Urban Land Use and Nonmotorized Transport in Kanpur, India

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In the United States, considerable priority has been placed on the segregation of land uses and the relatively free flow of motorized vehicles on urban streets and roads. This policy has allowed considerable economic benefits. In less developed countries, as in earlier U.S. experience, streets and roads are an integral part of the urban marketplace. Most of the economic activity in that marketplace is conducted with slow-moving vehicles or on foot. Research in Kanpur, India, has identified relationships between different travel modes and land uses that could lead to land use planning that would more effectively accommodate slow-moving vehicles and accord fast-moving vehicles their appropriate importance in the transportation hierarchy.

In the 20th century, American urban land use has become more formal and segregated as the scale of economic activity has increased. Large American cities at the turn of the century suffered from encroachment on streets and sidewalks by small-scale hawkers. This patten is still visible today in such isolated locations as the Italian Market in Philadelphia. However, increased affluence has resulted in strict building codes and segregated land uses. These characteristics have promoted the use of motorized vehicles, which has expanded the potential service area for commercial enterprises and introduced horizontal rather than vertical economies of scale. That land use environment has been characterized by declining density. This dispersion of development is a sharp departure from previous industrial age trends. Today the density of land use is again increasing. However, ideas about land use and transportation planning are still firmly rooted in the concepts of segregation and motorization.

Land use and transportation planning in less developed urban environments such as those found in most of the cities of the Indian subcontinent have been influenced to a large extent by the ideas prevailing in the United Kingdom and the United States. Motorization, in particular, was seen as a key indicator of economic progress, as was land use segregation to a lesser extent. However, almost no consideration was given to the relationship between small-scale enterprises and nonmotorized or slow-moving vehicles. Small-scale enterprises tend to be located in areas of high traffic volumes. This situation presents a fundamental conflict in urban areas with limited roadways. The limited road space, coupled with increased traffic of all types (i.e. potential customers), encourages the location of even more small-scale enterprises. When motorized vehicles increase their share of the traffic composition, their greater space requirement causes congestion to increase dramatically. In addition, their lack of maneuverability compared with that of other modes reduces their operating speeds to near those of nonmotorized vehicles.

In this environment, the greatest concern seems to be that motorized vehicles are operating inefficiently because of the road congestion. The first solution considered is often the removal of slow-moving vehicles and encroachments. Because many central area roads suffer the same types of congestion, small enterprises are encouraged or forced to relocate to areas where there is less congestion—exactly the opposite of their natural inclination and economic necessity. In the case study of the Indian city of Kanpur, motorized vehicles constitute less than 10 percent of person-trips. Although it is appropriate to improve their operating speeds, it does not logically follow that roads with the best potential operating surface should be cleared to serve their needs to the exclusion of those of others. Research conducted in Kanpur shows important relationships between land use and transportation that must be considered before any land use or traffic management decisions are made involving nonmotorized vehicles.

KANPUR URBAN ENVIRONMENT

Kanpur, located in north India's state of Uttar Pradesh, was a group of villages until the late 1700s. From then until 1857, Kanpur developed as an army camp for the British. It was chosen as a camp because of its nearness to both Avadh (a rich cultural and agricultural state) and Delhi and its location on the Ganges River. As is typical of many north Indian towns, Kanpur was partitioned into three parts: the cantonment, the civil lines, and the native town. The cantonment housed the military and its supplies, and the civil lines was the office and residential area for administrative personnel. The native town was the locus of all support activity.

The municipal boundaries were changed after the unsuccessful rebellion of 1857 but have remained fixed since that time. Even though it has ceased to be an army camp, the cantonment remains a key and active part of Kanpur's environment. Under military jurisdiction, the cantonment remains outside the control of city authorities. Geographically, it acts as a barrier to northeastern expansion of the native town. The civil lines is an integrated part of Kanpur and has no legal protection from urban growth. However, it has retained much of its distinct character because of the design of its structures and its low density. The principal change in its land use has been the conversion of many residential units into offices.

