Urban Density Measures in Planning for the Pearl River Delta

by

Sharmin Gani

Bachelor of Architecture
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Signature of Author:

Department of Urban Studies and Planning
August 8, 2000

Certified by:

John de Monchaux
Professor, Thesis Supervisor

Accepted by:

Dennis Frenchman
Professor
Chairman, MCP Committee

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ABSTRACT

The Pearl River Delta in Southern China is facing the task of formulating policy measures to manage urbanization and growth in its future urban development. Since 1978, under the 'open policy,' the process of urbanization in the region has accelerated, and the pace is expected to increase even more with Hong Kong's reunification with the rest of the region. This study looks at the urban density implications of three different scenarios in planning for the future of the Pearl River Delta. It looks at two cases in order to understand the policy variables related to developing urban density measures. The first case is Singapore, an example of high-density efficient urban planning that adopted urban density measures that yielded successful projections. The second is Bangkok, a city known for its inefficient urban systems where the urban population far exceeded the projections. The study is based on a premise that success or failure of urban density measures of any plan is a good indicator of the success or failure of the planning system it is the product of. It relies on the concept that when certain key policy variables, e.g. coordinated transit, land use and development plans, enforcement, evaluation, etc., are adequately considered, plans and their density projections are more likely to be realized as anticipated. The study looks at the selected planning processes, and tries to define conditions for successful density projections. It looks at historical processes of planning to understand the extent to which successful plans have been sensitive to density implications, and whether density measures have been used as indicators for evaluating plans. Finally, the study derives a set of density measures for the three different future scenarios for the Pearl River Delta, identifies key decision variables and proposes a set of policy recommendations.

Thesis Supervisor: John de Monchaux

Title: Professor of Architecture and Planning

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Chapter 1: Introduction to the Thesis Topic

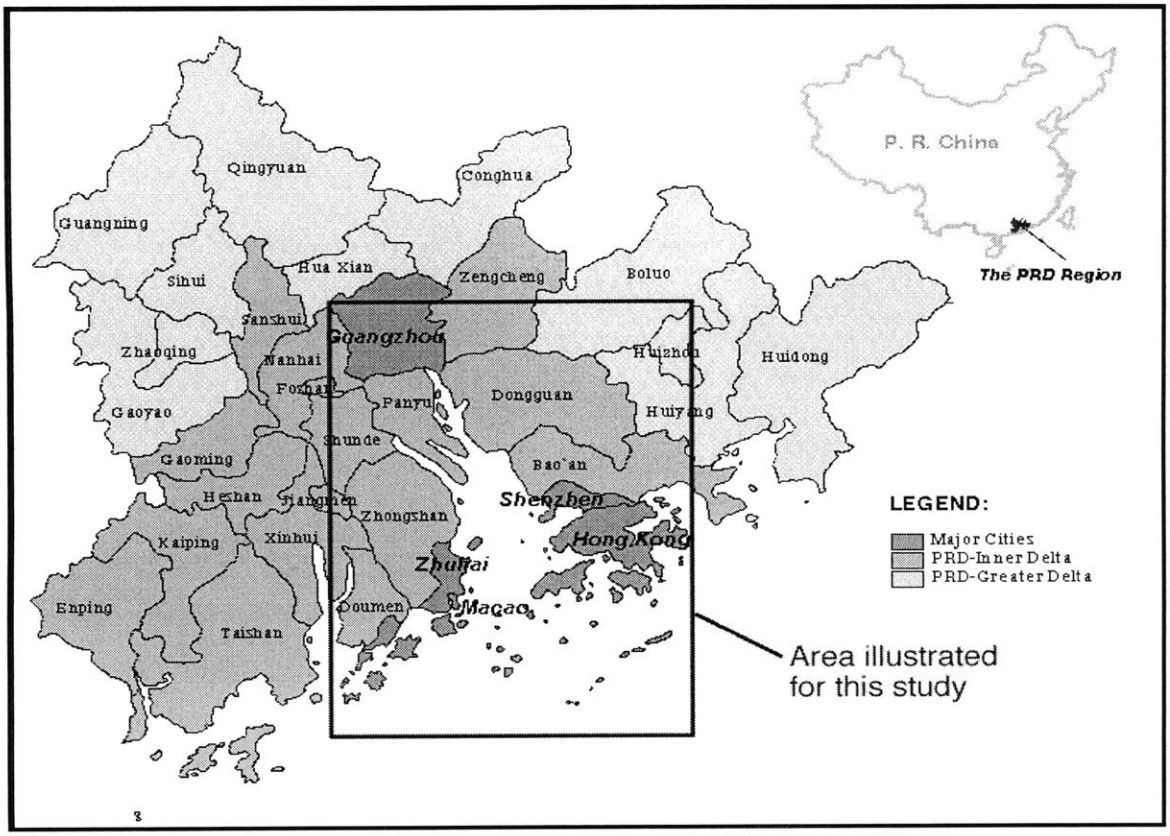
1.1 Introduction

Most of the developing nations in the world have been facing the task of managing rapid urbanization for the last fifty years or so. Experience shows that urban population densities achieved in any particular area are inextricably linked with the political, economic and social conditions of the region. China, before 1978, under strong central communist control, could effectively monitor the density of its cities, by controlling population mobility. However, since 1978, under the 'open' policy, the situation has changed. Like the majority of cities in other low income developing nations, Chinese cities have started facing the challenge of rural-urban migration and the resultant growing congestion.

The focus of this study is one such Chinese region, the Pearl River Delta (PRD), located in the southern part of the Chinese province of Guangdong. Prior to 1978, the region experienced little urban growth, being far away from Beijing, the seat of Chinese power. But since 1978, during the new economic era, in this southern part of China, urbanization has accelerated and several new cities have developed, such as Shenzhen and Foshan. This growth has given rise to the issue of planning for the region. Currently, there are 420 cities and towns in the PRD, with a population of 20.5 million spread over 41,600 sq. km. Its proximity to Hong Kong, a world financial center, has helped attract a significant flow of investment into the region during the new economic era. The reunification of Hong Kong with mainland China is expected to enhance this flow and create a positive economic impact over the region.

To Hong Kong, the PRD is the doorway to the rest of China, and the recipient of the primary thrust of investment, industrialization, and particularly, urbanization. With the new economic opportunities created in the region, the PRD has been receiving a large influx of temporary and migrant population, increasing both its urban population and its urban density.

Fig. 1.1: The Pearl River Delta Region



Source:http://web.mit.edu/11.hkstudio/www/home

A major concern for the policy makers of both Hong Kong and China is how to maintain and enhance the symbiotic relationships among the major centers in the regions. Project 2022, sponsored by a consortium of business people from Hong Kong, is one outcome of such concern.

One part of Project 2022 is the Pearl River Delta Planning Studio at MIT. The participants in the studio were divided into sector teams dealing with economic development, land use, transportation, environment and tourism. As a part of the team looking into land use issues, I have developed this individual thesis to look deeper into the issue of urban density and its related implications.

1.2 Urbanization and Urban Population

Urbanization is the transformation of hitherto undeveloped, rural land into urbanized areas through provision of urban amenities. It includes the renewal and upgrading of existing urban services to address changes in demand made by the urban population. The urbanization process has been synonymous with modernization, and in many instances, physical, as well as social and economic development. After the Second World War, a majority of the today's developing countries experienced a process of urbanization, through physical planning that allocated certain amount of resources for the development of a specific geographic area. In most instances, because of the scarcity of resources, such plans initiated the process of urban development at key locations, major centers or already established urban points.[1] A by-product of this process has been enhanced rural-urban migration, a process by which rural population moves to urbanized areas with the hope of getting better economic opportunities. This often resulted in a greater level of urbanization than the plans envisioned and greater urban density than the proposed carrying capacity in the planned areas. Individual countries tried to solve the problems with varying degrees of success. Some of the solutions have been to decentralize urbanization efforts and create a balance of job opportunities away from the established urban centers.

In terms of physical outcomes, the process of urbanization and rural urban migration has led to an increase in floating population, i.e. rural migrants with no permanent address, in the cities. In many instances, the failure on the part of the responsible authorities to anticipate the magnitude of migration and address the needs of those moving to the cities resulted in slums and squatter settlements. Cities like Bombay, Jakarta and Sao Paolo are all examples of this phenomenon. Such unplanned-for- increases in urban population have several serious implications. It requires that the urban systems of the city, like the public sewerage, water supply, electricity, drainage, sanitation, etc., have to serve a lot more people than they were intended for. It also generates a crowding effect, whereby the supply of amenities like housing, institutions, recreational facilities etc. become scarce,

[1] Ingham, B. "The Meaning of Development: Interaction between 'New' and 'Old' Ideas" *World Development.* Vol. 21, No. 11. 1993. p. 1807.

and the increase in demand pushes the prices up. Often other outcomes also follow, such as congestion, environmental degradation, widespread unemployment and a general worsening of the law and order situation. However, it is undeniable that urbanization has acted as a vehicle of economic development for many of these nations. But, in many instances, the failure of the planning processes to anticipate some of the physical outcomes of urbanization has not yielded the predicted social and physical development.

The developing nations have been struggling to tackle these residual products of the failures to anticipate urbanization adequately with varying degrees of success. That in many instances the worse cases have to combat poverty and under-development makes the problem of dealing with urbanization more difficult. Successful Asian examples include Japan, Singapore and Hong Kong, which have been able to anticipate and tackle many of these problems by effective strategic planning, while many others like India, Bangladesh and Thailand are still trying to cope with the issues.

In terms of physical planning, formulating an appropriate measure of urban population density has become important. A key assumption of this study is that successful plans adopt realistic density measures. Learning how different countries formulate their plans and density projections and comparing their outcomes will have meaningful lessons for the future planning for the PRD.

1.3 The Context: Urbanization in China

Unlike in most other developing countries, rapid urbanization in China is a more recent phenomenon. In 1949, when the New China was founded, China was an agricultural nation, with only 15% of its of its national economy in industry.[2] Its urbanization level, i.e., the proportion of people living in urban areas, was at only 10 percent.[3] Under the central control of the communist government, the mobility of the population was tightly controlled, reducing any possibility of migration. From 1949 to 1978, China developed heavy industries to strengthen the nation's economy. Housing, food and other daily

[2] Zhan, Q. A Review of China's Urbanization Process Since 1980's. *City Planning Review*. 13 (2), 1997. p. 5.
[3] Zhan, 1997. p. 5.

necessities were distributed by the state to the citizens at a subsidized price. Productive construction was top priority, and urban infrastructure was regarded as non-productive, which led to an inadequate allocation for urban development. As a result, the urbanization process remained slow. From 1952 to 1978, the annual growth of the urban population was only 3.43% (for China), and the urbanization level remained unchanged at around 17% for more than ten years during this period.[4]

However, the picture changed in 1978 when economic reform was introduced in China. In select areas of the country, including the PRD, the government allowed market-based economic practices. Since then, the average annual increase in urban population has been 4.28% (for China). By 1995, the urbanization level had reached 29%.[5] Foreign investment played a major role in this process.

Although belatedly, the effects of urbanization have started to be felt in China. Urbanization has given rise to a floating population in Chinese cities. It was estimated that by 1997 that more than 80 million people originally from rural areas had moved from their homes, among which some 70 percent had come to the cities, accounting for 25% of the country's total non-agricultural population living in cities and towns.[6] However, what China has experienced so far may only be the tip of the iceberg. In 1997, only 31% of the population in China lived in urban areas. During the next five-year plan period (1996-2000) to 2012, China will enter a new period of accelerated urbanization. To maximize the positive outcomes of urbanization, China needs to look at comparable examples from elsewhere. The Pearl River Delta Planning Studio is an effort along those lines.

1.4 Pearl River Delta Studio

In the Spring semester of the year 2000, twelve students of the Department of Urban Studies and Planning at MIT participated in a studio that engaged in discussing the future planning issues of the Pearl River Delta Region. This studio, called the Pearl River Delta Planning Studio, went for a field trip to the region and met with local people, including

[4] Zhan, 1997. p. 6.
[5] Zhan, 1997. p. 6.
[6] Zhan, 1997. p. 7.

scholars, planning professionals, politicians and activists. After the trip, the group continued the semester-long studio developing alternative future scenarios for the region.

The economy of Hong Kong (HK) and the Pearl River Delta (PRD) region have been growing economically at a very fast rate for the past twenty years. The PRD, in the aftermath of its initial wave of urbanization, now faces serious problems of environmental degradation, traffic congestion, chaotic growth, fragmented jurisdictions, and a lack of planning and intra-regional coordination.

On the economic front, HK today is still recovering from the Asian financial crisis while China is facing problems in carrying out economic reform. Competition from other cities in the region, such as Singapore and Shanghai, has become more intense. The entry of China into the WTO will create new problems and opportunities.

HK/PRD has the advantages of a homogenous cultural region, a large internal market, skilled and motivated managers and work force and HK as a source of capital, marketing, and technology. However, this region is unevenly developed with the potential for new directions in transportation and vehicular use, settlement patterns, environmental regulation, etc.

This studio has developed strategies and scenarios for the physical development of the HK/PRD Region as part of Project 2022. The purpose of Project 2022 is to provide the research data and analysis in urban planning, the environment and infrastructure to frame and focus the debate on how HK and the PRD should develop. The intention of the studio is to explore how policies that benefit both the Delta and Hong Kong can be developed, keeping in mind the problems and the prospects of the specific Chinese cities in the region.

The end product of the studio was a series of scenarios for developing the region based on varying and inter-related assumptions about policies towards economic growth, population, land use (agriculture, residential patterns), transportation (especially auto dependency), energy use, environment, etc. Studies at several scales - regional, local and

intermediate - will be done as necessary to understand the issues. Implementation issues will also be explored. The core scenarios being developed in the studio are:

Scenario A: The best possible future for the PRD region.
Scenario B: A moderately favorable future for the PRD region.
Scenario C: An unfavorable future for the PRD region.

A principal task in the studio is to find comparable examples of strategic planning and outcomes that can be used as surrogate measures in each of the scenarios. Singapore, for most sectors, has been used as the model for Scenario A. Tokyo, Paris, New York, etc., have been used for Scenario B and Bangkok for Scenario C.

1.5 Individual Thesis Topic

Within the realm of the Pearl River Delta studio, I have studied the urban population density implications of the different scenarios for the PRD that would be developed in the studio. The issue of urban population density is related to physical plans and land use planning. In this thesis, I examine how future urban growth projections can, together with urban policies, be translated into density measures, i.e., density figures and their associated physical implications. The study is being done to understand how decisions related to physical environment should be made and resources should be allocated for a developing region like the PRD, facing rapid urbanization and growth.

1.6 Methodology

The physical outcome of future development policies for a region depends on the adoption of appropriate population density measures. Evidence indicates that usually when a planning processs yields successful density projections, it has adopted a realistic density measure that is flexible enough to adapt to changing urban needs. The term 'successful' here refers to the capability of a process to forecast future trends and the ability to be modified, if necessary. It is rare that a plan is able to predict future population projections with hundred percent accuracy. But a successful plan would have

mechanisms for constant evaluation and upgrading. Singapore, an example of efficient and successful urban planning, adopted urban density measures that yielded successful projections though a practice of flexible adaptation. Whereas, Bangkok, a city known for its inefficient urban systems where the urban population of the city has far exceeded its projections, display a process where the decision makers had evidently failed to predict the trend of urban development and where a mechanism of adaptation is not present. In planning for the future development policy for the Pearl River Delta region, coming up with an appropriate density measure is therefore important. The case study method is adopted here to understand policy variables related to the issue of density. I propose to conduct a couple of case studies to understand the issue of density, planning projections and related issues. For the purpose of my study, I have selected Singapore, as one of the better cases, and Bangkok, as one of the worse cases in terms of success of urban density projections.

Why choose the case-study method? Formulation of policies is linked to a complex array of context-specific socio-economic issues. It is difficult to categorically reduce these to a generally applicable objective format. Each requires looking deep into its historical process of decision making. Case studies provide the opportunity to do so by looking at a limited number of cases with great scrutiny.

The next problem was how to choose the case studies. Not all from the global list of policy precursors can help decision-makers in China. Only those with similar contexts and facing similar development goals are appropriate. The cases included here, Singapore and Bangkok, are both in East Asia, in the same macro-economic setting as China. Both the areas put in place policy formulations for development in the past, whose effects or traces can be observed now. Therefore, they provide concrete evidence of policy outcomes from which it may be possible to learn important lessons for China.

Another consideration in the selection of the case studies was to contain the possible range of planning outcomes in a similar set of contexts. Hence the inclusion of one of the better and one of the worse cases. In the global arena, in terms of living conditions,

Singapore scores high with its efficient urban systems. Bangkok on the other hand, takes a much lower place, with its inefficient sprawl-type development. The contention here is that learning from one of the better and one of the worse cases would provide illustrations of the widest range of possible options and outcomes. To formulate a successful policy for the Pearl River Delta, it is important to have a thorough grasp of the related issues in policy making. The case study method, with the cases being in similar contexts, may help to do just that.

1.7 Objective of the Study

This study begins with the premise that success or failure of urban density projections is a good indicator of the success or failure of the urban planning systems that they are the products of. We think that the extent to which an urban planning system can act as an 'enabling setting' is reflected in its capacity to produce a 'successful' plan that can predict possible future trends and modify according to changing urban needs.

The study also assumes that when certain key decision variables (coordinated transit, land use and development plans, enforcement of the plan, evaluation of the plan, etc) are adequately considered, plans and their density projections are more likely to become real. The attempt here will be to test these assumptions. For doing so, I propose to do the following:

- Look at selected planning processes, try to understand when and why a density projection is successful and when and why it is not, i.e., try to define conditions for successful density projections.
- Determine the components, i.e., the 'the build-up' of successful urban density projections and their characteristics, and what (if any) are the usual physical outcomes of successful projections.
- Determine from the historical process of planning to what extent successful plans have been sensitive to density implications, and whether density measures have been used as indicators for evaluating plans in the process of modification and upgradation.

- From the lessons learned from Singapore and Bangkok, derive a set of density measures for the Studio scenarios
- Identify key decision variables and propose a set of policy recommendations.

1.8 Overview of the Thesis

In this introductory chapter, the context of the study has been defined and the related issues have been elaborated. In the Chapter 2, I discuss the issue of urban density and the related implications. Chapter 3 describes and analyses the planning processes so far in practice in PRD and Hong Kong. It includes what future plans PRD has formulated so as to understand how policy makers currently perceive the issue of urban density. Chapter 4 presents Singapore and Bangkok, the two case studies, tracing outcomes to planning decisions. Chapter 5 applies the lessons from case studies to the scenarios developed in the studio to generate a range of density outcomes under each of the scenarios. Finally, Chapter 6 concludes the study by emphasizing the major issues that emerged from this thesis, and presents some recommendations for the future planning of the Pearl River Delta.

Chapter 2: Planning Intentions and Urban Density Outcomes

This chapter presents definitions of various measures of density, ranging from urban density to residential density. It will include discussion of factors that affect urban density and the components of urban density. How building standards and regulations may be used as tools to manipulate density will be elaborated. Finally, the chapter will look at the relationship between plans and density outcomes.

2.1 Density

Physical density measures the intensity of use over a certain amount of space.
There are many measures of density in the context of physical planning of cities. Density measures are projected initially to plan and later to assess the physical outcomes of city planning policies.

A ratio is a common form of density measure. The numerator is usually some entity or unit that occupies space, such as persons, dwelling units, serviced land, rooms, etc. The denominator is usually a unit of area, ranging from the residential plot scale to city scale. Numerators like population units and housing units are interchangeable and convertible from one form to another. Increasing any measure in the numerator would increase density, while increasing the denominator would decrease density. Table 2.1 shows the components and units of density ratio measures.

Another form of density measure, also in the form of a ratio, is the urban space allocation for a certain number of population. This can be expressed as the per capita urban space, where the numerator would be urban land area, or any particular measure of built area (commercial or residential floor area). The denominator would be the population number. This measure has a qualitative dimension, as it expresses the actual amount of space available to people. Examples of this kind of measure include hectares of urban land per ten thousand population and per head allocation of urban space in square meters.

Table 2.1 Density as a Ratio

Ratio Component	Unit		
Numerator	People	Residential Population	Persons
			Families or Households
		Working Population	Workers
	Housing	Number of housing units or dwelling units	
		Number of habitable rooms	
		Number of bedrooms	
		Number of bed spaces	
	Built Floor Area	Gross Floor Area, i.e., the area within the envelope of the building, including the thickness of its external walls	
		Net Floor Area, i.e., the area within the envelope of a building after circulation space, mechanical services and thickness of walls are excluded.	
Denominator	Molecular	Space within a dwelling unit, i.e., room, area or dwelling unit.	
	Molar	Land base, i.e., site area (net and gross), neighborhood area, suburban area, city area	

Chan C. K. Measuring Physical Density: Implications of the Use of Different Measures on Land Use Policy in Singapore. Masters Thesis, MIT, 1999. pp 44-46.

Some of the commonly used density measures are discussed below.

2.1.1 Population Density

Population density is the total population in a given area divided by that total land area. This figure is usually mentioned at the national and city levels. The figure is specific at the national level because of the set political boundary. But at city levels, the figure for population density may become hard to establish: often not enough distinctions are made about what boundary is being used, and whether vacant land adjacent to city boundary is being considered.

Table 2.2. shows the 1990 population density of selected cities in the United States.

Table 2.2. Population Density in Selected US Cities, 1990

City	Persons/ Sq. Km.
Baltimore	1230
Boston	1202
Chicago	1654
Detroit	1275
Houston	952
Los Angeles	2239
New York	2087
Philadelphia	1400

Source: Demographia, The Public Purpose, Internet Public Policy Resources, http://www.demographia.com

2.1.2 Urban Density

Urban density is the density of population over the urbanized area. Often this figure is not immediately apparent, and may have to be arrived at by looking into land use allocations. In general, urban density is calculated over the total urbanized land area excluding land devoted to agriculture, natural open space, military, cemeteries and land that has not been developed. Table 2.3. shows the urban density in the same cities whose populations density has been shown in Table 2.2.

Table 2.3 Urban Density in Selected US Cities, 1990

City	Persons/ Sq. Km
Baltimore	3513
Boston	4593
Chicago	4748
Detroit	2856
Houston	1158
Los Angeles	2856
New York	9148
Philadelphia	4516

Source: Gibson, C., Population of the 100 Largest Cities and Other Urban Places in the United States: 1790 to 1990, population Division Working Paper No. 27, U. S. Bureau of Census, Washington, D. C.,1998.

A comparison between Tables 2.2 and 2.3 shows how the urban density is always higher than the population density of an area. The degree of variation between the population density and the urban density is not constant. New York's urban density is almost four and a half times the population density, whereas Los Angeles's urban density is less than one and a half times the population density. The variations between the population and the urban densities are partially explained by the amount of land available for urban development in different areas. But public policy on urban development also plays an important role in the resultant urban density of an area, as will be discussed later in this chapter

2.1.3 Neighborhood Density

This is the density calculated over the total land devoted to neighborhood uses. It includes residential land, streets and neighborhood community facilities (schools, shopping, recreation and religious facilities, including open space for local neighborhood use).

2.1.4 Residential Density

The population or number of dwelling units calculated over land area devoted to residential purposes. The net residential site area considers the total land devoted to residential dwellings, including, private driveways, yards, parking areas, and gardens. The gross residential area takes into account the specified portion of feeder roads serving the residential area by adding to the numerator the area of such roads.

2.2 Public Policy and Urban Density

Urban density is the number of people over an urbanized land area. In the context of physical planning and land development, urbanized land area is the land serviced with urban amenities, i.e., road, sewerage, water, sanitation, transit etc. This is the land designated for urban development, and have direct implications on the infrastructure investment decisions. Not all possible urban infrastructure provisions may exist in a particular piece of urban land. What amenities a particular urban area will be served with

depend on issues like national resources, cultural preferences, development choices, and most importantly, public policy directions.

Urban policies on land use, housing, transportation, infrastructure, recreational facilities, environmental standards, etc., are instrumental in the space allocation at the city and the neighborhood levels. These urban policy variables guide the location, quality and quantity of urban facilities. They also determine the extent of urban provision provided by public and private enterprises. For example, a set of urban policies that emphasizes public housing, strong land use regulations and transit development will lead towards certain relationships between the urban and neighborhood densities. Another set of policies that promotes self-help housing and auto use would have quite a different implication on urban and neighborhood level urban densities. A set of policies that is concerned with adequate allocation of facilities would emphasize measures such as hectares of urban land available to a certain number of people.

The effect of policy variables on the urban density outcome of an area is evident in the variations between the population density and the urban density. Table 2.3 calculates the multiplier percentage, when calculating urban density from population density figures

Table 2.4 Percentage Multiplier for Density Measure, from Population Density to Urban Density, in Selected US Cities, 1990

City	Percentage Multiplier (From Population Density to Urban Density)
Baltimore	286
Boston	382
Chicago	287
Detroit	224
Houston	122
Los Angeles	128
New York	438
Philadelphia	323

Source: Various plans and surveys listed in the Reference Section

for the same U.S. cities shown in Tables 2.2 and 2.2. The table shows varying percentages of increase, ranging from as low as 122% in Houston to as high as 438% in New York.

Higher multipliers for urban density indicate the possibility of greater non-urban land (agricultural, military, reservoir, catchment area, etc.) within their jurisdictions. Notwithstanding, it is interesting to note from this study that cities with strong rapid transit systems and zoning regulations that encourage mixed-use development, like New York, Boston or Philadelphia have higher multipliers for urban density. On the other hand, cities that have poorly developed rapid transit, auto-based development and single-family dwellings as the predominant residential type, like Houston or Los Angeles, have low multipliers. There are also cities in between the extreme cases, like Baltimore or Chicago, whose density outcomes are no doubt a resultant of similar policy components. Although a detailed analysis of the exact effect of a set of policies on urban forms is beyond the scope of this study, it is nevertheless important to understand that policy measures do impact urban density outcomes in a definite way. In the next sections, the discussions will elaborate the components of urban density measure and the impact of policy variables on these components.

2.3 Components of Urban Density

Urban density is composed of several components. As mentioned before, it is measured by a ratio, and has a numerator and a denominator. The numerator generally is the the number of persons under consideration, at the national, city or block neighborhood development scale. The number of dwelling units or households can also be the numerator, although then we would need to have information on occupancy rate and average household size.

The denominator can be calculated in two ways. The first way would be to take the amount of urbanized land at the national or city level. This information is often available from land-use plans or infrastructure provision decisions. Although using this figure as

the denominator certainly helps us to see how intensely the overall urban land is being used, it may sometimes overlook some other qualitative indicators, for example, if people are getting transportation and community facilities, or if there is adequate recreational and open space. Therefore, another way to get at the denominator is to add land area devoted for all the urban functions, i.e., residential, commercial, institutional, recreational and open space, and use the aggregate figure.

Specific land uses need to be accompanied by provision standards that specify how much area a certain use would have. Usually the minimum level is set, so that people have access to adequate urban facilities. Regulations and provision standards are instrumental in shaping the built environment. Availability of land, infrastructure and building guidelines go hand in hand with policies and provision standards in defining the built forms, i.e, compact high-rises versus sprawling low-rises. Table 2.5 shows, albeit in a very simplified manner, the various land use categories and related policy variables.

