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Planning of Forest Road Network in Palm Form Working System (I)
—— Establishment of Unit Block ——

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The goal of forest management is the maintenance of a often difficult equilibrium between economic timber production and the securing of the service function of forests. The Palm Form Working System is one of the forest working systems which has been applied to a part of Kyushu University Forest in Hokkaido since 1962 to attain it. Forest road network that is required to maximize the efficiency of the system to applied forests is not yet constructed. This paper analyzes the establishment of unit blocks as the first step in determining the planning of road network. The 50 unit blocks are requisite for sustained yield management, and the standard size of those occupies 23 ha. As a result of the establishment of the unit blocks considering essential items, i. e. the boundary of compartment, ground conditions and the standard size relating to it , the sizes of 47 unit blocks occupied within plus or minus 20 percent of the standard size.

INTRODUCTION

Recently in addition to providing a stable supply of lumber, greater emphasis than ever before has been placed on forestry activities which take full account of many functions.

The trees cutting and road construction among the forestry activities generally bring about the sudden change in the conditions of forests. As they are closely related, the cutting planning and the planning of forest road network should be simultaneously determined from the standpoint of applied forest's overall area and long-range forest management. Accordingly, there should be various road networks corresponding to working systems (Peters, 1978 ; Weintraub and Navon, 1976).

So far, road network has been planned out based on the topographic and growing stock conditions and logging system in applied forests (Hiraga, 1971 ; Greulich, 1980 ; Kanzaki, 1974 ; Kitakawa, 1984 ; Kobayashi, 1983; Koger and Webster, 1986 ; Minamikata, 1968 ; Sakai, H., 1978 ; Sakai, T., 1981 ; Wellburn, 1981 ; Weintraub and Navon, 1976). However, forest road network will be constructed in accordance with working system to maintain a difficult equilibrium between timber production and the securing of the service function of forests in the near future. The palm form working system is one of the forest working systems to attain the equilibrium. This system was devised in 1961 (Yano and Imada, 1966) and has been applied to a part of Kyushu University Forest in Hokkaido since 1962. The unit blocks have been partially established at most, because it was intended to establish unit blocks keeping step with the advance of series of operations.

At that time, owing to the skidding system of timber simply transported by horse, the importance of forest road was not taken consideration. However, as the skidding system has been changing to tractor or truck-crane, the importance of planning of the optimal forest road network has been recognized recently (Kakihara, 1974). When further adding, it is also required to maximize the efficiency of the system.

In this paper, we would like to outline the first stage, i. e. the establishment of unit blocks, in the planning of forest road network which will be applied to the adopted forests of the palm form working system.

The unit block is the most fundamental cell of this working system, and is indispensable to lay out the planning of the forest road network. The number of unit blocks is concluded by the rotation and the cutting cycle, and those boundaries are fixed on the ground conditions, compartment border and the standard size. Established the unit blocks under these constraints, adequate results were obtained.

OUTLINE OF PALM FORM WORKING SYSTEM

Before establishing the unit blocks in the palm form working system, it is necessary to give the outline of it. Kyushu University Forest in Hokkaido locates in the east of Hokkaido island and covers an area of about 3,740 hectares (Fig. 1), in which approximately 1,170 hectares occupies the applied forest of the system (Fig. 2).

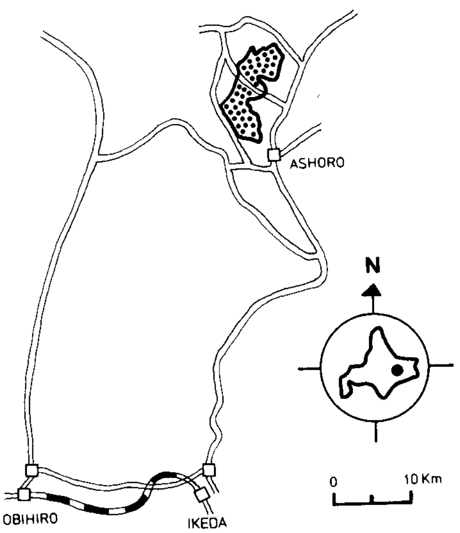

Fig. 1. Location of Kyushu University Forest in Hokkaido.

