

# URBAN GROWTH AND LANDSCAPE CHANGE IN THE TOKYO METROPOLITAN AREA

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## I. INTRODUCTION

This paper intends to examine the relation between the growth of Tokyo Metropolis and the subsequent changes of land use and landscape in the 50 km sphere around Tokyo (Fig. 1). With regards to landscape, the study laid a particular concern on the change of such open spaces as woodland and farmland. The diminishing of such open spaces has been recently familiarly enlightened as the environmental problems in the metropolitan life and they contain general decreasing problem of open spaces in the level of metropolitan sphere as well as the problem of mozaic invasion of open spaces by unplanned sprawl of housing land in localized level.

Regarding these problems, some articles have already clarified the recent decrease of open spaces around Tokyo quantitatively (Ministry of Construction, 1974, Sasaki, 1976, Hashizume, 1979), while this paper aims to analyse the long-term trends of it since the beginning of the growth of modern Tokyo in the Meiji (1868–1911) or Taisho (1912–1925) era.

For this purpose, the paper concerns on the three or four components of the phenomena in combination with each others; the metropolitan population growth, the outward (or sub-urban) expansion of population as well as housing lands, and the change of non-urban landscape which includes open spaces of woodland and farmland as its main participants.

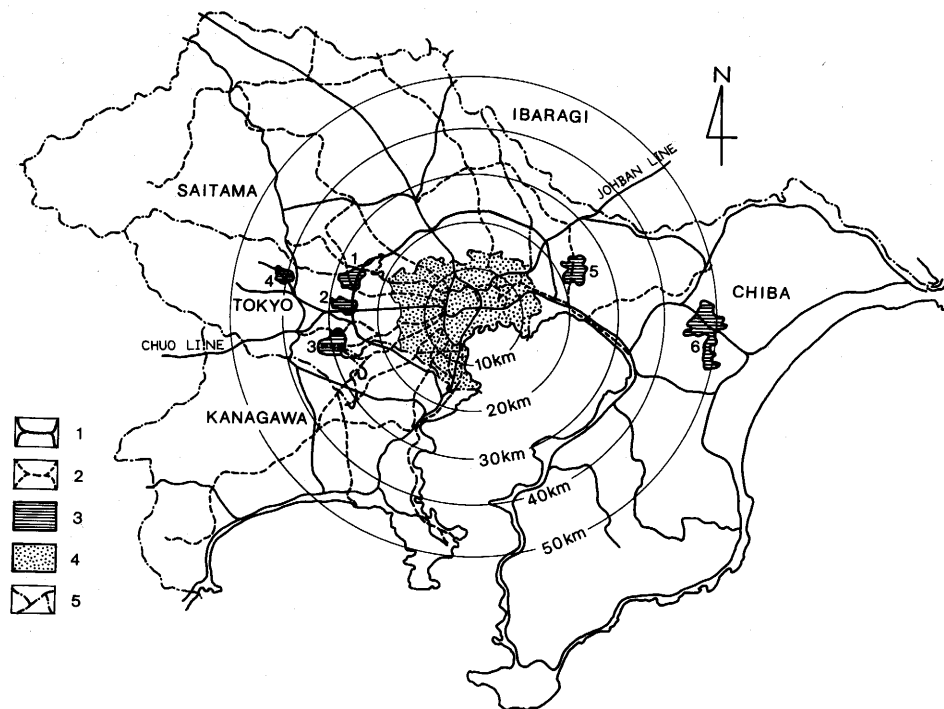
The basic data sources are got by the taxation statistics of land use categories concerning to the expansion of housing lands (in II and III chapters), and are earned by the measuring of the topographical maps of scale 1:50,000 concerning to the change of land use items including open spaces (see IV chapter).

## II. THE GROWTH OF TOKYO METROPOLIS AND THE DEVELOPMENTS OF METROPOLITAN SUBURBS

The constant growth of modern Tokyo began to start in the early Meiji era when she was endowed the seat of the national capital city. Tokyo, who consisted of only about 600,000 population in 1873, had attained 1,310,000 population in 1888, and now about 8,000,000 peoples are living in the *ku*-area (Tokyo proper).

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- 1: The Japanese National Railways      2: Private Railways  
 3: Study Area (1. Higashiyamato-shi 2. Kunitachi-shi 3. Tama-shi 4. Hamura-cho  
 5. Kamagaya-shi 6. Yachimata-cho)  
 4: Ku-area (Tokyo proper)      5: Prefectural border line

Fig. 1 Location map.

A continuous concentration of functions and population into Tokyo throughout the period has consequently brought the striking development of metropolitan suburbs till today. For chronological sketch of its spatial features, the expansion-front maps in some periods are drawn by the help of indicators of population increase ratios as well as increase ratios of housing lands (Fig. 2~9). The selection of the sampling periods is determined on the presumption that the growth of Tokyo since the Meiji era can be roughly divided into three periods; that is, (1) the period of gradual but steady growth, since the start in the early Meiji era till the late Taisho or early Showa era, (2) the period of alternation of the two distinct expansion periods and the two rather stagnated periods, since the late Taisho or early Showa era till about ten years after the close of the World War II, and (3) the period of explosive and long-run expansion to greater Tokyo of 50 km sphere, since the starting of so-called "postwar rapid economic growth of Japan" in the middle Showa era. The chronological delimitation of these periods will be referred again more exactly in later. Aspects found in those maps can be described as follows.

(1) The first stage till the late Taisho era.

Formation of the suburban development seems, excepting the last several years, to be not

so apparent in this stage referring in both the senses of population and housing land. This can be comprehended by Figs. 2 and 4, which manifest the fact that suburbanization fronts (the zone of maximum increase ratio of population or housing land) at the end of this stage were only fringing the urbanized area of the old *Edo* town. During this period, the population of Tokyo increased from 600,000 in 1873 to about 4,500,000 (about seven times the number of the former) in 1925, but this increased population was mostly accommodated in the delimitation of the past urbanized area of the *Edo* town. This manner of increase was possible because the feudal *Edo* town had contained a vast area of thinly inhabited "Daimyo" or "Samurai" residential quarters together with the smaller size of densely inhabited residential quarters for marchants and craftsmen. Furthermore, she had once reduced her size in the period after the collapse of the *Edo-bakufu* Authority in 1868. Only the outer expansion clearly overpassing the restoration of the old *Edo* town can be observed in western suburbs along the new national rail way, the Yamate line, constructed in that time.

(2) The second stage till the middle Showa era.

The first noteworthy suburbanization of Tokyo emerges in the early period of this stage (Figs. 3 and 5). This outer expansion of urbanized area was manifestly resulted by the destruction of the core built-up area of Tokyo by the Great Kanto Earthquake in 1923, but it in genesis rose on the background of the gradual saturation of the old *Edo* town area in that time (Figs. 2 and 4). The population increase of Tokyo had been progressively accelerated in the last several years of the first stage, when the industrialization impatiently developed in the nation, especially in the Tokyo Metropolis, under the impulse of the World War I. Besides, the tendency of private railway companies to construct suburban passenger transportation systems (or to convert their radial freight railway systems for passenger's use) much encouraged these out-flow of residents to suburbs. They also began to furnish housing lands in a style of planned suburban residential quarters.

This first period of suburbanization of Tokyo metropolis signified the two distinct characters as shown on the maps (Figs. 2, 3, 4, and 5). (1) Increase of population and housing land in suburbs was intensively concentrated into the relatively narrow zone immediately adhering to the built-up areas already existed. It spread within 20 km sphere till about 1925, and began to expand to a part of 30 km zone (zone from 20 km to 30 km apart from the city core) after 1925 (Figs. 3 and 5). It was the time two years after the damage of the Great Kanto Earthquake. (2) Being in contrast with its areal limitation into narrow zone, the grades of population increase often presented so high ratios locally as they have never been exceeded even by those in the postwar explosive suburbanization. Many *shi, cho, son* units (types of administrative unit within prefectural unit) in the suburbs recorded population increasing ratios of more than 500% in five years during 1920-25.

With the short interruption in the world-wide depression period after the World War I, the suburbanization of Tokyo began to start again at the national industrialization period before and in the World War II. The outer expansion of urbanized area of Tokyo in this period was undoubtedly led by the establishments of many manufacturing factories for military use in the 30 km zone, and its expansion front spread to the farthest limit of the 30 km zone till the close of the War in 1945 (Figs. 6 and 8). But Subsequent outer expansion can not be mentionably acquired in the depressing period till 1955 after the War, besides

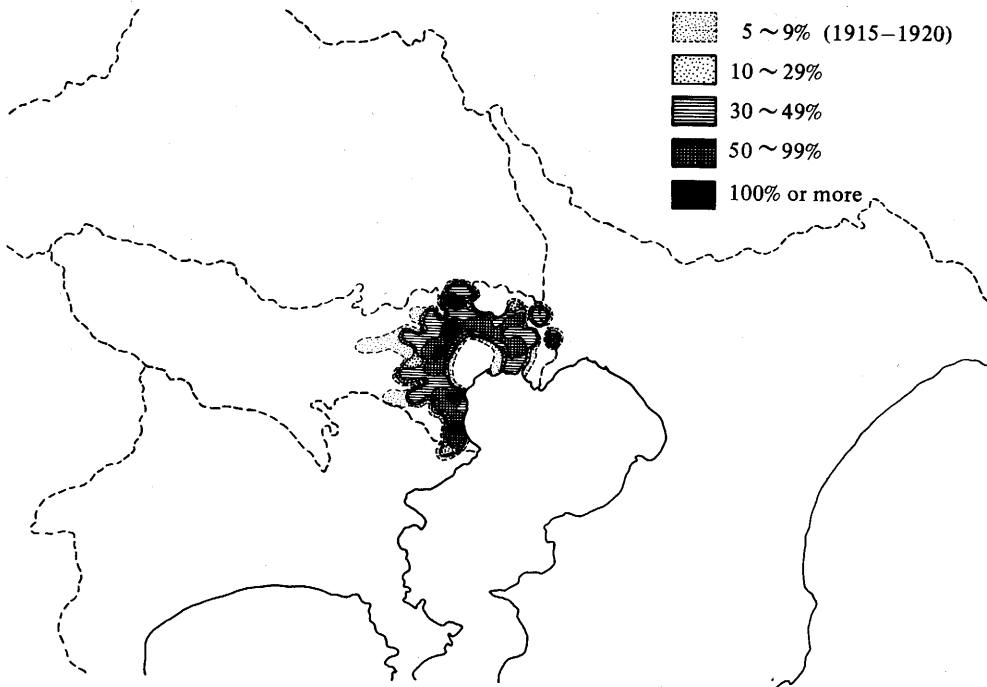


Fig. 2 Population increase ratio 1915-1920.

