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Editor(s)	
Citation	Bulletin of the University of Osaka Prefecture. Ser. B, Agriculture and life sciences. 1993, 45, p.47-55
Issue Date	1993-03-31
URL	http://hdl.handle.net/10466/2755
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Bull. Univ. Osaka Pref., Ser. B, Vol. 45,
大阪府立大学紀要，農学・生命科学，1993

Research into Types of Deforestation in the Suburbs

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(Received, 1992)

Abstract

In this research, the factors that are thought to have a large effect on the structure of forests are examined comprehensively from a social factor and a natural factor. The objective is to clarify the ways in which forested land retreats from the periphery of a large city.

It was found that deforestation can be divided into a "partial" type and a "complete" type, and that each type has its own mechanism. The next step will be consider how to conserve the different types of deforestation.

Research Goal

Forested land in and around large cities is disappearing at a remarkable rate. At the same time, calls for measures to conserve these forests are growing in intensity. Among the many functions of forested land, its scenic and recreational aspects are thought to be especially important.

In this research, the factors that are thought to have a large effect on the structure of forests are examined comprehensively from a social factor and a natural factor. The objective is to clarify the ways in which forested land retreats from the periphery of a large city, and to thereby gain an understanding of how to conserve forested land.

Research Methods

The Minami Kawachi district of southern Osaka Prefecture was chosen as the study area for this research. A relatively large amount of forest remained in the study area until rapid urbanization took hold in the 1980 s. The study area, shown in Figure 1, measures 13.92 km from east to west and 12.72 km from north to south. Its total area is 177.06 km^2.

A mesh analysis was used to analyze the study area. The size of a single mesh segment was set at 240 meters square, so there were 53 segments from north to south and 58 from east to west, for a total of 3,074 segments.

As shown in Table 1, the distribution of forested land in 1979 and 1987 is noted among the items of analysis. The information on factors that are thought to affect forest structure comes from 1979. The natural factors are topography and slope, while the social factors are transportation facilities and legal restrictions. Next, the relationship between each item of analysis and the loss of forested land was clarified by way of