Kanpur, the native town, has grown from the cantonment in the east along the Ganges toward the northwest. Railroad

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lines and major roadways have left a narrow funnel for development along their transportation corridor. The railroad lines and the Grand Trunk Road (both with rare trans-Ganges bridges built to facilitate the transport of raw materials, particularly cotton, to the major industrial market in Kanpur) and the Ganges itself have linked Kanpur to the entire region. In the late 1800s, industries were established there with a regularity that quickly made Kanpur the principal industrial city of north India. Industries there were established along the Ganges or close to the railroad lines. However, because of the physical constraints of the narrow transportation corridor, the Ganges, and the cantonment, it was much more difficult to move within the city than into and out of it.

URBAN DEVELOPMENT

Much of the village form has been replicated in the Indian urban environment. This is in large part due to traditional Indian values that are substantially different from contemporary Western values. Contrary to Western urban economic behavior, many Indian families seek to minimize their total outlay of money rather than to reach optimal utility levels. Most people prefer to pay higher rent in crowded conditions in order to avoid travel, even when living conditions outside the central area could be obtained with only a small increase in total expenditure. It is not uncommon to find wealthy families in the same densely settled areas where the poor inhabit dormitory units in up to three shifts per day.

In Kanpur residential, commercial, office, and even light industrial land uses may be found in different rooms of individual buildings in the central areas. Heavy industry is also located there. The great demand by all land uses for space in the central areas results in direct competition between residential and nonresidential uses. Commercial and office uses have been able to outbid residential land uses for space near industrial facilities, forcing many workers to live farther away. With limited roadway facilities and inadequate public transportation, this results in an expansion of the high-density area with serious congestion.

In Kanpur the street network has remained essentially unchanged since 1930, whereas the population and traffic have grown considerably. The entire central area is generally under intense use, particularly the road frontage along major streets. The increases in traffic destined for central areas and in local commercial strip-based traffic remain only along narrow corridors. Thus, the limited existing transportation network reinforces strip development and the pattern of dense settlement in the central areas.

The severely limited access to transportation facilities is evident from the horizontal stacking of commercial activities along major streets. For example, it is common for stores to encroach on part of the sidewalk, *pattiwallas* to sell their wares from a cloth spread on the sidewalk or at the street edge, and hand carts and animal-drawn vehicles to conduct business on the street itself. With the myriad vehicle types parking on the street (parking space occupancy from 9 a.m. to 9 p.m. averages 200+ percent) added to the direct commercial encroachment, the strain on the streets becomes most severe. Even where sidewalks are relatively unoccupied by nonpedestrian uses, their awkward design height causes pedestrians to prefer the street. As a result, as little as 30 to 50 percent of the road right-of-way is available for vehicular traffic (Pradeep Tiwari, unpublished data).

Industrial production in Kanpur peaked in the 1940s when its mills, tanneries, and ordnance factory produced wartime supplies and drew additional rural labor. During this period, major urban infrastructure was not built, nor was industrial differentiation undertaken to broaden the city's economic base. Shortly after the war, Kanpur's economy slumped. The lack of raw materials nearby for heavy industry resulted in low priority for development for Kanpur based on the Five-Year Plan (*1*). The number of industrial workers, which had increased from 55,814 in 1939 to 116,252 in 1945, decreased to only 68,832 in 1953 (*2*). The population continued to grow at 3.1 to 4.0 percent and reached 1 million in the late 1960s and 1.74 million in 1981 (*2*) (see Table 1).

The increased population was not needed in the industrial sector, so instead many found casual jobs, plied rickshaws, or became hawkers. New residents did not generate the wealth that could even maintain, let alone expand, urban transportation services. Moreover, the occupations taken up by these new residents were dispersed throughout the city rather than being in factories at discrete locations that could be efficiently served by public transportation.

