

Note on Surabaya mobility and housing issues

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introduction

This note was prepared after a visit to Surabaya with a World Bank mission from June 11 to June 16th, 2012.

We thank the various officials we met in Surabaya and Jakarta , together with the faculty of the University of Surabaya for taking the time for meeting us and for providing guidance for our research.

The sources of the data used below are mostly from 2 DVDs provided to us by the Municipality of Surabaya. Some of the data including built-up areas and detailed land use in housing areas have been extracted directly either by vectorization of Google Earth images or from the detailed CAD drawings covering the entire city provided in the DVDs.

The geographic coverage of the data provided is limited to the area of Kota Surabaya (municipality of Surabaya) . This constitutes a major limitation as the conurbation of Surabaya overflows from its municipal boundaries into the kabupaten of Gresik and Sidoarjo ([Figure 1](#)).

It is hoped that any further spatial analysis would also include the kabupaten of Gresik and Sidoarjo.

The lack of households' income data and housing price and rent data is one of the major shortcoming of this report. The very fact that no income and price data could be found among the 25 gigabytes of urban data that were transmitted to us speaks volume of the neglect shown for housing issues in this otherwise very complete urban planning data base. This neglect is not unique to Surabaya but is found in most planning studies around the world. Housing is usually the larger land use category in urban area. The major objective of urban planners should be to allow an increase in the housing stock in such a manner as some part of it remains always affordable to the poorest of its inhabitant. To achieve this goal, it is necessary to regularly monitor the changing income distribution of households and the ever increasing housing price for each housing type.



Figure 1: administrative boundaries of Surabaya Metropolitan area

Surabaya spatial structure

The built-up area of the metropolitan area of Surabaya shown on *Figure 2*, included a population of about 6 million people in 2010. Due to the limitation of the data available the following spatial analysis is limited to the area of the municipality of Surabaya (2.97 Million people in 2010) shown on the map of *Figure 2* with a dotted line. Many of the inhabitants of Gresik and Sidoarjo commute to Surabaya during the day. Because of the limited geographic coverage of the data base available the following study, focusing on mobility and affordability, is therefore very limited in the interpretation of its results.

Surabaya - Built-up area

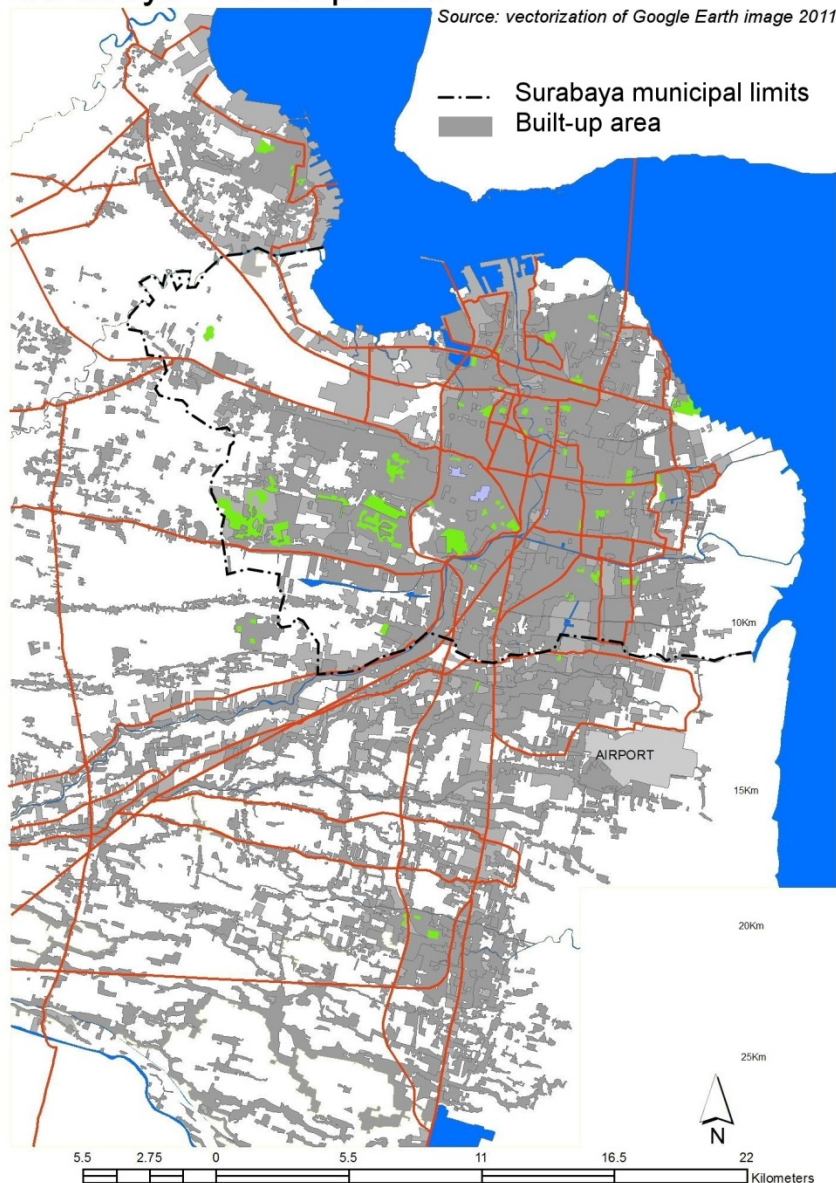


Figure 2: Built-up area of Surabaya Metropolitan region

The productivity of a fast developing city like Surabaya depends on the daily mobility of its workforce and on the ability of all its inhabitants to find affordable housing within a reasonable travel time from most of the jobs offered in the metropolitan area.

The spatial structure of Surabaya is analyzed therefore with two prime objectives:

- Improving the daily mobility of its inhabitants
- Maintaining housing affordability as the city expands.

It is important, first, to understand the characteristics of Surabaya spatial structure and what makes it quasi unique in providing a large stock of affordable housing; second, to recognize that this peculiar spatial structure is not going to change drastically but only to evolve very slowly; and third, to try to design a transport system adapted to Surabaya's spatial structure that would increase its inhabitants mobility and would decrease congestion in the future.

The average population density, at 153 people per hectare, is not particularly high by East Asia standard, but it is significantly higher than cities of Europe and Latin America (about 3 times higher than Curitiba's) (*Figure 3*). When selecting models for urban transport system, this relative high density should be taken into account.