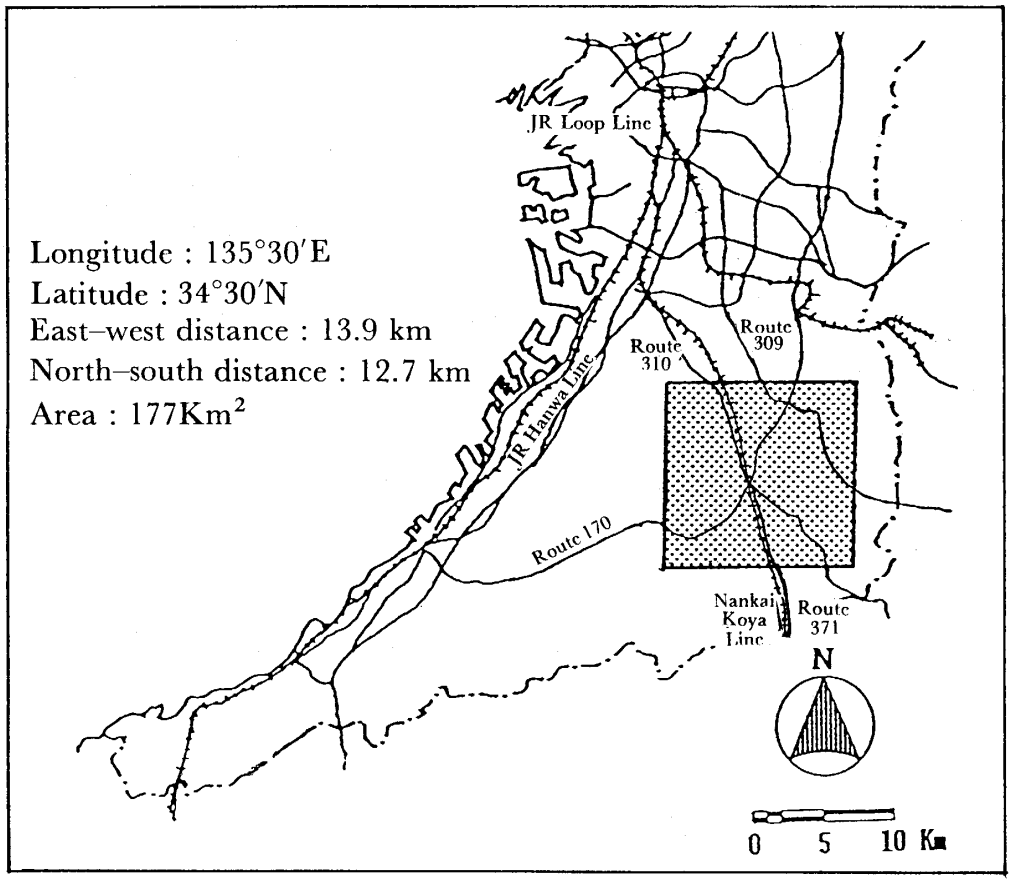


Fig. 1 Location of study area

analyzing the factors that affect the type of deforestation. Aerial photographs were taken in April 1979 and September 1987, and the distribution of forested land seen in these pictures was transferred to topographical maps that were made at the same time. Each of the 240-meter mesh segments was further subdivided into nine equal squares for the purpose of ranking the forested land. In any given mesh segment, each forested square counted as one point. Therefore, the range of possible forest ranks for each mesh segment was 0-9. A segment containing three squares with forested land would have a rank of 3, etc. The forest ranks of all 3,074 mesh segments were collected and tabulated in 1979 and 1987. Loss of forested land was investigated by comparing the 1979 forest rank of each mesh segment with the 1987 rank of the same segment. No change in rank was counted as "no deforestation". A decline of 1-3 was counted as "rank 1 deforestation", 4-6 as "rank 2 deforestation", and 7-9 as "rank 3 deforestation". Rank 1 deforestation was called "partial", while rank 3 deforestation was called "complete".

Results of Analysis and Consideration

1) *Understanding the characteristics of deforestation*

Table 2 shows the ratio of mesh segments by forest rank in 1979 and 1987. Figure 2 shows how the different ranks of deforestation (1979-87) were distributed. Also given in Figure 2 is the ratio of deforestation by rank (100%=all mesh segments that contained forested land in 1979).

Table 1. Classification of categories and basic data list

Item	Categry rank					Source (Scale)	Publisher	Year of survey
	I	II	III	IV	V			
Topography	Mountainous	Hilly	Plateau	Lowland	Other	Topographical classification map (1: 100,000)	National land agency	1976
Sloped land	More than 50%	30%-50%	15%-30%	Less than 15%	—	Topographical map (1: 25,000)	Geographical survey institute	1978
Road	No roads	width less than 1.5 m	Width 1.5 m -5.5 m	Width 5.5 m -11 m	width mor than 11 m	Topographical map (1: 25,000)	Geographical survey institute	1978
Urbanization promotion area	0%	Less than 25%	25% -50%	More than 50%	—	Osaka prefecture urban planning zoning map (1: 30,000)	Osaka prefecture	1979
Agricultural development region	More than 50%	25%-50%	Less than 25%	0%	—	Land use planning map (1: 10,000-1: 50,000)	Each city, town, village	1979
Forested land	—	—	—	—	—	Aerial photograths (1: 8,000-1: 10,000)	Osaka prefecture	1979 1987