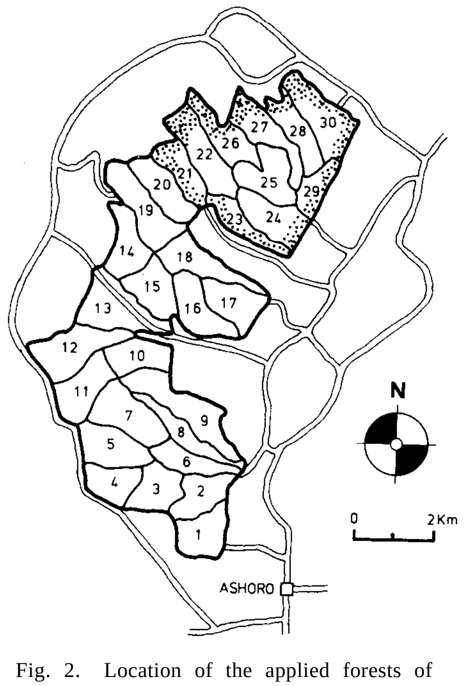

Fig. 2. Location of the applied forests of the palm form working system.

Though KARAMATSU (*Larix letolepis G.)* plantation had covered a considerable area before this system was introduced, the tree growth in an upper section of hillside was poor (Kakihara, 1976). In the nonplanted area of the section, on the other hand, there were the natural broadleaved stands mainly composed of MIZUNARA (*Quercus mongolica var. grosseserrata*) which is a representative useful species (Imada, 1972).

Therefore, the first lines of this working system were laid as follows: when converting natural broadleaved stands into coniferous plantations, the applied area must be limited on the lower section, and it should be silvicultivated broadleaved trees in the upper section.

According to the current practice plan (K. U. F., 1982), it is adopted the rotation of fifty years and the clear cutting in the plantations, and the cutting cycle of fifty years and the group-selection cutting in the natural broadleaved forests. These two silvicultural system are combined, as shown in Fig. 3. That is to say, the coniferous stand in the division is harvested by clear cutting in every fifty years, and the broad-leaved stand is simultaneously harvested by group-selection cutting.