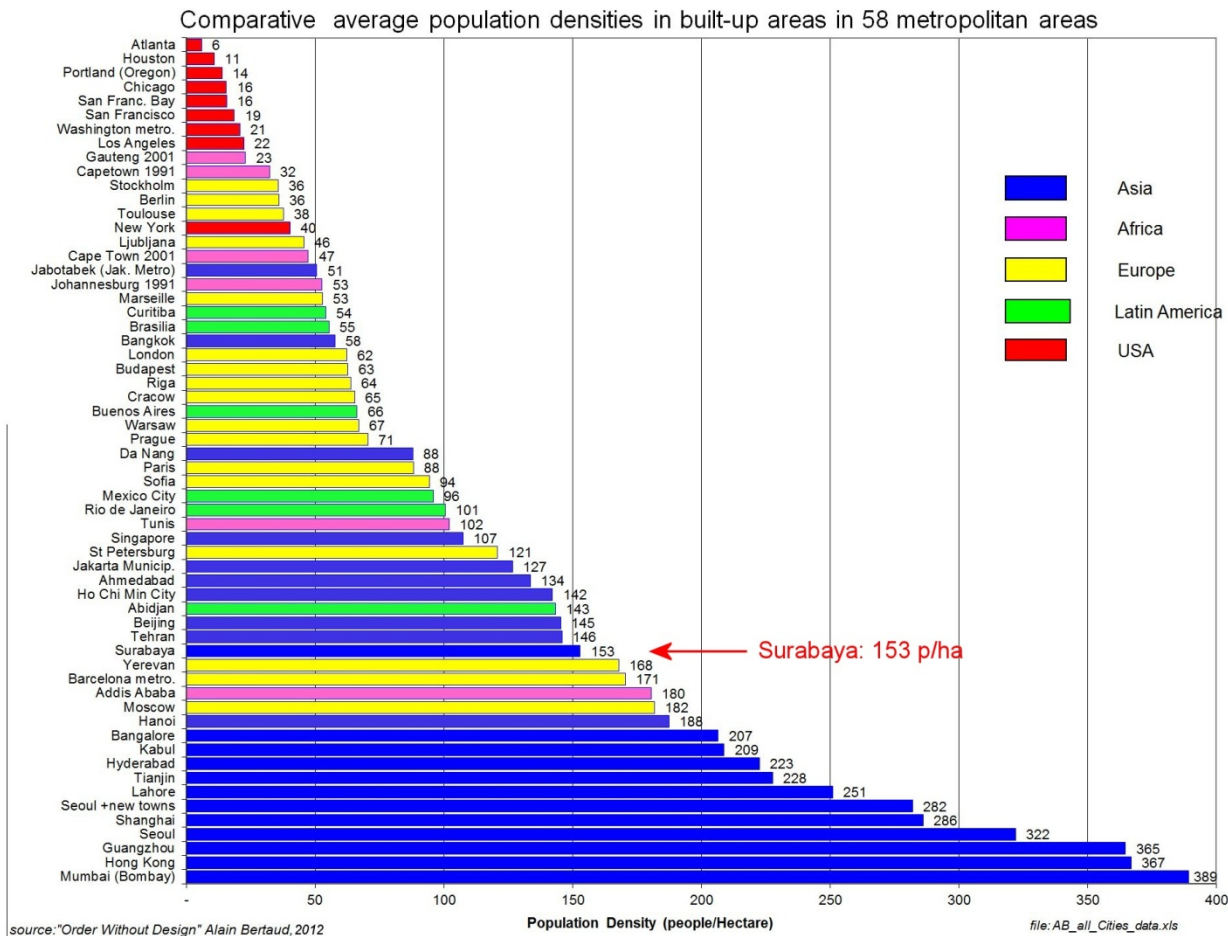


Figure 3: Average built-up population densities in 58 metropolitan areas

Surabaya's spatial structure is unusual. A large part of the population is concentrated in clusters of high density (often higher than 400 p/ha) on a wide area covering more than 60 km² (Left of *Figure 4*). High density job clusters (higher than 200 job/ha) are dispersed on an even wider area (map on the right of *Figure 4*). The mix of high density residential areas and high density job clusters is itself favorable to make jobs more accessible with shorter trips. However the large area over which these high density clusters are distributed will create a particular challenge for any type of public transport.

Surabaya built-up densities in 2010

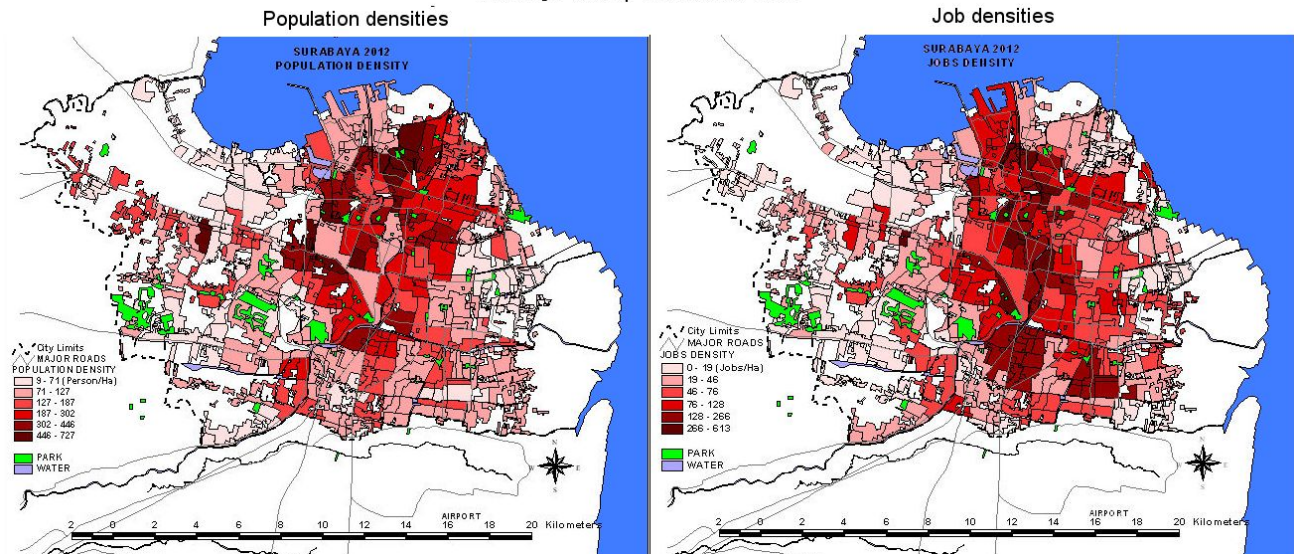


Figure 4: Surabaya distribution of population and job densities within the municipal boundaries

The profile of population density distribution by distance from the city center (top of *Figure 5*) shows the concentration of population density with average higher than 150 p/ha, within a radius of 6 km from the center. The high densities in the periphery (17 and 18km) correspond to small isolated kampongs and do not imply a reverse density gradient. The profile of population distribution (bottom graph on *Figure 5*) shows that about 90% of the population is concentrated within a radius of 10km from the center. The compactness shown on *Figure 4 and 5* is certainly favorable for reducing distance travelled but pose a particular challenge to manage the heavy flows of multidirectional traffic in a reduced area.

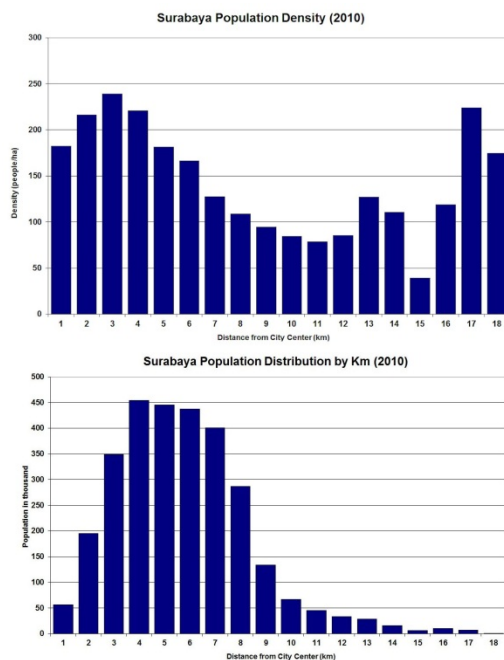


Figure 5: Profile of density and population distribution from the city center at 1 km interval

While Surabaya has an identifiable CBD, commercial areas and job are spread over a wide area (about 30km² about 15 times the size of Hanoi CBD and 10 times the size of Singapore CBD). Most of the retail areas are concentrated in very large shopping malls and markets while many of the shops in the main central streets are closed. The streets connecting the centrally located shopping malls are mostly traffic corridors with few pedestrians. The spread of large commercial activities over a large area will complicate the design of an efficient public transport network in the future.