In the 1940s and 1950s, housing construction was only 1.2 units per 1,000 population per year (*1*). This situation resulted in increased crowding of existing *ahatas* rental housing and in residential densities of up to 800 persons per square kilometer in some slum and squatter settlements (six times the maximum government standard). By 1975 the total population in such housing reached 0.5 million. Unlike other Indian cities such as Ahmedabad, Bombay, and Calcutta, these settlements in Kanpur are centrally and not peripherally located.

Slums and squatter settlements in Kanpur often encircle a commercial district or factory but rarely abut major roads (*1*). In 1977 two-thirds of those settlements were within 1 km of transportation, education, shopping, and banking services, and 58 percent were within 1 km of the workplace, but only 13 percent had access by *pucca* (macadam or paved all-weather) roads. One of the largest such areas, Gwaltoli, is not accessible by vehicular traffic. The Uttar Pradesh Town and Country Planning Organization recommends that the distance to work for residents of *ahatas* should be no more than 1 mi. In practice, that standard prevails, primarily because of the initial urban settlement pattern of workers living adjacent to employment opportunities. However, in the peripheral sites and services schemes the 1-mi standard does not apply.

The Second Five-Year Plan states that slums will remain a problem until steps are taken to prevent the establishment of new ones and until land use regulation is exercised to check unplanned growth (*1*). Both the Second and Third Five-Year Plans provided for slum clearance and improvements. A study team for the Third Five-Year Plan even went so far as to recommend the provision of paved streets and good approach roads to slums and squatter settlements. Most planning efforts for these settlements have involved plans to displace the residents to distant developments away from their social and economic contacts. As a result, there has been much resistance to most programs.

Various plans for slum improvement and upgrading have ignored a critical factor. In Kanpur, as in the rest of urban

South Asia, there is an acute shortage of affordable and economically viable commercial space. Planned space is available in peripheral developments but finds few takers, as has been observed in Lahore and Chandigarh. It is precisely because of the commercial land shortage that the squatter and slum settlements have been packed into areas that are both close to jobs and lacking in access to the street network. The low percentage of urban space devoted to streets (6.8 percent in the central area, 2.6 percent in the metropolitan area) in Kanpur causes acute competition for road frontage with high traffic volumes (*2*). Thus, workers often find housing directly behind commercial establishments, because the area away from the main streets has little or no commercial value.

Little employment is found within the slum. Of all slum and squatter units, 83 percent were residential, 15.4 percent residential with commercial use, 0.5 percent residential with industrial use, and only 1.1 percent commercial (*1*). After their first move to Kanpur, 75 percent of slum dwellers have not moved again. In a survey conducted by the Indian Institute of Public Administration, of the 32.9 percent of slum and squatter settlement residents who would not relocate under any conditions, 48 percent would not relocate because of increased difficulty in job-based travel. These data seem to indicate an individually optimized residential location pattern.

The problem with this type of optimization is that as population grows, the density will increase in previously established residential areas. It is difficult to establish new settlements farther out of town because of the separation from markets and employment opportunities. Any peripheral settlement would have to provide either affordable public transportation or densities high enough to sustain adequate internal employment. In the absence of either of these two requisites, it is likely that central area slums will become even more overcrowded and that commercial and manufacturing density will also increase in the central areas, thereby appropriating more road space and further constricting traffic flow.

KANPUR TRANSPORTATION ENVIRONMENT

The residence of both rich and poor in the early days of American industrialization was in the crowded business district (CBD) (*3*,p.28).

> When the only transportation was by horse, almost everyone lived within walking distance of his job in the central business district. Even afterward, when they could take a trolley to work, factory workers and office and store clerks generally preferred to pay relatively high rents for crowded quarters from which they could walk to work rather than spend the time and money to commute from neighborhoods where rents were lower.