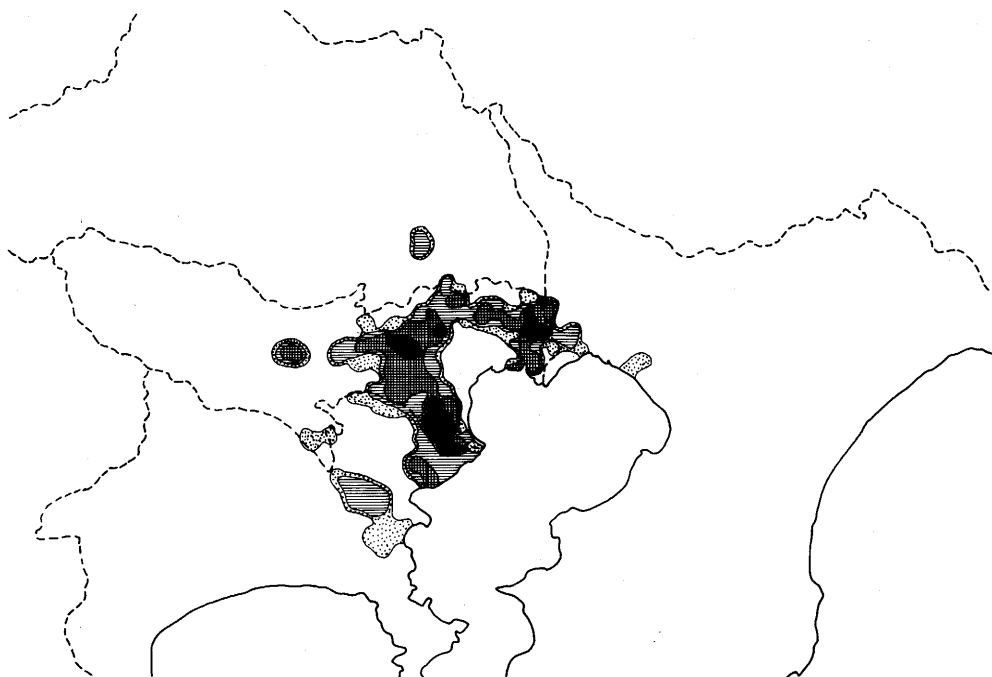


Fig. 3 Population increase ratio 1925-1930.

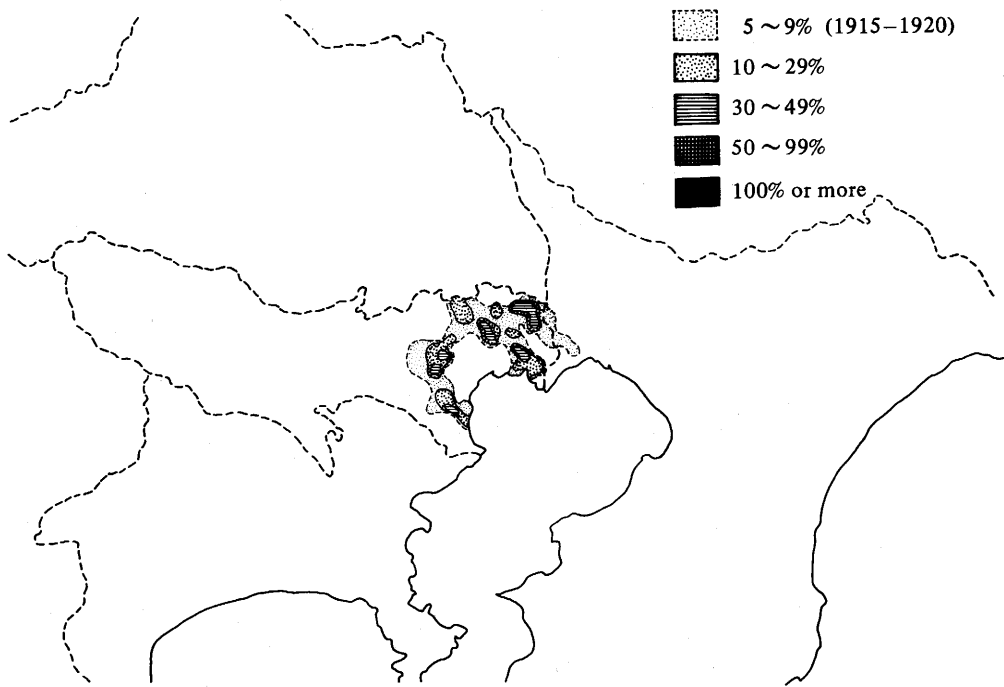


Fig. 4 Increase ratio of housing land 1915-1920.



Fig. 5 Increase ratio of housing land 1925-1930.

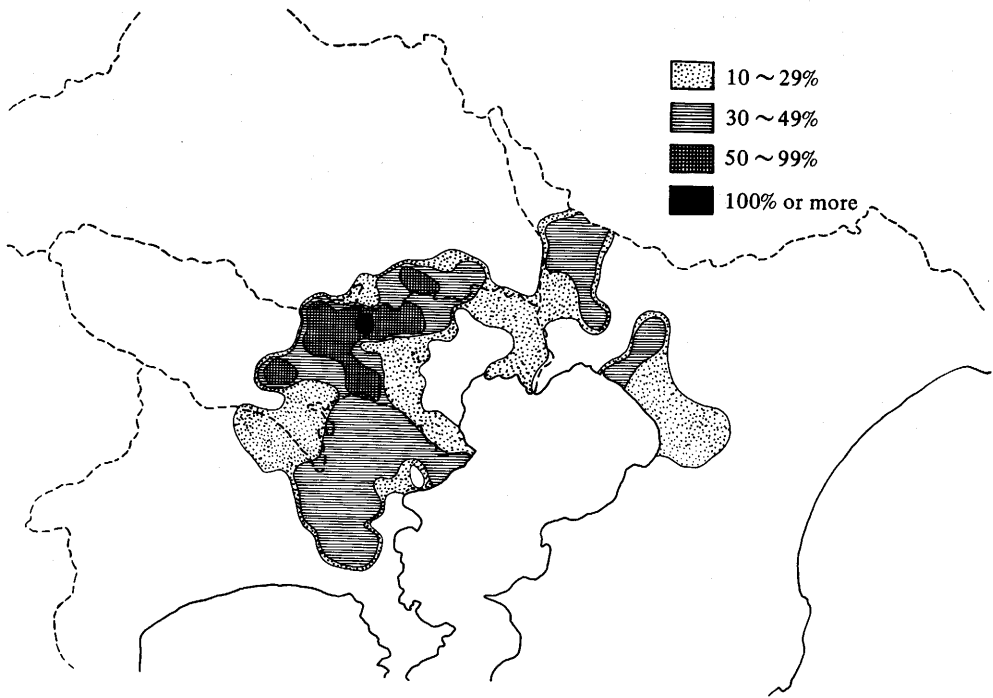


Fig. 6 Population increase ratio 1955-1960.

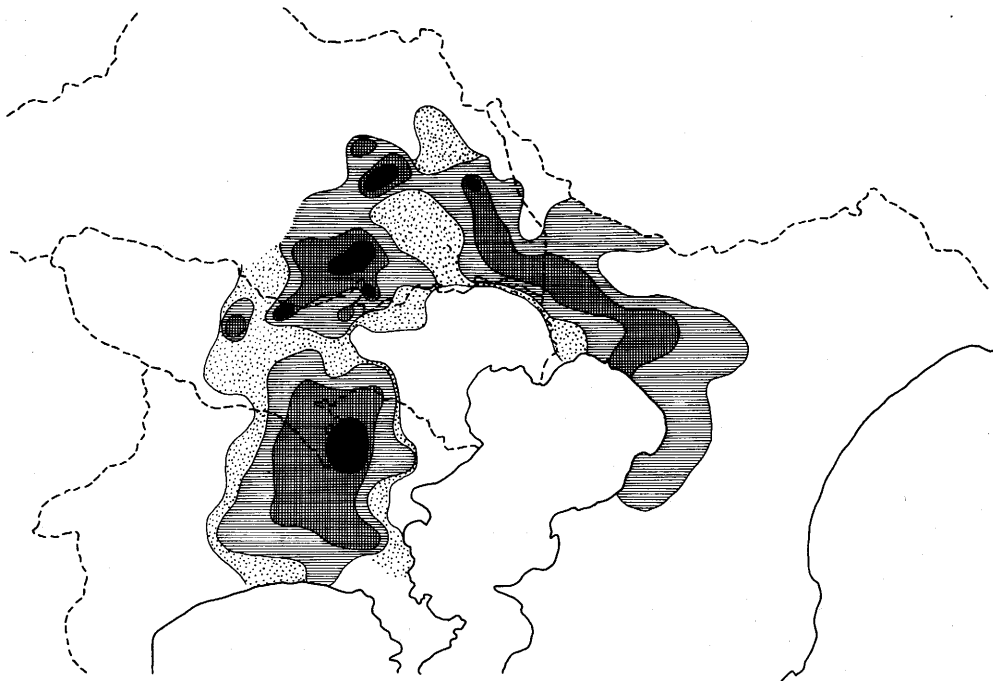


Fig. 7 Population increase ratio 1965-1970.