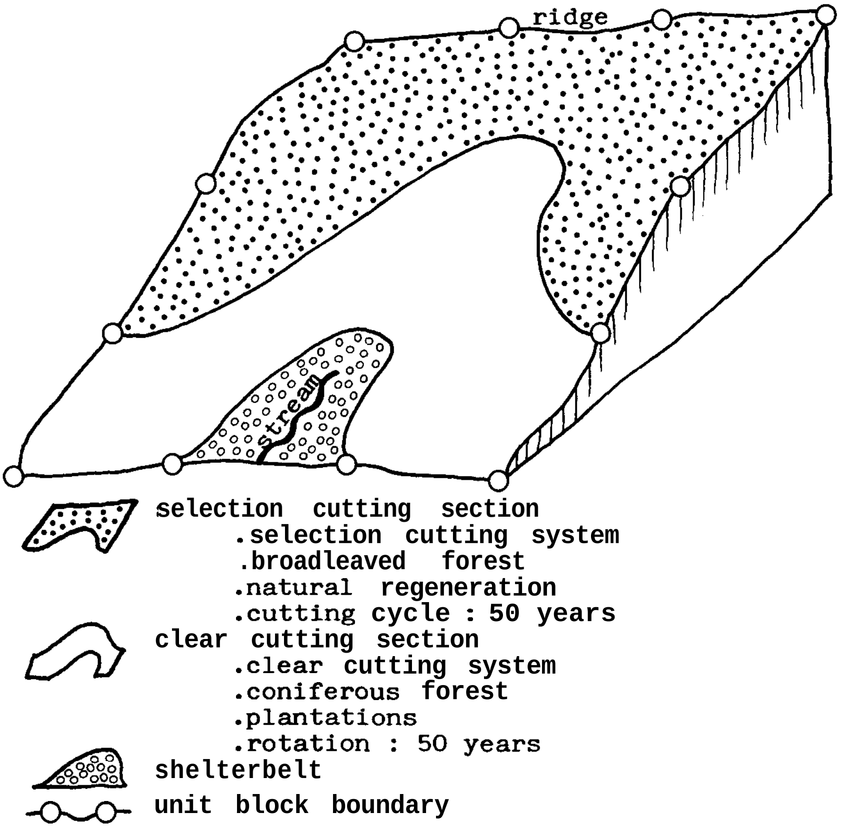

Fig. 3. The model of unit block composed of an only smaller watershed (Yano and Imada, 1966).

Such a division is defined as Unit Block, and fifty unit blocks are requisite for sustained yield managemant in the applied overall area because both cutting and rotation are fifty years. Moreover, Fig. 4 shows a typical form of unit blocks established in a small watershed. Owing to the topographic conditions, as is evident from Fig. 4, the boundaries between clear cutting sections and selection cutting sections look like as if it were a palm. Accordingly, this forest working system was named the Palm Form Working System (Yano and Imada, 1966).

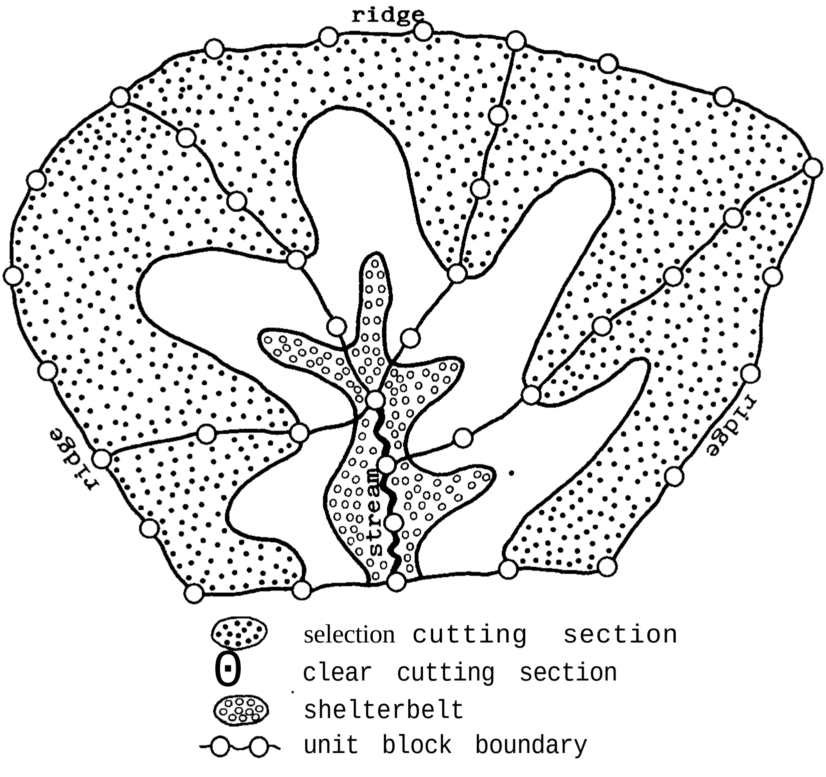

Fig. 4. The model of established unit blocks composed of a small watershed (Yano and Imada, 1966).

ESTABLISHMENT OF UNIT BLOCK

Topography

The applied region of palm form working system covers an area of 1,168.62 hectares composed of ten compartments, i. e. from twenty-first to thirtieth compartment. As shown in Fig. 5, it is divided into three watersheds : from twenty-first to twenty-third, twenty-fourth to twenty-ninth and thirtieth compartment. Furthermore, the third-watershed contains the only right slope.

