REPORT ON THE STRUCTURE OF THE TERRACEDFIELDS IN THE SOUTHERN PROVINCES OF EHIME PREFECTURE

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REPORT ON THE STRUCTURE OF THE TERRACED-FIELDS IN THE SOUTHERN PROVINCES OF EHIME PREFECTURE

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Introduction

In regard to the protection of the terraced-fields from erosion by water, we must consider various data in connection with its structure. The object of this report is to produce one of them. Of course the structure itself has a close connection with the physical properties of the soil, which problem, however, will be dealt with in another report.

1. The area surveyed

The survey was performed in Takayama-mura, Higashiuwa-gun, Ehime Prefecture, during the summer, 1950.

2. The configuration and nature of the ground

The ground belongs geologically to the Jurassic system[1]. The folded mountains in this area, produced by the organic movement at the end of Jurassic, rise near the seashore, and only narrow level land lies between them.

The terraced-fields cover the slopes of the mountains, from the foot to about 200 meters above the sea-level, except the outcrop-part of the sandstone or limestone; and sparingly scatter in the section higher than there.

Generally speaking, the gradients of the cultivated part are very steep as shown in Table 1, which contains the results of levelling at 200-meter intervals from the eastern side to the west by "Locke Hand Level".

Table 1.

Stand	1	2	3	4	5	6	7
Gradient	14°55′	18°26′	19°35′	21°49′	24°34′	2804′°	38°40′
Stand	8	9	10	11	12	13	14
Gradient	40°20′	45°01′	44°50′	32°38′	29°44′	38°40′	28°05′
Stand	15	16	17	18	19	20	21
Gradient	24°34′	24°34′	21°49′	17°45′	19°20′	21°49′	17°45′
Stand	22	23	24	25	aver.	max.	min.
Gradient	14°56′	10°05	10°28′	9°06′	24°42′	45°01′	9°06′

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According to Table 1, we can understand their gradients as follows:

1) The minimum value is 9° 06′, while the maximum as large as 45°.

2) As to the frequency, 21° 49′ and 24° 34′ are the most.

3) The results can be devided into three groups, namely: the 1st group ranging from 9° to 15°, and the 2nd 15° to 25°, and the 3rd 25° to 45°. The 2nd one has the mode.

4) Based on the foregoing paragraphs, we can state that the terraced-fields are built up on the steep slopes in this area.

As for rocks, we could find such sedimentary rocks made by shallow water as sandstone, conglomerate, shale, clayslate and limestone; but chlorite-schist also could partly be seen. The weathering soils are mostly composed of the pieces of sandstone.

3. The structure of the terraced-fields

The terraced-fields, being of the bench-terrace type, differ from the "terracing" in America[2]. Moreover, it can be classified into two types: the stone-wall type and the cutting type.

i. Stone-wall type

The foundation of the stone wall mostly reach the rock layer. In this case, the rock layer exists shallow under the ground, which fact can be easily recognized from the outcrop of the layer or the breaking part.

The cross section of the fields, when seen externally, is considered to be as shown in Figs. 1 or 2.

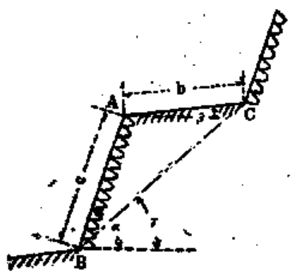

Fig. 1.

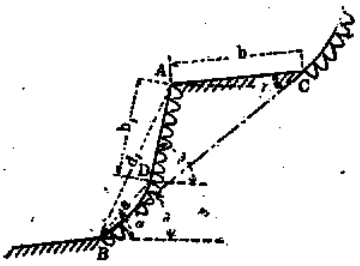

Fig. 2.

Measured values of b, c, α and β in Fig. 1 and a_1, b_1, b, α, β and γ in Fig. 2 are shown in Table 2.

(It follows, however, that, as is known from the nature of any data obtained statistically, these values, and those shown above as well, must not be taken as applicable to all cases of erosion protection. In practice, of course, each field under similar conditions in other districts are to be dealt with in such a way as will suit the actual state.)

The width of the stone-walls is commonly 0.2 to 0.75 meters larger than that of the fields, the former being usually between 2 and 3 meters. The gradient of the field surface is chiefly beyond 15.