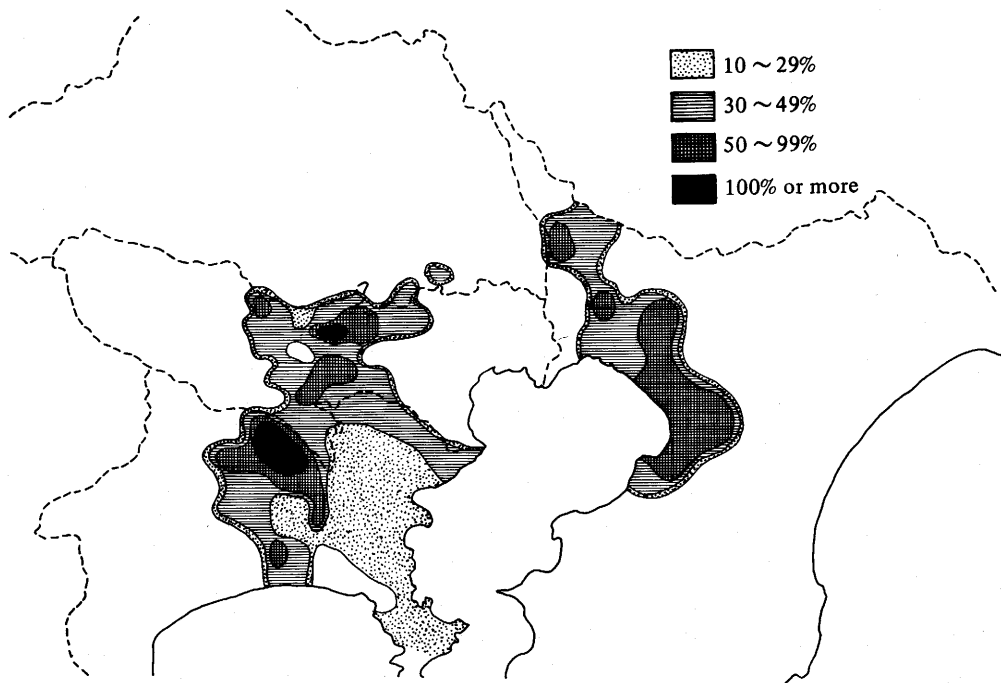


Fig. 8 Increase ratio of housing land 1955-1960.

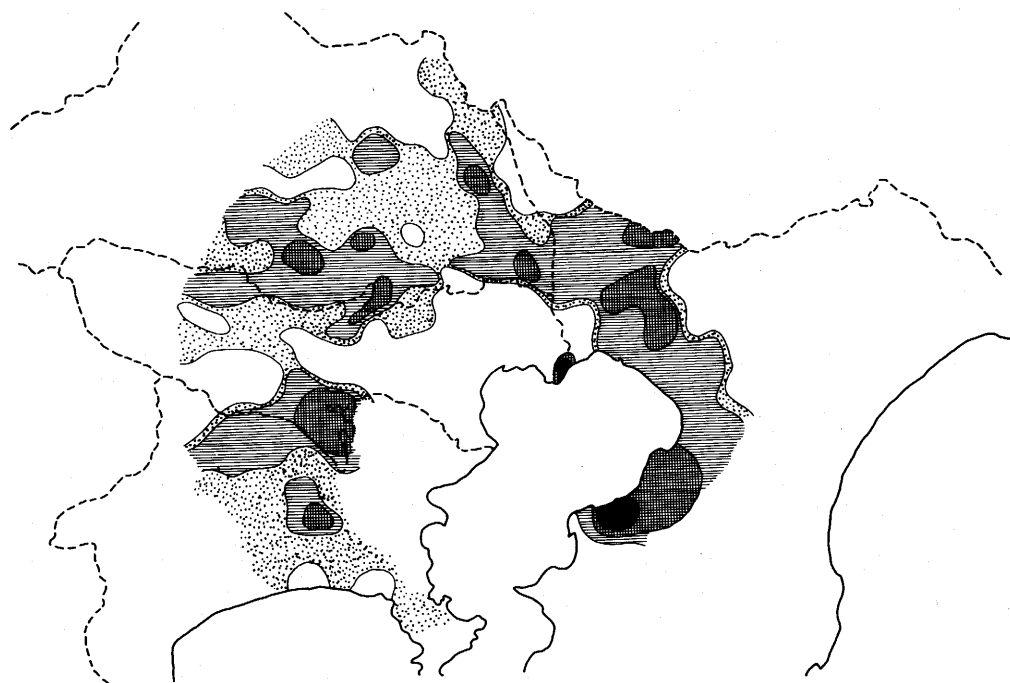


Fig. 9 Increase ratio of housing land 1965-1970.

the fact of recovery from lost population in 10 km zone. Through the periods of these two expansions in the second stages, the population of Tokyo increased from 4,500,000 in 1925 to about 7,200,000 in 1944 and 1953, inserting the decrease period by war destruction between the latter two years. The major parts of the prewar reclamation of Tokyo Bay, too, were accomplished in this two expansion periods, but they were mostly devoted for industrial sites and harbor yards and did not contribute much to the enlargement of residential areas.

(3) The third stage after the period of postwar economic development.

Lively postwar population growth of Tokyo and correlating outer expansion of suburban areas started again rather abruptly in about 1955, when the Japanese economy began to reorganize its heavy industries through a great inspirit moment of the Korean Struggle during 1950 – 53. The population of the Greater Tokyo (Tokyo, Saitama, Chiba and Kanagawa prefectures, conventionally in this paper) increased from 15.4 millions in 1955, to 21.0 millions in 1965, and to 27.0 millions in 1975. The total increase in this twenty years, 11.6 millions, was over two times as greater as the increased population during the peak twenty years in the prewar development period heavy (3.5 millions during 1920 – 40). Consequently, such severe population concentration brought the violent over-flow of inhabitants from the existing urbanized area into the surrounding rural lands. It can be observed in the figures of expansion front that this outwards over-flow produced the striking increase of population and housing land mainly in 40 km zone during 1955 – 60 (Figs. 6 and 8), and spread over 50 km zone after 1965 (Figs. 7 and 9).

The suburbanization in this period was quite dispersive as observed in the figures. The reason may be explained as follows. Since the early days in this period, many large-scale collective housings, so-called “*Danchi* residence”, were constructed by public housing corporations at distant area from city core, seeking the ample construction yards of low land price. Speaking generally they played a similar role as manufacturing factories in the prewar suburbanization, pulling the expansion front of individual housing toward the out skirts area of the suburb. Later such role was altered by private companies who construct the many new collective residential quarters of large-scale everywhere in the outskirts of suburbs.

These large-scale housings in distant area compeled the manufacturing factories to locate in farther distant zone, and all these tendencies affected the land price in the middle and inner zones to ascend so much as it surpasses the adequate level for consumer's purchase ability. The dispersive character of postwar suburbanization was thus formed on the unfavorable chain of phenomenal causality that the consumer's efforts to seek the low price land in the out skirts reflected to heave up the land price level in inner zones. The farmers in the middle and inner zones, in this situation, tended to reserve their farmlands with speculative aim (waiting the elevation of land price), which again operated to push the suburban housing to out skirts. On these courses, the intensive nature of urbanization, on macroscopic view, in the prewar periods has been altered to the dispersive nature which spread over broader zones, and its agglomerative pattern, in microscopic view, has been modified to the complicate mozaic pattern as commixture of small housing islands and remained open spaces. (Figs. 2 – 9)

Particular significance of this pattern change should be asserted not only for those who



discuss urban problems but for those who discuss the landscape change. It may be the largest reason why the population increase of less than twice (about 1.8 times during 1955 – 75) had to expand the metropolitan area from 30 km sphere to 50 km sphere (or the expansion of about 2.7 times in its spatial proportion). In the first stage of the growth of Tokyo till about 1925, the population increase of about seven times produced only little mentionable enlargement of urbanized area. The population increase of about 2.0 times in the second stage from 1920 to 1940 could be accommodated only in the narrow adjacent area of the existing built-up area or at largest in 30 km sphere, which means the enlargement of about 2.2 times the area of 20 km sphere in its areal size. The size of metropolitan sphere has been gradually enlarging in recent years in inproportional rates to the growth of the metropolitan population. Most recently, constant high population increasing ratios of Greater Tokyo have turned to gradual stagnation after the depress of economic development in the nation, but suburban expansion of population and housing land in 40 and 50 km zones has still kept an vigorous tendency even after 1970 (Watanabe, 1978). Further, it should be supplemented that the increase of population and housing land has still been continued even at present in the inner zones (in a manner of filling up the remained open spaces) where the expansion peak has already gone past.