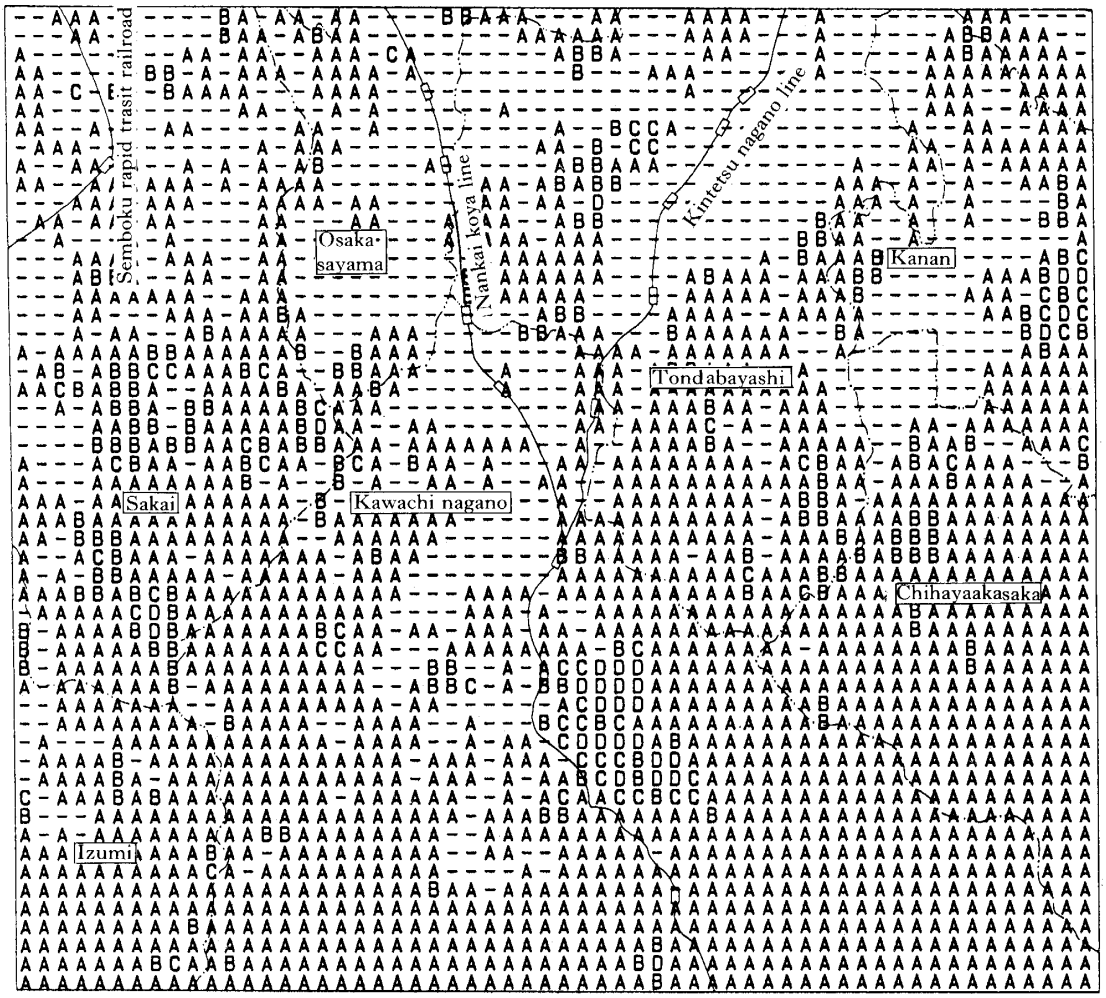
As shown in Figure 2, that there was no deforestation in 1,881 mesh segments, which is 87.2% of the segments that were forested in 1979. Some degree of deforestation was seen in 276 segments, or 12.8% of the forested total. In 192 of these segments (8.9%), there was rank 1 deforestation (partial). In 56 segments (2.6%), there was rank 2 deforestation. In the remaining 28 segments (1.3%), there was rank 3 deforestation (complete). Mesh segments that showed rank 1 deforestation were concentrated in the southern part of Sakai City, the western part of Tondabayashi City, the eastern and western parts of Kanan Town, and along the border between Chihaya-akasaka Village and Tondabayashi City. In other words, rank 1 deforestation was seen mainly around the edges of urban areas. Mesh segments that showed rank 2 deforestation were concentrated in mountainous areas, such as the southern part of Sakai City, the eastern part of Kanan Town, and around Mikanodai. Nineteen of the 28 mesh segments that showed rank 3 deforestation were concentrated just northeast of Mikanodai Station, which was newly constructed on the Nankai Koya Line in 1984. The vicinity of Mikanodai Station showed the heaviest concentration of forest loss in the entire study area, mainly because of rank 3 deforestation, although ranks 1 and 2 were also existed there. Another cluster of forest loss was seen in the northeast of the study area in Kanan Town. Mesh segments showing rank 3 deforestation account for 1/4 of this cluster. There were also a few scattered mesh segments along the border between Sakai City, Izumi City, and Kawachinagano City that showed rank 3 deforestation.