Table 2.

Stand	Gradient of stone-wall surface	Width of stone-Wall surface	Gradient of field surface	Width of field surface	True gradient
I	74°	3.0	17°	3.0	45°30′
II	72°	2.5	16°30′	1.75	32°53′
III	80° (β) 54° (α)	1.5 0.4	20°	1.5	50°18′
IV	76°	3.2	17°	3.0	47°01′
V	72°	2.6	17°	2.0	48°23′
VI	73°	2.0	16°	1.5	48°56′
VII	72°	2.4	18°30′	3.1	41°25′
IIX	76°	2.2	15°	1.9	45°30′
IX	68°	3.0	13°	2.25	36°15′
X	71°	2.8	16°	2.5	45°11′
XI	73°	2.5	18°	2.0	48°48′
XV	52°	0.95	13°	0.8	30°33′
XVI	82° (β) 53° (α)	2.4 0.8	10°	3.0	43°09′
XVII	71°	1.8	16°	1.6	45°05′
XIIX	73°	2.4	5°	2.2	40°40′

Supposing that a side BC in Figures 1 and 2 runs parallel to the surface of the rock layer right down, we can consider γ in Fig. 1 and δ in Fig. 2 are the true gradient of the slopes. The gradient of the rock layer surface exerts an influence upon the movement of underground water.

The true gradient can be calculated by some simple equations. The values of true gradients calculated are shown at the same time in Table 2. They range between 30° 33′ and 50° 18′, far larger than in normal cases in other districts. This is entirely due to the special configuration of the ground.

As to the frequency of true gradient, both the groups of 30° to 36° and 40° to 45° are observed to have the modes.

ii. Cutting type

Its structure is the same as the stone-wall type of Fig. 1, except that it has no stone-wall. Table 3 shows the measured values of b, c, α and β, and it contains the column of true gradient. The rock layer exists usually deep under the ground in this case. Consequently, tne true gradient is relative to the earth pressure.

Table 3.

Stand	Gradient of cutting	Length of cutting surface	Gradient of field surface	Width of field surface	True gradient
XII	58°	0.9 (m)	12°	0.8 (m)	36°25′
XIII	57°	0.95	10°	1.1	31°41′
XIV	57°	0.8	12°	0.8	34°30′

In comparison with Tables 2 and 3, all b, c, α and β of the cutting type are less than the stone-wall one.

4. Arrangement of terraced-fields

The length of a terraced-field in the direction of contour line is usually 20 to 30 meters, the little one being even less than 10 meters. As a rule, there is a path bordering the fields across contour lines. Some fields, however, are adjacent to those of different structure types. (Such disorderly arrangement will bring about "soil erosion" by water.) No path is found on the border line of such fields, and one each is on the opposite side. The directions of the paths are mostly at right angle to the contour lines, but not always. They are usually 0.3 meter or so in width. Three kinds are noticed of the path surfaces: of rock layer, stone-steps, and earth. Steep slopes are generally with the first two types.

No device is made for drainage on the slopes, only the paths playing the role. Consequently the top-soil has been eroded by water on the ground surface of the paths. The surface of the field has a small caving at the foot of the stone-wall retaining the upper field; and a little gradient along the contour line. Its draining ability being very poor, the rainfall easily percolates under the ground and some terraced-fields have been broken down.

5. Consideration

In view of the fact that these fields have been maintained pretty well for past some hundred years, the present structures may be regarded as such that will do fairly good. Apart from it, more important is the question of drainage. Better drainage should be devised that will fit the structure of the field and the configuration and nature of the ground as they are. Reference will be made to this problem in future.

What is worthy of special mention is as follows:

1) It could be clarified that the slopes have the steep gradients and the soil is mainly the sandy one of gravel.

2) As the rock-layer exists shallow under the ground in case of stone-wall type, it is assumed that the underground water will move remarkably.

3) The places broken down are more found in cutting type than the stone-wall one, and their break-down is due to the boiling of water.

4) Consequently, the soil is considered to easily percolate the water in cutting type, too.

References:

1) Explanatory text of the geological map of Japan, Unomachi zone 33 col. XLX sheet 249; Tatsuo Suzuki, Tokyo, 1935.

2) Soil conservation; H. H. Bennet, 1939.