### III. SUBURBANIZATION IN TERMS OF THE INCREASE OF POPULATION AND THAT OF HOUSING LAND

Considerable inconformity should be already noticed through the observation on Figs. 2 – 9 between the increase ratio of population and that of housing land in the suburban area in every stage. At the first development period of the Tokyo urbanized area during 1915 – 1920, the intensive population increase in the adjacent area to the existing built-up area was realized on the base of comparably less increase of housing land (Figs. 2 and 4). Responsible increase of housing land in the same area can be found rather in some later period, 1925 – 30. In this latter period, once again, the new development of population increase in the outskirts of the zone did not cause the corresponding increase of housing land (Figs. 3 and 5).

Such a prewar relation between the two components of suburbanization was considerably changed or reversed in the recent metropolitanization of Greater Tokyo. In the starting period of postwar metropolitanization during 1955 – 60, over-flow of population from the existing built-up area to the suburbs evidently accompanied the corresponding increase of housing land (Figs. 6 and 8). Moreover, increasing ratio of housing land in the outskirts of the expansion zone often exhibits the higher value than population increase. Such postwar tendency as is indistinctly presented in the earlier period seems to have distinctly escalated in the later half of the period (Figs. 7 and 9). It was already referred in the preceding chapter that earlier development of Tokyo till the late Taisho did not require much increase of housing land. Taking it into account, the facts as observed above may lead a recognition that requirement for the new housing land was little in the earlier stage of the metropolitan population growth, but it became equivalent to the grades of population increase in the middle stage, and finally it became recently to surpass the rates of the population increase in

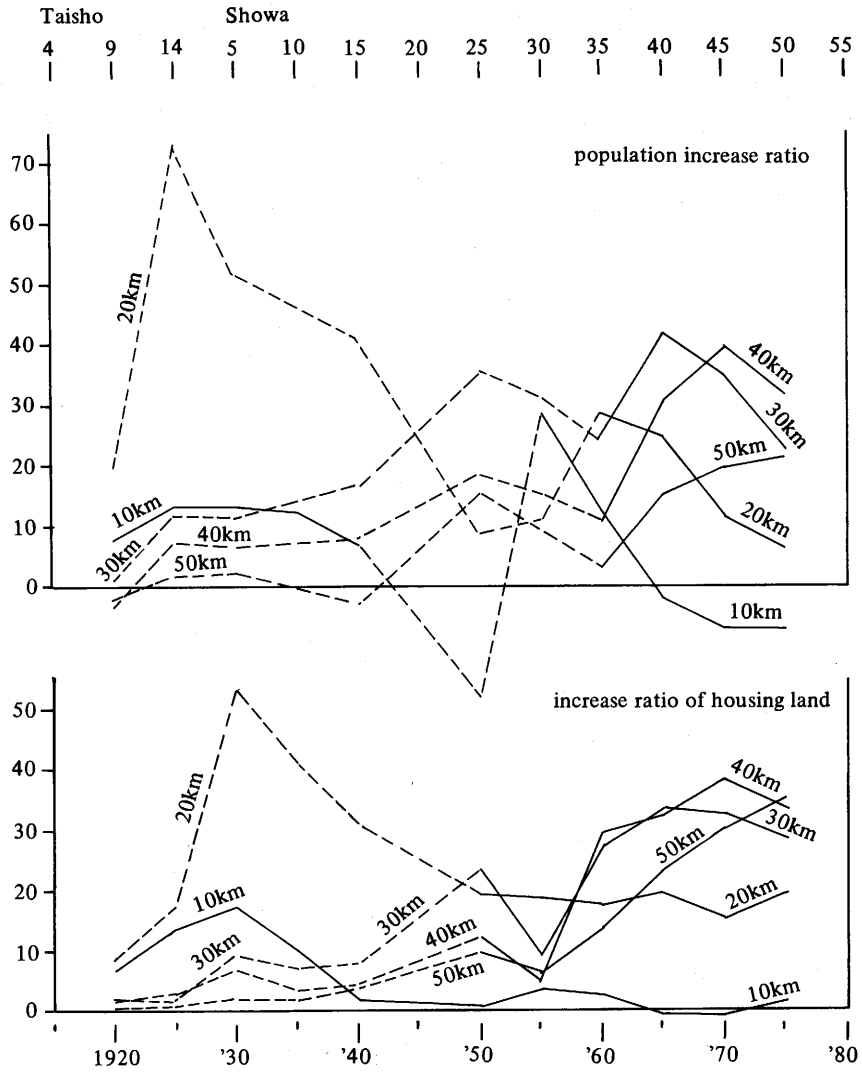


Fig. 10 The changes of population and housing land in every distance zone in each five years period.

suburban land.

To verify this tendency rather quantitatively on the year succession in chronology, data were collected and arranged by five years terms according to the divisions of distance zones and sectors of Tokyo Metropolis. Unfortunately, the various aspects in the prewar period had to be assumed only by the values of the two prefectures because of incompleteness of the chronological succession in the data source of the rest two prefectures.

Fig. 10 shows the changes of suburbanization aspects in every distance zone in each five years period. Here can be clearly found the outward shifting of the suburbanization fronts in the senses of both population increase and housing land increase. The difference between

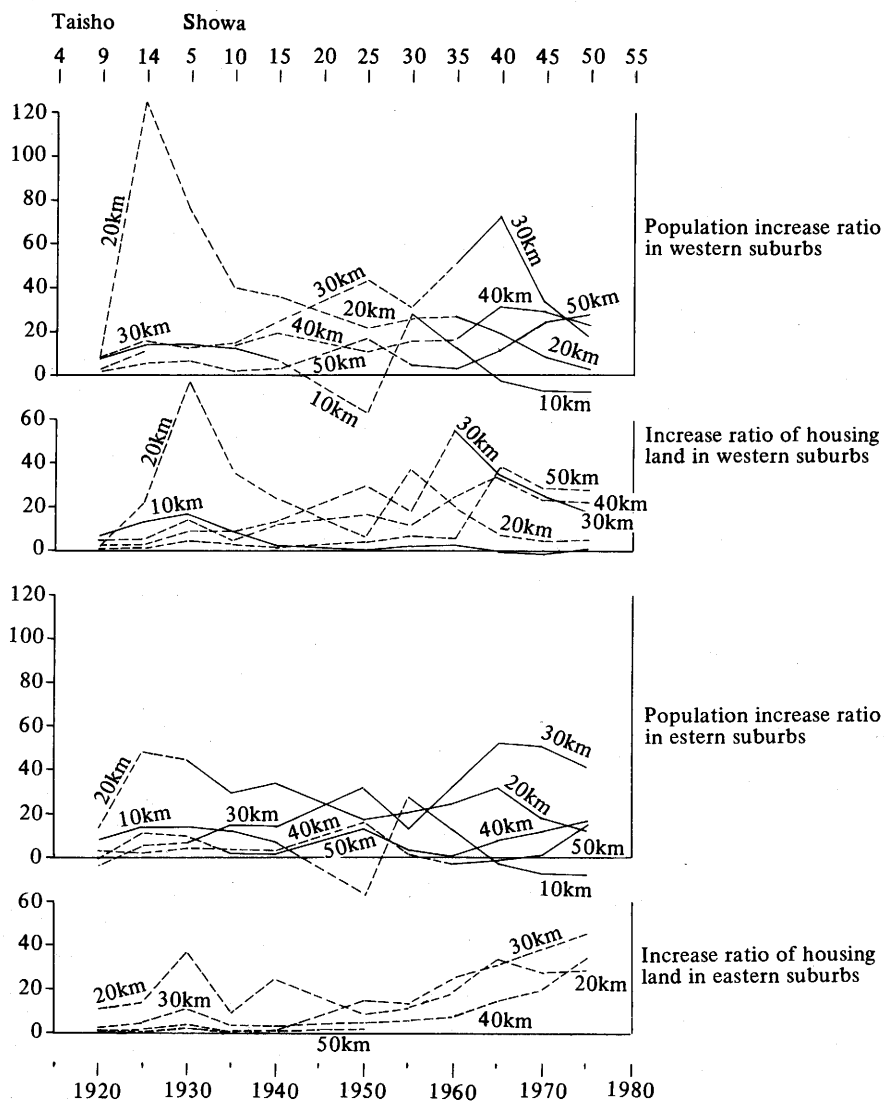


Fig. 11 The suburbanization feature in the western and eastern suburbs.

the suburbanization feature in the western suburbs and that in eastern suburbs has been often commented. These differences are, however, to be attributed to the relative difference of the grades in quantity, and their chronological characteristics seem to be fundamentally similar (Fig. 11). It is only recognized that the metropolitan expansion in every expansion period started in the Chuo line sector and ended in the eastern sectors. Therefore, the followings will be stated mainly on the observation of the figures of distance division of whole sectors.