2) *Understanding causal factors based on the characteristics of deforestation*

Table 2. Ratio of forested land by rank

	Rank	Forested land													
		Rank 1~3				Rank 4~6				Rank 7~9				Tatal of forested land	Total
	0	1	2	3	Sub-total	4	5	6	Sub-total	7	8	9	Sub-total		
1979	917	153	163	163	479	155	154	165	474	159	228	817	1204	2157	3074
	29.8	5.0	5.3	5.3	15.6	5.0	5.0	5.4	15.4	5.2	7.4	26.6	39.2	70.2	100.0
1987	1007	158	162	164	484	162	150	162	474	155	203	751	1109	2067	3074
	32.8	5.1	5.3	5.3	15.7	5.3	4.9	5.3	15.5	5.0	6.6	24.4	36.0	67.2	100.0

Upper figures: No. of mesh segments
Lower figures: %



A : No deforestation 87.2(%) B : Rank 1 deforestation 8.9(%) C : Rank 2 deforestation 2.6 (%)
D : Rank 3 deforestation 1.3(%) — : Urbanized land, etc.

Fig. 2 Distribution of deforestation ranks

Tables 3-7 show the ratio of the presence or absence of deforestation by topographical category, slope category, road category, urbanization promotion area category, and agricultural development region category. Figures 3-7 show the ratio of topographical, slope, road, urbanization promotion area, and agricultural development region categories by deforestation ranks.

(1) *Natural factors*

As shown in Table 3, deforestation ratio in the hilly category was 20.5%. This was a greater loss than seen in any other topographical category, which suggests that hilly land might be especially prone to deforestation. As shown in Figure 3, the hill category ratio in rank 1 deforestation was the highest among the three deforestation ranks. This suggests that partial deforestation might easily occur at hilly land. On mountainous land, however, only 9.1% of forested land was lost. This wasthe smallest loss seen in any topographical category, which suggests that mountainous land might be quite resistant to deforestation. Although the absolute number of mountainous segments that showed forest loss was small, the mountainous category ratio showed a very high proportion in rank 3 deforestation. This suggests that complete deforestation might easily occur at mountainuos land.

Table 4 shows that there were high rates of forest loss in the 15%-30% slope category and the less than 15% slope category, which suggests that gentle sloped land might be subject to easy deforestation. Figure 4 shows that the less than 15% category ratio in rank 1 deforestation was highest among the three deforestation ranks. This suggests that partial deforestation might easily occur at this sloped land. Among mesh segments with a slope of 30%-50%, the rate of deforestation was a low 6.7%. Land with a slope of 30%-50% is therefore thought to be resistant to deforestation, although complete deforestation can still occur in this area, as indicated by the high proportion of this slope category in rank 3 deforestation.

Table 3. Deforestation by topographical category

	Mountai-nous	Hilly	Plateau	Lowland	Other
No deforestation	1044	423	213	196	5
	90.9	79.5	85.5	87.9	100.0
Deforestation	104	109	36	27	0
	9.1	20.5	14.5	12.1	0.0
Total	1148	532	249	223	5
	100.0	100.0	100.0	100.0	100.0
	53.2	24.7	11.5	10.3	0.2

Upper figures: No. of mesh segments
Middle and lower figures: %

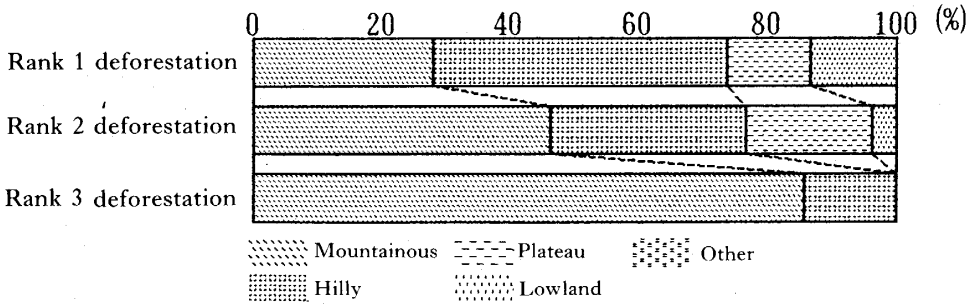


Fig. 3 Ratio of deforestation ranks by topograhical category

Table 4. Deforestation by slope category

	More than 50%	30%-50%	15%-30%	Less than 15%
No deforestation	36	636	667	542
	97.3	93.3	83.2	85.2
Deforestation	1	46	135	94
	2.7	6.7	16.8	14.8
Total	37	682	802	636
	100.0	100.0	100.0	100.0
	1.7	31.6	37.2	29.5