In the United States, the movement of affluent urban residents farther out along transportation corridors has resulted in a continuous filtering down of housing stock from the more to the less affluent and a general outward movement of population from the CBD. Once transportation corridors had been established, the affluent could continue to move farther out, and transportation lines were extended to serve them. From this movement, better housing was constantly made available to the less affluent who lived nearer the CBD. The transportation system was already in place for them, having been subsidized earlier by private trolley companies serving affluent customers. In addition, radial growth allowed more central area space for commercial use and transportation facilities.

Significantly, this pattern took hold while economic scales were increasing. More people worked in factories or offices in large buildings located in areas with little residential land use. It was easy to go from a residential area to a commercial area by public transportation, and less of the population needed to protect their financial interests by living close to their place of work.

The improved transportation technologies that led to the gradual movement of the affluent urban population along transportation corridors in the United States have largely not materialized in Kanpur. Instead, large numbers of merchants and other affluent persons continue to live in the Kanpur CBD.

In contrast to the development of the North American urban environment, which has resulted in higher scales of economy, development in Kanpur has moved toward lower scales of economy. As a result, travel destinations are dispersed and continuous along major streets. It must be stressed that some entire streets, and perhaps a large part of the CBD, are work and shopping destinations. It was previously pointed out that commercial land uses have outbid residential land uses for road frontage. The result is that bus service along these corridors is not efficient because it does not directly serve significant residential areas or offer the frequency or short stop spacing needed in this environment. As a result, ad hoc transport modes dominate.

In 1977 fast vehicles made up only 3.8 percent of total person-trips in Kanpur. The rest were delivered by pedestrian (72.3 percent), cycle (17.7 percent), and slow modes (4.3 percent). Trip length ranged from 1.1 km (pedestrian) to 3.12 km (fast vehicles) with an average of 1.43 km. Travel times ranged from 19.9 min (pedestrian) to 26 min (cycle) (*2*). In Kanpur fast-moving vehicles average only 7.9 km/hr and cycles, 5.4 km/hr. The minor variation in travel times and speeds is indicative of the acute congestion in the city and has also been noted in the case of Delhi's Walled City.

More than 9 out of 10 person-trips in Kanpur are either by foot or by cycle. These trips have negligible costs to the individual and can be considered free. Of the remaining 10 percent, bicycle rickshaws make up 62.5 percent, scooters, 31.9 percent; cars, 5.4 percent; tempos, 3.3 percent; and buses, 0.8 percent. The remaining direct-cost outlay modes are buses, tempos, and cycle rickshaws. Their shares in total vehicle movement are rickshaw, 6.3 percent; tempo, 0.3 percent; and bus, less than 0.1 percent (*2*).

Among these three modes, design speed is highest for buses, followed by tempos and rickshaws. Operating frequency is the reverse, with rickshaws first, followed by tempos and buses. Comfort is difficult to define, but strictly in terms of occupant space the order would be the same as that for frequency. Fare pricing per kilometer is lowest for buses, then tempos, and highest for rickshaws. According to the Kanpur Traffic and Transportation Plan, trip length increases from 1.1 km for pedestrian traffic to 1.8 km for slow vehicles and 3.12 km for fast vehicles (*4*,p.208). The bus and tempo have significant service level overlap, as do the cycle and rickshaw.

The result of the congestion in Kanpur is that operational speeds and efficiencies are lowered in proportion to design speed. This means that a bus will be more adversely affected than a tempo and a tempo more than a rickshaw. Operational efficiency is directly related to the attainment of design speed and loads, which are much lower for a tempo than for a bus. Similarly, design speed and loads are lowest for the rickshaw. Tempos and buses both depend on passenger turnover to maintain the load factor. A rickshaw normally carries one or two passengers directly to a single location. As congestion increases, the operational efficiency of the rickshaw increases relative to that of tempos and buses. This efficiency is even greater for bicycles. Yet, ironically, as congestion has increased, the removal of cycle rickshaws and bicycles from certain roads has been considered, to increase the travel speeds of automobiles and buses.