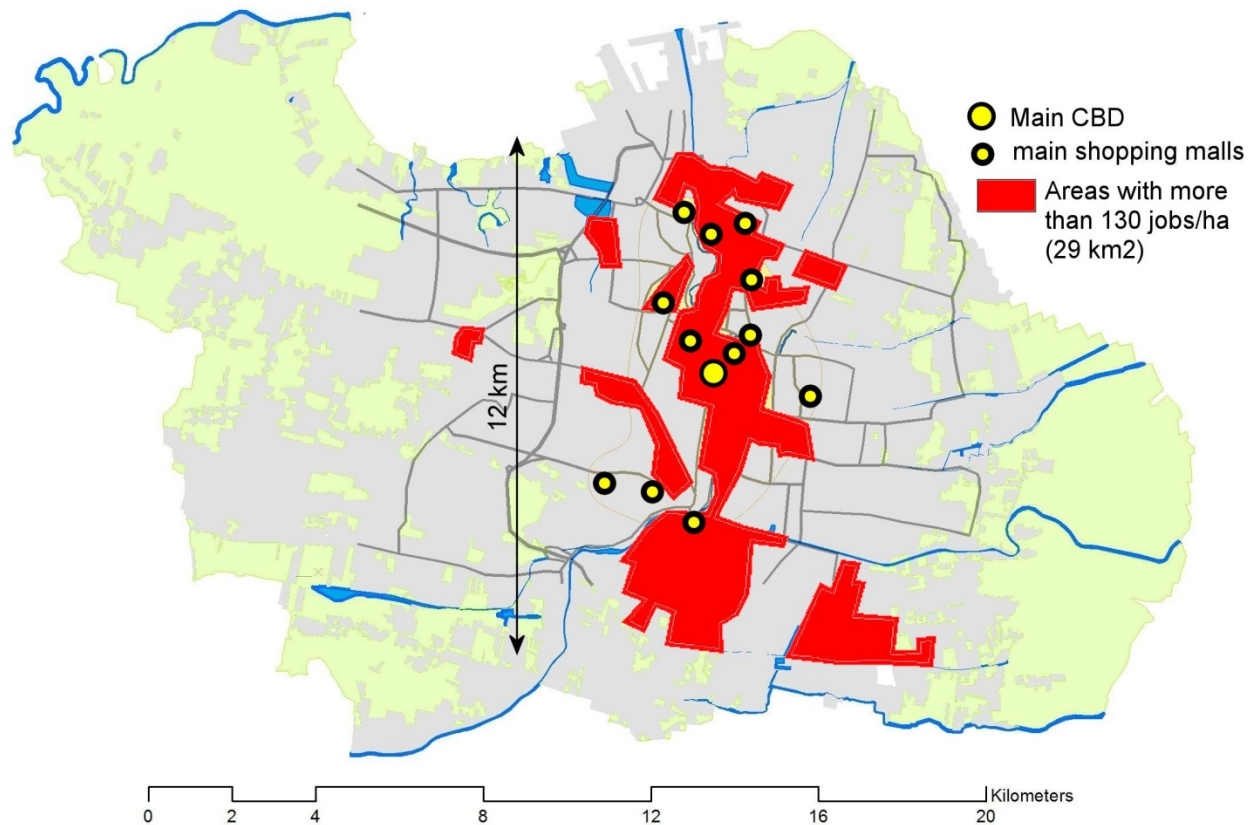


Figure 5: CBD, shopping malls and main markets

This unique spatial structure, which developed spontaneously over the years, has a number of advantages but it poses a particular challenge when developing a mass transportation system. Traditional mass transit solutions that are well adapted to spatial structures that are different from Surabaya (monocentric cities with radial movements, for instance) might be ill adapted to the Surabaya context.

Mobility and transport networks

Surabaya transport network consist in widely spaced major vehicular arteries linking large shopping centers surrounding large dense residential areas. The maps of [Figure 7](#) illustrate the challenges faced by transport in Surabaya. All the five cities shown on [Figure 7](#) have high densities and significant traffic problems, but Surabaya has the smallest area for major roads (5.8%) in the central area considered compared to the other 4 cities (Bangkok 7.9%, Hanoi 9%, Seoul 13.6% and New York 31.9%).