Upper figures: No. of mesh segments
Middle and lower figures: %

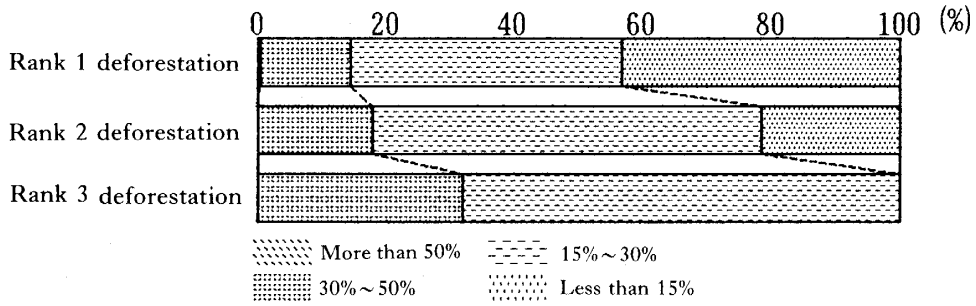


Fig. 4 Ratio of deforestation ranks by slope category

(2) *Social factors*

As shown in Table 5, deforestation ratio in the width more than 11 m category and the 1.5 m-5.5 m width category were quite high at 18.8% and 16.4%, respectively, which suggests that these area especially prone to deforestation. As shown in Figure 5, the width more than 11 m and 1.5 m-5.5 m width category ratio in rank 1 deforestation were higher than others. This suggests that partial deforestation might easily occur at these areas. Deforestation ratio in the no road category showed a low (11.1%). However, as shown in Figure 5, complete deforestation can still occur in this area, as indicated by the very high proportion of the no road category in rank 3 deforestation.

Table 6 shows that the highest rate of forest loss in any urbanization promotion area category was 24.4%. This rate of deforestation was recorded in the less than 25% urbanization promotion area category, which is commonly found around the periphery of urban areas. As shown in Figure 6, the less than 25% urbanization promotion area category ratio was highest among the three deforestation areas. This suggests that partial deforestation might easily occur at this area. Partial deforestation was also quite common in the more than 50% urbanization promotion area category. In the 0% urbanization promotion area category, which consists of undeveloped land that has been designated for protection, the deforestation ratio showed a low (12.3%). Although the absolute number of mesh segments that showed forest loss in these urbanization control area was small, the 0% urbanization promotion area category was a very high proportion of the deforestation in rank 3 deforestation, which indicates that complete deforestation can occur in urbanization control areas.

Table 7 shows that the highest rate of forest loss in any agricultural development

Table 5. Deforestation by road category

	No roads	Width less than 1.5 m	Width 1.5 m–5.5 m	Width 5.5 m–11 m	Width more than 11 m
No deforestation	615	259	554	414	39
	88.9	88.7	83.6	89.6	81.3
Deforestation	77	33	109	48	9
	11.1	11.3	16.4	10.4	18.8
Total	692	292	663	462	48
	100.0	100.0	100.0	100.0	100.0
	32.1	13.5	30.7	21.4	2.2

Upper figures: No. of mesh segmints
Middle and lower figures: %

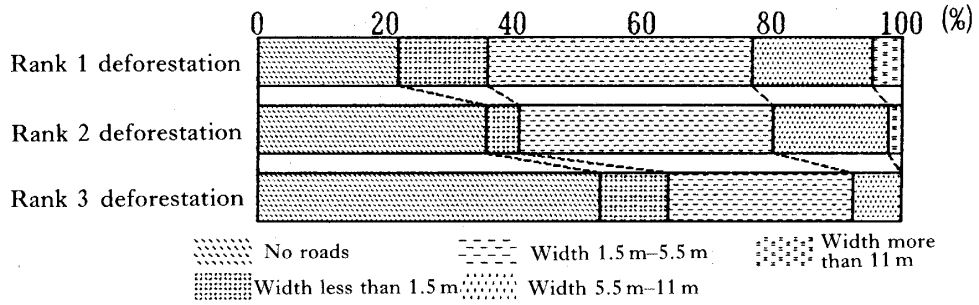


Fig. 5 Ratio of deforestation ranks by road category

Table 6. Deforestation by urbanization promotion area category

	0%	Less than 25%	25%–50%	More than 50%
No deforestation	1572	31	40	238
	87.7	75.6	78.4	87.2
Deforestation	220	10	11	35
	12.3	24.4	21.6	12.8
Total	1792	41	51	273
	100.0	100.0	100.0	100.0
	83.1	1.9	2.4	12.7

