

Residential areas

Low income areas are often an important source of air pollution because of the use of biomass for cooking and heating and informal burning of refuse. This is not an urban planning issue and no land use planning law can solve this problem. The solution lies in investment in slum upgrading which would regularize and legalize the existence of slums. Regular refuse collection system adapted to the layout and circumstances of the neighborhood can then be arranged. Forced removal and relocation of low income households is the wrong policy, except in the case of severe flooding. Informal burning of refuse in legalized residential areas arises from weak municipal solid waste management.

At times, land use regulations ban the establishment of commerce and cottage industries in residential areas because of the nuisances these may cause. Because there is often no alternative location for these small scale activities, the social and economic cost of banning employment in residential areas is much higher than the benefits accrued by the decrease in noise and air pollution.

Separating residential and industrial areas

In the interest of environmental improvement, there is a drive to earmark zones for all industry away from metropolitan areas. While strict enforcement of such zoning would improve air quality, such a policy points to conflicts between different sector objectives.

- ♦ Banning new industries in metropolitan areas exacerbates the phenomenon of increasing number of under- or unemployed workers forced into the informal sector.

- ♦ Urban-based workers have to be transported to and from their homes to far-flung industrial sites.
- ♦ Small and medium-size industries, which need urban locations to maintain profitability, are forced to operate illegally, making it more difficult to control them for labor, safety and environmental standards.

The process of establishing zoning should incorporate city-wide consultations with all the affected stakeholders. Unilateral decisions based solely on well-intentioned environmental concerns are most likely to have serious adverse social and economic impacts.

Conclusions

Effective urban planning requires careful balancing of divergent, and sometimes incompatible, objectives. Urban planners have to weigh the benefits of such socio-economic considerations as creating employment opportunities in cities by allowing new industries, and their potential adverse effects on air quality and traffic. There is scope in South Asia for allowing market forces to play a greater role in shaping cities, but it is crucial to coordinate policies across key sectors, such as urban and transport, to realize air quality improvement.

References

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3. South Asia Urban Air Quality Management Briefing Note No. 4. 2002. "What Do We Know About Air Pollution?—India Case Study", March. Available at <<http://www.worldbank.org/sarurbanair>>.
4. "The Redevelopment of C.G. Road: Innovative Design and Finance," available at <<http://www.bestpractices.org/cgi-bin/bp98.cgi?cmd=detail&id=18461&key=>>>.

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A full set of briefs and other materials are available at <<http://www.worldbank.org/sarurbanair>>.

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