The elevation ranges from 200 to 500 meters, and the relief energy is low. There

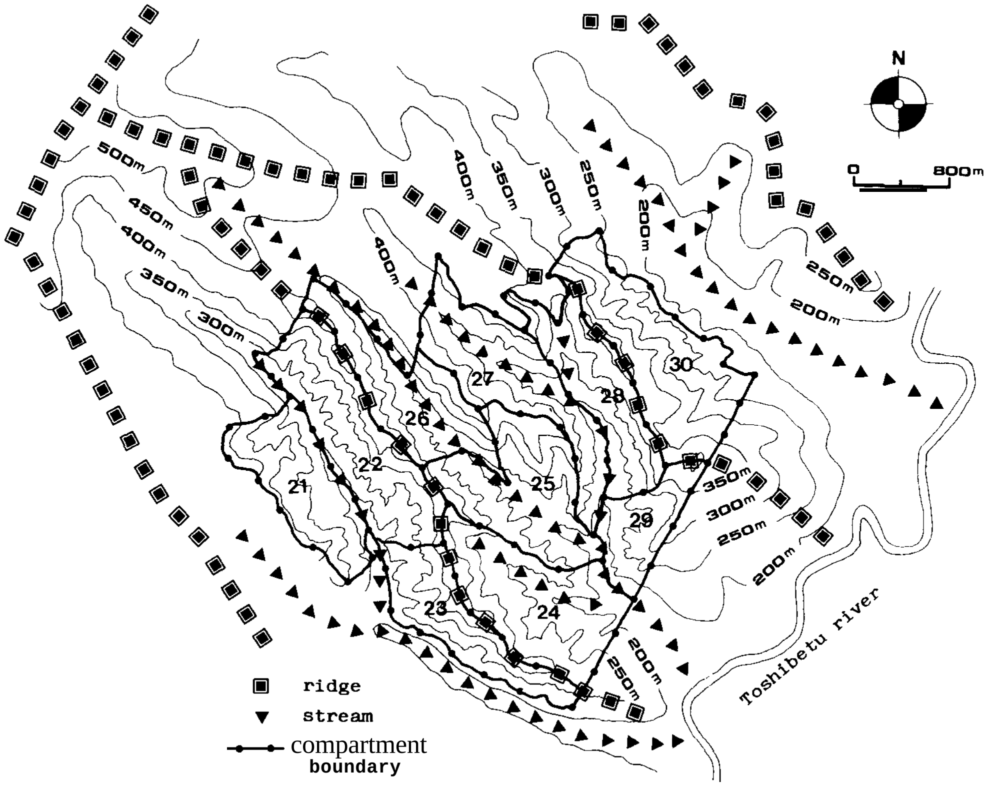

Fig. 5. Topographic outline of the palm form working system area.

are many valleys and streams per unit area, which means the uneveness of the ground. When planning a road network and selecting a skidding system, the gradient is the most important factor among the ground conditions. Fig. 6 illustrates the distribution of gradient class. What is evident from the figure is as follows : the majority of gradient class shows 2 and 3, slopes are, on the whole, moderate.

Constraints in establishing unit block

In establishing the unit blocks, constraints are as follows :

1. The number of unit blocks, as mentioned before, should be determined by the rotation and the cutting cycle. On the basis of fifty years of the rotation and the cutting cycle, it is requisite fifty.

2. The total area of 1,168.62 hectares divided by fifty unit blocks gives approximately 23 hectares as the standard size.