Data in terms of aggregate percentages for different travel modes are available for a number of Kanpur intersections. Volume counts were taken in 1963–1964, 1974–1975, and 1982–1983. The four key intersections of Bakr Mandi, Bara Chauraha, Deptyka Parao, and Afim Kothi reveal the change in traffic composition over time. The composition of automobiles has declined drastically from over 6 percent to just 2 percent of the total intersection traffic during the 20-year period. At the same time, buses have declined from 1.3 percent to only 0.4 percent. Trucks, as well, have declined from 2.3 to 1.4 percent. Scooters and motorcycles have increased rapidly from 3.7 to 15.4 percent (*4*,p.208).

Between 1963–1964 and 1974–1975, the percentage of rickshaws decreased but by 1982–1983 it had increased to more than the 1963–1964 level. (This increase was also observed in New Delhi and was attributed to increases in petroleum prices.) Cycle composition decreased, probably because of the increase in scooter use. Use of animal-drawn vehicles showed a slight increase similar to that for rickshaws, although use of handcarts declined throughout the period. The introduction of three-wheeled motorized tempo paratransit was evident for the first time in the 1982–1983 counts, with 1.6 percent of traffic composition (*4*,p.208).

In 1984 there were nearly 500,000 bicycles and 50,000 cycle rickshaws in Kanpur (Pradeep Tiwari, unpublished data). The Kanpur urban bus service of the state monopoly Uttar Pradesh State Road Transport Corporation (UPSRTC) consisted of only 92 buses (*5*). With a population of almost 2 million, Kanpur may be the largest city in the world without an independent urban bus service. The buses used were not designed for urban areas and cannot load and unload passengers efficiently because of narrow doors and high loading heights. Routes and timings are largely unknown and it is common for people to board any bus that comes before they inquire about the route. This is not surprising, because bus drivers have been known to abort trips because of congestion. Because buses have been commandeered by students, a driver may avoid bus stops with large numbers of students.

LOCATIONAL CHARACTERISTICS IN KANPUR

The urban slum population in India grew from 20 percent in 1951 to 35 percent in 1976. In Delhi, the squatter settlements grew 12 percent annually compared with a total city population increase of 3.4 percent (*1*). In Kanpur, the population is expected to grow from the present nearly 2 million to 3.2 million in 2001, of which 70 percent will be low-income earners. The principal characteristic of these squatter settlements is their location in any available space when affordable housing is not provided.

Transportation planning for this urban population, whose economic activities are confined to the lowest levels of organization and are often called ad hoc or informal, requires an understanding of their behavioral patterns and economic needs. In order to identify these key factors, a random, nonscientific survey was conducted with Raka Sharan of the Department of Humanities and Social Science at the Indian Institute of Technology, Delhi. In the survey, 350 workers from six employment groups were interviewed (S. Gibbons and R. Sharan, unpublished data).

In the survey, all groups showed a preference for residential locations near large wholesale markets (*mandis*). It is not surprising that this preference was greatest among the wholesalers themselves. Even when the option of living near a small market was raised as a possibility, the respondents continued to prefer the *mandi*. Considerable mode split existed for different trip purposes and varied among occupational groups. Cycles and rickshaws were preferred for all trip purposes except visiting relatives.

This survey again confirmed the residential proximity to work place shown in earlier surveys in Kanpur. The preference of many respondents for residential locations in areas around large wholesale markets could be caused by employment there or by the lower cost of goods in those markets as compared with smaller neighborhood stores. Nevertheless, the results do not indicate much potential for a less congested urban environment.

A bus passenger survey was conducted in Kanpur in 1980. The most interesting information contained therein is that 35 percent of trips could not be attributed to standard trip purpose categories (S. L. Dhingra, unpublished data). This finding tends to support the observation that many trips are, in fact, miscellaneous in that people travel to check things out or to spend time. Eastern cities are in fact oriented this way, and it is not surprising that people settle densely to facilitate this behavioral preference. Many of the miscellaneous trips could have been made in search of job or business opportunities. Nevertheless, public transportation is least able to serve precisely these trips.