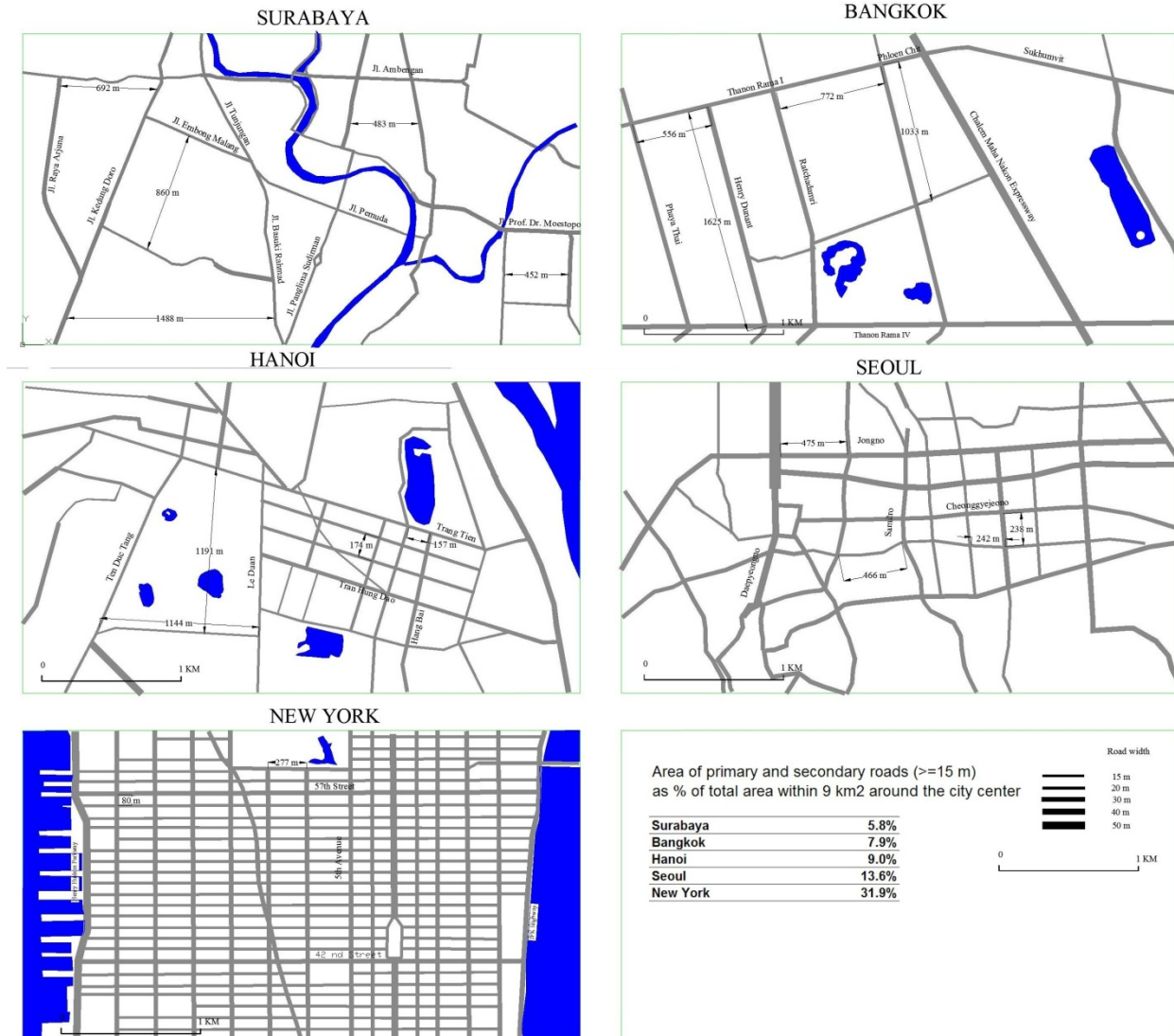


Figure 6: Streets equal or wider than 15 meters in an area of 9 km² around the city center in 5 metropolitan areas (same scale)

The current transport network of the central part of Surabaya could be improved in its design or in the way traffic is managed but it is unlikely to change much in the future. Nothing is more resilient than a road network. The challenge faced by Surabaya is to adapt its transport system to its road network.

The new road system planned in the future (*Figure 8*) shows a widely spaced grid of major roads with a distance between roads of more than 3km. These roads will channel in the future most of the commuting traffic.

Given the densities in the built-up areas of Surabaya the distance between major roads even in the suburbs should not be farther apart than 800 m if one day a transit system is to be extended to the suburbs. It should be strongly recommended that a grid of secondary roads distant of no more than 800m complete the current major roads plan. Major roads will have to be used by transit and should be accessible from a walking distance of no more than 400m, that should define the distance between major roads of the city network.

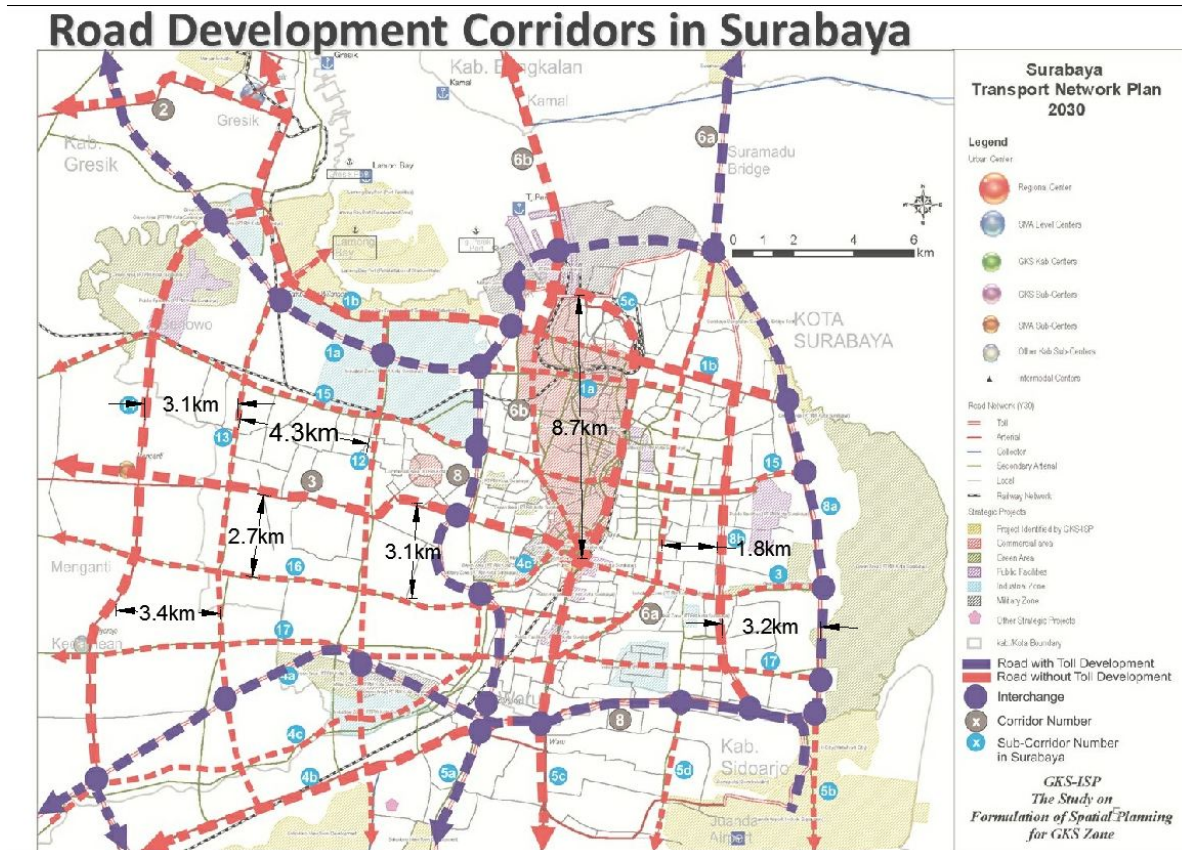


Figure 7: Road development corridors planned in Surabaya

The projected development corridors network of Surabaya is compared at the same scale to the current road network of Beijing, which has about the same built-up density than Surabaya. The interval between major roads is similar in the two plans. Beijing is notorious for its traffic congestion, in spite of its extensive underground transit network (340km in 2011). This congestion is attributed to the lack of alternative roads outside the ring roads. In other words, the grid formed by the main radials and the ring roads is too wide. In Beijing the blocks between ring roads and radials are too wide to be serviced efficiently by transit or by individual cars.