Table 2.5 Components of Urban Land Use and Related Policy

	Land Use	**Policy**
Urban Land (Serviced and Developed)	Residential (Living Space)	Housing and Land Policy
	Working Space (Commerce & Industry)	Land Policy
	Institutional and Community Space	Housing and Land Policy
	Open Space/ Recreation	Land and Environmental Policy
	Infrastructure (Transportation)	Housing and Transportation Policy
Non-Urban Land	Others (Undeveloped land, Cemetery, Agriculture, Quarry, Military, Central Catchment)	Land, Environmental, & Conservation Policy

Source: Chan, C. K., 1999. p. 68.

For the purpose of this study, urban land use is reduced to five categories. Which are,

- Residential Land Use
- Working Space (Commercial and Industrial Land Use)
- Institutional Land Use
- Recreational Land Use
- Infrastructure

2.3.1 Residential Land Use

Residential land refers to urban land dedicated to residential purposes. The location of residential land depends on urban form and policy, as does its extent of segregation from other urban functions. As shown in Table 2.2, urban residential land is the outcome of land and housing policies. These policies range from minimum to maximum intervention and provision. At the minimum level, urban authorities merely designate the location of residential land and make infrastructure available, with little restriction over building activities. At the other extreme, not only is the location specified, but the extent of building, occupancy and services is pre-determined according to existing standards.

The residential density figure depicts the principal served space for the residents, around which all other servant urban amenities are arranged. As has been mentioned before, one principal determinant of residential density is the type of residential development. Landed housing, i.e., detached and semi-detached low to mid-rise housing will yield a lower density than high-rise residential development. Also important are the room sizes and occupancy rates. Increase in room size will decrease residential density, while increasing occupancy rates, will increase residential density. Since residential space includes inner area for circulation, parking, garden and terraces, decreasing area for these purposes would lead to increased residential density.

Another important factor for residential density is the availability of mass public transit. Transit allows a high level of compact living with a highly centralized provision that encourages high-density compact residential living assured with adequate transportation. Since provision of mass transit is almost always an outcome of higher level of decision

making, provision of transit, among other large-scale infrastructure provisions, is almost essential for high-density residential space.

2.3.2 Commercial and Industrial Land Use

Commercial land is the space allocated for commercial and industrial purposes, i.e., the working area for the residents. This is an important component of urban land. The proportion of commerce to industry, the nature of commerce and industry, employment of technological advances in financial and production purposes, all contribute towards determining the amount of land to be developed for this purpose. A service-based economy can create high density commercial areas, while manufacturing based economies tend to be less dense.

Like residential land, transit is an important factor in the density level of commercial land. Availability of mass rapid transit can increase the density of central business districts.

2.3.3 Institutional Land Use

Institutional land is the land devoted for institutional purposes, including educational, health care, administration and other purposes. They are designated at neighborhood as well as in city or national level. Usually the land allocated is proportional to the number of users. Their allocation is dependent on available land and the intended quality of living for the citizens. It is fairly common for more affluent cities and communities to have greater institutional allocation.

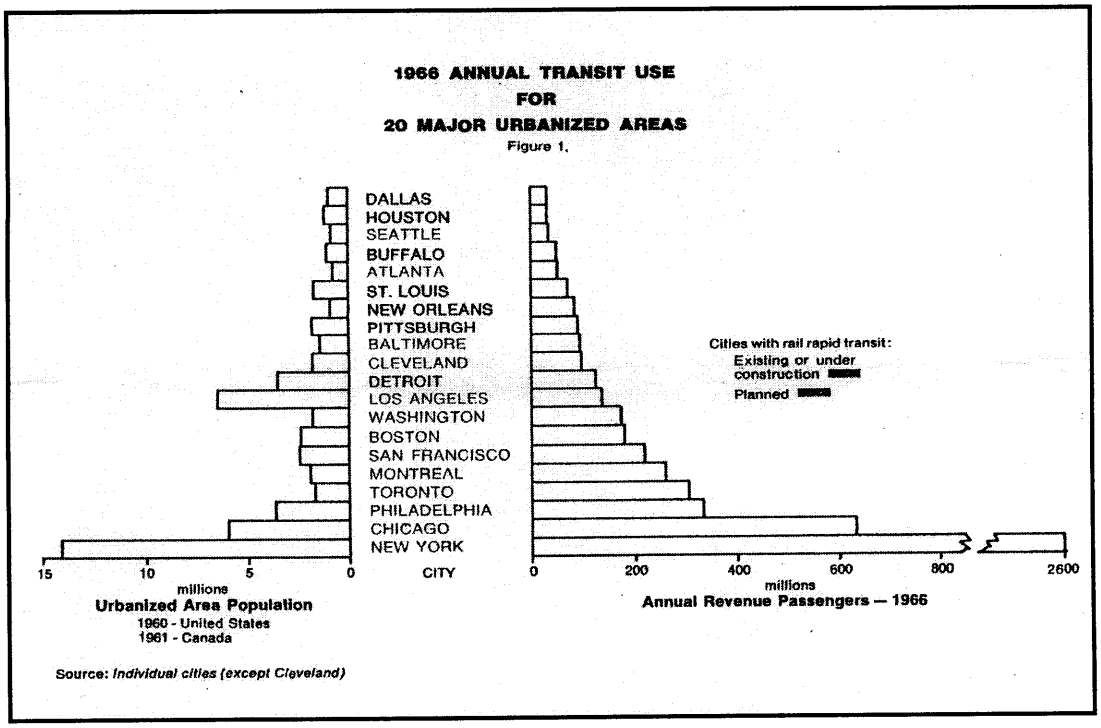
2.3.4 Infrastructure (Transportation and Other Utilities)

Transportation and other infrastructure require a certain amount of land be dedicated to service and circulation purposes. Roads are a major part of this land use, as is the land devoted to create mass transit system like rail transit. Decisions about mass transit are key determinants in the amount of land dedicated for transportation and affects density outcomes. Some communication facilities like airports or seaports needs to be provided at only the city or state level. But the adequate provision of other infrastructure at the

residential and neighborhood level is a major policy concern. Laying out daily necessary infrastructure provisions like electricity, water supply and sewage also requires land. These provisions, along with transportation are key determinants of the shape of urban development. The way they are laid out often encourages condensed as opposed to more dispersed urban development.

Figure 2.1 shows a positive relationship between the size of urban population and revenue generated from transit ridership in selected twenty cities in North America. Although the 1966 data does not establish a direct relationship between urban density and transit use, looking back at Table 2.2, we can see that the cities with high urban density, like New York, Philadelphia, Chicago and Boston, all have high revenue figures. On the other hand, Los Angeles has a large urban population, a lower transit use, and a lower urban density.

Figure 2.1 1966 Annual Transit Trip for 20 Major Urbanized Areas in North America



Source: Urban Transit Development in twenty Major Cities, Automotive Safety Foundation, Washington, D.C., 1968, p. 72

The relationship between urban density and transit ridership holds true for developing areas. Table 2.6 shows how cities like Singapore, Hong Kong and Tokyo, known for their high urban densities, have a high transit ridership. On the other hand, low-density development like Bangkok has a low transit use. This in all probability depicts a two-way process. Densities are positively correlated with the degree of ridership. Mass rapid transit, on the other hand, requires high urban density to be successful.

Table 2.6 Transit Ridership in Selected Asian Cities, 1990

City	Percentage of Total Passengers Km on Transit
Hong Kong	82.3
Bangkok	33.3
Singapore	46.7
Tokyo	63.4
Average	48.7

Source: Sustainability and Cities, Overcoming Automobile Dependence, Peter Newman, Jeffrey Kenworthy

2.3.5 Recreational Use

Sports and recreational facilities need space allocation. Cities as well as neighborhoods have to provide area for stadiums, play-fields and play-areas. Parks and gardens also serve as land that needs to be developed for recreational as well as environmental purposes. Similar to institutional land use, recreational allocation is greater in areas with greater wealth and higher standards of living.

Table 2.7. creates an urban density matrix and summarizes the various land use components along with the related policy and density implications. The urban density of any area would be the resultant of the combination of the various measures in the related policy fields.

2.4 Urban Land Allocation and Density Implications

Comprehensive physical plans designate the amount of urban land or area to be dedicated for a certain type of land use. The allocation usually adheres to some kind of existing or established norm, and is made in accordance with future population and urban growth

projections. The amount of land allocated in each category is often expressed as a proportion of the total developed urban land.

Table 2.7 Urban Density Matrix

Land Use	**Policy**	**Density**
Residential	Detached or semidetached individual houses, low FAR	Low
	Multistory high rise , high FAR	High
Commercial	More space per person	Low
	Less space per person	High
Institutional	More provisions per person	Low
	Less provisions per person	High
Recreational	More provisions per person	Low
	Less provisions per person	High
Transportation	Mass public transit	High
	Auto based transportation	Low
Other Infrastructure	More provisions per person	Low
	Less provisions per person	High
Total Urban Land	More provision	Low
	Less provision	High

Table 2.8 shows the findings of a research on available information about urban density measures in various places in various years. The data available are quite diverse in nature, the time frame ranging from 1958 to 1993 and the urban density ranging from 1185 to 10450 persons per square kilometer. The sizes of the areas also vary between 2.65 hectares to 1413 hectares, and the population ranges from 14,745 to 2.8 million. This table gives a comparison of urban density figures in different places in different times.

Table 2.8 Urban Density in Selected Areas

Urban Area	Year	Population	Area	Urban Density Persons/ Km^2
Portsmouth, NH	1958	30040	14.17	2120
Wisconsin (7 Counties)	1963	1674300	1412.39	1185
Los Angeles, CA	1964	2800000	887	3155
Los Alamos, NM	1964	14745	6.85	2153
Newark, NJ	1964	405220	38.7432	10459
Milton Keynes, UK	1965	250000	85.2	2934
Cleveland	1967	2200000	1131.12	1945
Bridgeport, CT	1971	155359	43.26	3591
Washington, D.C.	1980	638300	153.16	4162
Long Island City, NY	1993	23021	2.65	8699

Source: Various plans and surveys

Although useful for knowledge, this data do not give full information on related policy measures implications. Some additional information is in Table 2.9 where the percentage allocation of each urban land use type has been indicated. The table shows wide range of percentage allocation of each land use type.

Table 2.9 Percent Land Allocation by Use Type in Selected Areas

Urban Area	Year	Percent Land Allocation				
		Residential	Working Space	Institutional	Infrastructure	Recreational
Portsmouth, NH	1958	40	14	17	27	2
Wisconsin (7 Counties)	1963	37	4	11	29	20
Newark, NJ	1964	32	27	5	25	12
Los Angeles, CA	1964	46	12	7	24	11
Los Alamos, NM	1964	32	8	19	21	19
Milton Keynes, UK	1965	55	12	7	12	14
Cleveland	1967	72	11	3	4	9
Bridgeport, CT	1971	44	21	7	22	6
Washington, D.C.	1980	27	6	18	27	22
Long Island City, NY	1993	10	64	3	17	6

Source: Various plans and surveys

To get a sense of the physical implications of the density figures obtained in Table 2.8 and the land allocation percentages in table 2.9, further analysis needs to be done. Table 2.10 shows one such analysis, where the hectare of land available for every 10,000 people has been calculated. This measure creates a comparative basis to evaluate the density outcomes and related physical implications.

Table: 2.10 Urban Land Allocation, Hectare per 10,000 Population

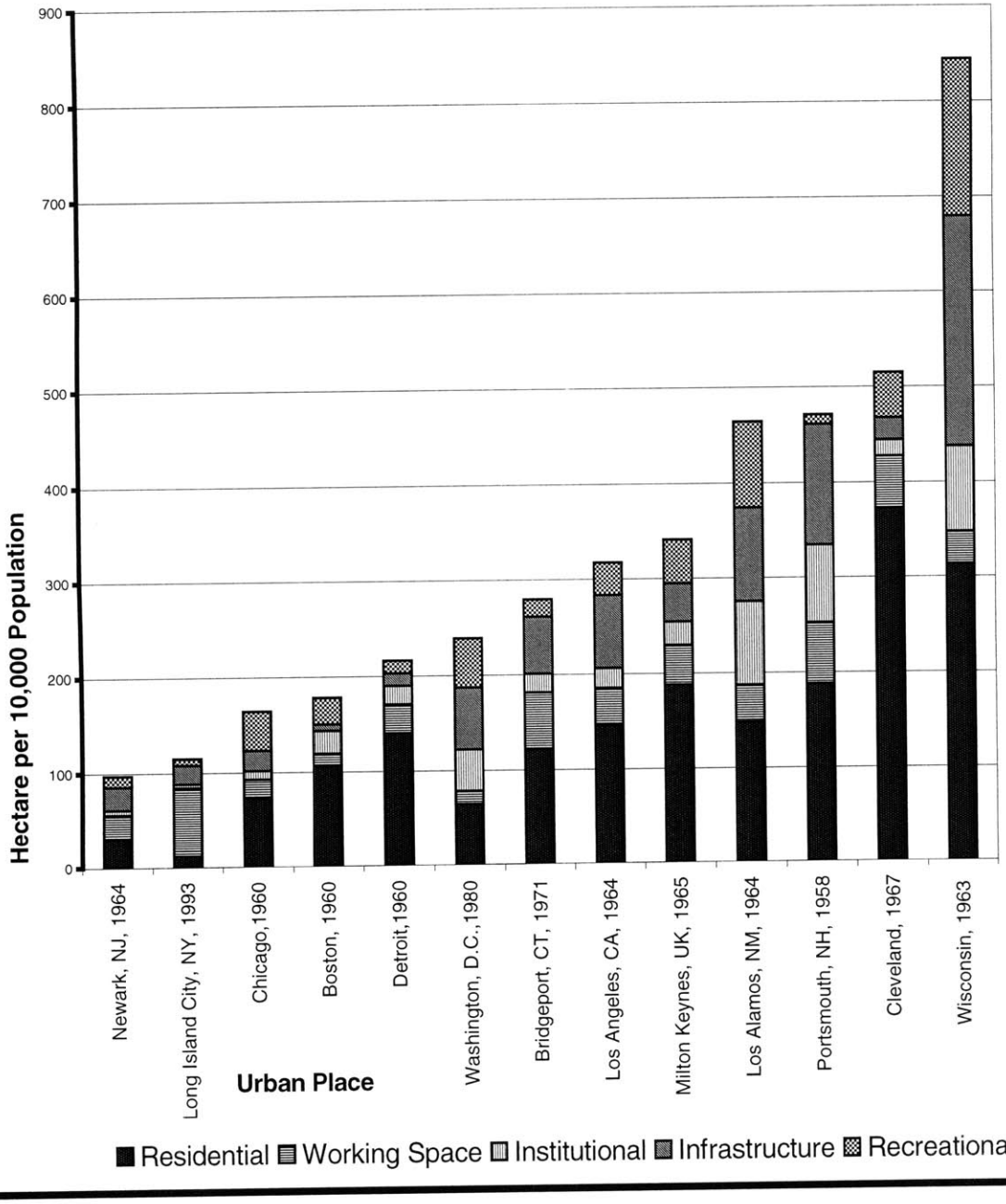
Urban Area	Urban Land Allocation Ha/ 10,000 population					
	Residential	Working Space	Institutional	Recreational	Infrastructure	Total
Wisconsin (7 Counties)	313	34	90	165	242	844
Cleveland	372	55	17	48	23	515
Portsmouth, NH	188	64	82	10	127	471
Los Alamos, NM	148	39	88	90	99	464
Milton Keynes, UK	188	42	25	46	40	341
Los Angeles, CA	146	39	21	34	77	317
Bridgeport, CT	122	59	20	18	60	279
Washington, D.C.	65	14	43	52	65	239
Long Island City, NY	12	73	4	7	19	115
Newark, NJ	31	26	5	11	24	97

Source: Various plans and surveys

Sorted by the total urban land allocation in descending order, the table above shows that the urban land allocation for every 10,000 people ranges from 844 to 97 hectares in this U.S. (with one U. K. example) data set. Each allocation is the resultant of composite

policy measures, and following each one would lead to a different scenario of development.

Fig. 2.2 Urban Land Allocation: Hectare per 10,000 Population



Source: Various plans and surveys.

Fig. 2.2 graphically depicts the findings of Table 2.10. As can be seen, the figure expresses some points that was hidden in the urban density figures and percentage land allocations. For example, residential allocation in Cleveland is the highest among the study group, but its land allocation in other use types is not significantly different from other samples. In Wisconsin, next to residential use, the largest allocation is for infrastructure. The graph can be useful for quick examination of adequacy of allocations, if certain known standards need to be applied.

2.5 Tools to Manipulate Density: Standards and Regulations

Certain physical planning tools can be used to manipulate the urban density outcome of any development scheme. Building rules, regulations and standards are all such tools. Building regulations containing specifications for Floor Area Ratio (FAR), Building Coverage or Height and Setbacks, Number or size of provision per unit area, minimum and maximum size of facilities, are instrumental in the resultant residential density.

2.5.1 Floor Area Ratio (FAR)

FAR is the built up floor area of a structure as a ratio of the site area on which the building sits, in the same unit of measurement. The resultant FAR is a decimal fraction. For example, a FAR of .5 would mean that the built up floor area is half the site area. Increasing regulatory provision of FAR creates scope for higher density.

2.5.2 Building Coverage

Building coverage is the ratio of the area occupied by the building at the ground level. It is also known as the footprint of the building, and like FAR, is used as a percentage or a decimal fraction.

2.5.3 Height and Setbacks

The combination of building height and setback determine the mass of the building. By increasing height, greater density can be achieved, as will decreasing the setbacks.

2.5.4 Number of Provisions

Regulating number and size of provisions, for example, minimum number of dwelling units per unit area, can play important role in the density outcomes. If none is specified, then the urban density becomes higher.

2.5.5 Minimum or maximum size of facilities and provisions

A limit to the maximum or minimum size of a facility is often set to control density. A minimum size of a certain facility is set to ensure the adequacy of that provision and to decrease density. For example, master plans often prescribe that there be certain amount of open space for a specified number of people. Unsuccessful forecasts, however, carry the risk of overburdening the facilities. On the other hand, a limit to the maximum size of a facility is usually set to plan effectively without undue wastage in land allocation.

2.6 The Relationship between Plans and Density Outcomes

Every physical plan has a target population over a certain planned area. That is why, whether explicit or not, there is always a density assumption in planning for the future. Together with policy measures and resource allocation, planners attempt to predict the future demography of the planned landscape. Urban planning history has examples of both successful and unsuccessful projections. In this study, the intention is to explore the relationship between urban density projections and the realized outcomes of the plans on the ground. Although outcomes are no doubt a product of a complex set of issues, actual urban population density, compared to the projected one provides, I believe, a 'litmus test' of the policies pursued in the past, almost a categorical measure of success or failure of the policies.

The study also intends to show that when policies effectively address critical issues like demographic change, settlement patterns, environmental quality, income distribution, transit use, industrial mix or regional authority, density projections are more likely to follow the predicted trend. As physical density changes from site-specific residential density to urban density, the whole array of critical issues assumes greater importance. Planning processes that predict this dynamic are apt to be more accurate in their

projections. In the developed world there exists a long history of planning with projections. The Western examples in this section were cited to analyze density measures and understand the related implications. However, the focus of this research is the developing world of South China, and as such planning practices and density issues in the developing areas need to be examined.

Table 2.11 shows the urban density of some select cities in the world. At one extreme, there is Singapore with its density outcomes under a planned system and a transit-based compact development. At the other extreme there is Bangkok, whose density is not planned, and which has a auto-based sprawl-type development. Tokyo, Paris and New York are in-between examples, whose development patterns show a mix of some compact and some low-density development.

Table 2.11 Urban Densities in Selected Cities:

Urban Area	Urban Density, persons/km^2	Density as a planned outcome	Transport Policy
Singapore	10,000	Yes	Transit
Tokyo	9,664	Partially	Transit and Auto
Paris	7,797	Partially	Transit and Auto
New York	4,434	Partially	Transit and Auto
Bangkok	4,000	No	Auto

Source: Demographia, The Public Purpose, Internet Public Policy Resources, http://www.demographia.com

In the next sections, the context of China will be analyzed and case studies will be conducted on Singapore and Bangkok to create future possible scenarios for the PRD region. The Western examples in this section demonstrate the wide range of possibilities that can result from urban policies, even within one country. They also show the importance of adopting appropriate density measures, so that adequate facilities are provided to urban population.

Chapter 3: Physical Planning in Pearl River Delta

In this chapter, we will try to gain a deeper understanding of the contextual issues related to the planning process for the Pearl River Delta. We will evaluate how the region was planned in the past, and what the future urban density implications are, as can be understood from current trends. We will also take a look at the physical planning process for Hong Kong, the immediate neighbor of Guangdong in PRD. Finally, we will discuss the implications for future coordination within the region in the context of physical planning.

3.1 Past Planning in PRD:

Prior to 1978, in pre-reform China, the Pearl River Delta, like the rest of the nation, was divided into distinct urban and rural spaces. With the top-down administration of the police state, there was little interaction between the urban and the rural areas. This meant that the cities had a fixed urban density. The state made various provisions for urban dwellers and thus had control over them. The population size of a city, a controlled unit of citizen mobility, was a determinant of the amount of state investment. Cities were classified as big, medium and small according to population size. Under this system, a city's growth and development depended on the central resource-allocation decisions. Local decisions were restricted to providing basic site-specific information. According to Ng and Tang,[1]

"Locally initiated comprehensive and integrated land use planning at the city level, therefore, became quite irrelevant and unnecessary. In fact, a city then was only required to produce a blue-print for 20 years according to population size and the nature of the city."

Six major land use categories were designated. Since cities were perceived as non-entities, they were not studied and analyzed independently. They would be part of large-scale indiscriminate planning. During the 1950s, master plans assumed an unrealistic

[1] Ng, M. K. and Tang, W. *The Pearl River Delta Urban Systems Plan, An Analysis.* 1997. p . 5

scale, especially during the Great Leap Forward.[2] Subsequently, these plans failed to accomplish the development objectives and led planning processes towards a more area-specific urban planning.

The 1978 reform brought about a less rigid control over people's mobility. The rural population was allowed to come into urban areas to work. The system freed up surplus labor from the agricultural sector and increased overall productivity. At the same time, it allowed migration into cities, and a group of temporary or floating population was created. The open door policy allowed foreign directed investment in the region. The temporary population became involved in the new ventures as labor. As a result, the percentage of temporary population increased significantly.

Table 3.1 Distribution of Permanent and Temporary Population in PRD by Cities

Year/ Location	1990	1990	1990	1993	1993	1993
	Permanent Population (million)	Temporary Population (million)	Temporary Population (%)*	Permanent Population (milion)	Temporary Population (million)	Temporary Population (%)*
Pearl River Delta	18.55	2.79	15.0	20.56	6-7.00	29.2
Guangzhou	3.51	0.41	11.6	3.70	0.91	24.7
Shenzhen	0.65	1.02	158.9	0.88	2.07	236.0
Zhuhai	0.47	0.16	33.9	0.58	0.33	57.4
Dongguan	1.30	0.44	33.9	1.39	1.00	72.0
Zhongshan	1.13	0.01	8.6	1.22	0.77	63.0
Panyu	0.75	0.04	4.7	0.82	0.30	36.7
Nanhai	0.91	0.12	12.7	1.00	0.44	44.4
Shunde	0.90	0.06	7.0	0.98	0.30	30.8

Notes: *Temporary population as a percentage of permanent population. Population figures have been rounded to 2-decimal places.
Source: Construction Commission of Guangdong Province (1996:13)

As Table 3.1 shows, in Guangzhou the increase in temporary population has been from a 11.6% in 1990 to 29.2% in 1993. In Shenzhen, a city that primarily consists of temporary population, the change has been from 158.9 % in 1990 to 236% in 1993. The percentage of agricultural land in Shenzhen also decreased dramatically as can be seen from Table 3.2, which shows the absolute decrease in the area under cultivation.

[2] Ng and Tang. 1995. p. 5.

Table 3.2 Agricultural Land in Shenzhen

Year	Areas Under cultivation 10,000 mu
1979	53.21
1980	49.01
1985	33.94
1990	28.01
1995	6.58
1997	6.36
1998	6.2

Source: Shenzhen Statistical Book, 1999

Within the PRD region itself, the reform gave rise to two distinct different systems of physical planning. The Special Economic Zones (SEZ) were permitted to follow market-based approaches where resources were allocated to entice more industries to enter the region. Dramatic changes began to occur. For example, from a small town in Bao an county with an area of a few square kilometers in 1979, Shenzhen is now the second largest city in the Guangdong part of the PRD with a population of 3.35 million. It is now planning for a future when it will become the Greater Shenzhen metropolis with several city groups over an area of 2,020 km^2.[3] However, older cities in the PRD, like Guangzhou, continue to pursue the traditional centrally controlled 'blue print' system of planning.

The urban nature and complexity of the growing population and the apparent discrepancy among the planning practices in the PRD has become a cause for concern. This has led the policy makers to give increasing attention to regional planning. The 1993 Pearl River Delta Urban System Plan (PRDUSP) is the outcome of such concerns. The PRDUSP is intended to provide a regional framework to coordinate the future physical planning of the region.

[3] Yuxin, Z. and Hengli Q. "Urban Development in Shenzhen" *China City Planning Review*. Vol. 13, No. 1. June 1997. p. 23.

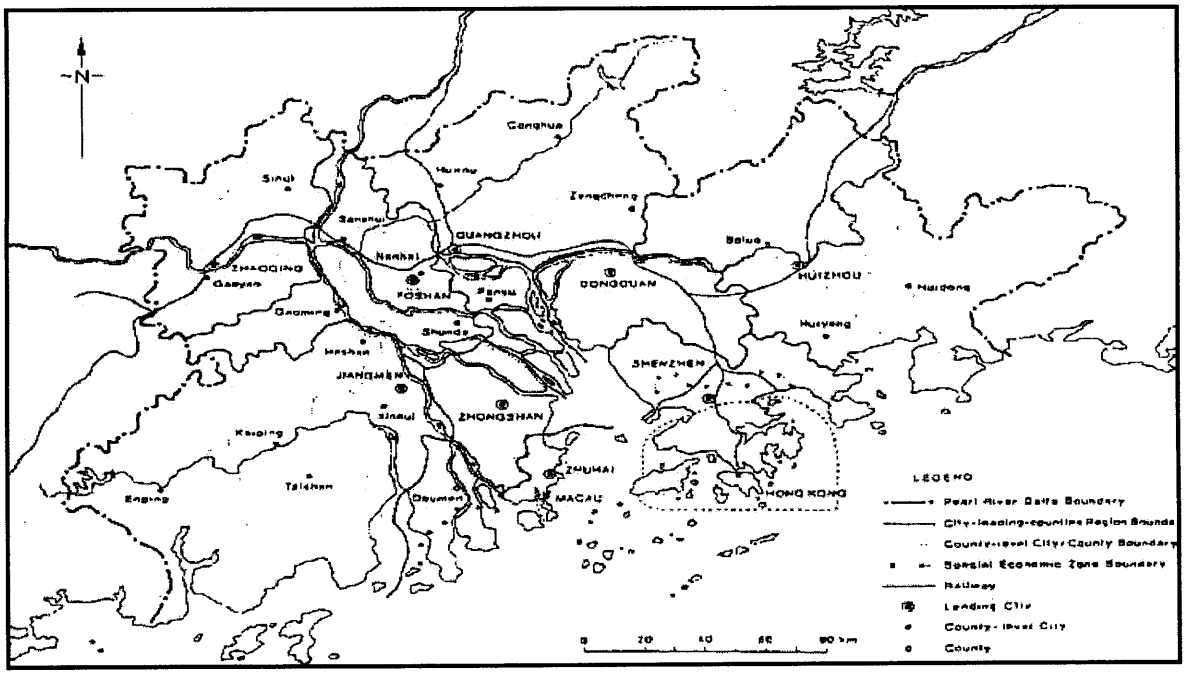
3.2 PRDUSP: The Future Plan for the Pearl River Delta

The PRDUSP has been drawn as an urban system plan for the region,. This covers the PRD Economic Region, defined by the Provincial Government in 1994, consisting of 25 cities and 3 counties, totaling an area of 41,956 km^2, with 20.65 million population in 1993, when the population density within the PRD was more than 500 per km^2.