In respect to population increase, the aspects shown in the figure 10 will imply the chronological division of the three periods of the metropolitanization process after the latest

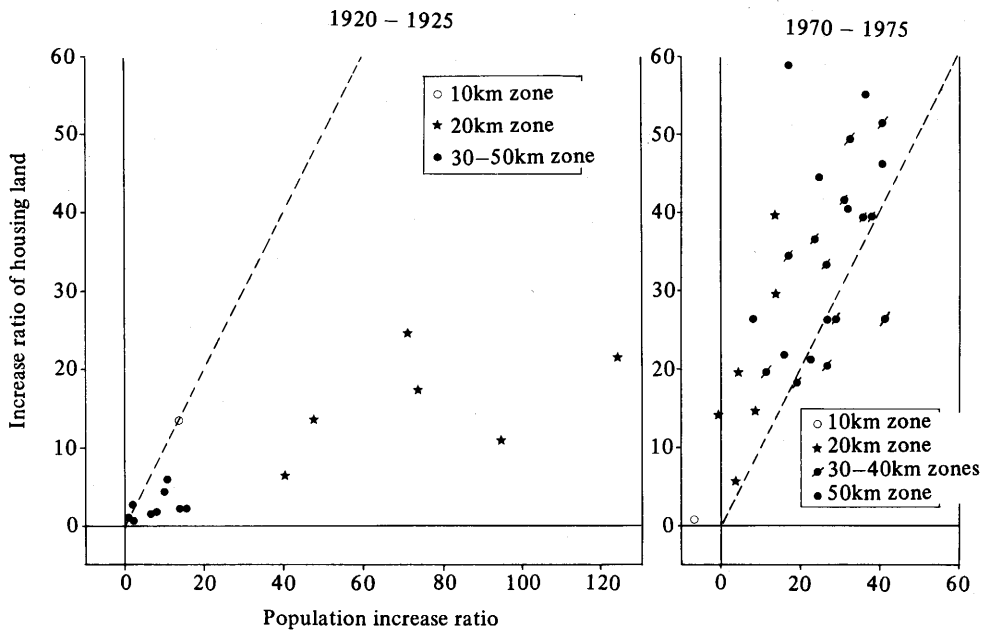


Fig. 12 Relation of the increase ratio of housing land to population increase ratio in the two periods.

period of the first stage. The first expansion period came abruptly in short term after the Great Kanto Earthquake, from 1920 to 1925, in which cumulative population increase was demonstrated only in the 20 km zone. The second period delimits the term from 1930 to 1955, which shows rather gradual expansion nature and in which the considerable increase of population started in the 30 km zone in the term 1935 - 1950 (pre and in the war time). In the third period after 1955, high population increase ratios appeared in the plural zones of from 20 km to 50 km, the maximum value being shifted from the inner 20 km zone to the 50 km zone in sequence of time. Recovery from the war destruction in 10 km zone arised in the term 1950 - 55 prior to the third period, and subsequent population increase spread on to the revival expansion of the 20 km zone at the beginning of the third period. Now expansion of 50 km zone has been still progressing. On the other hand, population in the 10 km zone turned to decrease after 1960, (its heavy decrease in the term 1940 - 50 being the result of the war destruction). Here can be confirmed again the pattern change of the metropolitanization, from the intensive nature to the dispersive one.

With respect to the increase of housing land, its outward shifting of expansion front is, in crude sence, responsible to that of population chronologically. But the quantitative relation and the short-term correlation of the two components provides another point of discussion, and they are gradually changed according to the progress of the metropolitanization. The maximum increase ratio of housing land was fairly smaller than that of population in the first period, and its peak period appeared after succession of some years in which population continued its increase. On the contrary, the increase of housing land in the third period tends to appear precedently to the peak period of population increase.

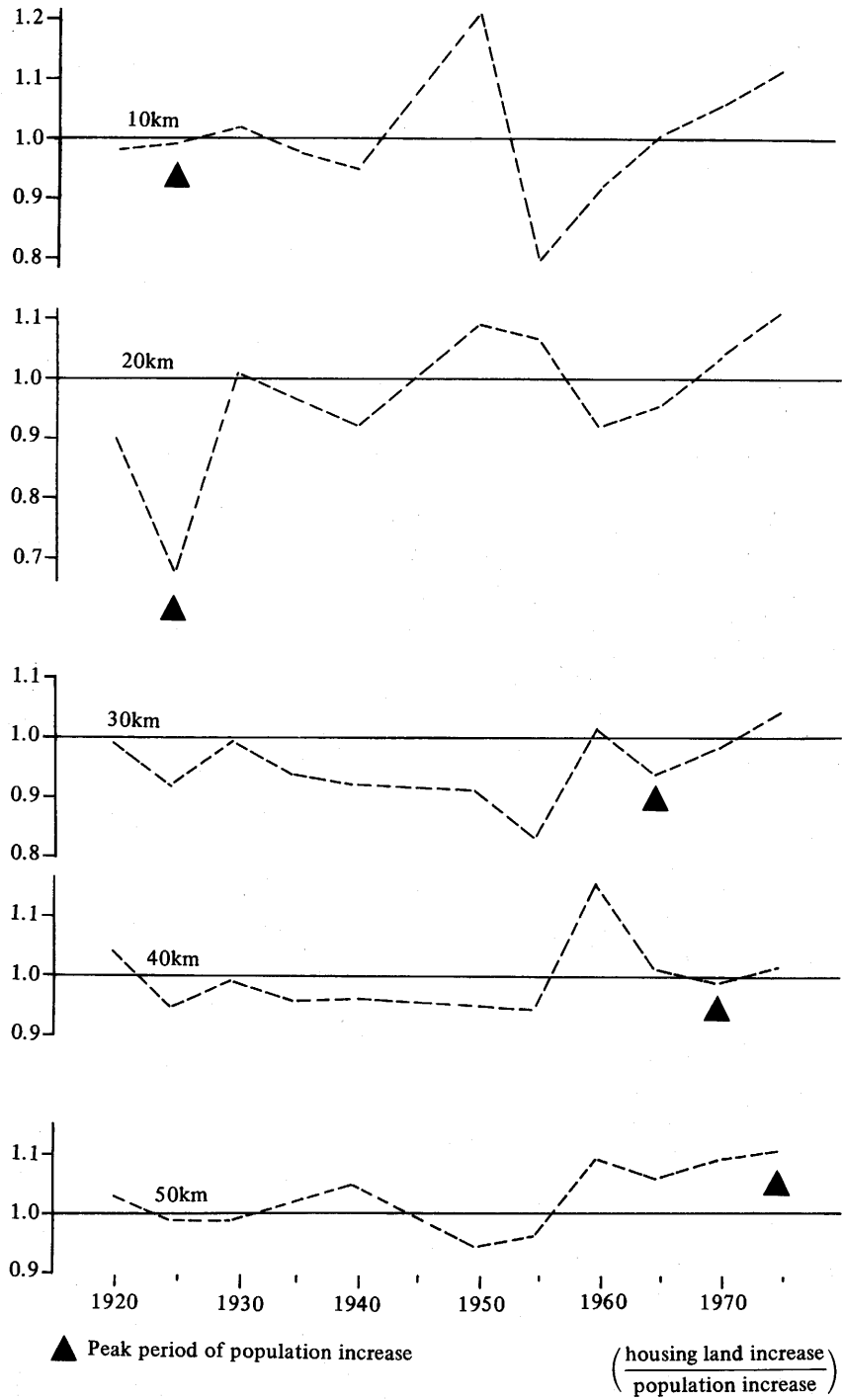


Fig. 13 Change of the relation between population increase and increase of housing land in every distance zone.

Consequently, its increase ratios in most cases has exceeded that of population especially in the outside area of the population increase front.

Fig. 12 and Fig. 13 show such change of the relation in Fig. 11 by calculating the increase rates of housing land to those of population, in a form of relative index value of the amount of housing land to that in five years ago, divided with, relative index value of the amount of population to that in five years ago.

Creation of such the postwar tendency will be perhaps attributed, samely to the postwar trend of the inproportional expansion of metropolitan sphere, to the extremely speedy and constant elevation of land price in the suburban area of Tokyo. The causal relation to be explained is as follows. On the condition of land price as is above described, speculative investments rushed on buying open spaces of low land price and converting them for the stock of housing lands, prior to the actual settling of suburban residents. It is already referred that the important role on this action was performed not only by individuals but by the public housing corporation in the earlier period and by the private companies supplying housing lands of large-scales in the later period. Competition among the companies to earn low price lands has accelerated the tendency. A recently enforced regulation law on large-scale development of housing lands effected to some degrees on the stock of housing lands to increase, because it compelled the developers to provide some rates of public yards for non-residential use.

The aspects were quite different in the prewar stage. For example, suburban out-flow of population in the first period was brought rather suddently after the destruction of the existing built-up area by the Great Kanto Earthquake. New housing lands in suburbs were prepared only in accordance with the rise of the actual demands by the in-flowing new dwellers. Especially on the early step, much of these new housing lands could be provided by the reformation of land use in existing suburban rural settlements and as well in traditionally established towns around Tokyo. Satellitic cities and residential quarters in agglomerative style thus could be formed without any increase of large amount of new housing land. Then, afterwards, land readjustment for land use conversion of open spaces into housing land (or immediate land use conversion for planned residential quarters) were prepared by local governments or companies in the subsequent stage.

These differences in suburbanization aspects in various periods will offer the reason why the alternation of pattern has come about concerning the relation of the increase of population and of housing lands. It can be referred, on the viewpoint of long-term trend, that the increase of housing land in earlier days was promoted by the prior population increase and that the former in recent years has been promoted, prior to the latter, by forecasting speculation of housing land demanded in future. The problem of land price as a key factor for understanding this change will be discussed in another issue in this volume (Yamamoto, 1980). Therefore this paper only refers that the pattern of the recent increase of housing land will imply the significant meaning on the regression problem of open spaces around Tokyo, because of (1) the over-invasion of open spaces by the increase of housing land which exceeds the grades of actual necessity to adjust to the suburban population increase, and (2) the invasion of open spaces in the far outer zone to which actual occupation of suburban residents has not yet expanded.