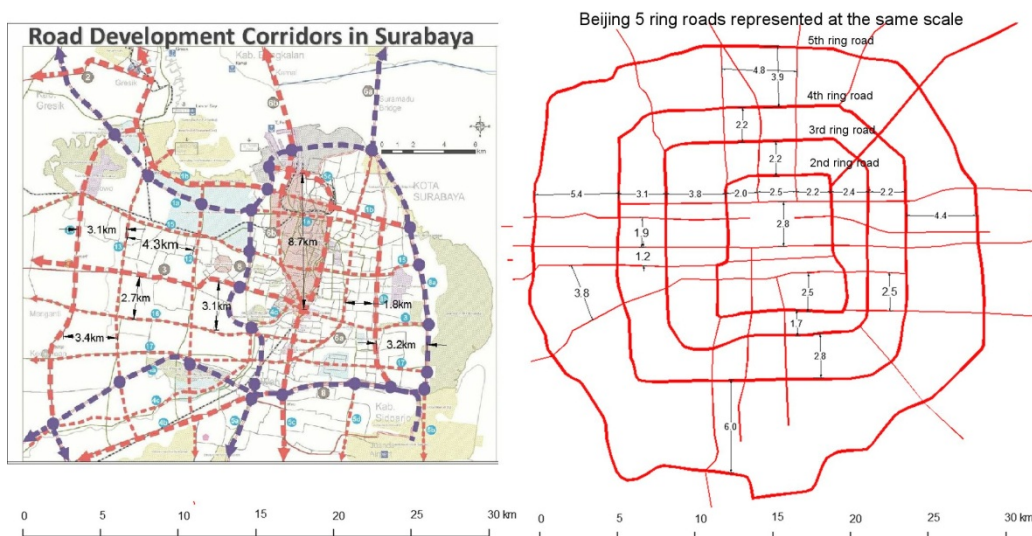


Figure 8: Surabaya planned development corridors compared to Beijing ring roads

The projected transit system: will it make a dent in congestion?

The city of Surabaya is planning to develop two new transit systems in addition of the current bus network: a tramway line (18 km) following the North South orientations of the densest job and residential areas and a monorail line (26 km) linking the Eastern and Western Suburb to the center.

Do the projected 44km of transit line are likely to alleviate congestion and increase the mobility of workers in Surabaya?

Currently, the motorized transport commuting modal share in Surabaya is motorcycle 71.5%, private cars 25% and public buses 3.5% (*Figure 10*). It is interesting to compare Surabaya's modal split to Hanoi's, a city of a similar size and density where motorcycles are also the dominant mode but where cars represent only 6.2% of the commuting trips. Cars in Hanoi are used for only 6.2 % of commuting trips compared to 25% in Surabaya, which probably explains the large difference in average commuting time between the 2 cities : 37 minutes in Surabaya against 19 minutes in Hanoi.

The highest GDP at PPP per capita in Indonesia explains the higher use of cars but it probably explains also the 50% difference in travel time between Surabaya and Hanoi. The combined effect of the high density residential clusters located in or close to the city center with the small percentage of land allocated to primary roads makes it impossible for cars to become a dominant mode of transport in Surabaya, now and in the future.

Surabaya - Commuting mode & travel time (2010)

| | Transport Mode | travel time (minutes) | Ponderated average travel time |
|------------|----------------|-----------------------|--------------------------------|
| Motorcycle | 71.5% | 37 | 37 |
| Car | 25.0% | 39 | |
| Bus | 3.5% | 23 | |
| | 100.0% | | |

Source: JICA Study Team. Trip diary survey

Hanoi (2008)

| | Transport Mode | travel time (minutes) |
|--|----------------|-----------------------|
| | 82.9% | 19 |
| | 6.2% | |
| | 11.0% | |
| | 100.0% | |

source: [Http://tramoc.com.vn](http://tramoc.com.vn)

Figure 9: Surabaya and Hanoi commuting mode and travel time

The motorcycle is an efficient mean of transport in cities like Surabaya where major roads are narrow and far apart. However, when households' income increase and motorcycles are replaced by cars, the road network cannot accommodate the additional space required by cars for the same number of trips.

One solution to decrease congestion is to develop rapidly a transit system that could be an attractive alternative to people who currently ride cars or ride motorcycles. In most cities, because of the time required to walk to and from a transit station, the travel time by transit is usually longer than when using individual mean of transport (motorcycle or car). A transit system, to have a chance to have an impact in increasing mobility, should have the following characteristics:

- a high capacity,
- a wide geographic coverage (at least 60% of the built up area accessible by transit)
- short headways, and
- Its own right of way additional to the existing road network and independent from the congestion created by individual means of transport.

In other words a transit system should offer a significant better alternative than individual means of transport but more particularly for car users. If the new transit system attracts only the users of existing buses and some motorcycle users, the improvement on traffic will not be significant. It may even

deteriorate if the number of motorcycle users that switch to cars is larger than the number of those that switch to transit. The following paragraphs provide a preliminary assessment of the potential impact of the planned transit system.

The tramway line (18km) will cross from North to South the job intensive area of Central Surabaya, crossing also the areas of dense kampongs. However, this line will not be free of congestion and might create even more congestion at peak hour by hindering left turns for motorcycles and cars. The tramway line will not increase the area of roads devoted to traffic, but will just reallocate it.

The monorail (26 km) will link the low density Eastern and Western suburbs to the Southern part of the CBD and will connect with the tramway line. The monorail speed would be independent from the traffic congestion on the road and its footprint would be less of an hindrance to the existing road traffic.

The catchment area of 800 meter for residence and jobs is shown on [Figure 11 and 12](#).

The table shown on [Figure 13](#) summarizes the findings of the spatial analysis.

Surabaya population densities and catchment area of projected tramway and monorail

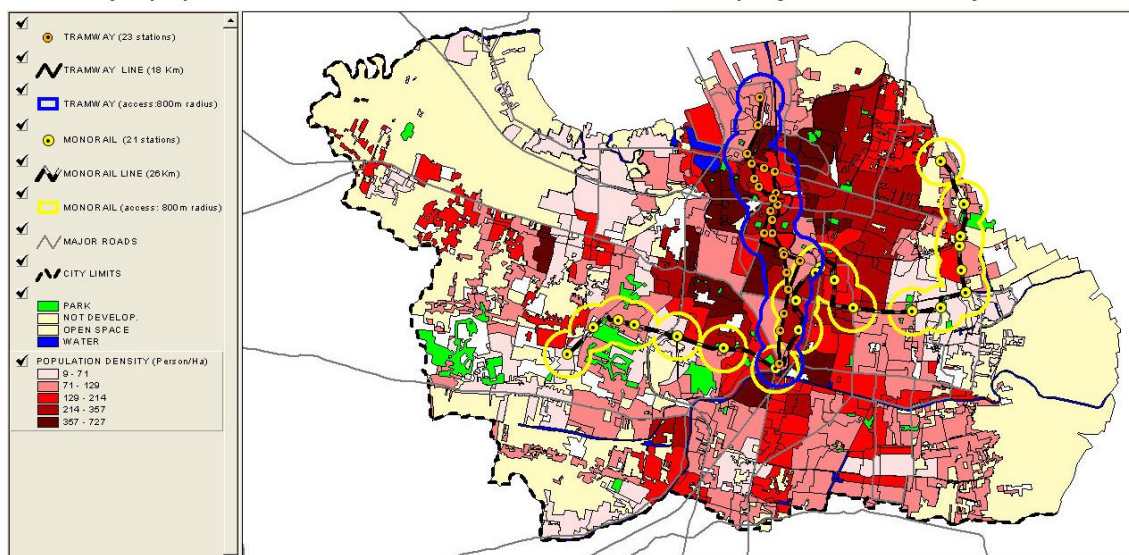


Figure 10: Surabaya – Population densities and the catchment area of 800m from projected tramway and monorail stations

Surabaya Job densities and 800 m catchment area of projected tramway and monorail