ANALYSIS OF TRANSPORTATION AND LAND USE RELATIONSHIPS

The high use of cycles, scooters, and rickshaws allows spontaneous decision making during travel, which is not possible with more organized modes. Commercial activity location promotes and is encouraged by this behavior. As a result, the lowest level of commerce (hawkers) is especially dependent not only on population concentration but also on absolute volumes of traffic. To explore these relationships, land use and demographic information was collected and analyzed together with work trip origin-destination survey data.

Raw data that have been collected for all urban areas of India document the population, economic activities, and eco-

nomic characteristics at the enumerator-block level. This information is contained in the *1980 Economic Census of India* and the *1981 Census of India* unpublished data sheets. Also contained therein is the breakdown of commercial activities into eight broad categories with their ownership and operational characteristics. Especially interesting is the separate listing in the *1980 Economic Census of India* of economic enterprises without premises (i.e., hawkers). Thus, for the first time, information is available that shows location patterns at the metropolitan level. For Kanpur, the data are available at three levels: 45 wards, 190 *chaks*, and 2,800 enumerator blocks (*Economic Census of India*, unpublished data).

During the course of this study, other significant unpublished transportation information was collected. This included an origin-destination survey conducted in the mid-1970s, which gives a breakdown of trips by mode and purpose as well as by origin and destination. Even pedestrian trips (70 percent of the total) were included.

For purposes of data analysis, the census data were aggregated to the ward level and the origin-destination map was adjusted to match the city ward map. Information for eight different types of enterprises with permanent (*pucca*) facilities was available. These types include retail and wholesale, manufacturing, hotels and restaurants, business services, agricultural, personal services, transport, and warehousing enterprises. For each of these enterprise types, the level of organization was given by three categories: directory (five or more persons employed), nondirectory (fewer than five persons employed), and own-account (no hired employment). Enterprises with temporary or no facilities (hawkers, etc.) were aggregated for all types. Population and employment figures were also available from the same source.

Densities were then calculated for each of 45 wards, or analysis zones. The highest densities for population, employment, and all activities except transportation and agricultural enterprises were found in the central areas. This result follows site observation and quantifies the concentration of commercial activities along transportation corridors and in central areas.

The origin-destination survey conducted previously was considered to be of poor quality except for the home-to-work data, which were considered to be of fair quality. However, the survey results were never used to develop a travel model and as a result were never verified. In addition, there were possible errors in conversion to analysis zones and in spreadsheet entry from hand tabulation sheets. In light of these factors, regression analyses were performed with special attention to the goodness of fit as well as the relationships among variables. The results observed in the models were encouraging from both points of view.

Population can be predicted from a model using only information on the number of the six enterprise types in each zone ($\bar{R}^2 = 0.893$). It is positively correlated with manufacturing, warehousing, and personal services and negatively correlated with retail and wholesale, hotels and restaurants, and business services. This location near more organized employment land uses such as manufacturing and warehousing confirms earlier observations and survey results that indicated the strong desire of workers to live near their places of employment. The results show the strong relationships between various enterprises and population that occur in an environment characterized by mixed land use. This reinforces the need to investigate further the relationships between the economic land uses themselves.

Attracted trips can be predicted from a similar model in which population, employment, and number of agricultural enterprises is added. The need for this relatively awkward model shows how difficult it is to identify the impact of individual variables on trip generation and attraction. Normally, employment-related variables would be sufficient for trip attraction and population-related variables for trip generation. However, the nature of the mixed land use environment is much more complicated than that of the segregated land use environment. Case studies and surveys may be the only approaches that will produce reliable disaggregated rates.