Furthermore, the above discussions are entirely based on the relative value, ratio, because

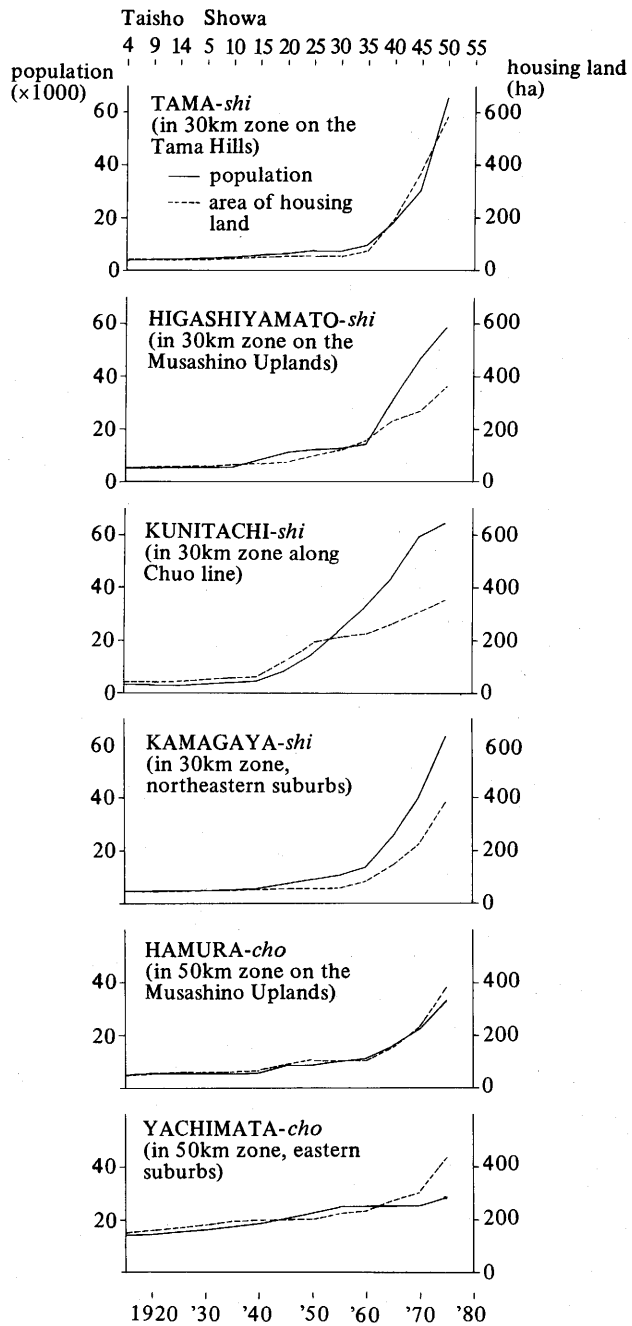


Fig. 14 Change of population and housing land in sampled areas.

of the lack of old data source in the two prefectures. There will be risk of misunderstanding on quantitative comprehension. For example, the change of denominator may lead it because the increase of denominator value as the result of the progress of suburbanization may produce the less evaluation of quantitative amount of housing land increase. On the other hand, another type of misunderstanding may be brought by the expansion of metropolitan sphere in time sequence. The real area is greater in the outer area than in the inner area, and the amount of recent increase of housing land in outer zone may be greater than that imaged on increasing ratios. To reject such misunderstandings on quantity, the changes of the amount of population and housing land are illustrated in Fig. 14, by using the method of sampling of *shi-cho-son* administrative units. The sampled areas are so selected that they contains various distance zones in the two sectors of different progression stage (Fig. 1).

The suburbanization aspects in the 20 km zone can not be shown in the figure due to the change of administrative boundaries. The Tama in the Chuo line sector is situated on the hill lands and represents the character of 50 km zone because it was not favored with transportation facilities till recent year. These figures may be capable enough to elucidate the accelerative increase of the amount of housing land. The similar pattern appears on this point of view throughout the various distance zones and secotrs, though the starting period respectively differs from each other according to their sites. In the next chapter, the paper will analyze how such increase of housing land has influenced on the open spaces.

#### IV. CHANGES OF LAND USE AND LANDSCAPE IN GROWTH OF THE METROPOLITANIZATION

To grasp the long-term trend of land use change in the Tokyo Metropolis, distribution patterns of land use in the four past years are measured by the method of 1 km<sup>2</sup> standard mesh provided on topographic maps (20 × 20 meshes in one map). Topographic maps published in about 1910, 1930, 1950 and 1970 are selected to offer fundamental data with the following purpose; (1) to possibly trace back to the oldest aspects in restriction of the data sources, (2) to divide the period with the equal intervals by which quantitative comparison is much simplified, (3) to make conformity to the three periods divided in the preceding chapters.

Here will be used the terms of the early period, the middle period and the later period to respectively indicate the periods of 1910 – 1930, 1930 – 1950 and 1950 – 1970.

Table 1 shows the composition in percentage of various land use categories in each period according to the division of distance zones and the total of the whole 50 km sphere. In this table, the term, urban land use, means the whole area of urban land uses, while the term, built-up area, indicates the intensively urbanized area mainly built up with residential houses and commercial buildings. From this table, decrease of woodland and increase of urban land use in the whole of the area can be clearly recognized as general tendency throughout the periods of 1910 – 1970. Woodland in 1970 becomes to less than half of that in 1910, while urban land use has finally increased to about 4 times the foretime amount (more than 3 times regarding built-up area) during the period. Dry fields, paddy fields and water surface manifest the slight extent of decreasing.



**Table 1** The composition of various land use categories in each year (%)

land use category	year	10 km zone	20 km zone	30 km zone	40 km zone	50 km zone	total in 50 km sphere
woodland	1910	4.10	8.93	25.37	29.89	38.01	28.35
	1930	0.00	3.68	19.84	24.04	34.17	23.42
	1950	0.00	2.79	14.44	19.48	31.13	19.86
	1970	0.00	1.23	8.64	12.52	23.22	13.72
waste and grassland	1910	0.68	3.91	2.90	5.33	5.19	4.44
	1930	5.46	6.03	3.24	5.61	3.76	4.52
	1950	3.75	4.91	3.04	6.38	4.44	4.74
	1970	1.71	5.02	5.06	7.10	4.63	5.34
dry field	1910	10.24	21.21	20.38	22.79	19.23	20.35
	1930	4.44	19.42	24.09	25.77	22.17	22.53
	1950	0.34	10.27	24.29	25.58	22.85	21.49
	1970	0.00	7.14	18.76	21.88	22.92	18.98
paddy field	1910	22.18	35.94	19.77	20.59	21.98	22.84
	1930	11.26	29.69	19.50	21.16	22.85	22.07
	1950	3.75	23.21	18.35	21.21	22.54	20.67
	1970	0.68	12.28	16.19	20.30	23.22	18.78
urban land use (built-up area)	1910	44.71 (34.81)	6.81 (6.47)	4.72 (4.11)	5.61 (4.99)	7.04 (6.90)	7.64 (6.85)
	1930	63.82 (49.15)	18.64 (16.85)	7.15 (5.86)	7.82 (6.77)	8.69 (8.38)	11.52 (10.08)
	1950	80.20 (55.63)	37.05 (28.91)	14.24 (9.85)	12.38 (9.40)	10.76 (10.01)	17.84 (13.94)
	1970	87.37 (56.66)	53.57 (41.07)	26.79 (19.07)	26.10 (18.33)	18.14 (16.09)	29.11 (22.01)
water surface	1910	18.09	23.21	26.86	15.79	8.54	16.39
	1930	15.02	22.54	26.18	15.60	8.36	15.93
	1950	11.95	21.76	25.64	14.97	8.28	15.41
	1970	10.24	20.76	24.56	12.14	7.87	14.06

Decrease of woodland can be observed in most of the periods and zones, but its rapid decrease can be recognized particularly in the later period and in the distant zones farther than 20 km. Dry fields and paddy fields within 20 km zone have been decreasing since the early period, and they in 30 km zone began to decrease in the later period. But their decrease is indistinct in the zones of 40 – 50 km throughout the periods.

Urban land use shows general tendency of increase. More precisely said, its rapid increase can be recognized in the early period lying on the 10 – 20 km zones and in the later period it shifted to 30 – 50 km zones. In respect of built-up area, it has increased more than two times the foretime amount during the later period in the 30 – 40 km zones. On the other hand, increase of built-up area in 10 km zone has already closed in the later period.

Fig. 15 is drawn to show the conversion system on the simple concept of the changes in land use allotment. The figure shows the quantity of land use conversion, by size of

quadrate, from each category of land use to another one.

Some trends can be so finely observed in this figure that slightest measuring errors due to the inaccuracy of topographical maps will be negligible. That is to say, the most prevailing conversion of land use throughout the whole period is that of woodland into dry field and, in the same time, that of dry field to urban land use. In the early period, conversion of woodland to dry field was greater than that of dry field to urban land use, but, in the middle period, these two types of conversion became nearly equivalent, and, in the later period, the latter became to be dominant to the former. Furthermore, paddy field, woodland, water surface, and waste and grassland sequentially formed, proportionally to their original size, a ranking order of land use conversion into urban land use.