The PRDUSP has three major strategic goals:[4]

- *"To develop the PRD as a major mega-urban region in Pacific Asia and to be the "dragon head" for socioeconomic development in southern China.*
- *To develop a modern urban system with an improved rank size distribution of different types of cities, a clear division of labour with complementary functions, and a rational and balanced distribution of transportation and communication network; and,*
- *To enhance rural urban integration."*

Fig. 3.1 Geographical Coverage of the PRDUSP, 1994



Source: Ng, M.K. and Tang,W.*The Pearl River Delta Urban System Plan, An Analysis.* 1997.p. 9.

[4] Ng and Tang. 1997. p. 22.

Some of the key concepts of the PRDUSP are:

1. Creation of Inner and Outer Rings

The PRDUSP divides the region into an inner and an outer ring. Strict control over inner core permanent population will be exercised. Among the activities that will be encouraged are agricultural developments, actions for improved ecological environment, development of large-scale technology and capital intensive industries. Guanngzhou is to develop as the core city, and Shenzhen and Zhuhai as sub-cores.

Natural resources would be more abundant in the outer rings, where there will be efforts to attract industries from the inner ring, to develop tourism, and to commercialize the agricultural sector.

2. Forming Development and Growth Axes

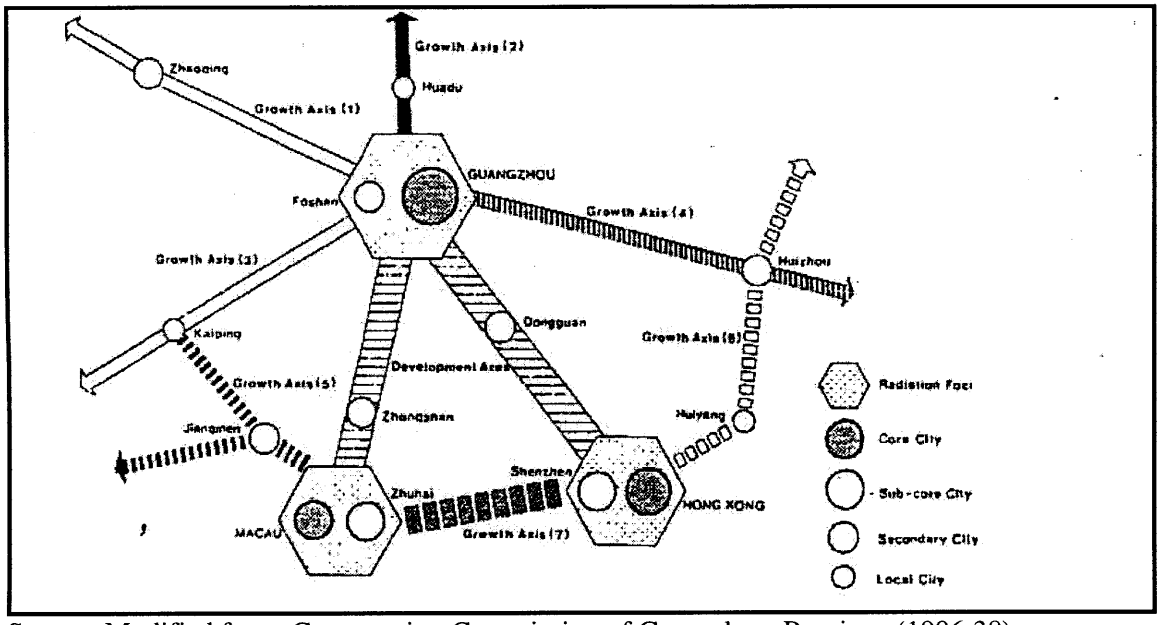
The core and the sub-core cities are to serve as radial foci to link infrastructure (highways, railways or information super highways) to form development corridors. This will integrate rural and urban areas, both economically and spatially. Two major development axes (Guangzhou-Shenzhen and Guangzhou-Zhuhai) and seven growth axes would be developed, to link inner and outer rings.

3. Developing Three Metropolitan Areas as the "Dragon Head"

The PRDUSP divides the region into three separate and independent sub-regions: central, eastern and western metropolitan sub-region, the cores of which are the central, east and west metropolitan areas (see figure). These areas are supposed to serve as "dragon head" of the region. The central metropolitan area should be the transportation hub, industrial base, and center for trade, technological development and scientific research. The populations are to be controlled within 10 million and population density at 1,000/km^2.

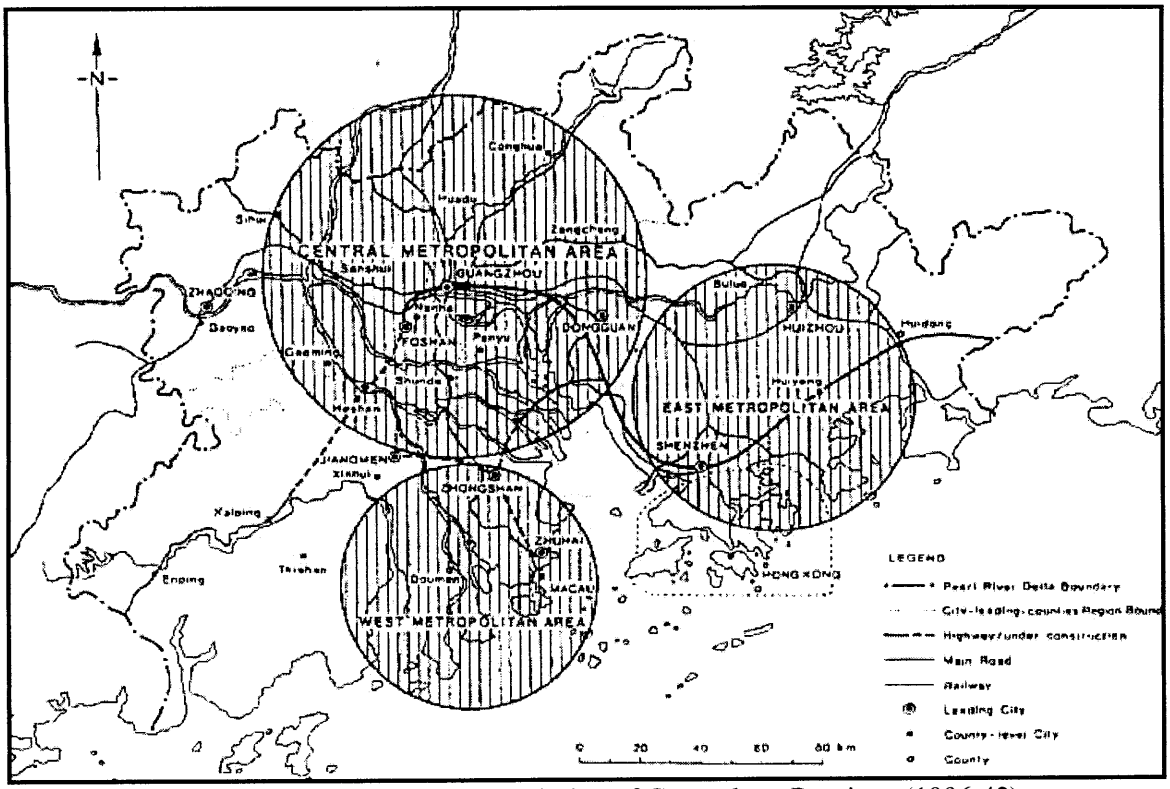
The east metropolitan area would be the export processing zone, intended to capture investments and industries from Hong Kong. The west metropolitan area is less developed than its eastern counterpart now. However, the PRDUSP identifies it as having potential for tourist and industrial development.

Fig. 3.2 Development and Growth Axes in the PRDUSP



Source: Modified from Construction Commission of Guangdong Province (1996:38)

Fig. 3.3 The Three Metropolitan Areas in the PRDUSP



Source: Modified from Construction Commission of Guangdong Province (1996:42)

Table 3.3 Forecasts of Population and Land Requirement by the Year 2010

	Number of People	Land Required
Registered Population • Natural Increase • Mechanical Increase	About 29,000,000 24,690,000 3,750,000	Each registered person in the urban area needs 100 m^2 Urban land requirement at a 75% urbanization rate: 28,440,000*75%*100 m^2 = 2133 km^2
Temporary Population	About 5,000,000	Assuming 90% of temporary population reside in urban areas and they require 60% of land required by registered persons: 5,000,000*90%*60m^2 = 270 km^2
Total Population	About 34,000,000	2785 km^2
Urban Population	Assuming 75% urbanization rate: 25,000,000	2,133 km^2 + 270 km^2= 2,403 km^2
Rural Population	8,500,000	Assuming 30% of the population living in urban areas and with a maximum limit of 150 m^2/person, land requirement : 8,500,000*30%* about 150m^2= 382 km^2

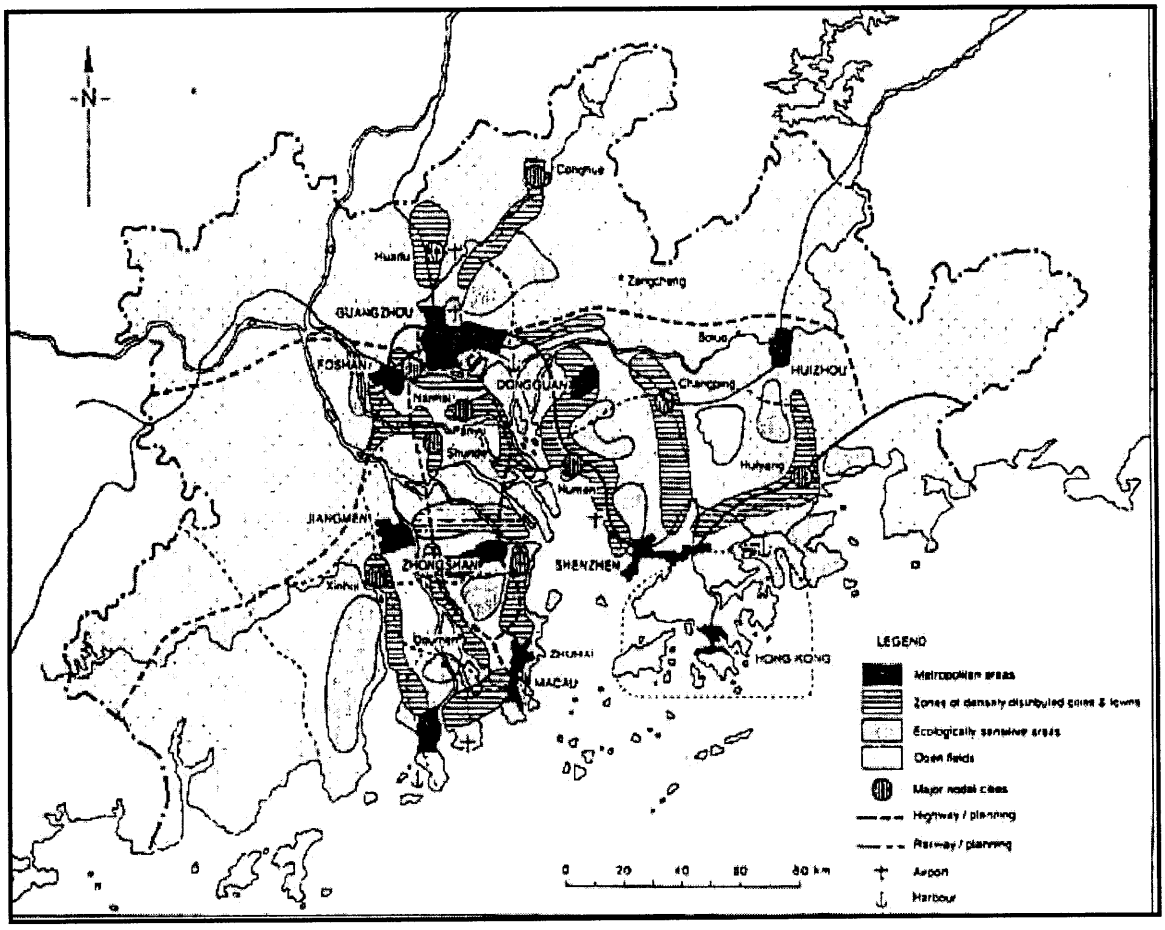
Source: Construction Commission of Guangdong Province (1996:28-31)

The PRDUSP also proposes the following:

1.*Four Types of Land Use to Ensure Coordinated and Sustainable Development*

PRDUSP establishes four basic types of land use: metropolitan areas; zones of densely distributed cities and towns; open fields; and, ecologically sensitive areas. Table 8 summarizes the content, characteristics and overall development strategies for each land use type, and Figure 4 shows a sketch of the distribution of the four types of land use.

Fig. 3.4 Development Strategy of the PRDUSP: Four Main Types of Land Use



Source: Modified from the Construction Commission of Guangdong Province (1996:56, 63, 70)

Table 3.4 Content, Characteristics and Overall Development Strategy of the Four Types of Land Use:

Urban Area	Content	Characteristics	Overall development strategy
Metropolitan Area	• Urbanizing region with dense and large-scale human settlements occupying central locations and performing central functions. For example, Guanzhou, Shenzhen and Zhuhai	• A spatial, not an administrative, concept and so may consist of one or more cities • With sound and functioning infra structure. • Highly concentrated settlements with buffer zones but not clear-cut open fields in between. • Centre of the region	• Centre of an urban system or a region: finance, trade, technology, information centre; transportation hub, and focus on high tech industrial and large scale infrastructure development. • To improve city functions and the quality of city life. • To develop the old urban areas.
Zone of densely distributed cities and towns.	• Zone where central cities and towns converge. • Area with a higher density of cities and towns. For instance, from Xinan in Shenzhen to Changan in Dongguan, Human; and the cities and towns around Guangzhou	• Close to Metropolitan areas. • High density of cities and towns with narrow buffer zones in between. • While most of the land is for agricultural use, land use functions are determined by the cities. • Follows economic development corridors: along rivers, coast line, and transportation network. • Industrial base can be found in first grade management areas.	• Reasonable industrial and complementary development should be encouraged in these zones. • Should control the "blind" growth of urban settlements along transportation links. • Protect agricultural conservation zones. • Development intensity and urban built-up areas should not exceed 25% of total area within the zone.

Table 3.4 (Contd.) Content, Characteristics and Overall Development Strategy of the Four Types of Land Use:

Urban Area	Content	Characteristics	Overall development strategy
Open field	• The agricultural base of the PRD economic region. Basically agricultural land uses such as township, villages, agricultural fields, rivers and hills, etc. • New settlements of low density and appropriate scale can be developed. For instance, the low density development zone around the central city of Guangzhou	• Villages, green, vegetation and the natural environment constitute the landscape of this zone. • Low density development area. • Low density of cities and towns with agricultural land uses in between. • Land use is determined by agricultural development. • Small scale industrial development in first grade management areas; • Poor transportation infrastructure	• Major agricultural zones within the economic region. Town and townships enterprises or secondary industries should be controlled. • Density of towns should be monitored and the scale of non-agricultural development has to be constrained • A base to facilitate agricultural development has to be constrained. • Support leisure activities of the urbanites. • Development intensity and built-up areas of the towns and villages should be less than 8% of the total area of the zone.
Ecologically sensitive area	• Area whose development will have significant impact on the overall ecology of the PRD: national conservation zones, forests, water sources, reservoirs, coastline and natural tourist spots, etc. For instance, White Cloud Mountain in Guangzhou and Mirs Bay in Shenzhen	• Significant to the wider ecological environment and is not reversible once destroyed by human activities. • Can also be large-tract of agricultural fields, orchards, fish ponds or conserve hills to prevent urban sprawling and consequent degradation of the environment.	• Important for guaranteeing environmental quality. • Development intensity has to be strictly controlled to prevent urban encroachment. Development projects have to be strictly controlled and built-up areas should be restricted to 1 to 25 of the total land area.

Source: Modified from Fang, Yang and Cai (1997:9-10)

2. *Construction Requirement of Regional Transported Network:*

The PRDUSP attempts to coordinate land use and transport planning. The description of the plans mentions this policy and places the mechanism of coordination under the administration of the Ministry of Transport.

3. *Standards and Guidelines for Various Facilities:*

PRDUSP divides the cities in PRD into three types. This division is meant to create a guideline for the allocation of infrastructure provisions. These standards propose the creation of a hierarchy of cities in the region. The types are:

Type A : Guangzhou, Shenzhen and Zhuhai.

Type B : Foshan, Jiangmen, Zhongshan, Zhaoqing, Dongguan and Huizhou.

Type C : Local centre cities and satellite towns.

3.3 Observations on PRDUSP :

The PRDUSP is a proposal dependent on road and rail corridors, developed around transportation links. Its whole character is yet to be elaborated. However, several points demand attention even at this initial level.

- The transportation rings are not yet interconnected or looped, creating scopes for future bottleneck development.
- The road networks do not always connect the emerging urban centers, such as Panyu, Shunde, Conghua and Changping, Huiyang and Humen.

The plan proposes a population density of 1000 persons/km^2 over almost 42,000 km^2, but says nothing about the expected urban or residential densities. It allocates a per capita of urban space of 100 m^2, or a density of 100 ha/10,000 people. Such an allocation may seem like an attempt to density future urban settlements in the region, but it also leaves room for doubt whether sufficient urban amenities will be provided.

PRDUSP sets a maximum limit of 10 million people to the type A cities, and recommends high-density settlements in the metro areas. Except for the three type A cities, there is little mention of transit, which definitely limits the possibility of high-density development. No standard has been set for achieving any target residential density, or setting up the infrastructure necessary for dense development. Also, the PRDUSP proposes that the cities of different types will receive preferential allocation of infrastructure, thus creating a potential for migration to centers with better urban conditions.

3.4 The PRD Context: Hong Kong, the Immediate Neighbor

Hong Kong is situated at the southeast corner of China, occupying an area of 1084 km^2, with a population of 6.5 million, of which 95% live in urban areas. It was a British Colony for almost 150 years, during which period it was transformed from an isolated group of islands to a world-class financial, trading and business center. Although Hong Kong has very little natural resources, being comprised of hilly mountainous terrain of steep slopes, it did have a deep–water harbor. Its geographic location on the rim of the Pacific Basin with relation to Europe and North America made it a flourishing international trade center under the British rule.

In 1997, Hong Kong was handed back to China as a Special Administrative Region (SAR) of China. Hong Kong will operate according to the "One country, two system" principle, whereby it will maintain its open capitalistic structure and the position as a leading free-trade port for at least 50 years after 1997.

3.4.1 History of Planning

Sir Patrick Abercrombie drew up the first Strategic Plan for Hong Kong in 1947. The plan set a maximum population of 2 million within the urban areas and proposed extensions in new industrial locations, future reclamation, and possible new towns that

would come about with new communication and infrastructure facilities.[5] This plan was not implemented because of the large immigration from Mainland China and rapid industrialization of the region. The colony was benefiting from influx of people, and so it was probably deemed impractical to adopt a plan that imposed strict population limit.

Instead of adopting the master plan, in 1951 a five-year program was initiated to create the necessary infrastructure.[6] At this time, the urban areas were experiencing influx of migrants, which led to the creation of squatter housing in the inner city areas. As an adoptive mechanism, both 'approved' and 'tolerated' areas for squatter settlements were set aside. But a more definite step came about for increase in accommodation through an amendment of land-use legislation in 1951, which initiated inclusion of some major considerations in reviewing building legislation.[7] Two of the recommendations were that the rate of building must be increased and that increased heights must be permitted in view of the scarcity of suitable building land.

In 1956, a new legislation was introduced, the Building (Planning) Regulations. Before 1955, the plot ratio, or the floor area ratio, had an average not more than three. The maximum height of the buildings was also restricted to eighty feet. The new regulations increased the floor area ratio to a normal level of six, and created a system where the height of the buildings would be related to the width of the streets. This allowed greater height and floor area ratio of buildings. Under the new system, in areas with wide streets and larger lots, FAR as high as 20:1 could occur.[8] For the first time, very high spot density could be witnessed in Hong Kong, as much as 10,000 persons per acre (plate 5b). As Bristow states, the new regulations, ".... were fundamental in altering the built form of Hong Kong at that time, thus determining a major element of the present urban landscape."[9]

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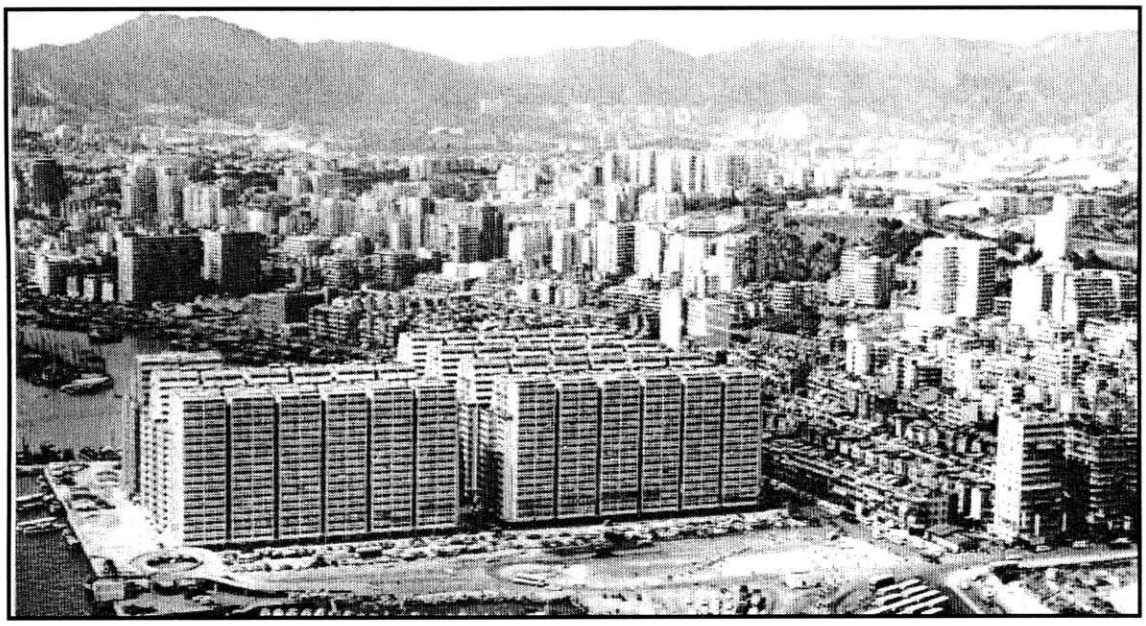
[5] Bristow, R. *Land Use Planning in Hong Kong: History, Policies and Procedure.* Hong Kong, 1984. p. 69.
[6] Bristow. 1984. p. 72.
[7] Bristow. 1984. p. 73.
[8] Bristow. 1984. p. 77.
[9] Bristow. 1984. p. 77.

Fig. 3.5 An Example of Extreme High-Density Development as a Result of the 1955 Buildings Ordinance: The Ba Man Residential Complex, Yau Ma Tei, Kowloon



Source: Bristow, R. 1984. 172. Plate 5b

The intensity of development, however, soon led to congestion, overtaxed services and infrastructure, along with increased land value. Since the system was laissez faire, private real estate development boomed. The government subsequently introduced additional reform regulations in 1966 to overcome these problems. However, by then, as Bristow points out, "... the face of Hong Kong had been fundamentally changed."[10]

3.4.2 The New Towns

In 1956, the Town Planning Office conducted a general review for industrial land requirement and came up with looking at five possible sites for new towns in the New Territories: Tsuen Wan/Kwai Chung, Sha Tin, Castle Peak (Tuen Mun), Tai Po and Junk Bay. By 1956, due to the building boom, the prime areas in Kowloon became saturated. Reports of two housing surveys were published in 1958, which showed the poor conditions in the inner city high-density residential facilities. Overcrowding was a serious problem. Another socio-economic problem was the gap between income of those who

[10] Bristow. 1984. p. 77.

could afford developer-built housing and those living in resettlement schemes and squatter areas.

The new revelations had important effects on Hong Kong government's housing policy. Resettlement programs received priority, and large-scale public housing program was initiated. The housing would be made available to households with a monthly income of as low as HK$300, based on the findings of the survey.[11]

3.4.3 Hong Kong Outline Plan 1979

In 1971, a number of government committees and foreign experts completed the Colony Outline Plan. The plan was revised several times and was subsequently finalized in 1979 as the Hong Kong Outline Plan. The plan had two components. The first was a development strategy for the next 20 years. The second was planning standards and guidelines for the provision of infrastructure facilities and services. This document was instrumental in the placement of the present key service and infrastructure provisions in Hong Kong.

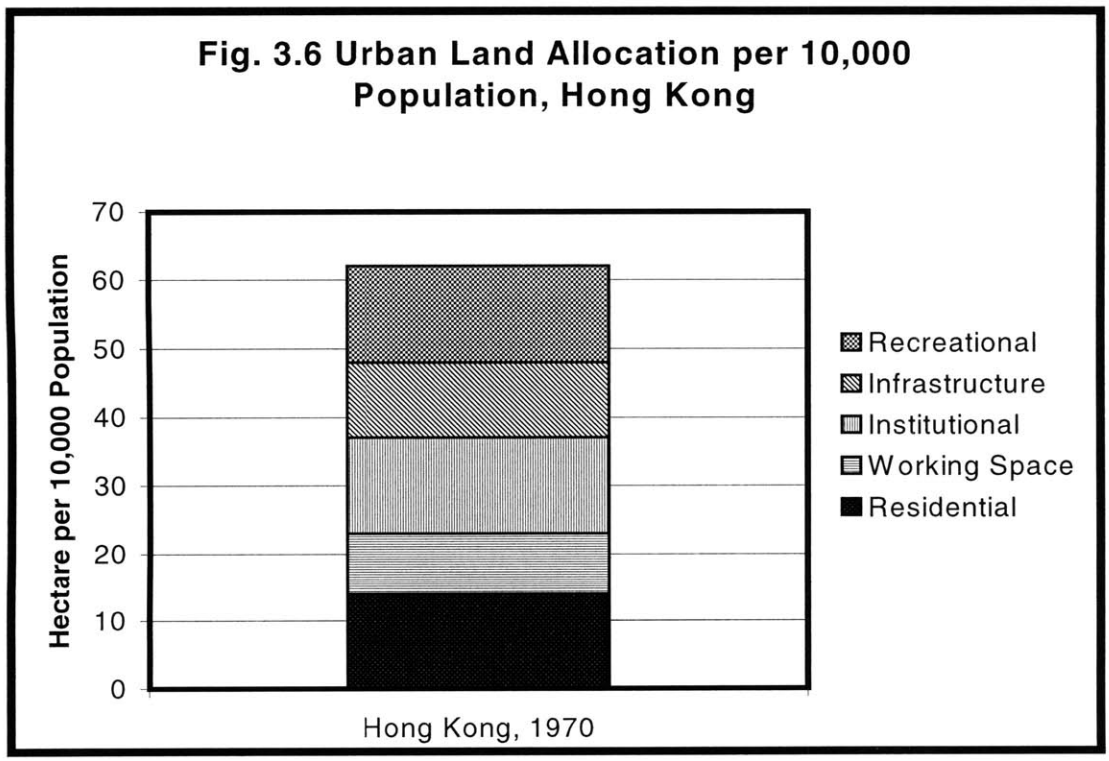
Significant among the regulations were the development of allocation standards for urban land use within planned jurisdictions. Table 3.5 calculates the urban land allocation per 10,000 population for Tsuen Wan, Sha tin and Tai Po, three New Towns in Hong Kong.[12] The average allocation of the three areas for each land use type has been calculated. The allocation depicts the planning standards set in a schedule of uses and areas in the '70s.[13] The allocation is shown graphically in Fig. 3.6. As can be seen, the urban land allocation figure for Hong Kong, which is 62 hectares per 10,000 population, is lower than any of the Western examples we studied in Chapter 2. Among those examples, Newark, New Jersey, had the least allocation, which was 97 hectares per 10,000 population. Hong Kong shows also lower allocation for residential, working area and infrastructure than any other example we studied before. But interestingly, Hong Kong has higher land allocation for

[11] Bristow. 1984. p. 83.
[12] Bristow. 1984. p. 286
[13] Bristow. 1984. p. 128

Table 3.5 Urban Land Allocation per 10,000 Population in Hong Kong, 1970

Urban Land Use Type	Hectare per 10,000 Population
Residential	14
Working Area	9
Institutional	14
Infrastructure	11
Recreational	14
Total	**62**

Note: Allocation for infrastructure has been calculated from the Schedule of Uses and Areas, Bristow. 1984. p. 128
Source: Bristow, 1984. p.286



Source: Bristow, R. 1984. p.286

institutional and recreational purposes than both Long Island city in New York and Newark, New Jersey.