Level of enterprise employment is not sufficient to predict trip attraction ($\bar{R}^2 = 0.26$). It is possible that the narrow distinctions among the three categories is not adequate to identify the contribution of truly large businesses such as factories. It may also be true that the categories simply do not reflect significant differences in trip attraction. However, own-account enterprises can be predicted from a model that includes directory and nondirectory enterprises ($\bar{R}^2 = 0.757$). Own-account enterprises are positively correlated with nondirectory enterprises and negatively correlated with directory enterprises. This result indicates a greater similarity between the two lower levels in location pattern.

Hawkers tend to be positively associated with trip generation ($\bar{R}^2 = 0.49$) and negatively associated with trip attraction ($\bar{R}^2 = 0.32$). The positive and negative coefficients for hawkers are more than four times larger than those of permanent establishments. This finding is one of the most important of the analysis. It would indicate that hawkers were more likely to be found around residential than employment concentrations. It may also be represented in the relative absence of hawkers around a factory and their substantial presence in commercial strips near residential concentrations. Because the relationship between commercial enterprises and residential units has not been explored in a rigorous way, it is difficult to draw definite conclusions from these relationships. However, it is possible to infer that as the scale of economic activities becomes larger and more organized, lower levels of economic enterprise such as hawkers are less significant.

The association of hawkers with trip generation four times as great as enterprises with permanent facilities indicates their much greater need for large traffic volumes. This agrees with visual observation of hawkers in the most congested areas of Kanpur. It also suggests the need for a level of location analysis that is in common use in the United States and other parts of the world. Such analysis, which is often used to determine the location of gasoline stations, eating establishments, and other service facilities, considers the likelihood of passing trips (not vehicles) to stop at a given enterprise. In this case, four times the passing trips appears necessary to sustain a hawker than are needed for a fixed enterprise. Analysis by mode has not yet been possible, but it is likely that all the transport modes associated with hawkers are nonmotorized or scooters, simply because of their ability to make quick decisions en route.

CONCLUSIONS

Kanpur is representative of many cities in developing countries. Once a center of more advanced economic life, it is now assuming more characteristics of the traditional village as the rural poor continue to settle in the city. The growth of the percentage of poor people in Kanpur prevents land use segregation and its supporting transportation infrastructure. As a result, increased numbers of slow-moving nonmotorized vehicles serve enterprises with low levels of organization along limited transportation corridors and cause congestion in central areas.

This study has identified the need of hawkers for heavy traffic volumes. Currently, those volumes are composed mainly of nonmotorized vehicles and pedestrians. Traffic regulation to restrict nonmotorized vehicles in the most congested areas would have serious adverse consequences for the economic survival of hawkers and probably other small-scale enterprises. If hawkers and others who need the heavy passing traffic are moved to peripheral locations lacking access to streets with sufficient traffic volumes, they will inevitably return to the central areas.

The intensive use of urban commercial space in Kanpur and other developing cities is associated with lower-level economic organization. The human face of this economic organization is represented by hawkers and squatters, who usually find nonmotorized vehicles to be their only usable source of business and transportation. Until the overall level of economic organization can be raised to allow more segregated land use, more efficient use of urban commercial space can be obtained. For example, in Calcutta at Sealdah Station, two-level stalls have been constructed for sidewalk vendors to double the density of commercial activities while freeing sidewalks for pedestrians (*6*,p.106). The results of this study, demonstrating empirically that in Kanpur entrepreneurs without premises have pass-by trip requirements four times higher than those with premises, indicate the need for more dense commercial development and the analysis of traffic volumes to ensure adequate potential for new commercial developments.

All materials indicate that fewer informal-sector workers and entrepreneurs will emerge in the years to come. Now is the time to organize commercial land planning that will be more intensive in space use and for transportation system management techniques that will distribute traffic more equitably. This planning may begin with an understanding of the role and importance of nonmotorized vehicles in the urban transportation hierarchy. As a result, wherever lower-level economic activities are concentrated, nonmotorized vehicles should be given priority, and motorized vehicles should be diverted to other less congested areas where less operational flexibility is needed and they can operate most efficiently.

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