Fig. 16 illustrates another type of land use conversion system, the animation of conversion flow. Every arrow in the figure shows direction of change, and their thickness indicates intensity of conversion (percentage of converted land in each category of original land use). The most animate conversion of land use in this meaning in the early period was from woodland to dry field, and next, from dry field or paddy field to urban land use. It is a noteworthy fact in this period that mutually flowing conversion of land use can be recognized among the various categories within open space.

This means the character in this period to be altering of quality of open space and its course was composed of the change into high agricultural productivity by land consolidation or field improvement works. It may be referred as the occurrence in non-urban land use side. Fig. 17 shows the distribution of conversion from woodland into farmland by which main change of open space in this period was realized. The fact found in the figure, that land use conversions of this type were spread over the whole area especially on uplands in no accordance with the distances from Tokyo, will imply those conversions to be independent to urbanization.

On the other hand, the most characteristic nature of land use conversion in the middle period was that of open space (in all the categories of dry field, paddy field and woodland) to urban land use. The other types of conversion of land use were not so distinct in the period, excepting that from woodland to dry field, in which a little greater amount of woodland changed to dry field rather in outer areas excelling the amount of dry field converted to urban land use in inner areas. It must be annotated that conversion from water surface to urban land use (construction of built-up area by land reclamation) began to appear since this period. Viewed from all the facts above mentioned, the rapid increase of housing land seems to have had modified, directly or indirectly, the system of land use change.

In the later period both the mutually flowing conversion among land use categories within open space and the conversion from open space to urban land use can be observed, while the scales of conversion in both types are magnified. In this respect, changes in the period represents both the characters of the early period and of the middle period, though both changes have been more animated than before. The evident affection of urbanization in enlarged scale can be recognized on the complicated system of land use change in the figure, in which all categories of land use are mutually converted from one to another. Such the tendency of the land use reformation as a whole will be probably supported by the rapid urban growth before the World War II and in the period of so-called the postwar

In early period (1910-1930)

1930 \ 1910	urban land use	dry field	paddy field	waste and grassland	woodland	water surface
urban land use	—	•	•	•	•	•
dry field	■	—	■	■	■	•
paddy field	■	■	—	■	•	•
waste and grassland	■	■	■	—	■	•
woodland	■	■	■	■	—	•
water surface	■	•	•	■	•	—

In middle period (1930-1950)

1950 \ 1930	urban land use	dry field	paddy field	waste and grassland	woodland	water surface
urban land use	—	•	•	•	•	•
dry field	■	—	■	■	■	•
paddy field	■	■	—	■	•	•
waste and grassland	■	■	■	—	■	■
woodland	■	■	■	■	—	•
water surface	■	•	•	■	•	—

In later period (1950-1970)

1970 \ 1950	urban land use	dry field	paddy field	waste and grassland	woodland	water surface
urban land use	—	■	•	•	•	•
dryfield	■	—	■	■	■	•
paddy field	■	■	—	■	•	•
waste and grassland	■	■	■	—	■	■
woodland	■	■	■	■	—	•
water surface	■	•	•	■	•	—

□ 100km<sup>2</sup>

Fig. 15 The area of land use conversion from each category of land use to another one.

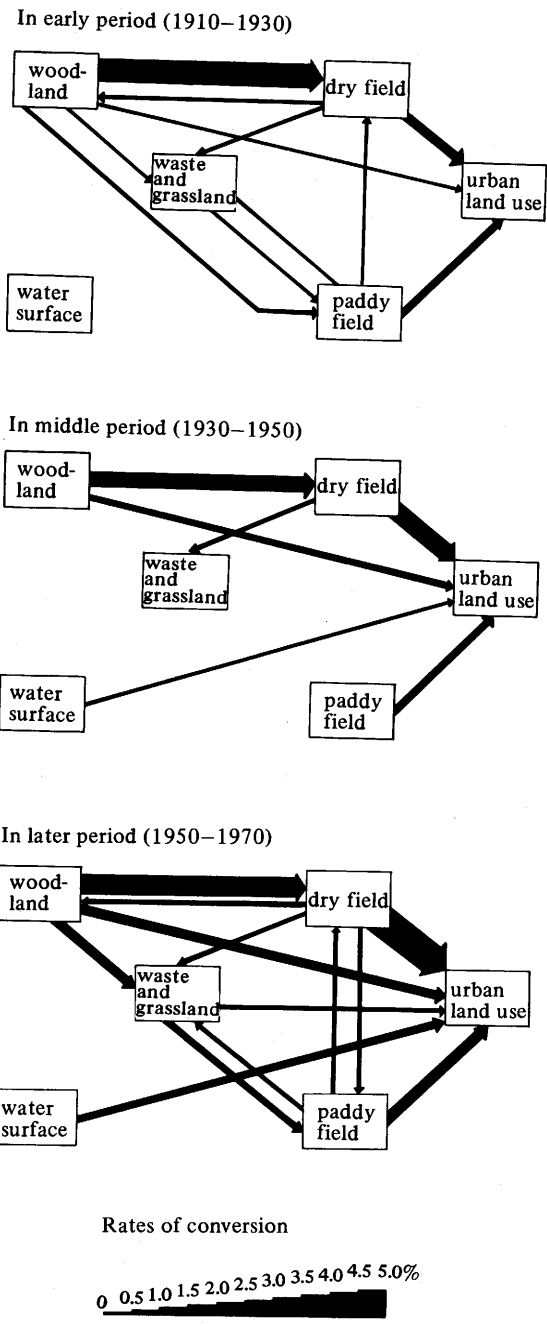


Fig. 16 Percentages of converted land and conversion flows in each land use category

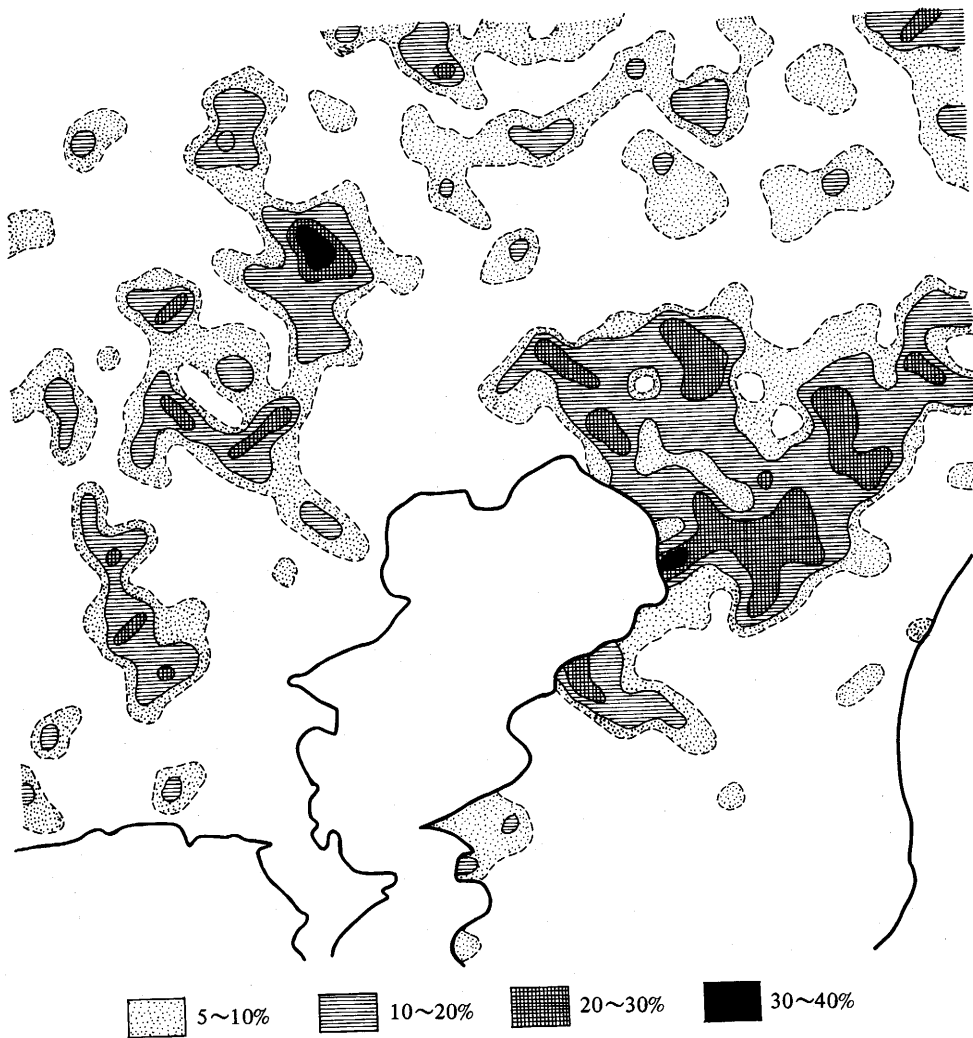


Fig. 17 Distribution of conversion from woodland into farmland.  
 (Shares of converted land in every 25km<sup>2</sup> of woodland).

economic growth of Japan.

Throughout the whole process, total area of woodland has decreased and that of urban land use has increased. Its zoning pattern around Tokyo will be analyzed in the followings. In this analysis, Table 2 is available showing on square kilometer measure the amount of converted areas from open space (including water surface) to urban land use. It will offer worthy complementary analysis to refine the discussions in the preceding chapters in which viewing point mainly focused upon the interpretations on the base of relative values and ratios. It has been already stated that observations not only on the relative value but on absolute value of quantity are necessary when zoning pattern of decrease in open spaces is chronologically examined.

