

# The Morphological Characters of Two Villages in West Bengal — Radhaballavpur and Tentleberia —

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西ベンガル南部の微地形

大竹義則\*

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## Preface

The Ganges Delta is one of the largest alluvial plains in the world. Ganges branches into many tributaries and forms the vast Ganges-Brahmaputra delta in the Bay of Bengal, which stretches from the Meghna in the east to the River Hugli in the west.

On the south-western part in this delta, two villages (Radhaballavpur and Tentleberia) which were surveyed in this time (Sep. – Oct. 1992) are located at a distance about 100 km away from Calcutta. 25 years ago, geographical survey was done in these two villages (Yonekura, 1973).

Tentleberia is a small village which is located a southern part of junction of Hugli that is an ancient course of Ganges and Rupnarayan that is a tributary of Ganges and rises in the Chota Nagpur plateau. Radhaballavpur is also a small village located on the spot which follows up along Rupnarayan almost 20km from Tentleberia (Fig. 1).

These rivers adjacent to two villages are in tidal limit, and the range of tide is wide. The Rupnarayan plain is located on the mouth of this great delta, and is extremely flat and low. In this extensive plain the settlements located on limited upland are scattered

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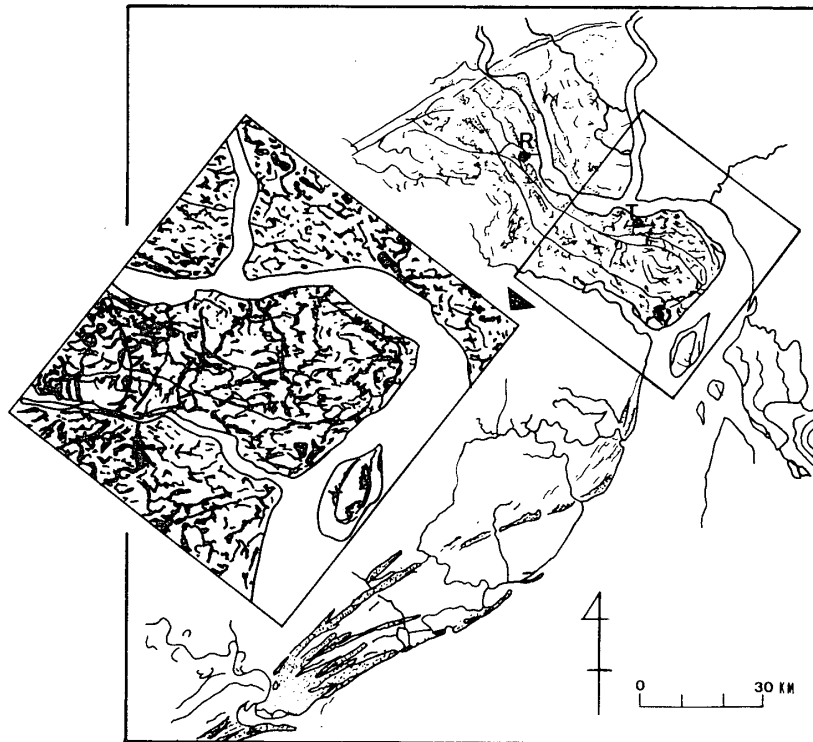


Fig. 1) Location of the two surveyed villages in the south-west area, West Bengal \* from the satellite images  
R : Radhaballavpur T : Tenteberia

over. These settlements are apart from under 2km and classified in compact or semi-compact types (Department of Science & Technology, 1986).

On limited upland which is called *highland* many houses are densely built up, and this upland is used for fields, reservoirs, which are called *tanks*, and woods. The highland is surrounded with the *lowland* where paddy fields are expanded. In this district this landscape that consists of a set of settlements and paddy fields extends almost indefinitely. It leads us to ask questions, for example, the relationship between geomorphic environment and settlements.

The landforms of alluvial lowlands of Bengal are classified into three alluvial surfaces, namely the older, younger and youngest surfaces (Umitsu, 1985). The older alluvial surface is broadly distributed in this region. It is slightly higher than younger and youngest alluvial surfaces. Sediment of the alluvial lowlands is mainly composed of non-weathered sand, silt and clay layers.

## **I . Purpose of the study**

This paper has two purposes. One is to make clear the landforms, especially the highland where settlements are located and to make a better understanding of the geomorphologic characters of the two villages. The other is to make clear the relationship between geomorphic environment and settlements.

To achieve the first purpose, it is necessary to grasp the morphology of highland. For that we made a level survey by using a hand-level and measuring the distance on foot. At the same time, we measured the height of bases of houses and the water table level of tanks along the base lines.

In addition to this, the author made an observation of land use and made hearing of the depth of tanks. And we sampled soils in some places, and made an analysis of a soil composition. Further more to understand about the shift of earth, we measured the bases of houses and tanks.

In Tentleberia, the landform has changed respectably because of construction of PHE (20 MGD water treatment plant) during 1981-92 and a new canal dug during 1983-85. It is impossible to make clear the influence of these large scale changes without topographic maps. Topographic maps, however, were not available in this district.