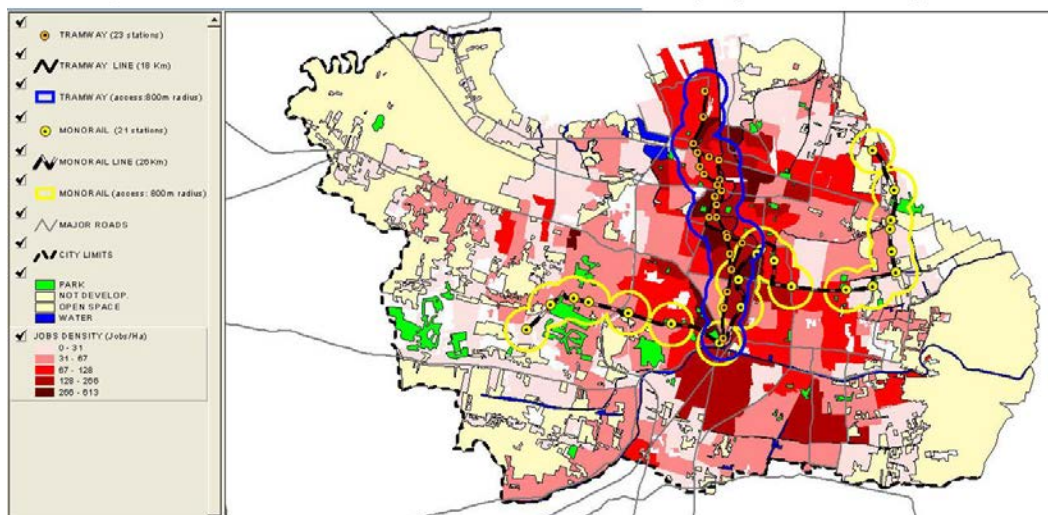


Figure 11: Surabaya – Job densities and the catchment area of 800m from projected tramway and monorail stations

Population and Jobs Within 800 meters From Projected Transit Stations

| | units | Tramway | Monorail | Total Impact |
|--|-------|----------------|----------------|-----------------|
| Built-up area within 800 m from station | ha | 1,737 | 2,511 | 4,248 |
| Population | | 344,441 | 337,003 | 681,444 |
| Population density in stations catchment areas | p/ha | 198 | 134 | |
| % of total Surab.Kota population | % | 12% | 11% | 23% |
| Jobs | | 295,083 | 213,906 | 508,989 |
| Job density in stations catchment areas | p/ha | 170 | 85 | |
| % of total Surab.Kota jobs | % | 22% | 16% | 38% |
| Number of people who are likely to live and work within 800 m from a station | | 2.5% 75,000 | 1.8% 53,200 | 4.3% 128,200 |
| Total Surabaya population in 2010 | | 2,973,700 | | |
| Total Surabaya jobs in 2010 | | 1,355,000 | | |

Sources: 2010 Census: population per kelurahan
 JICA: jobs distributed per kelurahan
 Authors calculations: Area and densities within 800m from stations

Figure 12: Number of people and jobs in the catchment area of the tramway and monorail

As can be seen on the table of [Figure 13](#) about 23% of the municipality population (2010 census) and about 38% of the current jobs would be located at less than 800 meters from the tramway and monorail stations.

If we assume that job locations and workers housing are randomly linked, then the number of workers living at less than 800m from a station and also working within 800 m from another transit station is about 4.3% of the population and would represent about 128,200 people.

As planned the transit system represent a first step in increasing the share of transit trips in Surabaya, making better use of scarce road space, at least for the monorail, but it is doubtful that the small capacity of the system will significantly increase mobility. Other transit systems would have to be built to complement this first attempt. Given the scarcity of road space and unlikelihood that this road space can be significantly increased in the future (at least for the central city) underground transit systems independent of the current road network will have to be eventually developed. Because of the wide acceptance of the motorcycle in Surabaya a transit system could be developed specifically to combine motorcycle and rapid transit. Stations could be designed with well-connected large motorcycle parking. This would considerably enlarge the catchment areas of stations beyond the 800 meters normally used for people who walk to the stations. The advantage would be to allow a shorter transit network with fewer stations and therefore greater speed.

Meanwhile, in the short and medium term, the main transport objective should be to maintain the motorcycle as the preferred transport mode, making individual cars an expensive commuting niche market by charging market parking fees and eventually tolling the city center for cars entering it. A toll for cars in the city center is equivalent of recovering a land rent for the 65 m² of road space that a car is using when circulating at 30 km/h on a city road.

Housing

Kampongs constitute a parallel housing market maintaining affordable low costs housing standards

For over 30 years, housing in Indonesia has benefited from a consistent policy aiming at upgrading kampongs. The housing stock in kampongs has constantly improved over the years because of the investments made by their inhabitants and because of the constant upgrading provided by the government. The investments made by the government in infrastructure and the continuity of policy over many years have also convinced households living in kampongs that the government had no intention to use eminent domain to displace them to redevelop the land under different use. This exceptional stability in government policy over many decades has resulted in creating a housing stock that is constantly evolving while being entirely demand driven.

The infrastructure provided in the kampongs insure that no matter how small and simple a dwelling is, people living in it have access to safe water supply, sanitation and storm drainage and social services.