3.4.4 Territorial Development Strategy (TDS), 1990

The newly created Hong Kong Planning Department developed this strategic plan that contained long term strategies for the1990s and planned for up to the year 2001. Main concerns of this plan were to retain sustainable economic growth, coordinate urban development with transportation provision, especially in the development of the new towns.

The TDS was reviewed and revised during the mid-1990s. The final Territorial Development Strategy Review (TDSR) was approved in 1998 by the Executive Council of the Hong Kong Special Administrative Region Government. Some of the focal concerns of TDSR are:

- Create a land use, transport and environment framework for guiding detail plans and programs.
- Take into account Hong Kong's changing role in the regional context, especially with regard to development trend in the Pearl River Delta in South China.
- Analyze different development strategies and formulate recommendations.

TDS provides a strategic planning context aiming to provide long-term development framework for HK. By integrating government policies on land use, infrastructure development and environmental protection, TDS serves as a basis for formulating guiding principles for planning at sub regional and district levels.

For its future, Hong Kong is considering two potential scenarios:[14] Scenario A: The PRD will be HK's main economic catchment; this is a trend-based scenario in terms of population and economic growth for HK

[14] Chu, T. and Wong, O. "Territorial Development Strategy" *China City Planning Review.* Vol. 13, No.1. 1997. p. 4-11.

.Scenario B: HK economic catchment will extend into other parts of Guangdong and into other inner provinces of China. The two scenarios have been projected up to 2011

3.4.5 A Review of the Planning Process of Hong Kong

Hong Kong has been able to develop effective ways of using urban space intensity. Through high-density development, it has built a number of self-contained and independent new towns. These new towns, where almost 40% of the Hong Kong population reside, are conveniently connected to their mother towns with rails, provide considerable job opportunities and comfortable living environment.[15]

Hong Kong has also created a successful example of mass public transit network that handles most of the city's passenger volume. The ownership of private cars in Hong Kong is lower than that in similar cities in Asia.[16]

3.5 PRD and Hong Kong: Possibilities for an Integrated Future:

This brief overview of the two adjacent planning regions depicts a picture of contrast. Hong Kong demonstrates a relatively sophisticated physical planning practice, being an experienced hand at planning and experimenting with its density figures for a long time. By comparison, the PRD is just starting the process through PRDUSP, its first urban system plan.

However, the necessity for regional cooperation in planning is undeniable. The PRD and Hong Kong share a symbiotic relationship, more so after the economic reform. For example, in the 1990s, 80% of Hong Kong's manufacturing industry moved to PRD.[17]

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[15] Yeh, A.G.O. "Spatial Impacts of New Town Development in Hong Kong" *New Towns in East and South-East Asia: Planning and Development.* Hong Kong, 1987. p. 62.
[16] Kenworthy, J.R. and Laube, F.B. "Automobile Dependence in Cities: An International Comparison of Urban Transport and Land Use Patterns with Implications for Sustainability." *Environmental Impact Assessment Review.* Vol. 16, No. 4-6. Nov. 1996. p. 284.
[17] Yuxin, Z. and Hengli Q. "Urban Development in Shenzhen" *China City Planning Review.* Vol. 13, No. 1. June 1997. p. 23.

Greater integration and cooperation between the two regions, supported by an effectively formulated physical planning process, will be mutually beneficial. The PRDUSP should introduce adequate enforcement mechanisms and appropriate evaluation criteria. Hong Kong's planning process has proved to be sensitive to changing contexts and demand over the past five decades. The PRD can take useful tips from Hong Kong in the further development of PRDUSP, which may include integration of land use and transportation planning, as well as planning for high urban density.

Chapter 4 Case Studies: Learning from the Extremes

In this chapter, we look into the planning processes in Singapore and Bangkok as case studies, in terms of their physical density projections and subsequent outcomes. The study involves looking at demographic information and trends, the historical process of planning, and future plans, so as to understand the context of policy formulation. Here, we examine planning outcomes and resultant densities to arrive at the urban density measures in practice. It is helpful to compare the conditions between the PRD and these two instances to understand points of similarities as well as dissimilarities.

4.1. Singapore

4.1.1 Demographic Information and Development Trends

Singapore became an independent nation in 1965. During the early years of independence from the British, unrestrained population growth was a concern for the policymakers of the ruling People's Action Party (PAP). The Singapore Development Plan (1961-64) expressed concern over population growth.

"Singapore's population is rapidly expanding at a rate which is the highest known in the world. The Average annual increase between the census years 1947 and 1957 was 4.3%: of this, 3.6% was natural increase and 0.7% was due to migratory surplus."[1]

The aim became to prevent the vicious cycle of uncontrolled population growth, perpetual poverty, unemployment, low quality of life, health and education. Aware of the fact that Singapore had almost no natural resources, the policy makers deemed economic growth to be inseparable from control of population growth. Another constraint was land,

[1] Teo, P. "Population Planning and Change in Singapore" *Population and Environment.* Vol. 16, No. 3. 1995. p. 239.

which in 1965 was 536 km^2. Eventually, land reclamation would increase the area to 648 km^2 by 1999.

The first action that the government took was to build a strong infrastructure. With an aim to create an attractive setting for foreign investment, infrastructure sectors – transport, sewerage, water and power supply, post and telecommunications, port facilities, housing and education were stressed. The emphasis was on industrialization and openness to the world economy.

Singapore was successful in attracting foreign investment through the vigorous upgrading of telecommunications, public utilities, wharves, and roads. Manufacturing, oil-refining and shipbuilding industries developed. Low-cost public housing, education and health were also major areas of development. The plan was to create a skilled work force to fill the newly created jobs.

To achieve the economic goal set forth, controlling population growth was important. The following steps were taken:

- In 1966, the Family Planning Act was passed. This initiated a number of measures to persuade people to adopt a two-child family value.
- Abortion was legalized and could be available by demand by 1974.
- A 1974 Voluntary Sterilization Act.
- Incentive based mechanisms like paid medical leave and expenses for sterilization, priority in school registration for children of sterilized parents.
- Disincentive measures for larger families like paid maternity leave only for the first two children, progressively higher delivery fees after the first two, income tax relief, longer waiting periods in getting public housing for families with more than two children, etc.

The Singaporean society is comprised predominantly by Chinese, followed by Malays and Indians. Each of these races is imbued with cultural values that encourage larger

family size and preference for sons. Government intervention nevertheless produced effects, as could be witnessed by the change in the socio-cultural practices. There was a rise in the age of marriage, delay in childbirth, and preference for smaller families all through the '60s to '80s. The nation experienced a change in collective values in the demise of large and extended families with greater educational and economic opportunities. As Peggy Teo states,[2]

"All these serve to underscore that point that in Singapore, population planning is one aspect of economic development that has occupied the government's planning strategies. Family planning was argued as necessary for the collective interest of the people. Without it, Singaporeans would not be able to attain such high standards of living. This argument was made more acceptable by virtue of the fact that economic success was a fact and part of the conscious experience of the people."

By 1984, Singapore's fertility rate fell to 1.4%, from 4.5% in 1966. In fact, as population growth rate kept falling, a new concern surfaced for the Singaporean policy makers in the early 1980's. By then, the 'stop at 2' policy had been successful, and the nation was experiencing a below replacement level population growth. According to McNicoll,[3] a maturing labor force can be accompanied by decreasing productivity, although technology and innovation, with wider female labor force participation, can offset this outcome to a certain extent. This may mean shifts in consumer demand, which is not necessarily bad for the economy. However, an unavoidable outcome would be the socio-economic implications of the smaller young working population to support a much larger population group.

In reaction to the implications of the present trend of population growth, the government, from the mid-'80s has been actively encouraging larger families. "Have three or if possible, more." Singapore's current population policy is the polar opposite of its initial

[2] Teo, P. 1995. p. 244.

policy. The policy makers think that the efficient workforce the nation has created will not continue if population is not at least at the replacement level. From the problem that it was once that needed to be housed, Singapore's population has become a resource that needs to be preserved. Today Singapore is in a position of being able to decide how it wants to foster its future population growth, either by natural means or immigration.

4.1.2 History of Physical Planning

Singapore's history of planning starts in 1958, when it adopted its first Master Plan. This statutory plan was drawn up during the last year of the colonial rule. There were subsequent seven revisions to this Master Plan. The first revision was under Federation of Malaysia in 1965. The others in 1970, 1975, 1980, 1985, 1990, 1998 were all done under Republic of Singapore.

Master Plans comprise of a set of land-use maps with attached explanations. They are necessarily prescriptive in nature and have little built-in flexibility. These are some of the key reasons that Master Plans have often failed to keep up with the pace of real events in the developing world, in the face of rapid change. The Master Plans drawn up for Singapore were no exceptions and they often became obsolete as soon as they were finished. So, to complement the Master Plans, the government resorted to drawing up Concept Plans.

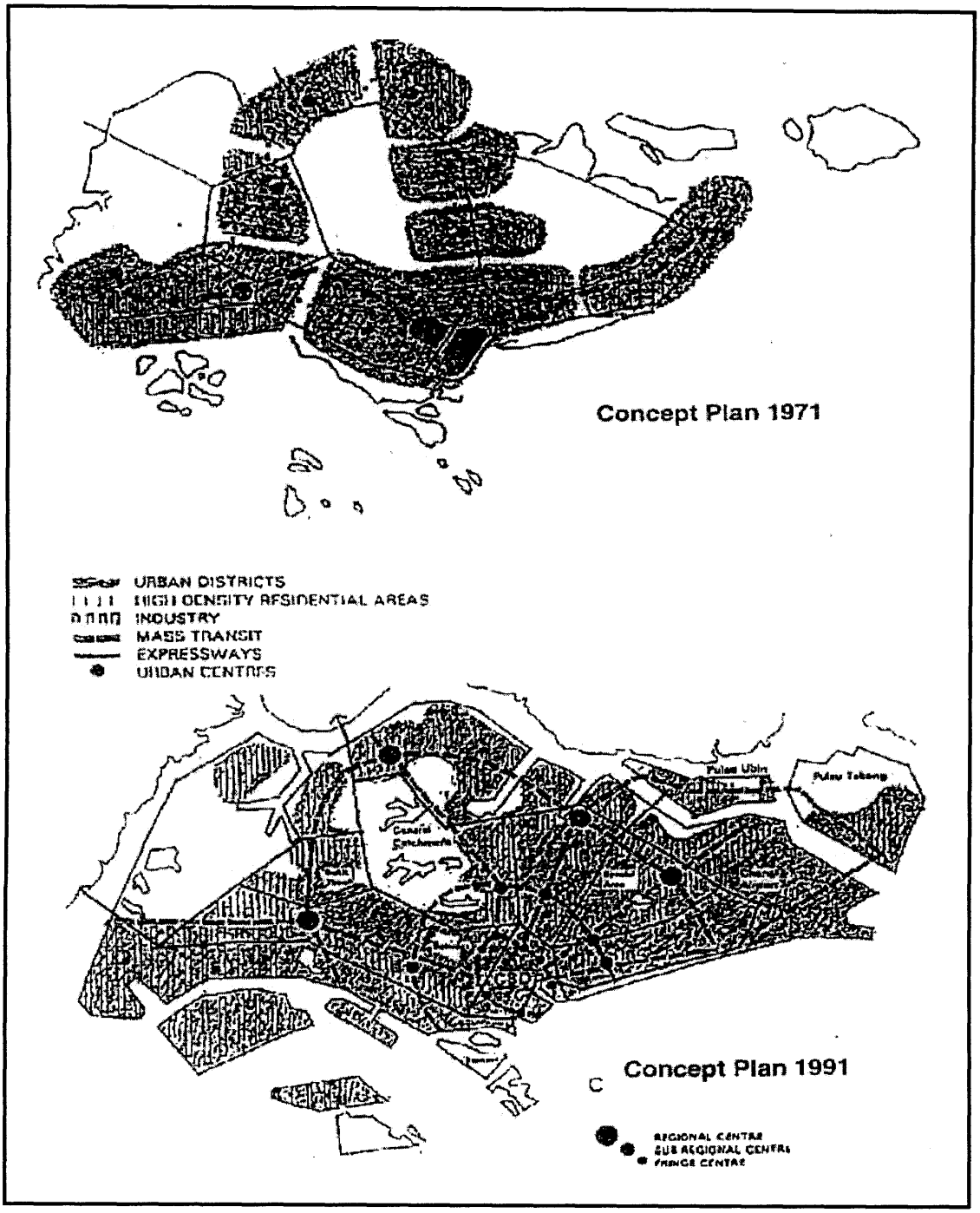
Whereas Master Plans were more regulatory, Concept Plans were more policy-oriented. They create guidelines for long term land-use and establish a framework to integrate all the physical components of planning, i.e., land use, infrastructure, transportation planning, etc. In addition, they set up the mechanism for updating Master Plans.

Singapore adopted its first Concept Plan in 1971. It was a Ring Concept Plan that planned the new infrastructure to be built, including the new airport, network of expressways, mass rapid transit system and the location of new residential towns. The plan had a

[3] Teo. 1995. p.240.

definite target population of 4 million, which the nation was supposed to reach by the early 21st century.

Fig. 4.1.1 Singapore's Concept Plans



Source: Chan. 1999. p. 36.

As discussed before, strong population policy led to a smaller population than projected. Singapore found itself in an advantageous position in terms of resource allocation. The second Concept Plan, "Living the Next Lap" was drawn in 1991. The target population of this plan was also 4 million, which would be reached after 2010. The main concerns of this plan were how to sustain economic growth, how to plan the transportation system, how to maintain the Asian character of the city and how to improve the quality of life.[4] Singapore is currently preparing the third concept plan, to be completed in 2001.

The Plans

The planning process in Singapore uses the following hierarchy of physical plans:

The Concept Plan: Macro level plans to provide strategic directions to subsequent plans. Accommodates growth needs, studies typologies and set standards.

The Layer Plans: Macro level plans constituting the six different layers of the Concept Plan. They are the strategic transportation plan, natural environment plan, leisure plan, culture plan, sports plan, and science habitat plan.

Development Guide Plans (DGP): Detail plans to elaborate on the Concept Plans. Singapore is divided into 55 DGP planning units. The 55 DGPs, in turn, form the statutory Master Plan. The DGPs are complemented by urban design and conservation plans.

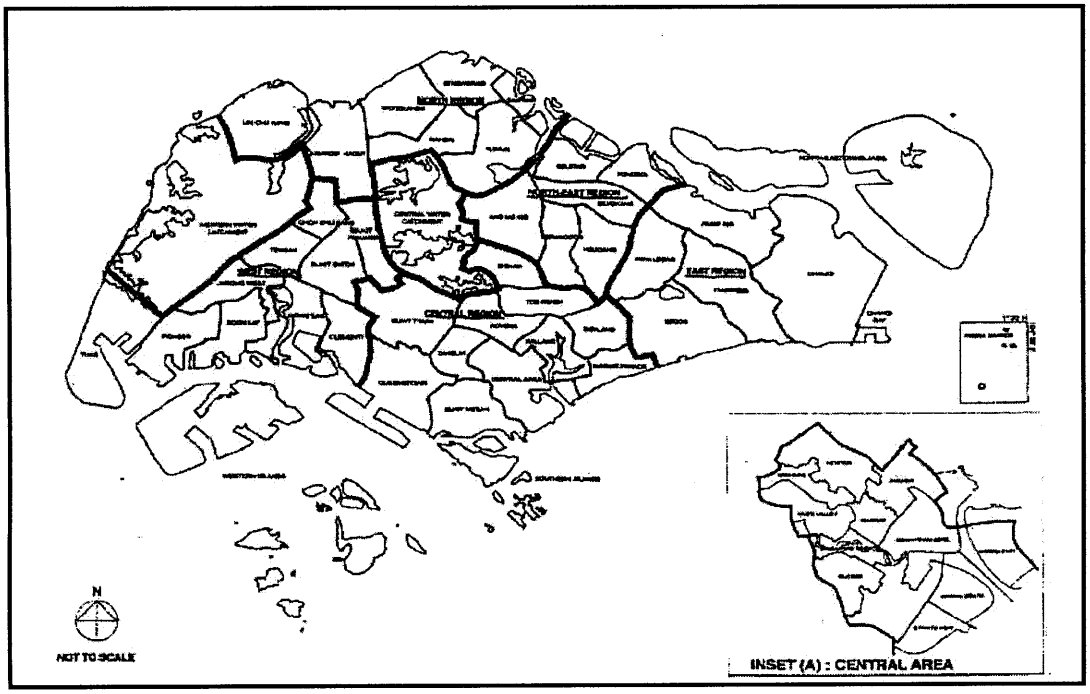
4.1.3 Planning Approaches

Singapore's approach to planning is quantitative in nature and achieving certain pre-set densities in the development parcels has been an overriding concern. Land supply is limited, although the government has increased some land area through reclamation. But from the very beginning, the attitude was to maximize the utility of the scarce land resource. There was also the political will to provide housing to all, ensuring minimum health and living standards. In Singapore, the state took the responsibility of planning to

[4] Chan. 1999. p. 35.

satisfy total demand. The outcome is a pattern of high-density development, which has since become a characteristic of most development in Singapore.

Fig. 4.1.2 Singapore's Planning Area and Regions



Source: Chan. 1999. p. 55.

4.1.4 Physical Density in Singapore's Planning Process

Density is a direct and important component of Singapore's physical planning process. From the very beginning, the concept plans showed the awareness of the implication of different densities. Table 4.1.1 shows how densities are calculated at various phases. With time, Singapore's urban density has decreased. This can be attributed to three factors. They are the successful control of population growth, more land reclamation, and efforts to create higher standards of living.

In Singapore, planning starts from the central city-state level. Table 4.1.2. shows how land use is allocated for the whole country.

Table 4.1.1 Singapore: Population and Urban Densities (1970 to Year X):

Parameters	1970	1990	1999	2010	2030	X
Land Area (sq. km.)						
Total	586	626	648	665	703	736
Urbanized Area (%)	187 (32 %)	302 (48%)	375 (58%)	418 (63%)	485 (69%)	544 (74%)
Population ('000)						
Total	2,074.5	3,016.4	4,000.0	3,853.8	4,060.0?	4,770.0
Resident	2,013.6	2,705.1	3,230.5	3,453.8	3,664.5	4,000.0
Population Density (persons per sq. km.)						
Total	3540	4819	6173	5795	5775	6481
Resident	3436	4321	4985	5194	5213	5435
Urban Density (persons per sq. km.)						
Total	11094	9456	9975	8660	8371	8768
Resident	10768	8480	8056	7761	7556	7353

Source: Department of Statistics, various years and Urban Redevelopment Authority, 1991.

To combat the constrained supply of land, Singapore opted to invest in the creation of new towns. New Towns are typically high-density satellite towns, with population ranging from 70,000 to 266,000. Provision of public rapid transit was considered essential for achieving such high densities. The aim was to achieve high residential density, but at the same time maintain an acceptable standard of living.

Table 4.1.2 Singapore: Land Use Distribution at the City-Scale

Year	1991	1991	X	X
Population	3.01 million	3.01 million	4.77 million	4.77 million
Land Use	Area (hectares)	Percentage (%)	Area (hectares)	Percentage (%)
Living Space (Housing)	7,200	11.4	15,000	20.4
Working Space (e.g. Commerce, Industry)	12,700	20.3	19,000	25.8
Community Space (e.g. Institution)	2,900	4.7	5,500	7.4
Open Space / Recreation (e.g. Golf Courses, Parks)	4,000	6.4	7,500	10.2
Infrastructure (e.g. Transportation)	7,400	11.8	10,600	14.4
Military	12,300	19.7	10,300	14.0
Central Catchment / Reservoirs	5,300	8.5	5,300	7.2
Others (e.g. Undeveloped Land, Cemetery, Agriculture, Quarry)	10,800	17.2	400	0.6
TOTAL	62,600	100.0	73,600	100.0

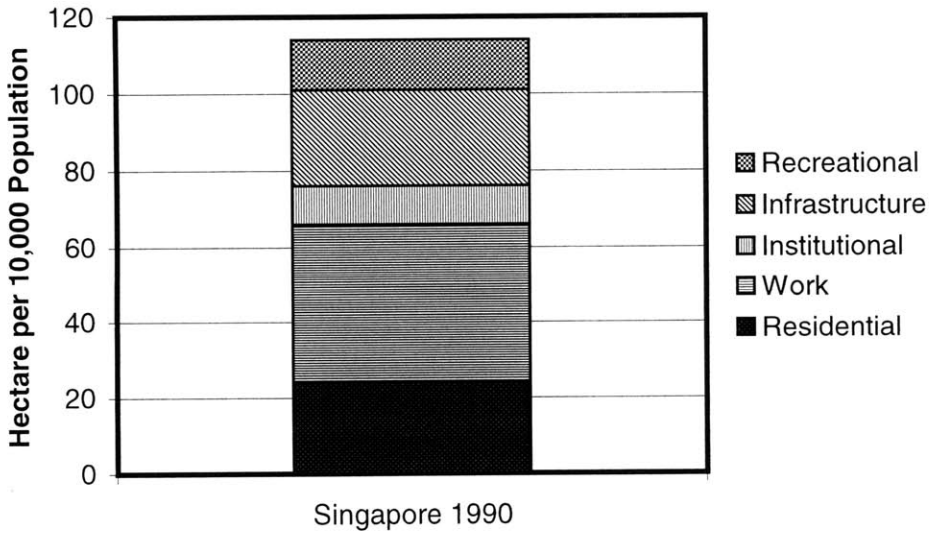
Source: Urban Development Authority (1991).

So, even while higher residential densities were sought, the per capita urban space allocation was not compromised. The New Towns eventually became the symbol of the new Singaporean way of living, the high rise towers whose FARs were adjusted to

achieve pre-set density level. By 1987, Over 80% of the population in Singapore were living in publicly built high-density residential accommodations.[5] Table 4.1.3. provides information on 16 new towns. The density in new towns ranges from 15,000 to 52,000 persons per km^2 (Jurong seems to be an outlier with only 3396 persons per km^2). Residential density within these new towns is much higher, ranging from 56,000 to almost 195,000 persons per square km of residential land.

Table 4.1.4 shows the 1991 standards for space allocation in the new towns. It is noteworthy how a variety of urban amenities are being prescribed along with building of dwelling units. Here, the provision of community and institutional facilities is an outcome of central intervention, and can be seen as an attempt of the central authority to ensure such provisions in case market mechanisms fail.

Fig. 4. 1. 3 Urban Land Allocation per 10,000 Population: Singapore, 1990



[5] Wang, L.H. "Residential New Town Development in Singapore: Background, Planning, and Design" *New Towns in East and South-East Asia: Planning and Development.* Oxford University Press. p. 26.

Table 4.1.3 Data on New Towns of Singapore

Construc-tion started in	Name of the New Town	Total Land Area, km^2	Residential Land Alloca-tion km^2	Planned Dwelling Units '000	Planned Popula tion '000	New Town Density, persons/ km^2	Residen tial Density, persons / km^2
1957	Queens town	2.85	1.4	28	150	52632	107143
1963	Jurong	58.9	2.52	24	200	3396	79365
1964	Toa Payoh	3.3	1.41	36.6	190	57576	134752
1971	Telok Blangah	3.65	0.85	13.7	70	19178	82353
1972	Woodlands	10	3.3	55	290	29000	87879
1973	Bedok	7.7	2.7	48.8	225	29221	83333
1973	Ang Mo Kio	7.05	2.54	49.5	245	34752	96457
1973	Clementi	4.34	1.58	24.5	120	27650	75949
1978	Hougang	5.22	2.04	25.5	120	22989	58824
1978	Yishun	9.07	2.82	40	200	22051	70922
1979	Jurong East	2.36	0.82	12.8	160	67797	195122
1979	Jurong West	1.76	0.92	14.5	70	39773	76087
1980	Tampines	9.57	3.22	45.7	230	24033	71429
1980	Bukit Batok	7.5	1.65	24.8	125	16667	75758
1981	Serangoon	6	0.83	18	90	15000	108434
1995	Punggol	9.57	4.74	85.8	266.84	27883	56295

Source: HDB (1984), URA (1995)

Table 4.1.4 Singapore: Land Use for a Prototype New Town of 40,000 DU (High-Density)

Land Use	Provision Standard	Numerator / Denominator	Site Area Standard (ha)	Total Provision (#)	Land Area (ha)
Residential					**250**
Residential	160 du / ha	Dwelling Unit / Land area	-	-	250
Commercial					**71**
Town Center	1/ New-Town	Facility/ Town	29.0	1	29
Neighbour-hood Center	1/ 5,000 to 6,000 du	Facility/ Housing Unit	6.0	7	42
Educational Institute					**63**
Primary School	1/ 4,300 du	Facility/ Housing Units	1.8	13	25
Secondary School	1/ 6100 du	Facility/ Housing Units	3.0	8	26
Junior College	1/ 40,700 du	Facility/ Housing Units	6.0	1	6
Vocational Institute	1/ New-Town	Facility/ Town	6.0	1	6
Institutions					**14**
Community Center	1/10,000 du	Facility/ Housing Units	0.1	4	1.8
Polyclinic	1/30,000 du	Facility/ Housing Units	0.5	1	0.5
Library	1/ New Town	-	0.5	1	0.5
Place of Worship	-	-	0.2-0.4	10	42
Reserve Sites	-	-	0.5	14	7

Parks and Gardens					**30**
District Park	1/ New Town	Facility/ Town	10.0	1	10
Town Center Garden	1/ New Town	Facility/ Town	3.0	1	3
Neighbour-hood Park	1/6,000 du	Facility / Housing Units	2.0	7	14
Precinct Garden	1/800 du	Facility/ Housing Unit	0.3	10	3
Sports and Recreation					**9**
Indoor Stadium	1/ New Town	Facility/ Town	1.2	1	1.2
Sports Complex	1/ New Town	Facility/ Town	3.0	1	3
Swimming Pool	1/30,000 du	Facility/ Housing Units	1.5	1	1.5
Games Courts	1/1,200 du	Facility/ Housing Units	0.1	33	3.3

Industry	**55**
Roads	**88**
Utilities	**20**
TOTAL	**600**

Source: Chan. 1999. p. 65.