3. As shown in Fig. 4, the unit blocks are partitioned by a smaller watershed.

4. The boundary of unit blocks must be coincided with the permanent compartment border.

5. While the boundary of unit blocks is the same boundary as smaller watersheds

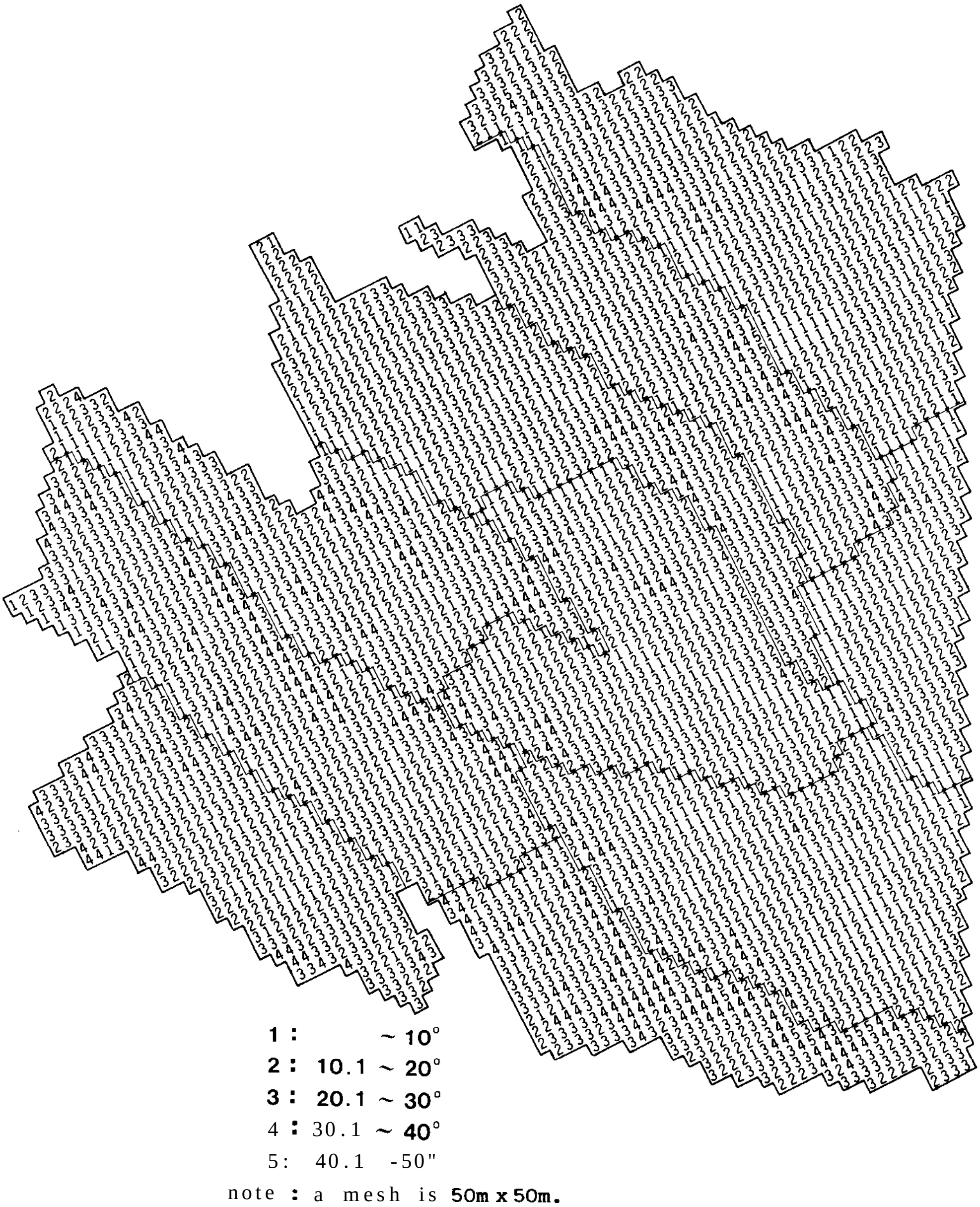

Fig. 6. Distribution of gradient class in the applied area.

and compartments, the size of every block is made as equal as possible.