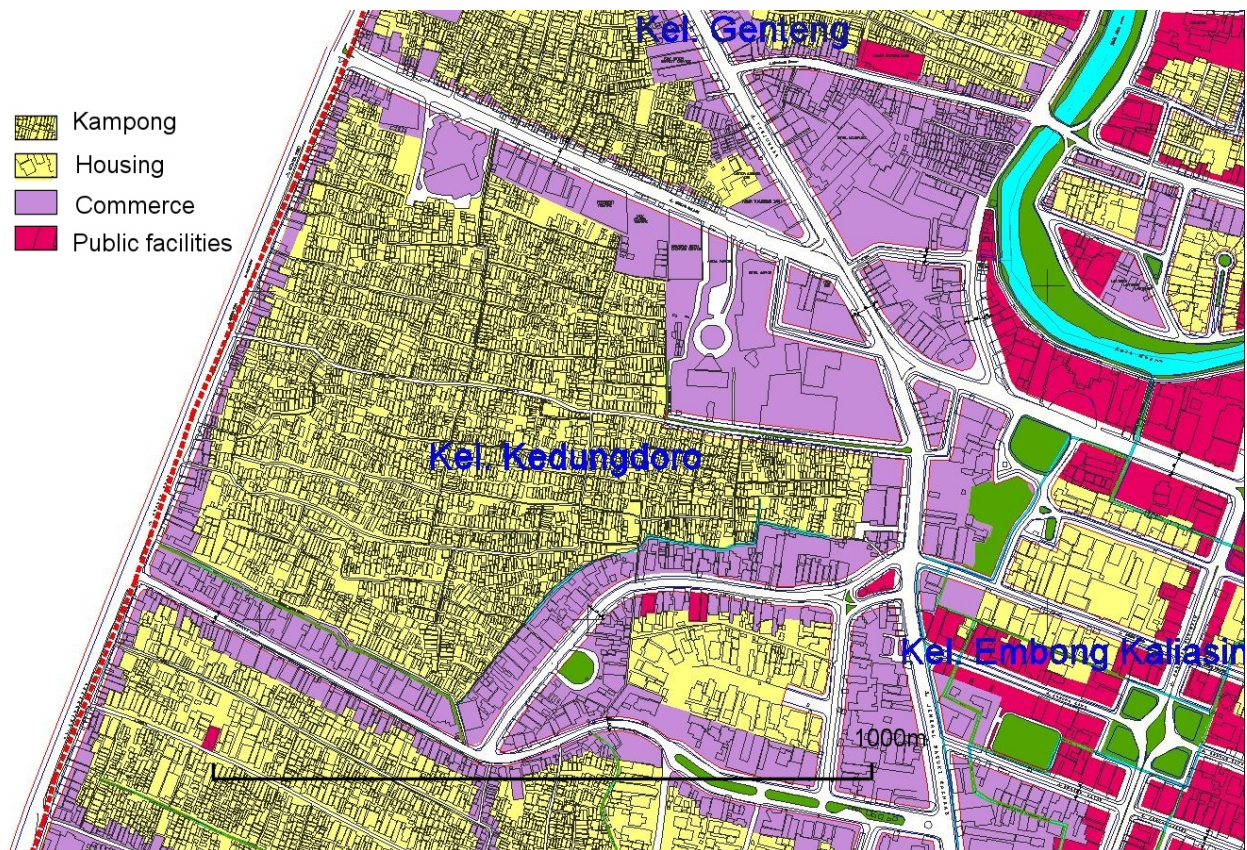


Figure 13: Typical Surabaya Land use in the central areas showing kampongs and commercial areas

Kampongs constitute an invaluable stock of housing affordable to those who cannot afford a car or are ready to trade-off the convenience of a car for the centrality of kampongs' location. The original rights of ways of narrow lanes and footpaths have been kept intact, even after significant improvement in drainage; water supply and paving have been made. As a result, most of the houses located inside the kampongs are hardly accessible by cars. These low road standards prevent land prices from aligning themselves with those of the more traditional houses built along vehicular roads. The housing stock located in kampongs constitute a parallel housing market for low-middle income households. Most

kampongs are densely populated, centrally located and close to commercial areas and job clusters (*Figure 14*). The lack of car access or at least the impossibility of parking a car on a residential lot makes the kampongs' population more likely to prefer motorcycles, electric scooters or transit their preferred mean of transport.

Kampongs are making an efficient use of land. *Figure 15* compares the maps of a kampung with that of a residential middle class area. The lots are much smaller (average about 100m²) in kampongs than in middle class housing (about 240m²) and the resulting density is more than double. The area devoted to roads is about one third of the one in a middle class area. The kampung's map, on the left side of *Figure 15*, shows also the wide variation in plot sizes, insuring also a variety of income within the same neighborhood. A study of housing prices and rents in kampongs would also most probably show wide prices differences depending on accessibility and proximity to a vehicular road. These differences in prices, within the same neighborhood, would insure that a wide range of lower income groups could be accommodated in kampung in the future without social segregation.

Are kampongs current low space standards able to evolve in the future?

Kampongs represent a large part of the current housing stock of Surabaya. What will happen when in, say 20 years, income would have risen to such a level that households, even at the bottom of the income scale, would be dissatisfied with their low space standards?

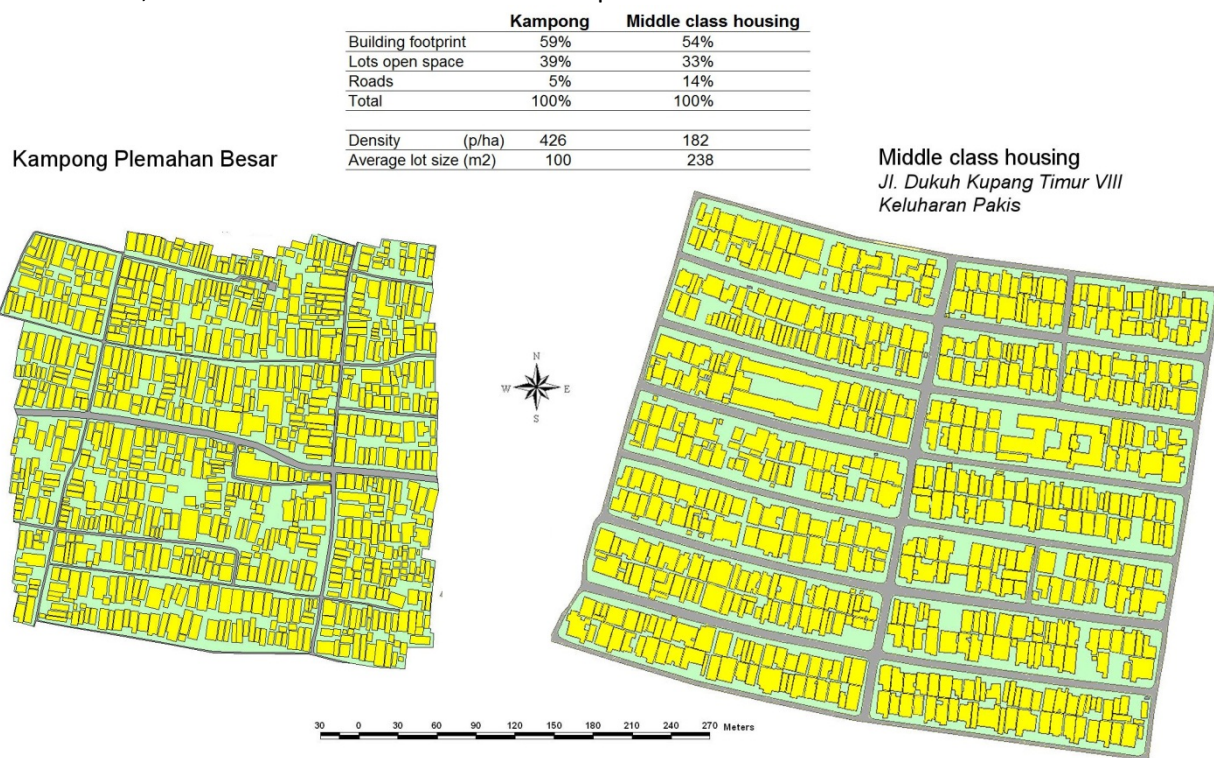


Figure 14: Kampong and middle class residential land use

It is likely that adjacent lots will get progressively consolidated into larger lots where higher houses could be built. This is already happening in the most accessible parts of the kampongs. These higher houses would be aligned on wider setbacks from the lanes allowing eventually better vehicular access. After a few decades some lanes in the better located kampongs would not look too different from the middle income housing development shown on *Figure 15*. It is important, however, that this evolutive process be demand driven from the inside of the kampung and under the control of the local

community. Any government or large developer driven “urban renewal” scheme would be detrimental and would progressively erase the advantages that a parallel markets offer to low income households.



Figure 15: New Kampongs formation in Surabaya suburbs

New kampongs are being created in the expanding suburbs of Surabaya (Figure 15). These new kampongs forms around existing villages and expand informally. The acceptance by the planning authorities of the low spatial planning standards (plot size and road width) in newly developed area insure that a constant flow of demand driven low cost housing is being built and added to the Surabaya housing stock.

The subsidies involved in improving kampongs’ infrastructure and providing social services is a much more cost efficient way to insure a flow of affordable low cost housing than the more traditional “low cost housing” supply driven programs current in many other countries of the world.