Table 4.1.5 shows the calculations of land allocation at the city state level. It shows that Singapore allocates 208m^2 of its land to each of its citizens. This includes both urban and non-urban land. More important is probably the amount of urban land developed for each person. This figure is seen to be 114 m^2 per person, the rest 94 m^2 per person being used for non-urban purposes. The urban land use intensity of 114m^2 per person can be translated into 114 hectares of urban land being developed for every 10,000 people. This figure, 114 ha/10,000 people, is an important measure of urban density and forms a useful basis of comparison among different planning outcomes. Fig. 4.1.3 graphically depicts the hectare of urban land allocation in Singapore.

Table 4.1.5 Singapore:Calculation of Space Allocation per Person at the City-State Level.

Land Type	Land Use	Hectare	m^2/person	Hectare per 10,000 Population
Urban Land	Living Space (Housing)	7200	24	24
	Working Space	12700	42	42
	Community Space (Institution)	2900	10	10
	Open Space, Recreation (Parks, Golf course)	4000	13	13
	Infrastructure (Transportation)	7400	25	25
Total Urban Land		34200	114	114
Non-Urban Land	Military	12300	41	N/A
	Central Catchment (Reservoir)	5300	18	
	Others (Undeveloped land, Cemetery, Agriculture, Quarry)	10,800	36	
Total Non-Urban Land		28400	94	
Total Land (Urban and Non-Urban)		62600	208	

Source: Urban Redevelopment Authority, 1991

4.1.5 Urban Density Measures in Singapore

From the most recent new town brief (Table 4.1.4), we see that there are 160 dwelling units per hectare. If we take the average occupancy rate (3.11 persons/dwelling unit),[6] then we get almost 500 persons per hectare, or 201.38 people per acre, or 49,760 persons per sq. km. This measures typical spot density of areas dedicated for residential purposes within development parcels. However, if we take a look at the New Town figures from Table 4.1.3., we can see that the density has varied quite a bit over the years. Figure 4.1.4 shows how urban densities and residential densities have changed over time.

It shows that except for a peak period in the '60s, both the densities have declined over the years, although retaining a very high level throughout. Another example is Serangoon in the '80s, where the residential density is exceptionally high. The most recent example in the data, Punggol, has the lowest residential density among the new towns, no doubt due to the general expectation of higher standards of living with economic growth.

Fig. 4.1.4 Singapore: Density in New Towns

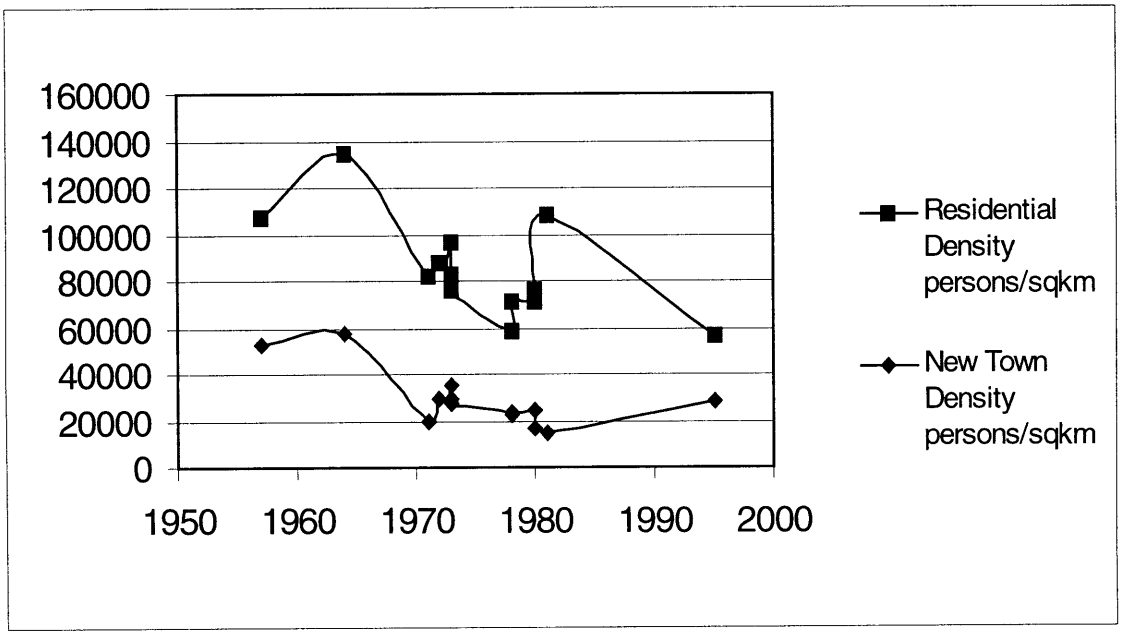


Table 4.1.6 Density Matrix for Singapore, 1999

Population Density	6173 persons/sq.km
Urban Population Density	9975 persons /sq.km
New Town Density	20,000- 67,000 persons/sq.km
Residential Density (Living Spaces in high density new towns)	50,000- 130,000 persons /sq.km
Urban space allocation	114 ha/10,000 people or 114 m2/person
Residential space allocation	56 m2/person

[6] Chan. 1999.

What is also noteworthy is the almost consistent gap between the residential and neighborhood densities. This would account for the urban amenities being provided to the residents, which is seen to be consistent among the various density levels.
The Table 4.1.6 shows the density figures for Singapore (1999).

4.2 Bangkok

Bangkok, the capital of Thailand, is estimated to have a daytime population of over nine million over its still growing square kilometers. The Bangkok Metropolitan Region (BMR) is over 7758 km^2,[7] and consists of the Bangkok Metropolitan Administration (BMA), Nontha Buri, Pathum Thani, Samut Prakan, Samut Sakhon and Nakhon Pathom. The BMA includes the city of Bangkok, its suburbs and is spread over a 1565 km^2.

The portion of the BMA, which is mainly perceived as its urbanized part, is the Greater Bangkok Area (GBA). It includes the BMA, Nontha Buri, Pathum Thani and Samut Prakan. It is spread over almost 4717 km^2. In 1995, more than eight million people, or over 90% of the BMR lived in this area.[8]

Although a city renowned for its vitality and old world charm, Bangkok has been far from successful in coping with the problems of urbanization and growth of the city. Traffic congestion, pollution, inadequate infrastructure and poor communication facilities characterize urban living in Bangkok. As a 1993 WB Report states,[9]

"It is severely congested over a wide geographic area for up to 16 hours a day. The negative impacts of this congestion include loss of time, enormous fuel wastage, and

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[7] Setchell, C.A. "The Growing Environmental Crisis in the World; Mega-Cities: The Case of Bangkok" *Third World Planning Review.* Vol. 17. No. 1. Feb. 1995, p. 2.
[8] Setchell. 1995, p. 2.
[9] Birk M.L. and Zegras, C. "Moving Toward Integrated Transport Planning: Energy, Environment and Mobility in Four Asian Cities" *International Institute for Energy Conservation.* March, 1995. p. 11.

numerous .... as air and noise pollution..... There are also severe social, health, and quality of life effects on Bangkok residents."

As an analysis of the planning process for Bangkok will show in this chapter, many of the problems faced by the city today are the outcomes of the past planning principles and processes that failed to anticipate the future urban development.

4.2.1 Demographic Information and Development Trend

The population of both the BMA and the BMR has been robustly increasing since 1960, when Thailand began to develop its regional and international market.[10] Table 4.2.1 shows the provincial breakdown of population increase between 1960 and 1986. The BMA population in 1986 was 5.7 million and the BMR population was almost 8.2 million. By a later estimate in 1995, the BMA population had increased to 7.9 million, and the corresponding BMR population is 11 million.[11]

Table 4.2.1 Population Growth Trend in Bangkok Metropolitan Region (BMR), 1960-1986

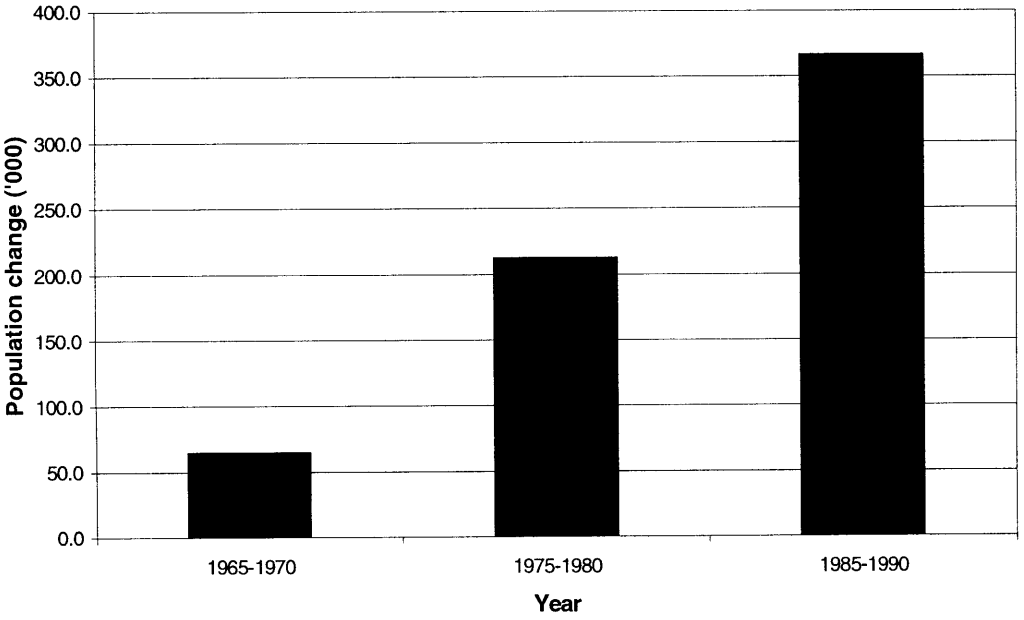
Province	Population in Thousands			
	1960	1970	1980	1986
BMA	2,136	3,185	4,852	5,773
Nonthaburi	196	278	383	473
Pathum Thani	190	242	332	406
Samut Prakan	235	341	503	625
Samut Sakon	166	208	256	294
Nakhon Pathon	370	434	545	614
Total	3293	4,688	6,871	8,185

Source: NESDB, 1986, cited in Dowall (1989)

[10] Dowall, D. "Bangkok: A Profile of an Efficiently Performing Housing Market" *Urban Studies.* No. 26. 1989. p. 328.

The population increase in the BMA has been approximately 200,000-235,000 each year during the '90s. A major portion of the increase is due to rural urban migration, as shown in figure 4.2.1.[12] The figure shows how Bangkok is acting as a magnet for rural migrants. Meanwhile, the average size of households has declined from 6.32 in1960 to 3.9 people in 1995.[13] This change has been attributed to higher levels of education, rising incomes and successful family planning programs.[14]

Fig 4.2.1 Increase in BMA Population Due to Regional Migration (in thousands)



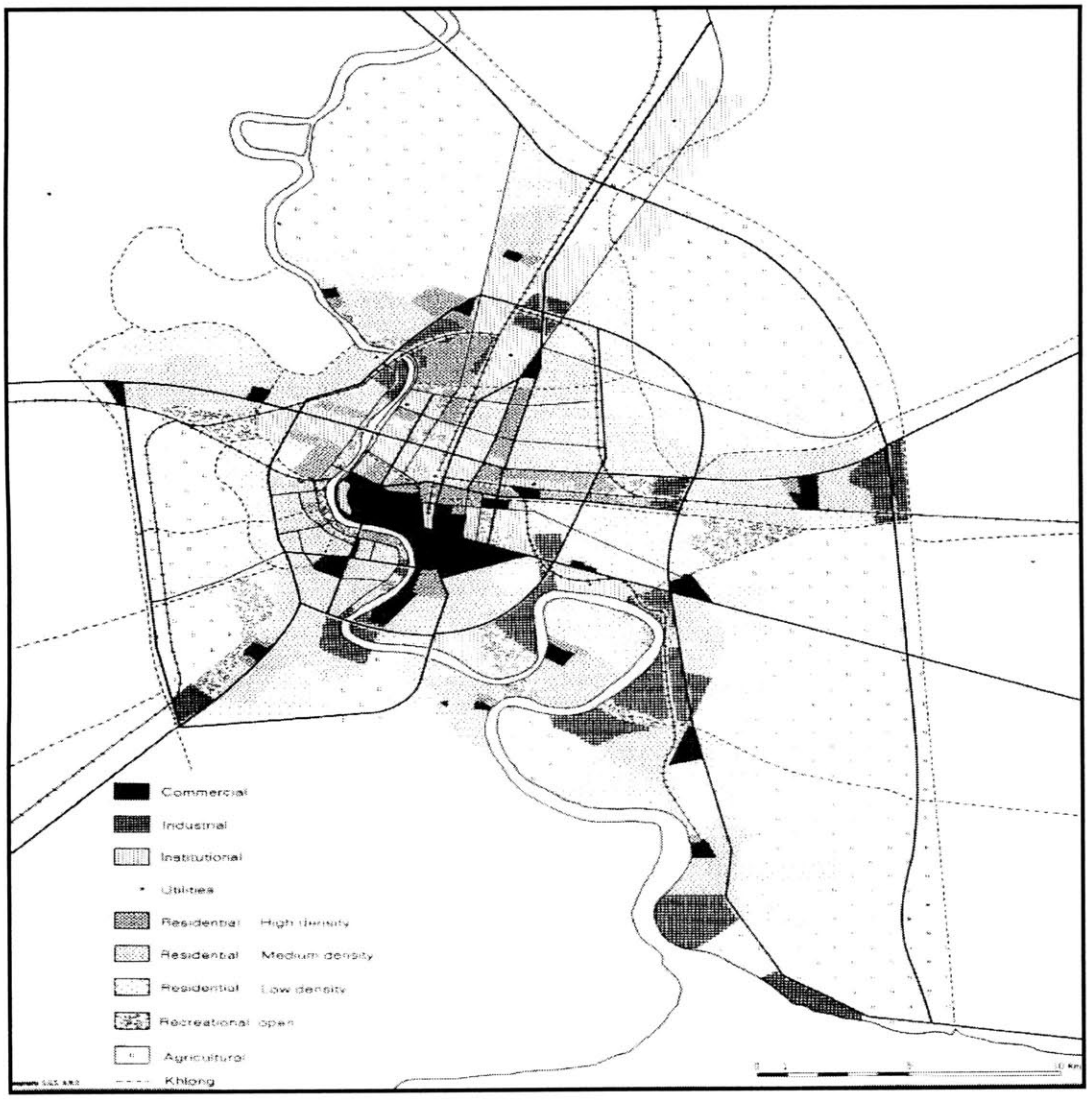
Source: MVA Asia Ltd, et al. Bangkok's Mid 1995 Population (Working Paper D6), Bangkok: OCMRT, July 1995, cited in The Bangkok Plan

[11] BMA Department of City Planning, the MIT Consulting Team and the EC/BMA Project Team. *The Bangkok Plan: A Vision for the Bangkok Metropolitan Administration Area, 1995-2005.* 1996. p. 4.
[12] *The Bangkok Plan.* 1996. p. 4.
[13] *The Bangkok Plan.* 1996. p. 5.
[14] Setchell. 1995. p. 5.

4.2.2 History of Physical Planning

Bangkok is generally known as a city that has developed mainly without any plans. But contrary to the general impression, the first formal physical plan for Bangkok was prepared in 1960. Thailand's Ministry of Interior contracted the American firm of Litchfield, Whiting, and Bowne and Associates to formulate a Master Plan for the metropolitan area.[15] The 'Greater Bangkok Plan 2533' (2533 is the Thai count of year) was the outcome, a Master Plan that considered a 30-year period (1960-1990). The Plan

Fig. 4.2.2 The Litchfield Plan



Source: Sternstein. 1971. p. 82.

has subsequently become known more commonly as the Litchfield Plan. The plan included the Municipalities of Bangkok, Thon Buri, Nonthaburi and Samut Prakan, i.e., the Greater Bangkok Area (GBA). As Litchfield himself said,

"*It is essentially a land use plan: blocks of different uses separated by access ways and coloured to produce a pleasant mosaic-like structure able to accommodate, comfortably four and a half million people, attendant facilities and anticipated industrial growth in 1990.*"[16]

After the Litchfield Plan, there were many revisions to it. In 1992, a Bangkok General Plan was drawn up, and in 1995, there was a new planning effort in the Bangkok Plan. These plans are going to be discussed in the next section.

4.2.3 Planning Approaches

4.2.3.1 The Litchfield Plan

At the time of drawing up the Litchfield Plan, the area was experiencing a population growth greater than the rest of Thailand. By looking at the population growth trend, the Litchfield Plan estimated that by 1990, the population within the planned area could increase to 5.5 million under one set of assumptions and to 9.1 million under another. The estimates were derived based on the following assumptions

Under the condition of effective population control

If population continued to increase at a rate equal to the rest of the nation, an annual increase of 3.2%, then the population in the four provinces would be 5.5 million, and in the planned metropolitan area, 4.5 million. The consultants recommended that the government develop other areas in the region and provide adequate public utilities in the

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[15] Sternstein, L. *Planning the Developing Primate City Bangkok 2000.* Occasional Paper 9, The Australian National University. 1971. p. 21.

[16] Litchfield, Whiting, Bownes and Associates, *Greater Bangkok Plan 2533,* as cited in Sternstein. 1971. p. 1

new developing areas so that population growth would not be so highly skewed towards the direction of the capital.[17]

Table 4.2.2 Density Distribution of Residential Population

	Low Density (Persons/km^2)		**Medium Density (Persons/km^2)**		**High Density (Persons/km^2)**	
	Avg.	**Max.**	**Avg.**	**Max.**	**Avg.**	**Max.**
Net Residential Density (a)	10,000	12,500	30,625	60,000	90,000	160,000
Gross Residential Density (b)	8,750	10,625	24,375	46,875	78,125	135,000
Gross Community Density (c) Outer Area	7,500	8,750	15,000	22,500	26,250	32,500
Gross Community Density (c) Inner Area	-	-	16,875	25,625	31,250	35,000

(a) Persons per sq. km of residential property.
(b) Persons per sq. km of residential property plus frontage along street to centerline.
(c) Persons per sq. km of residential area plus community service area.
(note: the areas have been converted from 'rai.' 1 rai= 1600 sq.m)
Source: Sternstein. 1971. p. 53.

Under the conditions of ineffective population control:

However, if population in the designated area continued to increase at the rate it had been experiencing in between 1947 and 1956, an annual increase of 4.31%, in 1990, the

[17] Sternstein. 1971. p. 35.

population of the four provinces would be 9.1 million and in the metropolitan area would be 7.4 million.[18] This second estimate indicated a terribly congested scenario for the future. This made the planning team fear the outcomes if population growth in the planned area was not checked.

Table 4.2.3 Population Distribution and Area of the Bangkok Residential Zone 1990

	Total	**Low Density**	**Medium Density**	**High Density**
Population	5,810,000	1,200,000	3,570,000	1,040,000
Sq.km	416	160	224	32
Density persons/km2	13966.35	7500	15937.5	32,500

Source: Sternstein. 1971. p. 54.
The above figures exclude 300,000 people in the commercial zone and another 390,000 people (soldiers, monks, students and others) in the Govt. and Institutional Zones.

The Litchfield Plan had specific recommendations for different land use areas. The residential areas would be divided into high, medium and low-density areas. The proposals in the Litchfield Plan are shown in Tables 4.2.2 and 4.2.3. Concerns about providing children's playground and recreational facilities were mentioned.

In 1968, there was no real commercial center in Bangkok. Business and commercial activities were spread out throughout all major roads, streets and lanes. The revised plan advocated specific standard be applied for creating commercial and industrial zones.

The Plans also designated specific areas for governmental, institutional, infrastructure and recreational facilities. There were assumptions about rail transportation being less popular. The plans suggested that existing railways be elevated over ground level roads. Improvement of services was proposed. It was suggested that the number of trains be reduced to the minimum, and that no train should run during rush hour. There were future

[18] Sternstein. 1971. p. 34-35.

plans to connect the railways to create a greater system, but it was not a priority. Table 4.2.4 shows the land use allocation under the Litchfield Plan.

Table 4.2.4 Land Use Allocation under the Litchfield Plan

Land Use	Km^2	Percent
Agriculture	320	41
Residential	305	39.1
Industrial	45	5.1
Institutional	45	5.7
Utilities and Services	26	3.3
Commercial	18	2.3
Recreational	27	3.5
Total	780	100

Source: Sternstein. 1971. p. 12-13.

From table 4.2.4 we see that in the Litchfield Plan, over 460 km^2 of urban area (excluding agricultural land) was planned to contain the 4.5 million population in the BMA. From this we calculated the proposed urban density to be 9782 persons/km^2, and the residential density to be 14,754 persons/km^2.

4.2.3.2 Revisions to the Litchfield Plan

As Sternstein comments,[19]

"In the absence of the necessary fiscal, legal and administrative infrastructure, the Plan has languished. The authorities refer to it when, by chance, a development project included crops up also in the traditional ad hoc approach, otherwise the Plan is ignored, and justifiably so."

[19] Sternstein. 1971. p. 2.

A new revision of the Litchfield Plan was proposed, the Metropolitan Plan (1971-1990), the first revised edition. It included the following:

- Definition of land use and communications in the metropolitan area.
- Specifications of land use, residential, industrial, commercial, governmental and recreational zones were demarcated.
- Major roads , as was deemed adequate) were drawn up for communications.

It proposed additional area to the Litchfield to contain an expected population of 6.6 million over an area of 732 km^2. A series of revisions followed, but little was implemented.

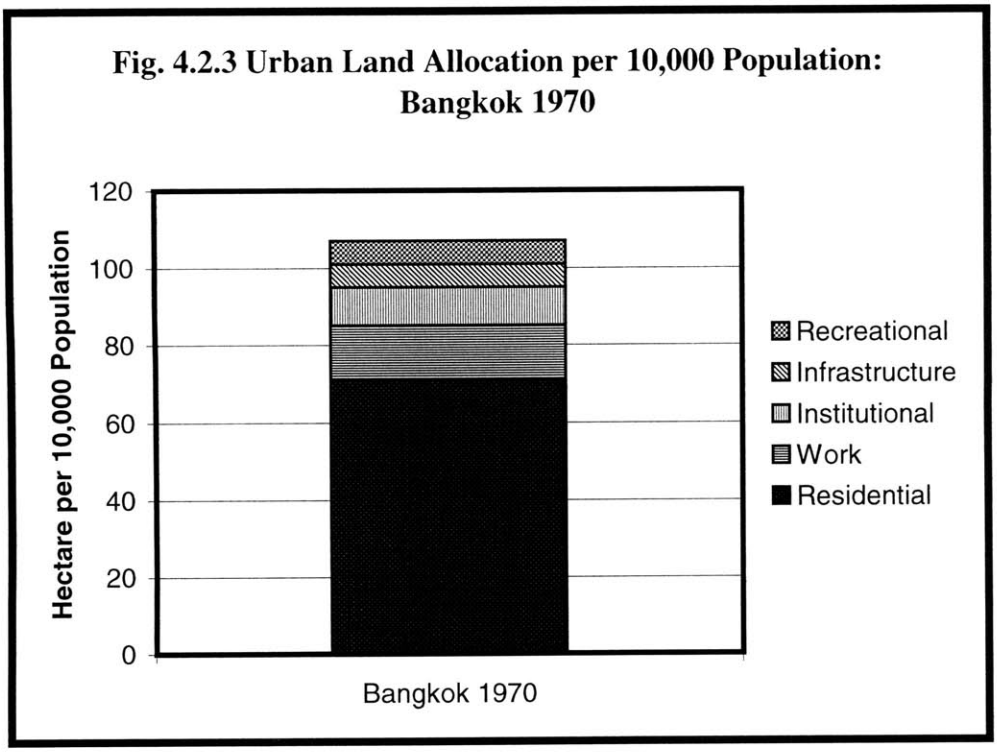
According to the Litchfield Plan and its later revision, the allocation of urban land per 10,000 population would be as shown in the following table:

Table 4.2.5 Urban Land Allocation, Hectare per 10,000 Population, Bangkok 1970 (proposed)

Land Use	Bangkok 1970, Hectare per 10,000 Population
Residential	71
Work	14
Institutional	10
Infrastructure	6
Recreational	6
Total	107

Source: Sternstein. 1971. p. 12-13.

Fig. 4.2.3 Urban Land Allocation per 10,000 Population: Bangkok 1970



The allocation per 10,000 population is shown graphically in the above figure.

As we know, these land projections did not materialize. However, the projections made by Litchfield for under the conditions of no effective population control indeed became true. Despite warnings to take action about migration, little was done to create new jobs in the rest of the country. From a report published 10 years after plan implementation,[20] it becomes apparent that the Litchfield Plan was not taking place as envisioned. The high-density development proposed by Litchfield would have required substantial initial investment in building infrastructure for housing. It would also have to be accompanied by proactive intervention by central authorities to yield the desired high-density housing stock. As population projections clearly were going astray, the authorities let the market mechanisms operate in full force.

[20] Sternstein. 1971. p. 2.

Thailand in the late '60 s was experiencing an unprecedented economic boom, and policy makers did little to impediment the market movements. Rapid industrialization was taking place. No doubt to optimize the utilization of resources, a major portion of the development budget was allocated for roads, bridges, dams and water and electricity in accordance with the plans. This in turn, increased the mobility of people. Lured by the attractions of the opportunities possible in urban settings, rural-urban migration increased tremendously. Bangkok and Thon Buri had the most infrastructures invested in them, and thus received the most migrating rural population.

In response to the growing housing need, as has already been mentioned, the private sector had to respond. This they did quickly and as many critiques claim, quite impressively. As Dowall[21] states,

"..... the Bangkok land market is performing well. Land speculation and land hoarding are not evident and long-term increases in land values are not excessive. The supply of fringe area land with roadway access is growing, keeping the land price increases moderate."

Table 4.2.6 demonstrates just how this supply came about, which is, chiefly by the conversion of agricultural land. As can be seen, areas away from the city core were rapidly urbanizing. Between 1974 and 1984, the conversion peaked at 11-20 km away from the core, where almost 45% of the total conversion took place. Between 1984 and 1988, the maximum conversion occurred at more than 30 km away from the city center. This denotes how the urban border of the city was expanding.

Major roads from the city center experienced building activities along their sides. Subdivision of plots occurred to create narrow strips of plots. Bangkok became private developer's paradise, where they could acquire land to for residential uses beside highways, going away from the city center to access land at a lower price.

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[21] Dowall, D. "Bangkok: A Profile of an Efficiently Performing Housing Market" *Urban Studies.* No. 26. 1989. p. 339.