RESULTS AND DISCUSSION

After the applied area of the palm form working system, as mentioned above, was divided into three watershed, unit blocks were established through trial and error method taking five constraints into consideration. Fig. 7 illustrates the map showing this results. The numerals in the figure represent the number of unit blocks.

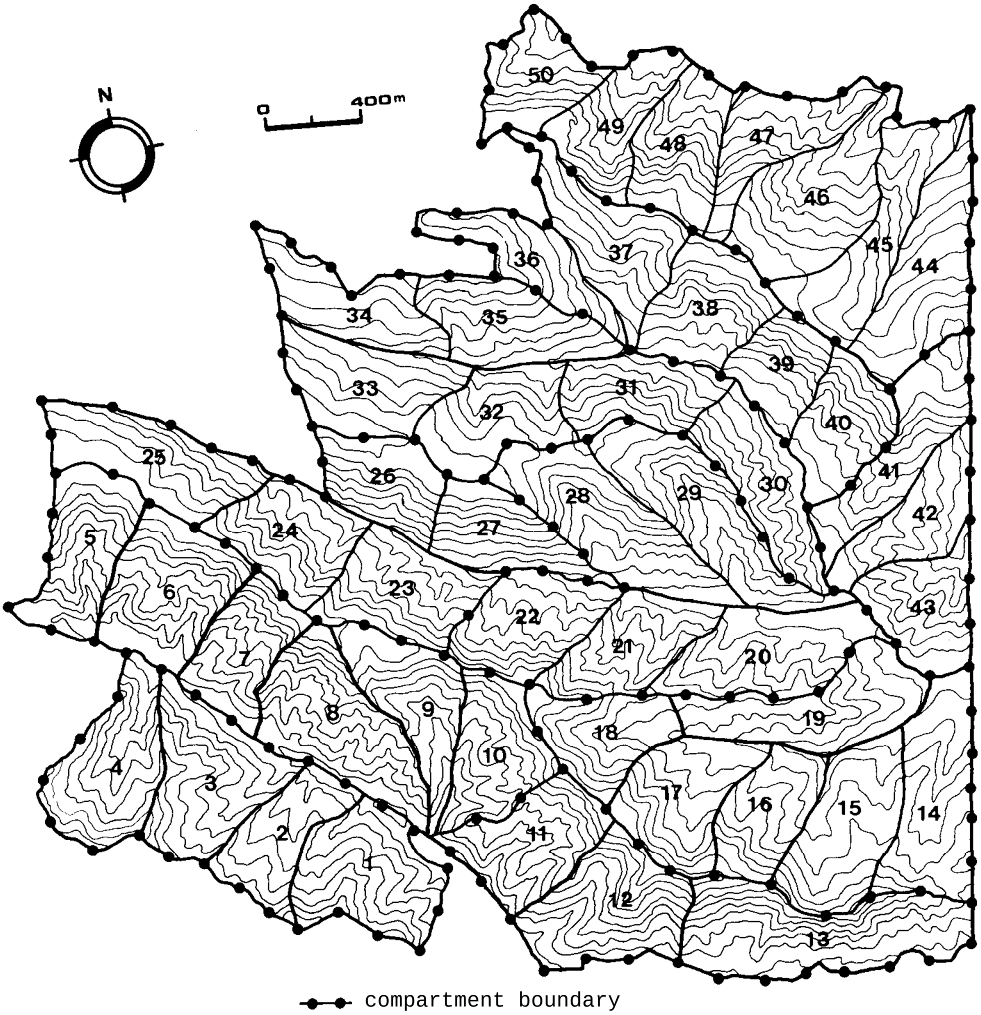

Fig. 7. The map showing the established unit blocks.

As the figure shows, forty-one unit blocks correspond to smaller watersheds and remainders are anomalous, because a few of smaller watersheds cover an extremely large area as compared with the standard size.

Table 1. Outline of established unit blocks.