Table 2 Converted area from open space to urban land use (km<sup>2</sup>)

period	original land use	10 km zone	20 km zone	30 km zone	40 km zone	50 km zone	total in 50 km sphere
1910	woodland	8	7	7	10	14	46
	waste and grassland	2	7	2	2	0	13
	dry field	21	46	12	26	23	128
	paddy field	19	46	9	8	8	90
1930	water surface	8	1	8	2	2	21
	total	58	107	38	48	47	298
1930	woodland	0	3	32	27	15	77
	waste and grassland	6	12	8	4	0	30
	dry field	13	87	48	57	28	233
	paddy field	19	51	10	7	14	101
1950	water surface	10	14	8	4	1	37
	total	48	167	106	99	58	478
1950	woodland	0	7	31	53	53	144
	waste and grassland	2	13	11	21	11	58
	dry field	1	48	108	124	113	394
	paddy field	9	72	25	38	27	171
1970	water surface	9	12	15	58	1	95
	total	21	152	190	294	205	862
sum total		127	426	334	441	310	1638

Conversion of open spaces to urban lands has progressively increased in sequence of the period. Its area in the later period indicates almost three times greater than that in the early period. In the early period, increase of urban land use was mainly restricted in the 20 km zone, while, in the middle period, its outer limitation expanded to the 40 km zone, still remaining its dominant share in the 20 km zone. In the later period, its dominant part was found in far distant area of the 40 km zone and allocation of urban land increase more evenly spreads covering the zones from 20 km to 50 km.

By these expansions, total increase of urban land use in every twenty years amounted to about twice of that in preceding twenty years, showing logarithmic increasing curve. Especially, that in sum of the 30, 40 and 50 km zone only in the last period constitutes the largest share to contribute to the whole increase in this sixty years around Tokyo. Its rate for the whole is 42%.

These aspects conform enough to the discussion in chapter II, which stated the following; The general characters of urbanization were concentration into the inner zone on the earlier step, and dispersion to the broader zones in recent years, besides it identified on metropolitanization process the three periods of the first period (1920 – 1925), the second period (1930 – 1945) and the third period (after 1955). These results can explain chronologically much of the change of land use conversion systems described in this chapter.

The most noteworthy land use category converted to urban land throughout the whole period was dry field, being attributed its reason to its share in original land use. It occupies almost half of the whole converted area. In the zones of 10 and 20 km, where urbanization

has developed since the early days, conversion of dry field rather qualitatively characterized the urban developments in initial stage, leaving paddy fields for the future urbanization. On the other hand, in the zones from 30 km to 50 km, conversion of dry field on the middle and more distinctly on the later steps offers the largest mass of conversion type throughout the zones and the periods.

A considerable amount of conversion of paddy field or water surface can be observed especially in the later period. These two types of land use conversion seem, in their trends, to have had appeared on the subsequent stage delaying to the conversion of dry field. Conversion from water surface was mainly brought by the construction of industrial area by land reclamation.

Direct conversion of woodland to urban land use has emerged since the middle period in the zones farther than the 30 km, and this type becomes more clear in the late period especially in the 40 and 50 km zone.

The minor category of smaller values is conversion of waste and grassland and it has been gradually increasing toward the later period. Since pasture or meadow in original meaning are scarcely found in the 50 km sphere of Tokyo, most of wastes and grasslands is non-utilized land or transitional stage of land use conversion mainly to urban land. As construction of agglomerative housing lands or industrial yards become large-scale in recent years, transitional period from its preparation to its accomplishment becomes longer and conversion of waste and grassland must consequently increase. Such a type of waste and grassland on the preparative stage for urbanization will more increase in the future due to the more prevailing of such scale of constructive operation to build planned residential quarters.

Notable features of land use and landscape change in the 50 km sphere of Tokyo Metropolis as above described will be summarized as follows.

- (1) One of the most apparent results brought by the long-term history of land use change around Tokyo since 1910 is the conspicuous decrease of woodland which amount to 78% of total new increase of urban land use in the period. The correlative change of these two components is, however, realized through the two processes; that is, (a) combination of the two processes of conversion of woodland to farmland (mostly dry field) and that of farmland to urban land use characteristically till the middle period, and (b) the directly conversion of woodland into urban use mainly in the later period. The former is far larger than the latter in its quantity on total of the periods.
- (2) Conversion system of open space land use can be summarized on each period; reorganization of open space for increasing agricultural productivity in the early period, conversion of open space toward urban land use in the middle period, and large-scale conversion of open space to urban land use accompanying reorganization of open space together with it in the later period.
- (3) Through these processes, open space around Tokyo was decreased concentratively in the inner zones of the 10 and 20 km zone at the earlier period and more voluminously and dispersively decreased over a wide area farther than the 20 km zone in the later period.

## V. SUMMARY AND CONCLUSION ON THE LAND USE AND LANDSCAPE CHANGE IN THE TOKYO METROPOLITAN AREA

The paper demonstrated the long-term change of land use in and around the Tokyo Metropolis since its early development.

On the early stage of the growth of Tokyo, the land use changes within urbanized area and of surrounding rural area were mutually independent, both of them seeking the way to promote high productivity or efficiency of land use. Within the urbanized area, conversion of residential land use to the business and industrial land use necessarily required, for the accommodation of increasing laborers, the improvement of efficiency of residential land use. It was realized by the conversion from thinly inhabited *Samurai* town to densely inhabited modern residential quarter. In the surrounding rural area, on the other hand, conversions of woodlands of low productivity into cultivating lands raised, at first, the increase of farmsteads and next, the enlargement, though slight, of housing land use in rural settlements. Conversion of dry farm field into more productive paddy field, too, brought the similar result. The changes in both urban and rural spheres are comprehended as a type of reorganization of land use to seek high productivity within the major categories of the land use items. They were separately promoted but integrated on the common basis of the economical development on national level.

As national economy aimed at its progress way on the manufacturing industrialization after the World War I, the requirement of land use modification overpassed the capacity of conventional change earned by separative reorganization of rural and urban lands. Moreover, reorganization of this type had already wholly accomplished the works in the preceding stage. Readjustment of the areal shares of the two major categories of land use, urban and rural, started in the contact zone of these two categories of land uses. On this readjustment course, the priority on decision of land use conversion was, in logic, assumed to be held by the urban side with high economical efficiency. In real cases, this priority was fully forcible because conversions happened individually and more locally in the area where the requirements on the two categories of land use directly contacted. Therefore, it produced a relatively simple style of land use conversion, in which all types of open spaces were independently or separately converted according to the necessity in enlargement of urban sphere. The difference of productivity by categories within open space could not be important decisive factor. As a result, open spaces mainly lost their cultivating land because of its distributing pattern. The conversion of woodland to cultivating land had to be continued on the more distant areas to compensate the lost farm land.

The postwar development of national economy brought in the Tokyo Metropolis more severe concentration of population and functions than those in the middle stage. Local readjustment of land use could no longer functionate to balance the discording requirements on the two major categories of land use. Necessities of the land use reformation on metropolitan level overwhelmed both the urban and rural areas in the 50 km sphere of the Tokyo Metropolis. All land use conversions became to be unified on a frame of the reformation system of the metropolitan area as a whole. Every conversion could not be free from the rules arranged in the frame, and their execution was realized only when their preference of site adequately conformed to complicated metropolitanization rule. The direct conversion



of less productive woodland into housing land emerged on this course in the outskirts area of the Metropolis. Productivity in rural use, utility as housing land, and speculative value as land resources stock, all these elements functionated on the complicated balancing of land use conversion. Land price, among them, acted a key factor to unify the all categories of land use to be mutually integrated.

Therefore, the great amount of conversion of various types of open space into housing land (the readjustment between the two major categories of land use) acted to compel the mutual conversion of land use categories within the open space itself (the reformation of the landscape within rural side). Similarly, renewal of the ready established residential areas in the built-up area, too, were promoted because of insufficiency of housing land resource of low prices in suburban sphere. (Nakabayashi, 1980)

The postwar pattern of land use change was thus interpreted as to be the reformation of metropolitan land use as a whole. Through the complicated courses as illustrated above, its final goal seems to be settled on filling up the metropolitan sphere with urban land use which holds the higher economical efficiency than any type of non-urban land use. On the matter of course, open spaces have been rapidly decreased around Tokyo, and the attention on the environmental problems has been focused on it. The decrease itself might be an inevitable result, if the nation prefers the way to promote the land use constitution of high economical efficiency. But it must be acquainted here that the pattern of land use change in the present Tokyo metropolitan area has produced a great amount of overpassing increase of housing land, that means at the same time, overpassing decrease of open space. This paper denoted on this problem "the converting of suburban open spaces inproportionally greater than actual increase of suburban population" and "the converting of open spaces in the outer area where the expansion of suburban population has not yet realized." The problem has been gradually escalated in the long history of the development of Tokyo Metropolis.

Perhaps these aspects can suggest us enough the severe situations environing the problem of landscape conservation around present Tokyo and particular important of deliberating its emergent perspective at present stage. On this point of view, this paper, which traced the regression of open spaces in the metropolitan sphere in combination with long-term change of population and housing lands in the very area, would propose a conclusion that collaboration of synthesized reorganization planning of landscape at this stage is earnestly desired to harmonize the urban development and the reservation of open spaces in the future.

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