Table 4.2.6 Urban Land Conversion Patterns in Bangkok, 1974-88

Distance from city center (km)	Total Land Area (km2)	Percentage of Land Area in Urban Use			1974-84		1984-88	
		'74	'84	'88	Land Converted to Urban Use (km2)	Percentage of Total Converted	Land Converted to Urban Use (km2)	Percentage of Total Converted
0-5	100.83	82.8	91.9	91.9	9.21	2.7	.03	0.0
6-10	183.98	35.7	51.8	60.0	29.77	8.8	15.08	5.1
11-20	950.50	21.2	37.4	45.3	153.22	45.2	75.48	25.6
21-30	877.66	8.1	15.4	23.5	64.36	19.0	70.49	23.9
Over 30	1537.02	2.9	2.9	16.9	82.12	24.2	133.88	45.5
Total	**3650.09**	**12.8**	**22.1**	**30.1**	**338.68**	**100**	**294.96**	**100**

Source: Tabulations by the author of the Thailand National Housing Authority's Aerial Photographic Survey, (1987) and Dowall (1990)

As Dowall mentions,[22] until the late '80s, most of the development in Bangkok was low-density, mainly comprising of shop houses and walk-up residences. But in the late '80s there came about a high rise building boom, when over 500 condominium projects were initiated over a period of 5 years.[23] Such increased building activities needed an efficient circulation system. However, apart from the laying out of the primary roads, there was little guidance for creating secondary roads that would connect the major roads. Narrow lanes were thus created in a piecemeal manner. As a result, congestion increased. It became increasingly difficult to provide adequate infrastructure far away from the city following the development trend. From this point onward, the already fragile urban

[22] Dowall, D. "A Second Look at the Bangkok Land and Housing Market" *Urban Studies,* Vol. 29. No. 1. 1992. p. 25.
[23] Dowall. 1992. p. 25.

support system seemed to collapse. As sprawl increased, so did automobile ownership. Few development guidelines were in place, and the urban landscape of Bangkok became a mixed picture of low density with occasional spot high density development, but without any efficient system of public transit. The next two decades saw the continuation of this situation.

4.2.3.3 The 1992 Bangkok General Plan

It was not until 1992 that Bangkok developed a comprehensive land use plan as an attempt to solve the problems of the city. The 1992 Bangkok General Plan intended to integrate the sprawling city. It identified 14 land use categories and as an attempt to simplify the practices, assigned six basic Floor Area Ratios (FAR), decreasing outward from the center of the city.[24] These were:

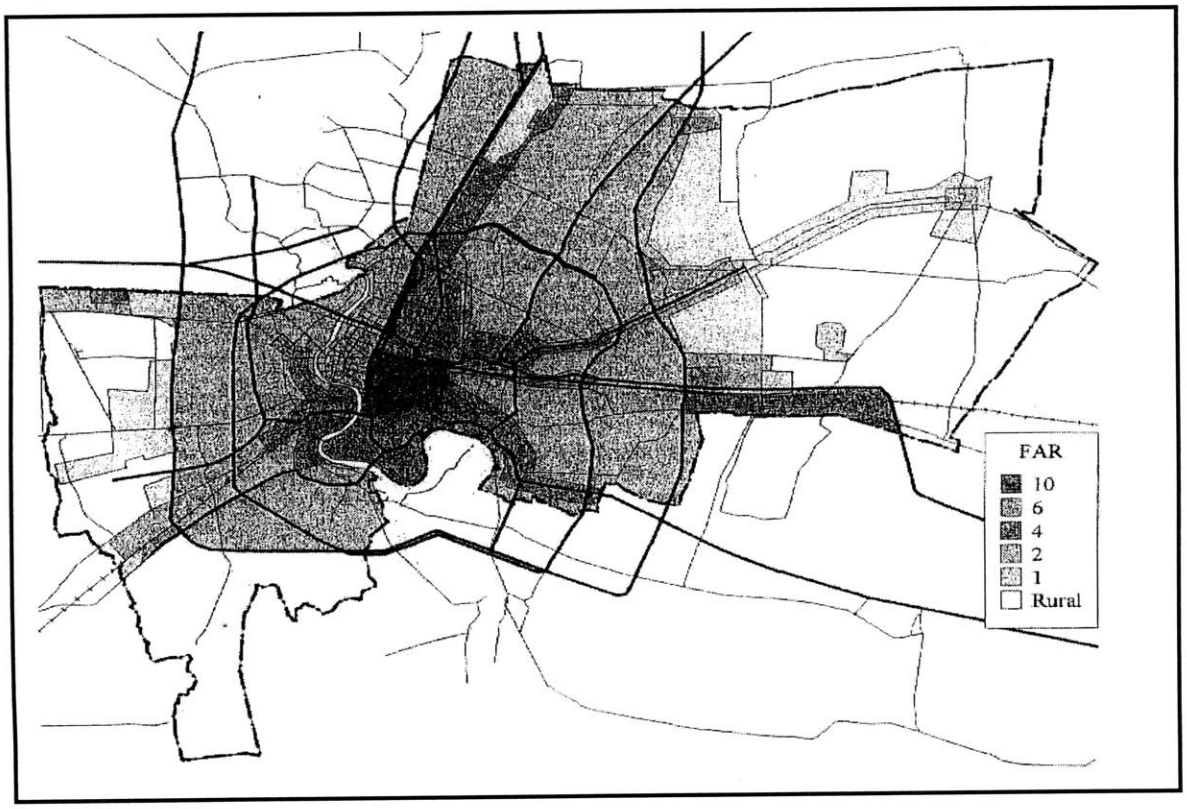
FAR	Location in the City
10	City Core
6	Inner Area, with the exception of heritage conservation areas, commercial corridors, to be served by mass rapid transit
4	Inner areas more than 10 minutes walk from mass rapid transit
2	Outer areas within OBRR, as well as heritage conservation areas
1	Outer development areas beyond OBRR
R	Rural intensities, where only one dwelling and associated agricultural facilities will be allowed for each 6 rai of land.

Figure 4.2.4 Shows the geographic distribution of the assigned Floor Area Ratios. The regulations encouraged intensive development and can be seen as an attempt to condense the sprawling city. However, such high densities are inextricably tied with the proposed transit facilities. Tokyo, for example, has a FAR of 8 in its CBD, and has extensive transit use to make the planning viable.[25] Bangkok's increased FAR is therefore not only a belated effort, but also something that may very well backfire as building will continue without necessary transit facilities, leading towards an even greater congestion than the

[24] *The Bangkok Plan.* 1996. p. 10-51.

one the city faces now. Allowing increased FARs may seem rational, but the anticipated results may prove to be difficult to achieve in a city where in the last thirty years little investment went into public transit.

Fig 4.2.4 The Maximum Allowable FARs in the 1992 Bangkok General Plan



Source: *The Bangkok Plan.* 1996. p. 49.

4.2.3. 4 The Bangkok Plan

In 1996, through a collaborative effort of the BMA Department of City Planning and MIT, a plan was prepared to improve the quality of life in Bangkok. This plan, titled as the Bangkok Plan, evaluated the past planning policies and problems, and came up with recommendations. It strongly endorsed investing in a transit system, to reduce congestion and increase spot density in a coherent manner.

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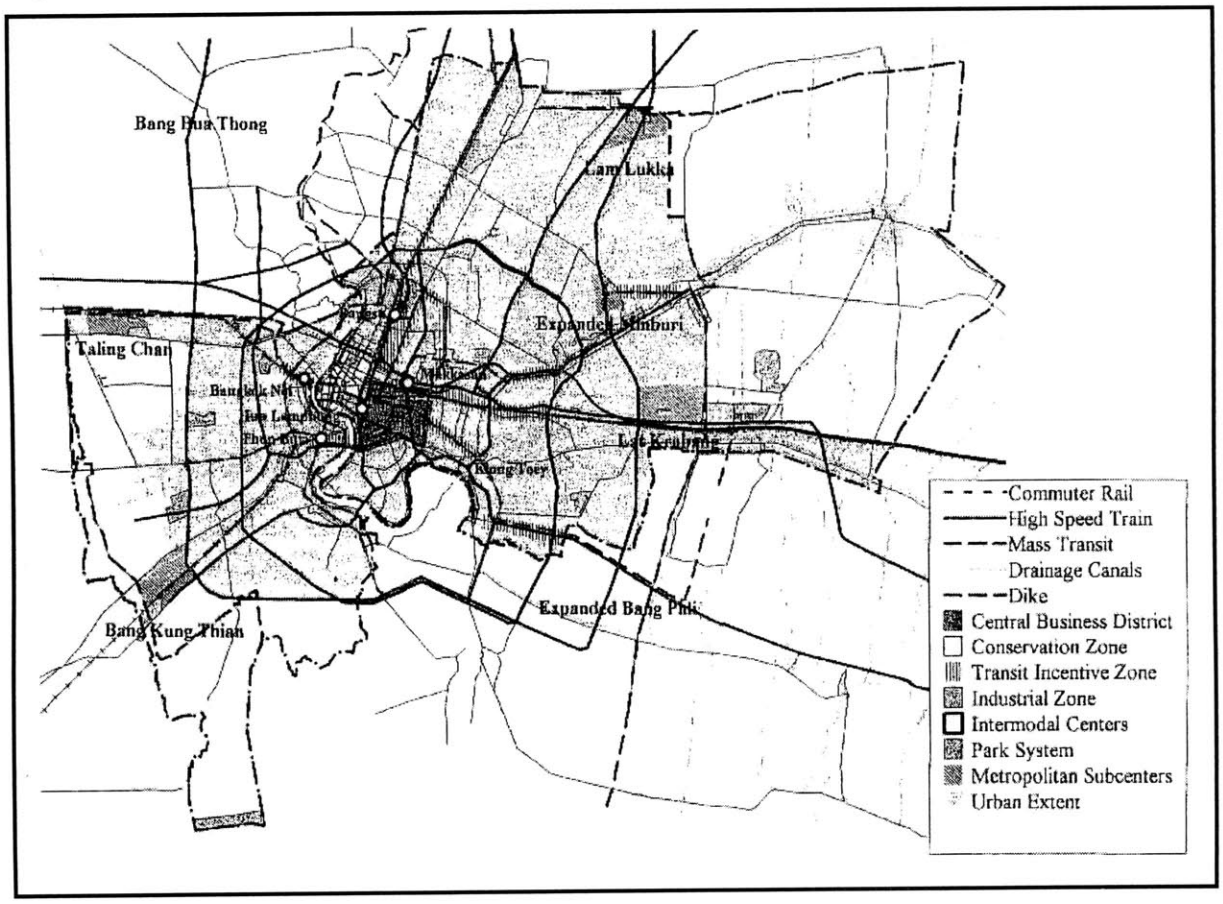
[25] *The Bangkok Plan.* 1996. p. 50.

Fig. 4.2.5 The Bangkok Plan 1996



Source: *The Bangkok Plan.* 1996. p. 69

The main principles of the plan are as follows:[26]

Improve Mobility

- Construct an integrated mass transit system
- Develop multi-modal centers to facilitate interchange between transportation systems
- Develop an improved arterial road network

Concentrate Urban Development

- Create a system of metropolitan subcenters
- Encourage the highest density development in areas accessible by mass transit
- Establish higher standards for infrastructure

[26] *The Bangkok Plan.* 1996. p. 51.

Balance Jobs and Housing

- Create suburban employment cores
- Increase housing opportunities in inner city areas
- Encourage mixed use development

Improve the quality of the urban environment through controls on development

- Protect the integrity of historic area
- Create high quality urban districts
- Preserve ecologically sensitive areas
- Protect irreplaceable agricultural land

The Bangkok Plan proposed six use districts.

Mixed Use Districts, which will encourage mix of commercial, residential and light industrial uses. Up to 50% of the permissible FAR can be commercial use and at least 30% of the site must be left undeveloped.

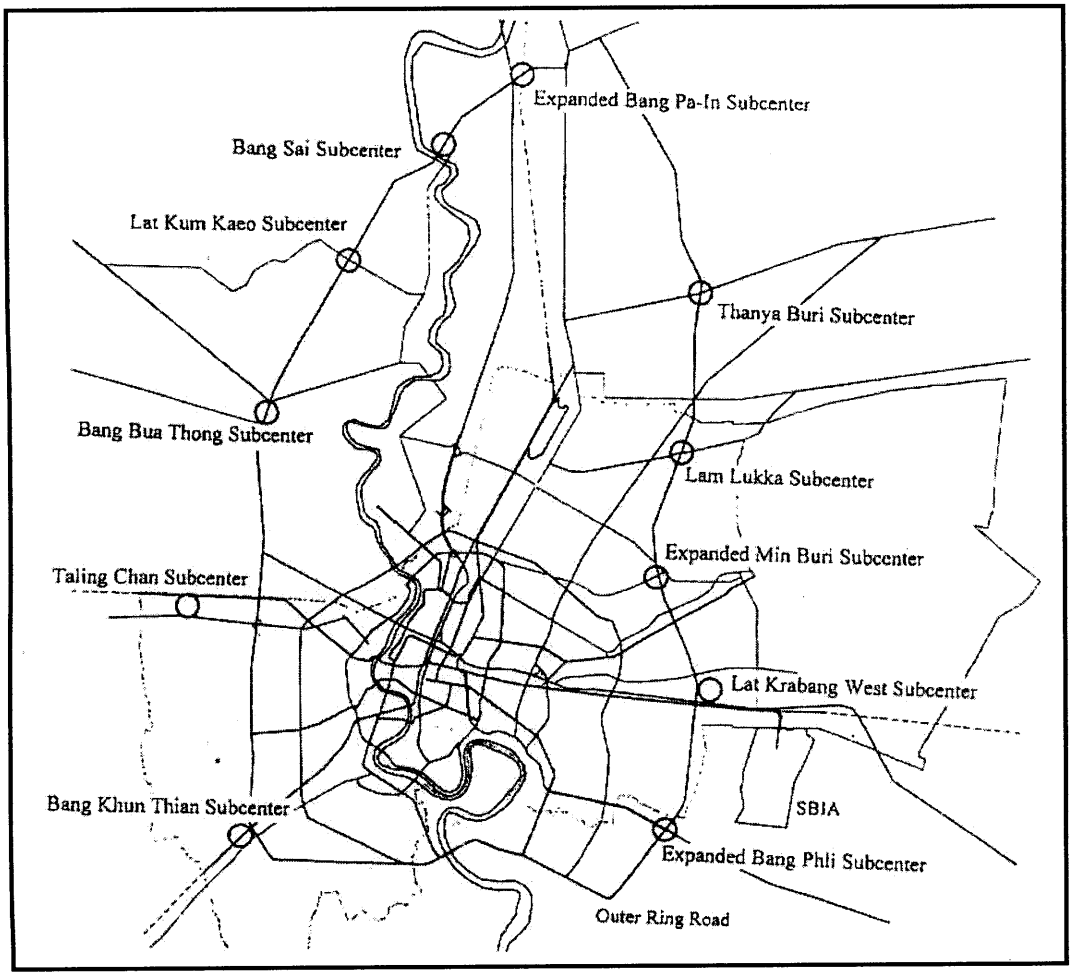
Commercial Use Districts, 100% of the site can be developed for commercial use. Residential, institutional and governmental uses would also be permitted. Parking requirement will vary with distance from mass rapid transit or commuter rail facilities.

Residential Use District, up to 20% of the permissible FAR can be commercial space, but not exceeding 5000m^2. Maximum building heights will be five floors. A minimum of 30% of the site area has to be kept as open space.

Public Park and Open Space, sites that are currently used for public parks or designated for future parks.

Industrial/ Warehouse, Facilities and businesses that may be potentially nuisances in terms of environment or use hazards. Performance standards will be introduced for quality control.

Fig. 4.2.6 The Bangkok Plan: Proposed Patterns of Metropolitan Subcenters



Source: *The Bangkok Plan.* 1996. p. 130.

Agricultural Use District, areas intended for agriculture and aqua-culture. Residential, warehouse and industrial structures directly associated with the primary uses will also be permitted.

One key strategy of the Bangkok Plan is the creation of Metropolitan Subcenters at the urban fringe area as an effort to densify future development at strategic locations. Fig. 4.2.6 shows the proposed pattern of Metropolitan Subcenters. The planning team developed the core of one of the Subcenters, the Lat Kranbang, West Subcenter's core area. The proposed land distribution and the FARs are shown in tables 4.2.7 and 4.2.8.

Table 4.2.7 Proposed Land Use Distribution- Lat Krabang West Core Area

Use	Area Km2	Percentage of Total Area	Total Area Km2
Private Development		**50**	**1.07**
Commercial uses	0.86	40	
Hotels	0.06	3	
Residential uses	0.15	7	
Public Development		**12**	**0.26**
Govt. Offices	0.07	3	
Exposition centers	0.19	9	
Infrastructure and Amenities		**38**	**0.80**
Major roadways	0.34	16	
Public squares	0.06	3	
Major park	0.20	9	
Drainage/open space	0.13	6	
College/Library/Hospital	0.035	2	
Total Core Area		**100**	**2.13**

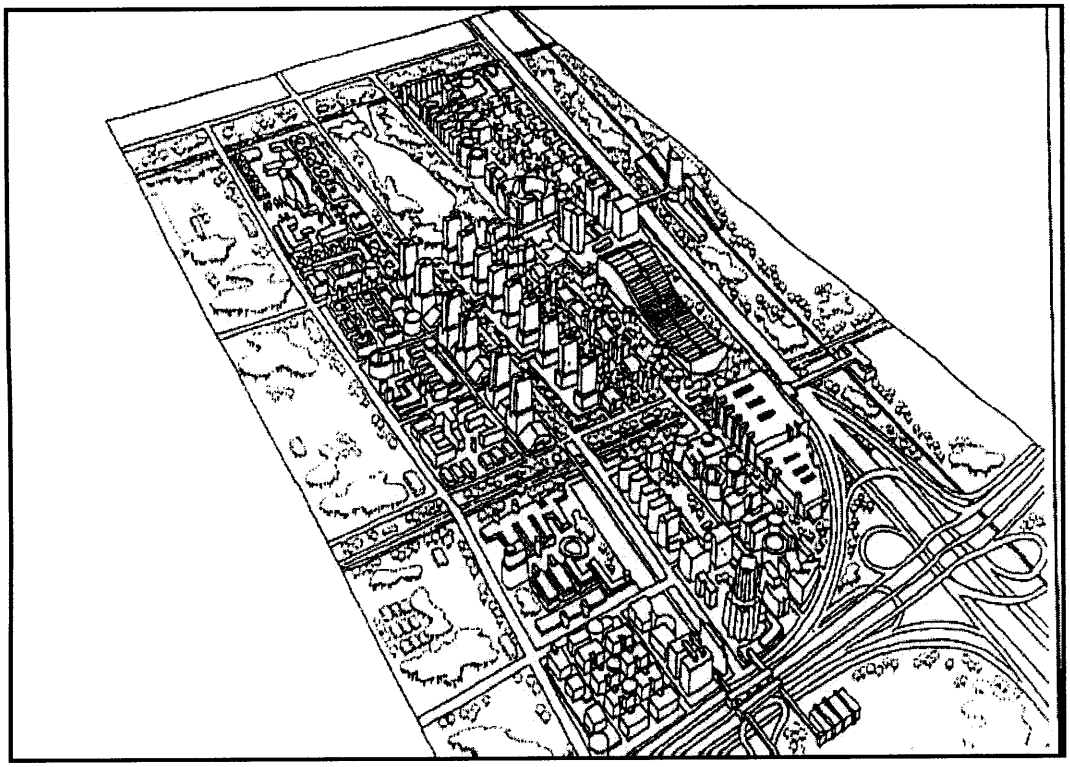
Source: *The Bangkok Plan.* 1996. p. 141.

Table 4.2.8 FARS and Development Capacity: Lat Krabang West Core Area

Use	Permitted FAR	Area km2	Development Capacity sq. m.
Commercial	4	0.20	640,000
	6	0.40	1,920,000
	10	0.26	2,080,000
Hotel	10	0.06	480,000
Residential	6	0.15	720,000
Total		**1.07**	**5,840,000**

Source: *The Bangkok Plan.* 1996. p. 141.

Fig. 4.2.7 Aerial View: Lat Krabang West Core Area



Source: *The Bangkok Plan.* 1996. p. 137.

The study did not reveal how many people or dwelling units this proposal advocates. If we take the Singapore example, where per person residential space allocation is $56m^2$ (including circulation space and parking), then the residential density can be calculated as (900,000/56) 16,071.43 persons per km^2. This gross residential density can be seen much lower than that achieved in Singapore. From a very rough calculation , we can see that even this situation is better than the current regulations that would implicitly let the density be only 9375 persons/km^2 over the same parcel. However, this density is proposed over a stated high-density mixed-use area. For the more general residential use, no definite density is mentioned. In the next chapter, we will try to build out the density implications for residential uses.

4.2.4 Physical Density in Bangkok's Planning Process

It is difficult the assess the density outcomes in Bangkok's planning processes. Although the Litchfield Plan had definite density proposals, we know the plan had not taken place accordingly. The subsequent proposals have proved to be somewhat hypothetical. With the projections made in the Bangkok Plan fresh in our minds, it may be not a bad idea to revisit the real situation in Bangkok.

Unlike Singapore, arriving at an urban density figure for Bangkok is not easy. The problem is not so much lack of data. Rather, there seems to be an abundance of confusing data, not surprising for a city that has several boundaries, the BMR, the BMA and the GBA, which have expanded many times. One source calculated an urban density of almost 19,000 persons per km^2 for Bangkok in 1985.[27] This was calculated by taking a population of almost 5 million over an urban area of 102 square miles or 264 km^2. However, we could not ascertain exactly which area this referred to. In 1999, the population of Bangkok was 1999 is 9,114,852.[28] Again, it was not explicit over what area this figure has been calculated. It seemed likely that it has been considered over the BMA, which consists of Bangkok Metropolis and its suburbs, which is spread over 4717 km^2. If we consider this area, then the urban density would be 1933 persons per km^2. Another set of data shows the following:

Table 4.2.9 Density of Population per One Square Kilometer by Region in Thailand : 1960-1990 Census Years

Regions	Census Years			
	1960	1970	1980	1990
Whole Kingdom	51.2	67	87.4	106.3
Bangkok Metropolis	1365.1	1966.4	3000.9	3758.2
Central (Excluding Bangkok Metropolis)	59.9	73.6	95	118.0

Source: Population and Housing Census 1960,1970, 1980, 1990, National Statistics Office, Thailand

[27] Wendell Cox Consultancy. *Demographic Briefs and Urban Policy, The Public Purpose, Top 85 World Urbanized Areas: 1985. Population, Land Area and Density.*
[28] Bangkok, Asia's Best Cities, Asia Now. www.cnn.com

Table 4.2.9 shows how the urban density in Bangkok metropolitan area has been much higher than the rest of the country for the last four decades. The density in Bangkok was almost 27 times the density of the rest of the nation in 1960, and it became almost 35 times in 1990. During this period, the density of the Bangkok metropolis has increased threefold, while the population density in the rest of the nation has increased twofold in the same period. The table also shows how the density drops suddenly as it gets to the outskirts of Bangkok. Taking an average between the density in Bangkok metropolis and the central region excluding Bangkok metro, we arrive at a density figure of 1938 persons per km^2. This is very near to our previous estimate of 1933 persons per km^2. However, it is apparent that this average figure overlooks the higher densities in the city center. For the purpose of this study, it probably is not unrealistic to conclude that the urban density of Bangkok is almost 4000 persons/km^2 within the city, with an average density of 2000 persons/km^2 if we consider the immediate vicinity.

Unlike Singapore, no predominant prototypical planned neighborhood exists in Bangkok. As a result, it was not possible to calculate a neighborhood density. However, we have tried to make an estimate of residential density based on what would appear to be typical residential development in Bangkok. The following section shows the calculations.

4.2.5. Urban Density Measures in Bangkok

To arrive at an urban density measure for Bangkok, we start with the following the table that shows the household types in Bangkok. Table 4.2.10 shows how for the last four decades detached house has been the predominant form of private dwelling type in Thailand. Although we do not have data for Bangkok, it is natural to assume that a large portion of dwellings in Bangkok will also follow this pattern. We have tried to estimate the residential density over a typical residential area with detached houses over small plots.

Table 4.2.10 Percentage of Private Households by Type of Living Quarters 1976-1996

Year	Type of Living Quarter as a Percentage of Total stock of Households					
	Detached House	Town House	Apartment, Flat, Condo	Row House	Room	Others
1976	89.9	-	0.2	8.9	1.0	-
1986	85.7	0.8	1.0	10.4	1.7	0.4
1996	80.7	4.4	1.9	11.0	1.9	0.1

Source: Report on Housing Survey 1996,1986 and 1976, National Statistical Office, Thailand

Under existing regulations, on a small plot of 50 ft. by 70 ft. (or 325 m^2), the buildable area, after keeping 30% of the area open, would be 2450 sq. ft. or 227.6 m^2. If we build two-story structures, then the total floor area would be 455 m^2. According to Singapore standards (56m^2 per person), this would house 8 people, leading to a residential density of almost 24,604 persons per km^2. However, if we consider the Singapore standards too unrealistic for the context of Bangkok, and assume even an occupancy rate twice that of Singapore, the residential density would be 49,200 persons per km^2, barely reaching the lowest residential density achieved in Singapore.

If we consider a situation when the same plot will be built up to its maximum possible potential, we can get to the following set of calculations. Assuming a 5-story maximum build up, with 30% open space (the implicit FAR is 3.5), the maximum built floor area would be 1138.025 m^2. This would accommodate 20 persons by Singapore standard, leading to a residential density of 62,500 persons/km^2. This figure is more than the lowest residential density achieved by Singapore. However, it is less than half the maximum residential density achieved in Singapore. The following matrix shows the estimated density figures for Bangkok

Table 4.2.11 Density Matrix for Bangkok

Urban Population Density	4,000 persons/ km,^{2} average 2000 km^2
Neighborhood Density	Could not be estimated
Residential Density (Living Spaces in high density new towns)	24,000-62,500 persons/km2
Per person urban space allocation	According to Litchfield Plan , 107 hectares per 10,000 population. In reality, could not be specified

4.3 Comparison between the Planning Processes in Singapore and Bangkok

Table 4.2.12 summarizes the findings on the planning processes practiced in Singapore and Bangkok. Figure 4.2.8 compares between planned land use allocation between Singapore and Bangkok. The Singapore allocation is from the city state level, and the Bangkok figures are from the Litchfield Plan. It can be seen that, in the Litchfield Plan proposed high residential density, the residential allocation is quite high, 39% of the total urban land, compared to only 11.4% in Singapore.

However, after this level, Singapore went on to define the proportion of residential land allocation at the New Town and Neighborhood level, where the proportion increased to almost 50%. In the neighborhood level, Singapore employed a minimum standard provision, a 56 m^2 of residential space per person. As we saw this minimum standard was accompanied by a set of commercial, institutional and recreational, and infrastructure provisions standards to ensure a certain quality of life. The remarkable density came about through maneuvering FARs, and allowing greater building heights. But every effort was made so that the efficiency of urban living is not compromised, that the residents have access to all civic facilities, and that environmental concerns are upheld.

Figure 4.3.1 shows the comparison of planned land allocation between Singapore and Bangkok and fig. 4.3.2 shows their urban land allocation per 10,000 population.