No. of unit block	Compartment	Area (ha)	Hillside slope length (m)	Average gradient (°)
1		26.27	550	21
2		19.36	660	14
3	21	27.45	500	19
4		25.61	860	21
subtotal		98.69	–	–
5		22.16	790	21
6		25.64	620	21
7		23.61	600	21
8	22	24.15	470	21
9		19.93	940	18
10		20.03	750	19
subtotal		135.52	–	–
11		22.58	540	21
12	23	27.45	570	25
13		36.38	360	25
subtotal		86.41	–	–
14		23.70	820	15
15		24.91	730	15
16		18.60	720	18
17	24	21.38	620	18
18		21.31	780	18
19		21.87	330	16
subtotal		131.77	–	–
20		26.21	500	16
21		22.31	590	19
22	25	24.64	450	18
28		35.51	860	18
29		34.87	1060	18
subtotal		143.54	–	–
23		24.90	490	19
24		22.42	480	19
25	26	26.03	360	18
26		18.60	400	21
27		18.51	420	22
subtotal		110.46	–	–
30		22.42	290	21
31		19.51	300	22
32		23.46	450	17
33	27	24.85	400	15
34		20.79	320	15
35		23.33	410	19
subtotal		134.36	–	–

Table 1. Outline of established unit blocks.

No. of unit block	Compartment	Area (ha)	Hillside slope length (m)	Average gradient (°)
36		18.60	340	18
37		22.80	350	20
38	28	23.20	510	20
39		18.55	410	21
40		19.93	480	19
subtotal		103.08	–	–
41		23.92	1000	16
42	29	19.11	800	18
43		20.44	540	17
subtotal		63.47	–	–
44		27.00	1260	14
45		25.03	1460	14
46		27.45	950	16
47	30	20.31	480	17
48		22.24	680	19
49		20.61	810	21
50		18.68	430	21
subtotal		161.32	–	–
Total		1168.62	–	–
Average		23.27	610	19

Table 1 shows the size of established unit blocks. As is evident from the table, sizes of unit blocks vary from 18.51 to 36.38 hectares. However it is very difficult to divide uniformly an uneven mountainous area. It should therefore be regarded the area of unit block as appropriate, in practice, if it were within plus or minus 20 percent of the standard size. If based on such a standpoint, three blocks, i. e. block number 13, 28, and 29, are beyond allowable range, which is no more than six percent.

A very steep slope is situated in the central part of upper hillside in unit block 13. In the case of block number 28 and 29, there is a wetland in the lowest part of hillside. These sites are substantially eliminated from the production area, i. e. the selection cutting or clear cutting area. Accordingly, the sizes of these unit blocks are anything but large.

In recent years there is a growing tendency that one section of a clear cutting area has been reduced in response to the social needs regarding forests, especially environmental conservation. The maximum allowable cutting area, generally speaking, is 5 hectares in Japan. Furthermore, the shelterbelt should be established to protect young plantations on an area occupied by the ridge and the stream of every unit block. Accordingly, the proportion of its production area will be changed in accordance with the length of ridge and stream along each unit block. Consequently, it may be feasible to uniform the production area by the adjustment of shelterbelt width between unit blocks. Table 1 also gives the average gradient of every unit block. The values range from 14 to 25 degrees, and the average gradient of total area is approximately 19 degrees. As can be seen from the distribution of hillside slopes, though it is necessary to select a skidding system of an appliad area after due consideration, a unified skidding system is expected to be workable.

The hillside slope length of each unit block is shown by Table 1. Those values vary from 290 to 1,460 meters with a large variation. It is the important factor when we determine the number of route alignment to be constructed in each unit block. Accordingly, it means that the number of route to be allocated differs between unit blocks because of a large variation.

In this paper, we established unit blocks in the applied area of the palm form working system as the first stage in the planning a forest road network. In spite of that its establishment is essentially restricted by terrain conditions, the results obtained agreed approximately with those expected.

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