Upper figures: No. of mesh segments
Middle and lower figures: %

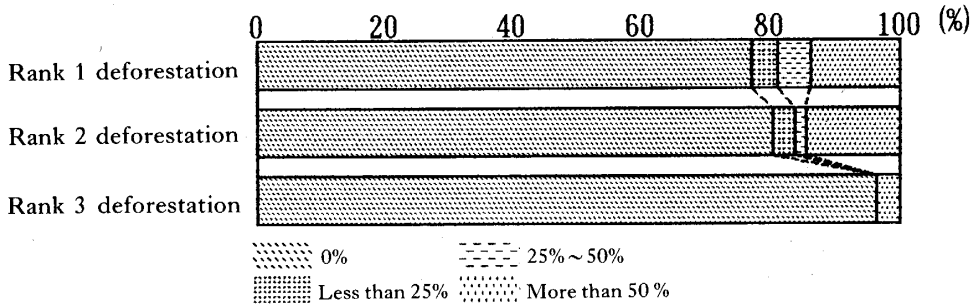


Fig. 6 Ratio of deforestation ranks by urbanization promotion area category

Table 7. Deforestation by agricultural development region category

	More than 50%	25%-50%	Less than 25%	0%
No deforestation	919	176	111	675
	85.6	88.9	87.4	89.1
Deforestation	155	22	16	83
	14.4	11.1	12.6	10.9
Total	1074	198	127	758
	100.0	100.0	100.0	100.0
	49.8	9.2	5.9	35.1

Upper figures: No. of mesh segments
Middle and lower figures: %

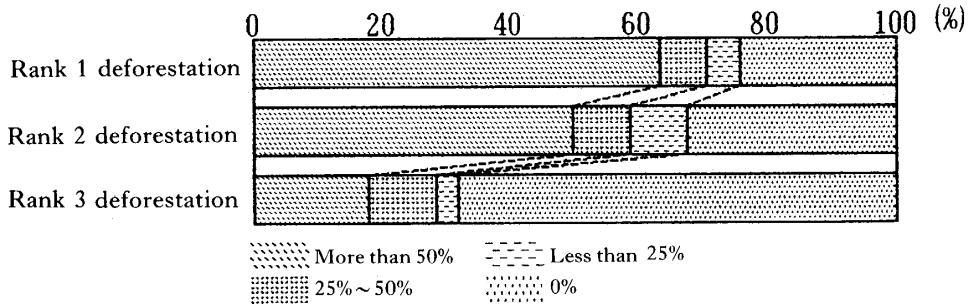


Fig. 7 Ratio of deforestation ranks by agricultural development region category

region category was 14.4%. This rate of deforestation was seen in the more than 50% agricultural development region category. The more than 50% agricultural development region category ratio in rank 1 deforestation was highest among the three deforestation ranks. This suggests that partial deforestation might easily occur at this area. The agricultural development region category with the lowest rate of deforestation (10.9%) was the 0% agricultural development region category, which consists of non-agricultural development region that has been left in a forested or otherwise undeveloped state. Although the absolute number of mesh segments that showed forest loss in these non-agricultural development regions was small, the 0% agricultural deforestation region category was a very high proportion in rank 3 deforestation, which indicates that complete deforestation can occur in wholly undeveloped areas.

Conclusion

These results make it clear that deforestation is unlikely to occur in the following settings, all of which are unsuitable for urbanization: areas that are too mountainous or too steeply sloped for buildings to be constructed, areas with no roads, urbanization control areas, mountain forests, and remote areas that are still in an untouched state. On the other hand, deforestation is relatively common in areas that are prone to urban-style land use. This includes land on which it is easy to construct buildings, hilly areas, land with a slope of less than 30%, areas with roads measuring more than 11 m in width or 1.5

m–5.5 m in width, areas in urbanization promotion areas, and the periphery of cities. At the types of deforestation, partial deforestation is relatively common and complete deforestation relatively uncommon in the areas where deforestation is most likely to occur. In the mountainous, roadless, and untouched areas where deforestation is unlikely to occur, there is still a possibility of complete deforestation owing to new residential developments, golf course construction, etc.

Thus, there are different mechanisms for partial deforestation and complete deforestation in the vicinity of a large city. The next step will be to consider how to conserve the different types of deforestation.

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