Table 4.2.12 Comparison of Planning Process between Singapore and Bangkok

	Singapore	**Bangkok**
Urban Density	Successful projection of urban density.	Unsuccessful projection.
Policy	Urban density is a direct policy component.	Urban density outcome is the residual of other policy components
Public Sector Intervention	Strong public sector intervention in development provisions.	Limited public sector involvement in development.
Planning Flexibility	Flexible planning that let population and urban density goals to be adjusted.	No follow-up of the original plan to make it flexibly adaptive to be context-specific.
Integration and coordination with other planning sectors	Totally integrated with environment, transportation, infrastructure and other services planning.	Disconnected with other planning sectors.
Enforcement mechanism	Strong enforcement mechanism.	Little enforcement mechanism.
Intention versus outcome	Intention: High density Outcome: High Density	Intention: High Density Outcome: Low Density

Figure 4.3.1 Comparison of Planned Land Allocation between Singaproe and Bnagkok

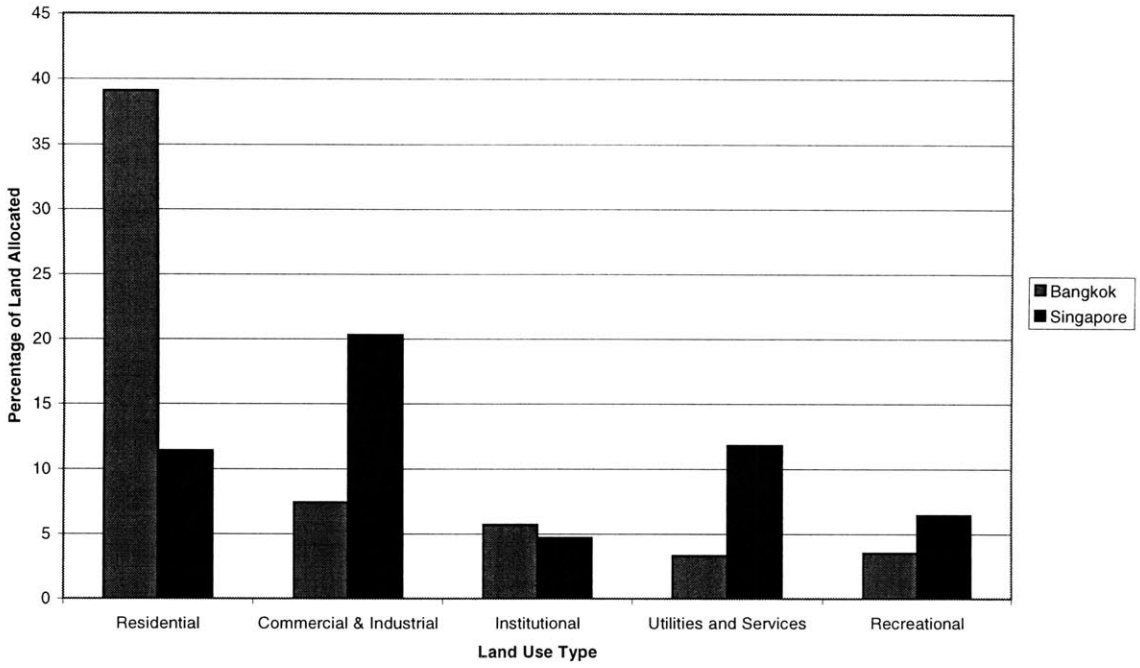


Fig. 4.3.2 Urban Land Allocation per 10,000 People

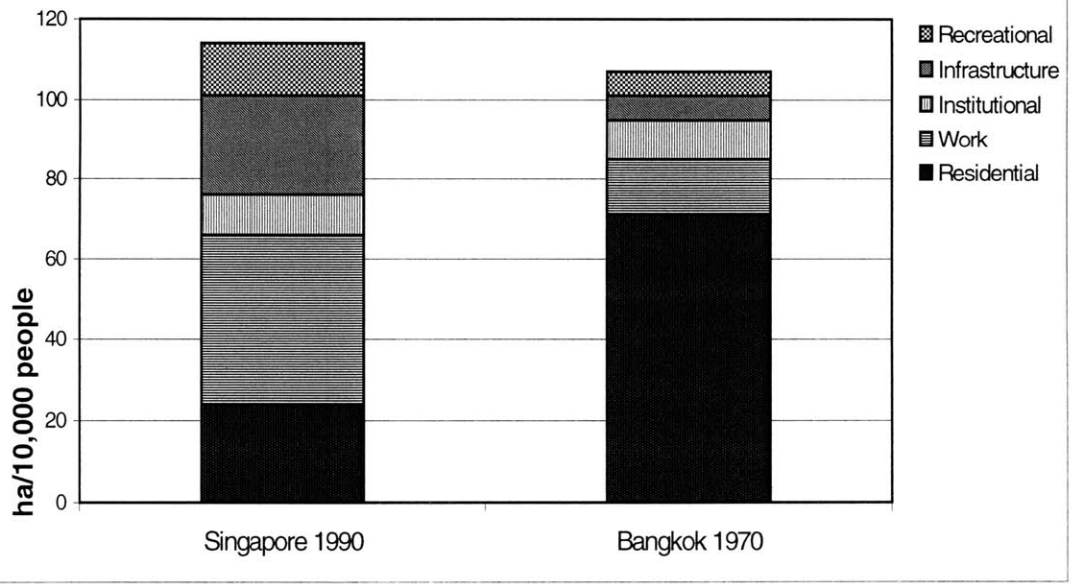


Fig. 4.3.2 shows that although Bangkok has a slightly lower total allocation than Singapore, it has a much higher residential allocation. Singapore, on the other hand allocates much higher for working space, infrastructure and recreation. All these no doubt contribute to the over all higher standards of living in Singapore.

4.4 Future Implication for PRD

From the case studies, it becomes apparent that the successful example of Singapore has achieved higher urban and residential densities than Bangkok. It leads to a valid supposition of whether there is a positive correlation between high density and successful planning projections. One thing this crude study does show is that the compact high-rise residential density achieved in Singapore can never be the outcome of a laissez-faire planning process like that in Bangkok. Singapore's extraordinarily high residential density is a deliberate effort of its planning objectives. That Singapore can increase its urban density by providing less per capita urban space is obvious. By providing adequate environmental standards and public amenities, Singapore has achieved an urban density that can be termed as 'optimum.'

The method of estimation applied here to get at the residential density of Bangkok demonstrates the capacity of such low-density urban development, with little transit facilities. The outcome is the small-lot detached housing development, mainly brought about by private sector, with little central intervention. As we calculated, such development is not capable to serve a residential density of more than 17,500 people per km^2 comfortably. That many cities in the developing world with similar development pattern carry far greater number of people (Jakarta: 50,225 persons/km^2, or Bombay: 49,202 persons/km^2) signals to the overtaxed urban systems of these cities.

4.5 Conclusion

In the case of Singapore, because urban density was a direct policy component, it is possible to use the intended figure to measure and gauge the planning policies to evaluate their outcomes. Singapore's success in evolving a planning process capable of practicing realistic planning measures, can be attributed to certain unique socio-cultural features. The absence of a rural hinterland and lack of rural urban migration are some of the major ones. Also important is the presence political will that made the large-scale land acquisition, squatter and slum clearance possible. The general people were also willing to move from congested city centers to high rise new towns.

In Bangkok although achieving a certain urban density was embedded in the plans, little effort was given to its enforcement even when it became apparent that the planning outcomes were deviating from their goals. The case studies demonstrate that urban density, when treated as a direct policy component, can be effectively used to organize and coordinate among associated issues of land-use, housing, transportation and infrastructure planning.

Chapter 5: Applying Density Measures in the Three Scenarios

In this chapter, I will apply the lessons learned from Singapore and Bangkok, in order to predict the possible future of the Pearl River Delta Region as an input to the Pearl river Delta Planning Studio. This thesis looks almost single-mindedly at the urban density outcomes of the case studies and compares them to the densities proposed in their plans. This chapter suggests appropriate density assumptions for each of the three possible future scenarios for the Pearl River Delta.

5.1 The Scenarios

I will begin by spelling out the scenarios as they were developed in the studio. The formation of the scenarios was the product of group efforts, and as such they are composite propositions. The studio participants came from multi-disciplinary backgrounds, and contributed to the discussions drawing reference from their experience as well as expertise. The 'scenario building' approach was used to predict possible future chain of events, where the participants were engaged in developing alternative plausible future scenarios. There were exercises on building scenarios based on city-models, as well as on alternative development approaches. Finally, three scenarios were selected and developed in such a way so that they would be distinct and helpful in the process of decsion-making, especially in dealing with the key policy variables. As products of brainstorming sessions, the descriptions of the scenarios may at times seem cryptic, and somethimes may appear to assume too much. However, they do portray how policies can impact the future urban environment.

Tables 5.1, 5.2 and 5.3 describes the key local factors, the implementation of regional priorities and the outcomes associated with each of the scenarios.

Table 5.1 Scenario A :

Key Local Factors	Implementation of Regional Priorities	Outcomes
Settlement Patterns	• Regional Transportation/Land Use/Housing Plan • Regional Housing Plan	• High-Density Housing • Housing Projects Coordinated with Transit Stops • Mixed-Use Development • New Towns Outside Major Cities
Environment and Agriculture	• Greenbelt Plan • Realization of Food Security Needs • Public Health Campaigns • Anti-Pollution Programs (Mandated or Market Driven) • Establishment of Minimum Standards	• Assurance of Future Open Space • Natural Habitats Preserved • Flood Control and Water Pollution Improved • Agricultural Land Preserved • No Net Loss of Agricultural Production, Possibility of Gain • Improved Public Health
Income Distribution	• Research and Development of Plans for Niche Markets for Different Cities and Regions in the PRD	• A More Evenly Distributed Income Pattern in the PRD (No One Area Favored) • Gradual Economic Equality with HK and Sector Change (labor-intensive to Capital Intensive jobs)
Auto Use	• Implementation of Rules That Make Auto Ownership Expensive and Thereby Undesirable • Quotas on Registration • Effective Transportation Alternatives in Place	• Less Wear on Road Infrastructure • Free Flowing Traffic • Lower Air Pollution from Auto Exhaust • A Need for a New Level of Bureaucracy • Only the Rich Can Drive • No Restriction on Hong Kong Drivers Could Be Problematic and Could Lead to Complaints and Downfall of Program
Demographics	• Subsidize Health, Educational and Cultural Facilities in Places Other than Hong Kong and Shenzhen	• Reduction in the Amount of Brain Drain as the PRD is More Desirable to Skilled People
Industrial	• Encourage Hong Kong Companies to Invest in IT in Guangdong • Encourage a Greater Diversity in Types of Companies in the PRD • Greater Emphasis on the Marriage of Biotechnology and Agriculture to Improve Farm Yields	• Attractive Area to Investors in the Future • Easier for Service Sector to Call Guangdong PRD Home • Varied Economy Less Susceptible to Market Rises and Falls
Authority	• Greater Emphasis on an Efficient Central Government to Coordinate Various Plans • Involve Hong Kong in Process, Since HK Has More Experience in Implementing Such Plans	• Improved Cross Border Working Relationships • Plans That Are More Likely to Come to Fruition

Table 5.2 Scenario B:

Key Local Factors	Implementation of Regional Priorities	Outcomes
Settlement Patterns	• Free movement of labor to meet market demand • Up-zone areas around transit station to allow greater densities • Quality urban design and variety of housing options to mitigate densities • Regional land use/transportation plan	• Dense, compact settlements • Rail-dependent development with high use of public transit (rail and bus) • High densities at rail stations • Mixed use development at rail stations • Higher residential densities on city edges (with easy access to CBD)
Environmental Quality	• Over-development in flood plains • Indiscriminate/high use of asphalt • Laissez-faire environmental policies	• Loss of green space and agriculture • Unsustainable development • Acceptance of increased environmental problems • Fragile watershed ecosystem
Income Distribution	• Regional economic strategy to attract wider variety of business opportunities • Regional revenue sharing to more evenly distribute concentration of businesses around transit stations	• Upgrading job market to accommodate more educated work force • All income groups accommodated through wider range of housing types (to discourage sprawl)
Auto Dependency / Transit Use	• Capital commitment to public transportation infrastructure • Incentives for private sector developments • High costs for private auto use	• Low auto use • High transit use • Mixed use development to encourage public transit use • Distribution of employment centers • Regional transportation demand management policies
Demographic Change	• Regional economic strategies to attract a wider variety of business opportunities • Eliminating legal barriers to employment • Using local university resources (avoiding brain-drain)	• More immigration (internal and external migration) • More innovation and new ideas • Rising incomes • Rising education levels • Women holding wider variety of jobs
Industrial Mix	• Regional economic strategy to attract wider variety of business opportunities • Create opportunities for investment (private, foreign, corporate, multi-national, domestic)	• Upgrading of industrial activities • Concentration of industry for increased efficiency to gain economies of scale (access to transportation system) • Broadening of employment sectors
Regional Authority	• Establish regional authority through better cross boarder cooperation • Incentives--Municipal buy-in to regional plans	• Regional authority or coordination of local authorities to implement land-use and transportation plans

Table 5.3 Scenario C:

Key Local Factors	Implementation of Regional Priorities	Outcomes
Settlement Patterns	• City center remain the focus of urban development. • Investment in infrastructure for high-density development is not made. • Self-help and private sector housing creating low-density settlements. • Little upgrading of land-use plan. • Little coordination among land use and transportation plans. • Plans do not accompany enforcement mechanism.	• Congested central cities and squatters at the outskirts. • Auto-dependent development with ineffective use of public transit (rail and bus) • Segregated land use. • Low residential densities on city edges (with difficult access to CBD) • Plans are ignored.
Environmental Quality	• Over-development in flood plains • Indiscriminate/high use of asphalt • Environmental policies are ignored in favor of attracting manufacturing industries in the region.	• Loss of green space and agriculture • Unsustainable development • Environmental problems are overlooked.
Income Distribution	• Regional economic strategy to indiscriminately attract economic opportunities. • Greater inequality in income distribution.	• No effort to upgrading and educate the labor force. • Housing supply is not commensurate with housing demand.
Auto Dependency / Transit Use	• Capital commitment to roads and highways construction as opposed to investing in public transportation infrastructure • No mechanism to control auto growth.	• Few people can afford cars, and inadequate road surface leads to congestion. • Low transit use because of inadequacy of transit systems. • Abundant use of reconditioned cars, two-stroke engine vehicles and personal motor bikes.
Demographic Change	• Lack of adequate opportunities away from the cities. • Low value added industries generate a society of low skill labor.	• Massive migration to the urban centers from the rest of the region. • High competition leads to low wages. • Women holding the majority of low paid jobs.
Industrial Mix	• Regional economic strategy to attract any of business opportunity. • No concerted effort to bring in high value added industries.	• Industrial activities remain low value added. • Abundance of sweat shops.
Regional Authority	• The regional authorities are more competitive than cooperative. • Little incentives for municipalities to conform to regional plans	• No coordination between regional and local authorities to implement land-use and transportation plans

After describing the scenarios, the chapter highlights possible outcomes that may be likely under each of the different scenarios. Emphasis is given to identify the key policy variables related to density issues and the objective is to predict a range of densities associated with each scenario

5.2 Description of Scenarios

5.2.1 Scenario A

This scenario has been developed as the most optimistic scenario, where all good things that can happen will happen. Long term visionary planning is envisioned, and sustainable outcomes are anticipated. Singapore is the underlying model of this scenario, and a proactive central planning system is in effect. In keeping with the development character in Singapore, this scenario assumes that the Pearl River Delta will develop in such a manner that productive agricultural land is preserved. Like the Singapore model, high-density development is clustered around rail stops. A central authority will intervene to ensure adequate infrastructure provision in the high-density settlements. More than 80% of the population will be accommodated in these settlements. There will be perfect coordination among transit, land use and housing policies. The public sector will bear the responsibility of making investment arrangements for the capital investment needed for infrastructure (As Singapore does with their Central Pension Fund). There would be efforts to clean up polluting industries and the establishment of standards for future industries. Auto use and ownership would be restricted. Additionally, there would be adequate investment in health, educational and cultural facilities, to make it a place where the future generation will find their increasingly higher standards of living. All these local factors are summarized in Table 5.1.

Singapore is the primary model for this scenario, representing an idealistic setting where a strong central authority ensures planning outcomes. To create a realistic range of possible outcomes associated with Scenario A, it may be useful to look at developments

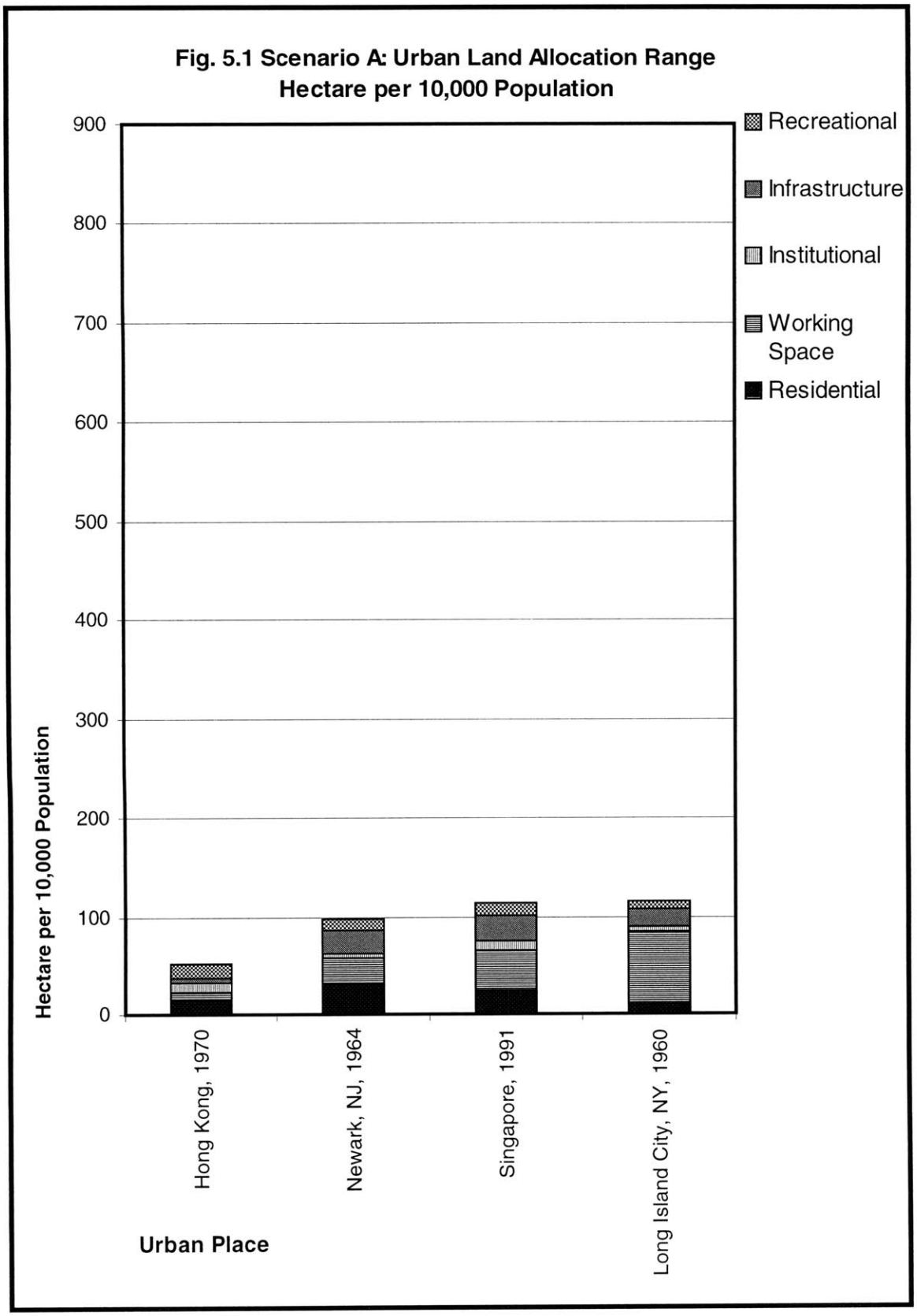


Fig. 5.1 Scenario A: Urban Land Allocation Range
Hectare per 10,000 Population
900
800
700
600
500
400
300
200
100
0
Hectare per 10,000 Population
Recreational
Infrastructure
Institutional
Working Space
Residential
Hong Kong, 1970
Newark, NJ, 1964
Singapore, 1991
Long Island City, NY, 1960
Urban Place

elsewhere that have achieved high urban density, with variations in planning and implementation principles. Going back to Chapter 2, where several Western examples were reviewed, it is possible to fit developments like Long Island City (New York) and Newark (New Jersey) to this scenario. The planning outcome in Hong Kong, which we reviewed in Chapter 3, also can be an example of this scenario. The examples of these high density developments are useful for sketching the range of outcomes associated with Scenario A. Figure 5.1 somewhat depicts this range, where the examples show urban land allocation ranging from 115 to 47 hectares per 10,000 population. Singapore probably portrays the ideal mix, with Newark as its nearest western counterpart. It. is interesting to note the urban land allocation in Long Island City, which is clearly a mixed-use area with very low residential allocation. Hong Kong, on the other hand shows an extremely low total allocation, but almost a similar amount of residential, recreational and institutional land allocation.

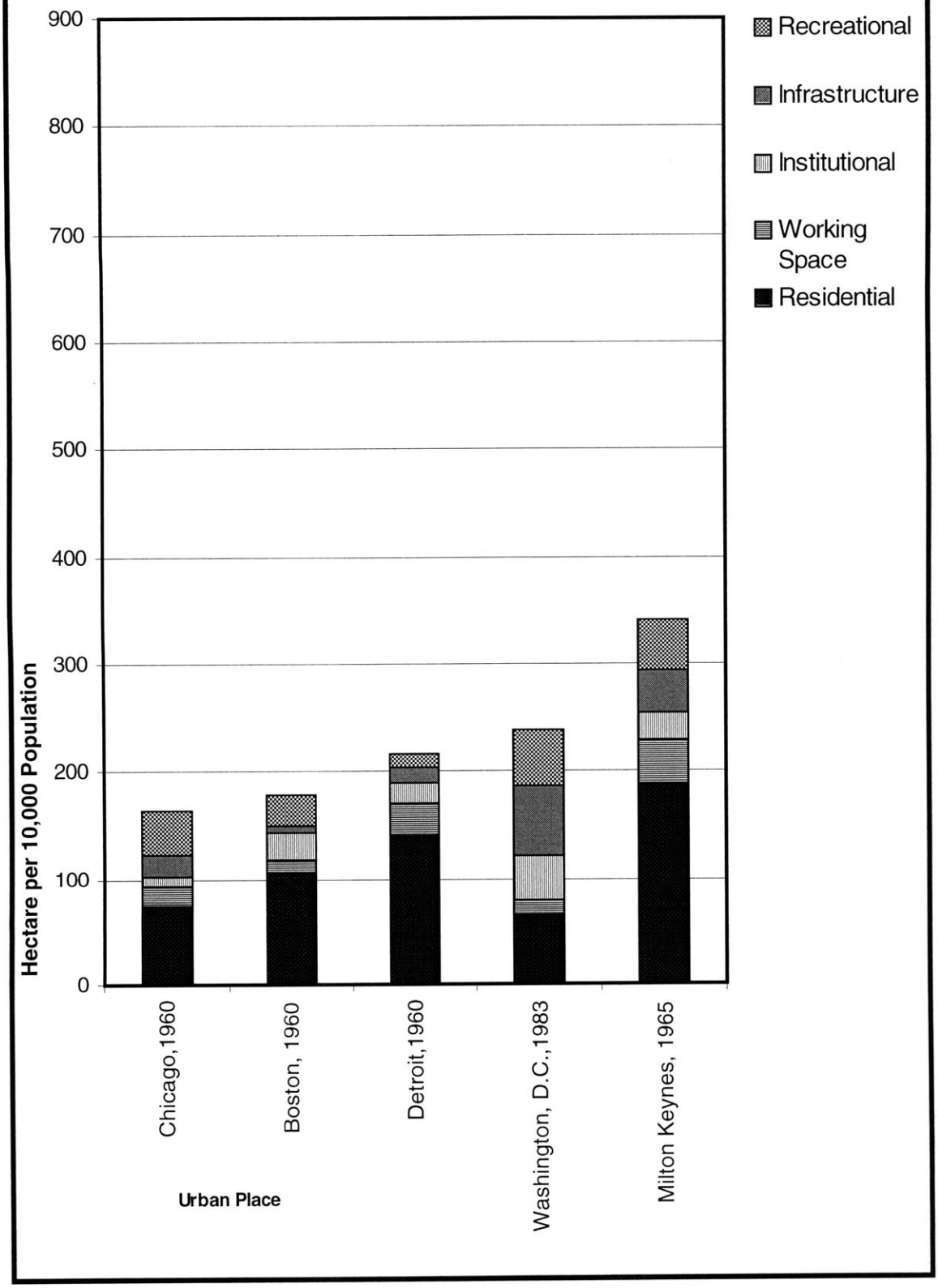
5.2.2 Scenario B:

This Scenario is in the middle ground between Scenario A and C. Moderate levels of centralized planning are envisaged with a market-based orientation. Incentives, along with regulations will direct development.

Under the assumptions made in Table 5.2, the PRD will become a multi-centered region with significant levels of urban sprawl with strong core cities containing significant concentrations of employment. There is likely to be an extensive rail network with high rates of transit use for work commutes. Moderate levels of centralized planning are coupled with a market-based orientation, where incentives and regulations will combinedly direct development.

This scenario predicts that the Pearl River Delta will become more homogenized over the next two decades, with higher-end industries, high technology and service sector businesses moving into mainland PRD. Per capita income in the PRD will rise, narrowing the traditional income gap that has existed between Hong Kong and the rest of the region.

Fig. 5.2 Scenario B: Urban Land Allocation Range
Hectare per 10,000 Population



Workers will possess both higher levels of education and skills to meet the new economy's needs. Growing population and expanding settlements will demand significant investments in high-speed rail and roadways. There will be some public sector directed high-density settlements around transit nodes, but there will also be significant private sector real estate development. As in Tokyo, around 40% of the population will be housed in the high-density settlements. But there will be lower-density private sector led residential developments as well. Despite regional transportation demand management policies that encourage high rates of public transit use, automobile ownership will increase along with rising incomes, resulting in significant road congestion. Failure to enact strict measures for land preservation on a regional scale will eliminate most green space and agricultural land, resulting in a sea of asphalt and sprawl.

Among the planning examples we reviewed in chapter 2., places like Washington D.C., Boston, Chicago, Philadelphia and Milton Keynes show urban densities that fit this scenario.