The continuation of kampong upgrading policy

The successful government kampong upgrading policy should continue to include the new kampongs under formation in the suburbs. In addition large investments in off-site storm drainage are obviously needed as shown by the map of flooded area provided by the planning department (*Figure 17*). The flooded areas represent a large part of the total municipality (about 20%). A large drainage investment project designed to deal with this city wide problem would certainly show a very high economic rate of return, in addition to improving the living quality of the Kampongs’ low income affordable housing.

While the preceding paragraphs were focused on issues concerning kampongs, it is important to complete a housing policy framework by monitoring the entire housing stock of the city. The typology provided in a separate document ¹ includes a number of housing types from Kampung houses to luxury suburban villas. The graph on Figure 18 shows the array of plot size and population density combination of the housing stock of Surabaya. Some types are still missing, apartments for instance, and should be added. When the typology is complete it will be necessary to add

- 1) a price range for each type and
- 2) An estimate of the number of units in each type.

¹ Power point presentation: "Spatial analysis using Google earth images and GIS" MA Bertaud 2012

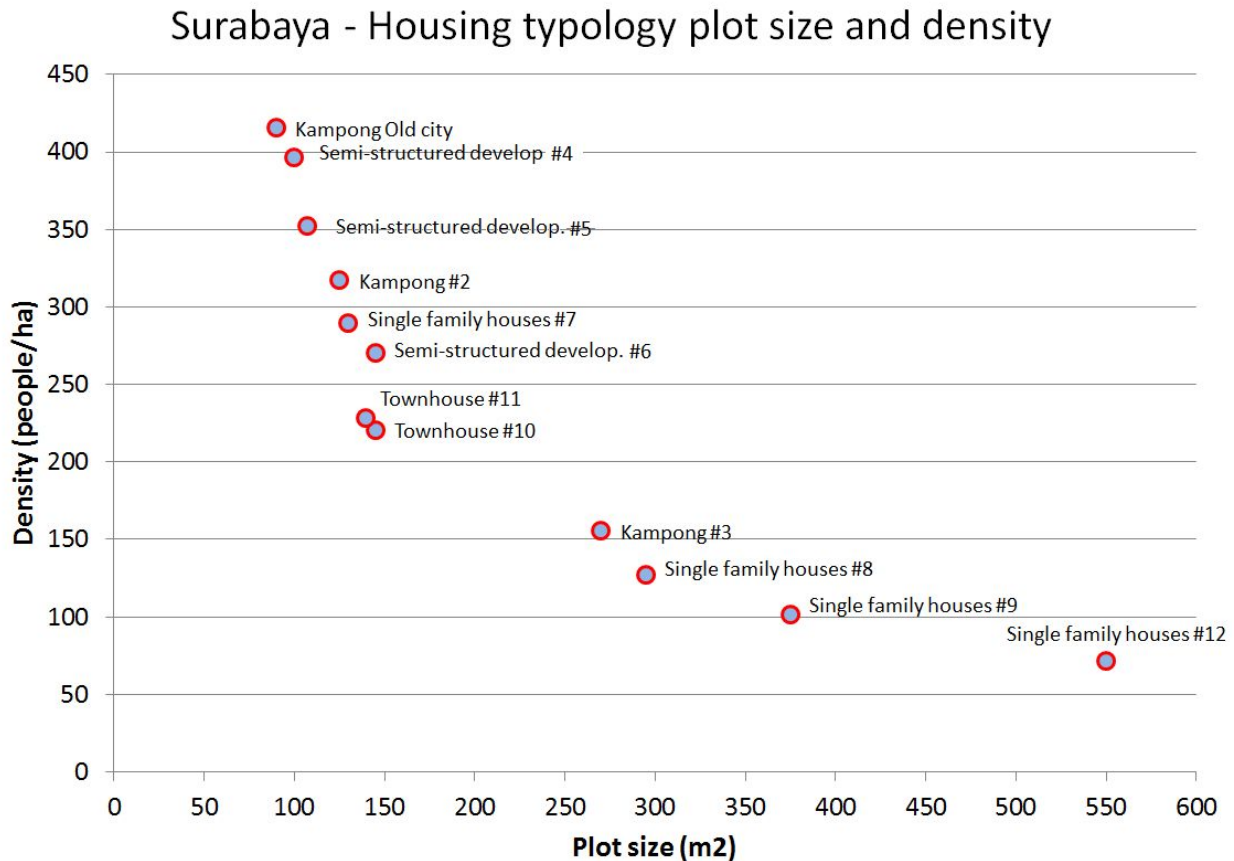


Figure 17: distribution of residential plot sizes and residential densities

Mobility and affordability issues within Surabaya current spatial structure

The spatial structure of Surabaya is different from many other cities. The area that is already built-up is not going to change much over the years to come, therefore housing and transport policy would have to be adapted to this structure and not the other way around (which is often the premises of many master plans). Surabaya spatial structure presents advantages and disadvantages that will have to be taken into account when designing new policy concerning transport and housing. The advantages and disadvantages and their implications are reviewed below.

Advantages of current structure

The distribution of businesses and jobs over a large area constituting a dense polycentric structure allow lower prices for business use while keeping a good accessibility.

The practice of mixed use and linear business areas along major roads surrounding kampongs and other residential areas reduces trip length and energy used for transport.

The kampung upgrading policy has created a large stock of affordable housing in good central location, mixed neighborhood, and a parallel affordable housing market for lower income groups.

Large and competitive commercial areas closer to residential neighborhoods, less centrality could reduce shopping and amenities trips.

Large shopping centers provide private pay parking for motorcycles and cars, and few on street parking provision.

Disadvantages of current structure and prospects for mass transit

Surabaya spatial structure creates severe limitations for transport.

Intense vehicular traffic is concentrated in few roads that loose commercial values because of noise, pollution and the difficulty of crossing streets. As a substitute to street retail, formal commerce concentrates in large shopping malls.

The very small primary road area put a strict limit on the number of private cars that could be used for commuting. There is therefore only the possibility of only two dominant modes: motorcycle or public transit.

However, Surabaya will always be difficult to service by mass transit because of the dispersion of trip origin and destinations. Traditional transit needs high density central destination points to be efficient to run and convenient for commuters. Trip destinations concentrated in few locations do not exist in present day Surabaya; jobs locations are spread on a wide area (about 100km² have a job density of more than 50 jobs/ha on a total built-up area of 190 km²)

Because of the small road area BRT is probably not the best form of transit within the central 100km² where jobs are concentrated. BRT could seriously disrupt existing motorcycle traffic without gaining much transit mode share.

The projected tramway and monorail would have probably a small impact on traffic because of their small capacity, slow speed and limited coverage.

Minibuses and small individual vehicles (electric scooters and motorcycles) might be the most efficient way to increase mobility in the short and medium term.

In the long term, a mass rapid transit network not using the existing right of ways, combined with stations that could allow motorcycle and electric scooter parking would be the best way to solve the traffic problem and provide a convenient alternative in term of speed to motorcycle or car used alone.

Mass transit stations designed specifically for access by two wheelers would allow a much wider coverage with fewer stations shorter mass transit network and more rapid trains.