5.2.3 Scenario C:

This is the worst case scenario, where the development potential of the region fails to be fulfilled because of inappropriate planning and policy decisions. Short-term and immediate economic gain will overpower decision making, and little effort will be given towards sustainable development in the long run as problems mount. The agricultural sector will decrease while the manufacturing sector will dominate. Many new factories will locate in the area, depending on the abundant supply of cheap labor. This will continue to attract low-skilled labor from the rest of China. The large population growth will strain capacity of water, sewer and waste disposal infrastructure. There will be little effort on the part of the private sector to make these provisions. Housing will be provided by the private sector, and the predominant form would be low density sprawl type settlement, with very small carrying capacity. Cities will have slums and squatter settlements, and the urban systems will be severely overtaxed. Pollution from new factories and development will causes decline in air and water quality, corresponding to

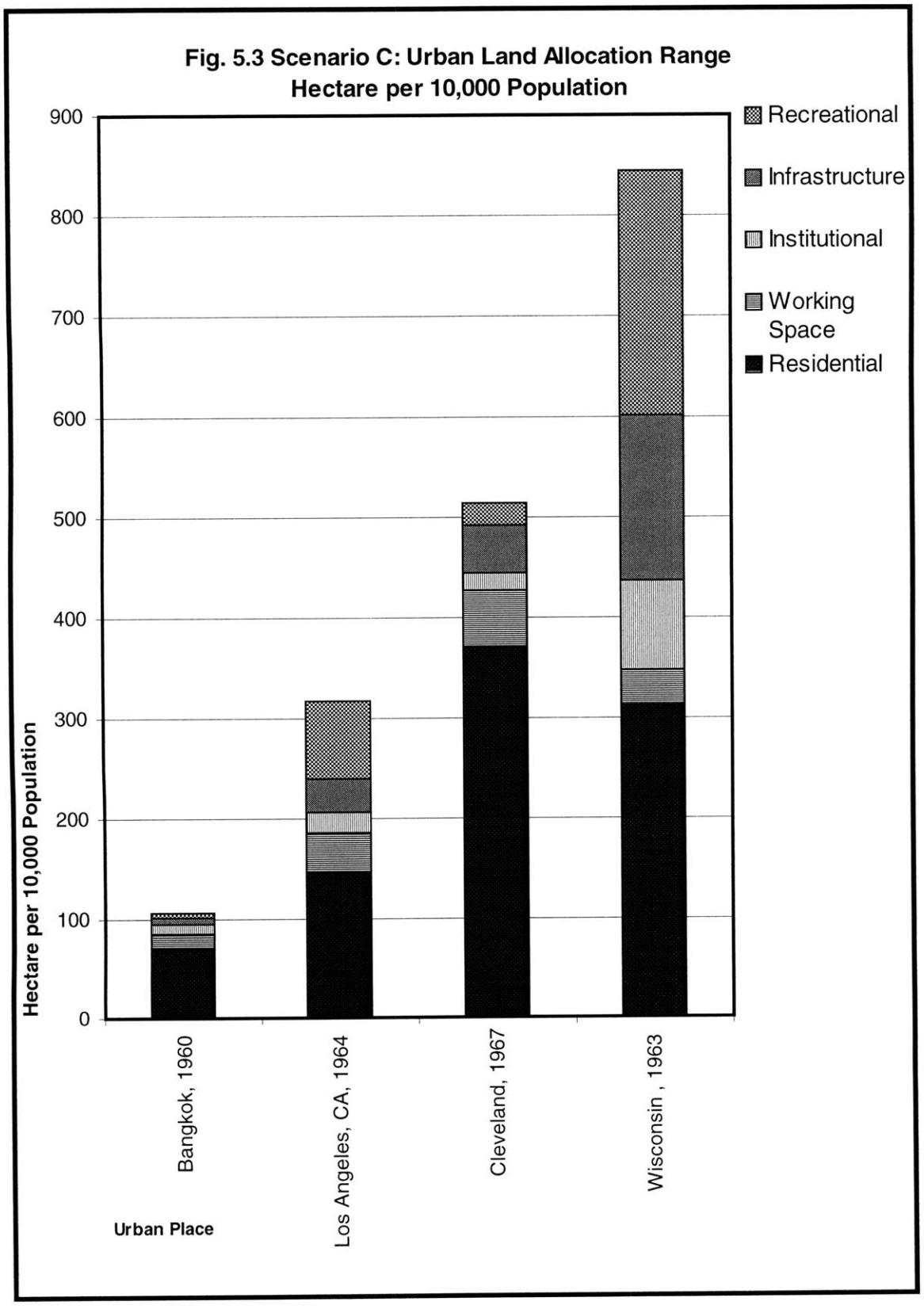


Fig. 5.3 Scenario C: Urban Land Allocation Range
Hectare per 10,000 Population
900
800
700
600
500
400
300
200
100
0
Hectare per 10,000 Population
Recreational
Infrastructure
Institutional
Working Space
Residential
Bangkok, 1960
Los Angeles, CA, 1964
Cleveland, 1967
Wisconsin , 1963
Urban Place

an overall decrease in quality of life. Severe water pollution will affect natural habitat resulting in a PRD fishery collapse. Uncontrolled ozone and other air pollution may potentially reduce overall crop yields.

Under this scenario, Hong Kong will protect its border, hindering overall regional relationships. The most likely physical outcome would be low-density sprawl with pockets of high-density developments. Little will be invested to create public transit, and streets. New construction and speculative real estate development will follow a boom-bust cycle. There will be proliferation of leapfrog development and incompatible land uses.

Bangkok is the primary model for Scenario C. To create a range of outcomes that may yield from this scenario, U.S. examples like Wisconsin, Cleveland, Portsmouth (New Hampshire) or Los Alamos may be useful. The range is quite wide in this scenario, as the next section will show.

5.3 Possible Future Implication for PRD

Table 5.4 describes the possible land and housing policies and associated outcomes for the three scenarios. In table 5.5, a range of densities have been put forward in the following table to provide measures of physical outcomes under the different scenarios. The range of figures and the key policy variables are presented together here to formulate comprehensive pictures of each of the scenarios. These are the essence of what has been shown in tables 5.1, 5.2, 5.3, and 5.4.. The intention is to attach some concrete numbers to the scenarios. These numbers are intended to generate a picture of the related quality of living, especially when considered in the context of the specific scenario settings. The key policy variables give specific values to these numbers. For example, the residential density in Singapore, without transit, would have spelled an awfully congested scenario. On the other hand, the much lower urban density figures for Bangkok, instead of spacious living, depicts a congested setting when it is considered in the light of the lack of transit

and low environmental concern. Table 5.5 shows the possible future of PRD under the three different scenarios, along with brief descriptions of key policy variables.

Table 5.4 Land use and Housing Policies and Outcomes Under the Different Scenarios

Policy	Scenario A	Scenario B	Scenario C
Land	Strong emphasis on preserving agricultural land accompanied by strong enforcement mechanism	Emphasis on preserving agricultural land, but at the same time road building is given priority	Central land use policy in place to preserve agricultural lands, but enforcement may be lacking
	Central authority creates guidelines to achieve the pre-set urban density	Densities are set lower than in Scenario A	No such mechanism
	Local govt. determines supply of urban land that will be served with adequate infrastructure, according to the guidelines set by the central authority	Local govt. determines supply of urban land according to central mandate, but will have greater flexibility to coordinate with market forces. More competition at the local level.	Local government has wide latitude in determining land use Free to tap into land as a revenue base
	Direct policy on urban density, i.e., the population density over urbanized areas, so that the central authority exercises direct control over the distribution of people in relation to job access, public amenities, etc.	Infrastructure and amenity provisions do not restrict lower density settlement	Residual of other policy measures (or lack thereof)
	Constant monitoring and updating bring about changes to mitigate unforeseen problems		Little monitoring

Table 5.4 (cont'd)

Policy	Scenario A	Scenario B	Scenario C
Housing	Policy at central level ensures that adequate housing is provided to all, in areas that are designated for residential uses Measures created to subsidize housing for those that the market does not provide for. Subsidization should decrease over time as more people can afford market housing.	Provision of housing is shared between public and private sectors.	Affordable housing is ensured only to a certain point. Informal sector provides housing to the rest of the population, often the stock is sub-standard and is located on land that plans call for to be preserved

In Table 5.5, the urban density capacity of the region under the different scenarios has been estimated. This measure implies that under each of the scenarios, associated with the related set of policies, a region has a definite range of carrying capacity. The carrying capacity may be defined as the urban population the region can comfortably house and provide with all the necessary urban facilities. The study shows that once a certain set of policies is set in motion, the urban density capacity of a region becomes fixed. For example, relatively high urban density may be achieved only with a set of policies that promotes a transit-oriented development. On the other hand, if provision of housing is predominantly the responsibility of the private sector, and the central authority exerts little regulation, then a low density housing development is almost inevitable. The scenarios have played out the various policy options, and the results are presented in the table.

Table 5.5. Future Implications for PRD

	Scenario A (Singapore, Hong Kong, Newark, New York)	Scenario B (Paris, Tokyo, New York, Boston, Chicago)	Scenario C (Bangkok, Wisconsin, Cleveland)
Urban Density Capacity	8,000- 12,000 persons/km^2	4,000-9,000 persons/km^2	1,000-4,000 persons/km^2
Block Development Density (or New Towns)	20,000- 67,000 persons/km^2	At Least 20,000 Persons/km^2	Unspecified
Proportion of Population Living in High Density Residential Settlements	80% of the population	40% of the population	2%-5% of the population
Urban Land Allocation, Hectare per 10,000 Population	65-120	150-350	100-850
Key Policy Variables	Strong public sector interventions and regulations in development and infrastructure provision standards.	Public-private partnership and shared responsibilities in development and infrastructure provision standards.	Private sector responsible for development and infrastructure provisions, with little regulations.
	Integrated land use, transportation and development plan	Density adequate to support significant public transit	Density inadequate to support mass transit.
	Decision to invest in public transit, high level of environmental concern	Invest in both transit and highway. Moderate environmental concern.	Invest in roads & highways, not in transit. Lack of environmental concern
	Enforcement mechanism in place.	Enforcement mechanism is in place through incentive-based market operation.	Little enforcement mechanism
	Constant evaluation and monitoring.	Market forces are responsible for monitoring.	Little evaluation or monitoring.

5.4 Future Implications for PRD: The likelihood of any one Scenario

PRD is at a critical threshold where its development can proceed along several alternative paths. How likely are each of the scenarios given the present context of PRD:

Scenario A:

Although Scenario A has been developed as an idealistic scenario that portrays the best possible outcome for all the sectors including economy, environment and land use planning, it may not be totally unrealistic. Under this scenario, the central authority controls market to bring about the planned outcomes. Given the present level interest on the part of the policy makers to make PRD the example for the rest of China, and the very real admiration for the achievements made by neighboring Singapore, PRD may adopt the necessary policy mechanism to arrive at Scenario A. One of the advantages PRD has is its present low population density and the sparse development away from the established urban centers. This situation makes it easier to initiate plans for capital investment in infrastructure and transit aiming to create high-density settlements separated by green belts and connected by rail. The PRDUSP has similar proposals, but the details need to be worked out for the plans to become reality.

Scenario B:

This scenario would be the outcome of a planning process that is supported by high to moderate economic growth. Developments would be a mix between some compact high-density settlements and also some low-density sprawl. This is a situation when investments have been made both in transit and highway development. Authorities have made certain provisions, but the market is also allowed to develop as a profit generating mechanism. As a result, along with some high-density development, low-density private development will occur. Tokyo and New York are examples of such development, where both transit ridership and auto uses are high.

This scenario is not implausible either, especially if the policy makers choose to intervene in certain sectors, and let market take care of others. For example, this could be accomplished through building some new town-type development, but simultaneously encouraging self-help low density housing by private developers.

Scenario C:

This scenario has been developed to illustrate the worst case. In this scenario, a central authority exerts little influence to put in any large-scale transit or infrastructure investment. Except for building an inadequate amount of road surface, provision of urban amenities is left to private sector.

Unfortunately, this is also a very plausible scenario for the PRD, as is already evident from the trend of transformation of agricultural land in the PRD during its urbanization process of the past 20 years. The tendency of Chinese authorities to invest extensively on building roads and highways, without laying out environmental and auto use standards can be seen as a clear move towards this scenario.

5.5 Conclusion

The urban density of an area is ideally determined by an exhaustive study of the carrying capacity of the area in relation to the agreed development goals. But as our study here denotes, some key policy variables do play very important roles in the projected density outcomes. The sensitivity of the population projections to these variables determines, to a large extent, the degree to which realized densities conform to projections. The three scenarios developed here show that in so far as they each contain a different mix of policies, they will lead to corresponding densities on the ground. Moreover, the range of possible density outcomes will also vary with the related set of policies. From a study of Figure 5.1, we can see that Scenario A contains less variation in possible range of density outcomes. The possible variation somewhat increases in Scenario B, as shown in Figure 5.2. Finally, 5.3 shows the large variation of possible density outcomes in Scenario C.

Chapter 6: Conclusion

In this concluding chapter, I discuss the major issues that emerged from this thesis to reveal some of the important lessons learnt in the process and in the light of my thesis, I suggest some policy recommendations to assist the policy makers in adopting appropriate density measures in planning for the Pearl River Delta.

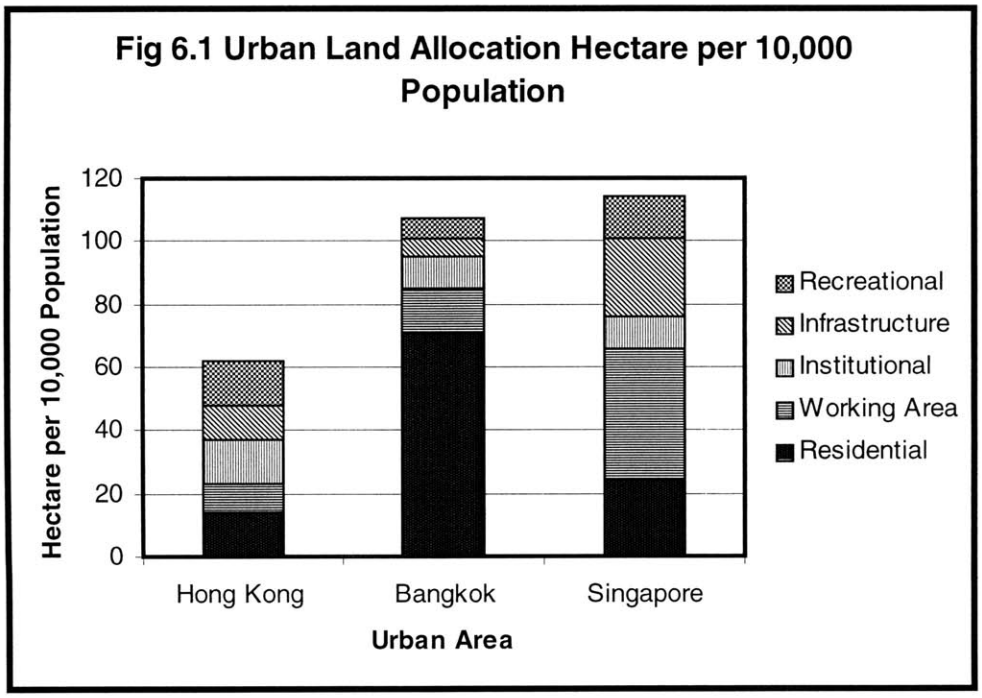
6.1 From the Premises to the Establishment of the Thesis

This study is based on two premises. The first one is that the realization or otherwise of the urban density measures proposed in a plan can be taken as a good indicator of the success or failure of the plan itself. The second is that when certain key policy variables are adequately considered, plans and their density projections are more likely to be realized. Taken together, the premises stipulate that the adoption of an urban density measure that takes into consideration certain key policy variables makes plans better able to anticipate future outcomes. To test the first premise, this study examines two quite extreme examples of planning outcomes in terms of urban density projections. By looking at successive plans for each case, the study establishes the conditions and components of successful density projections. This process establishes the second premise and identifies the key decision variables whose adequate considerations are important for the success of a planning process. At the same time, the process requires looking deeper into the following issues: 1) the quantity of urban land allocation; 2) the adequacy of urban land allocation; and 3) the role of the police state in successful plan implementation.

6.1.1 The Quantity of Urban Land Allocation

An understanding that emerges from this study is that in land-use planning, the amount of land allocated for the different urban uses has two quotients. The first is the set of policies that address the issue of density. The second is the amount of land available, depending on the supply of and demand for land. The first component denotes deliberate planning intentions, while the second expresses market mechanisms. Any given set of plans will be a product of these two components. The case studies that I present here are

examples of two extreme cases. Singapore is the extreme case where policy issues determine the supply of land. Bangkok is the other extreme where market controls the supply of land, and where plans and policy issues are more or less ignored. Hong Kong is also an interesting case where growth-oriented policies, combined with a restricted supply of land, have resulted in the high degree of utilization of its small quantity of developable land. My thesis analyses the outcomes of each, and draws inferences in planning for the PRD.



6.1.2 The Adequacy of Urban Land Allocation

Adequate urban land allocation is important for the adequate provision of urban amenities. An important lesson that can be learnt from this study is that in physical planning, the adequacy of urban amenities is an important consideration, which requires a separate set of density measures than that of urban land-use density denoted by the number of people over unit area (eg.: persons/km2). The measure Singapore employed for this purpose is the amount of urban land allocated to each person, and then breaking it up by land use types. An effective measure of this is the amount of land allocated for every ten thousand people. For Singapore, it can be measured how may hectares of

residential or recreational land for every 10,0000 people is being allocated, within the total allocation of urban land for every 10,000 people. Fig.6.1 shows the urban land allocations that Singapore makes, the allocation made in the Litchfield Plan for Bangkok and similar allocation made in Hong Kong. As can be seen, the total allocation does not vary all that much between Singapore and Hong Kong. Singapore allocates 114 ha of urban land for every 10,000 people, while Bangkok proposed to allocate 107 ha. However, what varies greatly is the breakdown within this land budget. Singapore allocates only 24 ha/10,000 population for residential purposes, Bangkok intended to allocate 71 ha, almost thrice the amount of Singapore, while Hong Kong performs with a very low total allocation of 61 hectares per 10,000 population. The figure also shows that the land allocations for working space and infrastructure in both Bangkok and Hong Kong is far lower than that in Singapore. Singapore's policy to create an effective high-skilled work force is no doubt a force behind its comparatively generous work space allocation. The relatively higher allocation in infrastructure probably protrays the amount of land Singapore has dedicated to build an efficient rapid transit system, as well as an extensive road network.

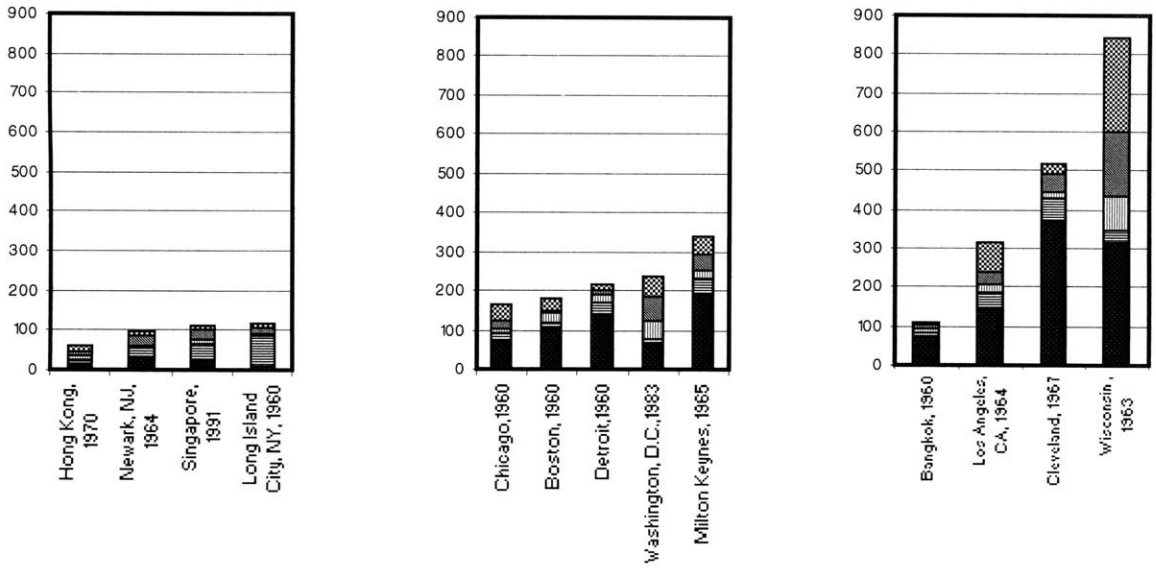
Such allocation measure serves two purposes. First, it ensures that there is adequate allocation of each land-use type. It is easy to see how this measure is closely related to the availability of urban amenities like park, open space, community facilities etc., which in turn can be translated into the resultant quality of urban living. By ensuring the minimum levels, Singapore has reached a certain standard of living that Hong Kong or Bangkok has not been able to achieve. As could be seen from the case of Bangkok, it lacks a planning process that creates and enforces such provisions adequately. While in Hong Kong, there has been a tendency to maximize the urban capacity of the area by accommodating as many people as possible.

The second purpose of such allocation is to set up a system of manipulating urban density. When urban density needs to be adjusted, the horizontal bands in fig 6.1 demonstrate the possibilities of manipulation while having a clear sense of the change in the provision of urban amenities. In the case of Singapore, if policy makers want to

increase urban density, then it is possible to decide what allocations may be decreased from this measure. Since such allocations in the Litchfield Plan were never carried out, similar manipulations for Bangkok are near to impossible. Efforts to create higher density in Bangkok may very well result in inadequate allocations in some other sector. Similarly the case of Hong Kong, any effort to increase density through residential allocation may lead to even greater congestion. On the other hand, Hong Kong has greater allocation for both institutional and recreational land uses than Singapore and Bangkok, and thus reducing any of these allocations in order to increase density might be possible.

In fig. 6.2, the range of urban land allocation under the different scenarios, as developed in Chapter 5, is revisited.

Fig. 6.2 Urban Land Allocation in the Different Scenarios



Scenario A	Scenario B	Scenario C
• High urban density • Small variation in the urban land allocation outcome	• Medium urban density • Moderate variation in the urban land allocation outcome	• Low urban density • Large possible variation in the urban land allocation outcome

6.1.3 The Role of the Police-State in Successful Plan Implementation

Plan implementation is Singapore is the outcome of central control exerted by an authoritarian political system. This may give rise to a speculation whether such effective enforcement of plans is possible only in a so-called 'police-state,' and may even be undemocratic. Such deliberations are beyond the scope of this research. Suffice to state that this study does not establish the necessity of a police-state for successful enforcement of plans. Hong Kong is an example where high-density physical planning has been the outcome of an efficient planning system that puts emphasis on sustainable development. However, the study does imply a certain extent of central involvement, and the need to create wide political consensus for an efficient planning process to be in place. This requires dialogue among the responsible institutions so that planning decisions are in accordance with the long-range regional priorities. The need for a detail analysis of the institutions involved in the planning for PRD is therefore important, as is initiating a process of consensus-building to settle long-term planning objectives, within PRD as well as across the border with HK.

6.1.4 Identification of Key Policy Decision Variables

From the case studies, it is clear that when adequate consideration is given to some key policy variables, plans and their density projections are likely to become successful. These key variables are: the level of public sector intervention, coordination among land use, transportation and development plans; decision for investment in public transit; adequate enforcement mechanism and the need for constant evaluation and monitoring. These are elaborated below.

The Level of Public Sector Intervention

For an outcome as outlined in Scenario A to come about, a significant level of public intervention is necessary, either in the form of direct involvement or through indirect policy mechanisms. The involvement of public sector lessens gradually from Scenario A to C, while the responsibilities handed over to private sector increases. The capital

investment and administrative mechanisms needed to create, for example, high density new towns, can only be the outcome of involvement of the central authority.

Coordination among land use, transportation and development plans

When development plans and projections are developed with the integration of land use and transportation plans considered, the outcomes are more likely to conform to the proposals. Coordinated land use and transportation plans carry the potential for developing high-density settlements. As our examples demonstrate, preservation of agricultural land is hard to achieve without having a corresponding policy on development and transportation. The very land that is to be preserved may be encroached by roads, squatters or even polluting industries.

Decision to investment in public transit as a part of environmental concern

The scenarios demonstrate just how important the decision to invest in public transit can be for the future possible outcomes. Decisions regarding auto use go hand in hand with decisions about transit, and are a product of the degree of environmental concern on the part of the policy makers. A policy of unlimited auto use may lead not only to a pattern of sprawl development to which it may be virtually impossible to introduce a transit later, but will also have irreversible effect on the environment, land use and density. A decision to invest in transit at the opportune moment is necessary for a high-density development.

Adequate enforcement mechanism

The scenarios, as well as the case studies also show that unless plans are accompanied by enforcement mechanism, even the best-laid plans may not become real. Most plans, including the Litchfield Plan for Bangkok seemed quite well laid out, with the appropriate related considerations voiced. However, if a stringent enforcement plan is not taken up, plans have little scope to materialize. Enforcing partial plans initiate a long process of mismatch between plans and outcomes. To achieve successful high-density development, it is important that plans carry enforcement mechanisms.

Need for constant evaluation and monitoring

Plans and projections need to be constantly monitored. As mentioned before, one of the theses here is that density figures can act as litmus tests of whether plans are coming along according to forecasts. The dynamics of reality is very likely to follow a course not exactly in accordance with plans. However, it is the task of planners to constantly evaluate and monitor the direction of change and development, so that key policy decisions can be adjusted. Singapore is a truly successful example of constant evaluation and upgrading of planning policies. Through this process, the sensitivity of any plan is tested.

Successful plans are more likely to yield higher densities

In the context of the developing world, where accommodating large population is a general concern, some of the most successful plans are those that aimed to achieve high densities, at least at the residential level. Both Singapore and Hong Kong are successful examples of this. This is because such plans are based on the need to make capital commitment to transit and infrastructure development to serve the high-density population. Their key decisions help to decongest city centers, create new decentralized urban employment centers, control large-scale highway development and can better plan for environment. As discussed before, achieving the minimum density that would make transit investment feasible becomes an overriding concern of the policy makers, and many other decisions follow suit.

On the other hand, plans that aim for lower density developments as a priority for housing certain segments of the population, without providing for the majority, and make investment decisions accordingly, run the high risk of doing only enclave developments. Not only do these plans have greater potential for not being realized, but when they do, they become overridden with multitude of urban problems soon enough any way.

6.2 Recommendations

This study set out to derive urban density measures in planning for the PRD. In the previous chapter, we developed a matrix that indicates the probable urban density outcomes and the carrying capacity of the region under different scenarios. The related policy recommendations, in the form of key policy variables, have also been narrated. What we will emphasize here, as supplementary measures to formulate the most effective policies, are some recommendations crucial for the future. These are, the need for deeper evaluation and elaboration of the PRDUSP, clearly define development paths and goals and designate urban density as a direct policy component and set up mechanism for constant evaluation.

6.2.1 The Need for Deeper Evaluation and Elaboration of the PRDUSP

The PRDUSP attempts to create a regional framework for physical development. The proposals it contains should be evaluated in the light of the trend of development it proposes. For example, it has an obvious inconsistency in trying to create a good transit in the Type A cities, while proposing a very low density of 1000 person/km,^{2} a figure that can not support mass rapid transit. It still has not arrived at any specific urban density or residential density figure, so there is little scope to evaluate at present the extent of mismatch that may occur between planning intentions and the allocation needed.

6.2.2 Clearly Define Development Paths and Goals

Development goals should clearly embody the path of development, and make clear choices between binary policy options, for example, whether the public sector will assume primary responsibility or not, develop or not develop transit, invest or not invest in infrastructure for high density settlements, etc. As we have seen, not only are these decisions crucial by themselves, but they also need coordination among themselves to bring about concerted development.

6.2.3 Designation of Urban Density as a Direct Policy Component

The probability that a certain physical plan will have the intended outcome depends to a large extent on whether the planned urban density is a direct policy component or a residual of other policies. For the best possible outcome, urban density measures should be designated as a primary policy component.

6.2.4 Set up Mechanism for Constant Evaluation

Since planning and implementation is a dynamic process, an evaluation mechanism that is sensitive to the changing context should be set up. Urban density, in this context, can act as an indicator of the direction or deviation of the actual outcomes. It will provide a useful basis to guide the necessary modification.

6.3 Conclusion

In planning for the future of the Pearl River Delta, concerns such as the need to preserve agricultural land and environment definitely seem to push towards a high-density development for any plan to be sustainable. The lesson that is learnt from the case studies is that different types of physical developments are linked with distinct density outcomes, which in turn defines the carrying capacity of any region. Future policy decisions should be driven by regional priorities, such as, enhancing competitiveness of the region, increasing productivity and creating a sustainable and efficient urban system. This thesis demonstrates the need to be sensitive to the urban density implications embedded in a physical planning process. It identifies the key policy variables that are instrumental in defining the density capacity of any region. It reveals the complexities of planning for a certain urban density, and is intended to provide a basis for future decision making for the policy makers of PRD.

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