So the author made a map survey and added some modifications on the plan based on cadastral map which was made at several decades ago.

## **II . Morphological characters of the two villages**

### **1 . Radhaballavpur**

The branch of Midnapore high line canal that flows from Kasai river to southern part of Calcutta crosses through a northern border of this village. The settlement expands from the embankment of this canal to the south about 1 km long.

Five geomorphic profiles were measured and the soil on highland was sampled. The geomorphic profiles are shown in Figure 3. The locations of profiles and sampling spots are shown on the map of the village (Fig. 2).

In this village, the highland expands alike the settlement from the north to the south. In the northern part, the highland is lower and narrower in width. The relative height that is a height from the adjacent paddy field is from a little under 50 cm to a little over

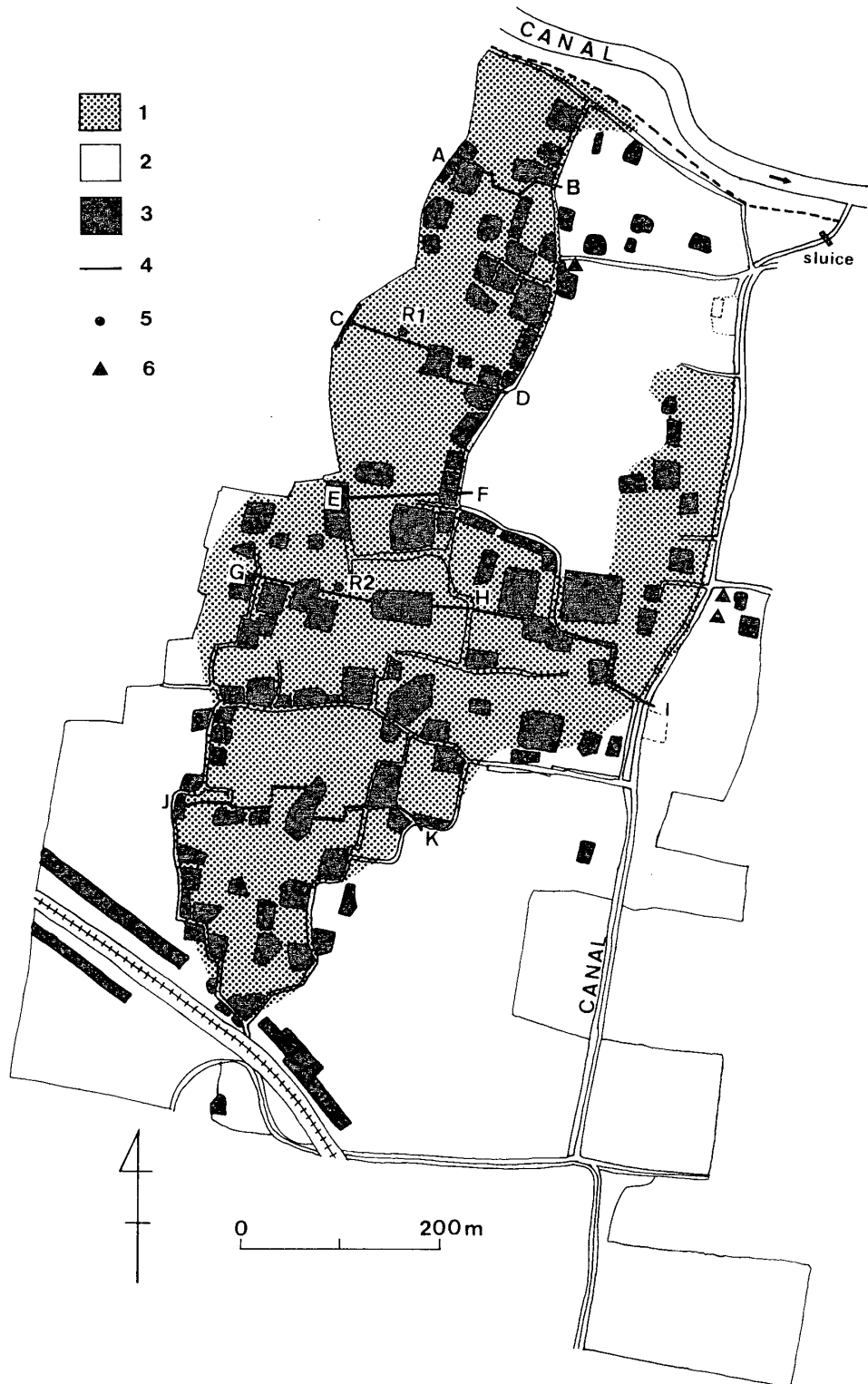


Fig. 2 Locations of tanks and geomorphologic profiles in Radhaballavpur  
 1 densely settlement area (highland)      4 position of geomorphologic profile  
 2 paddy field (lowland)                      5 spot of soil sample  
 3 tank    6 spot of tank and base of house surveyed

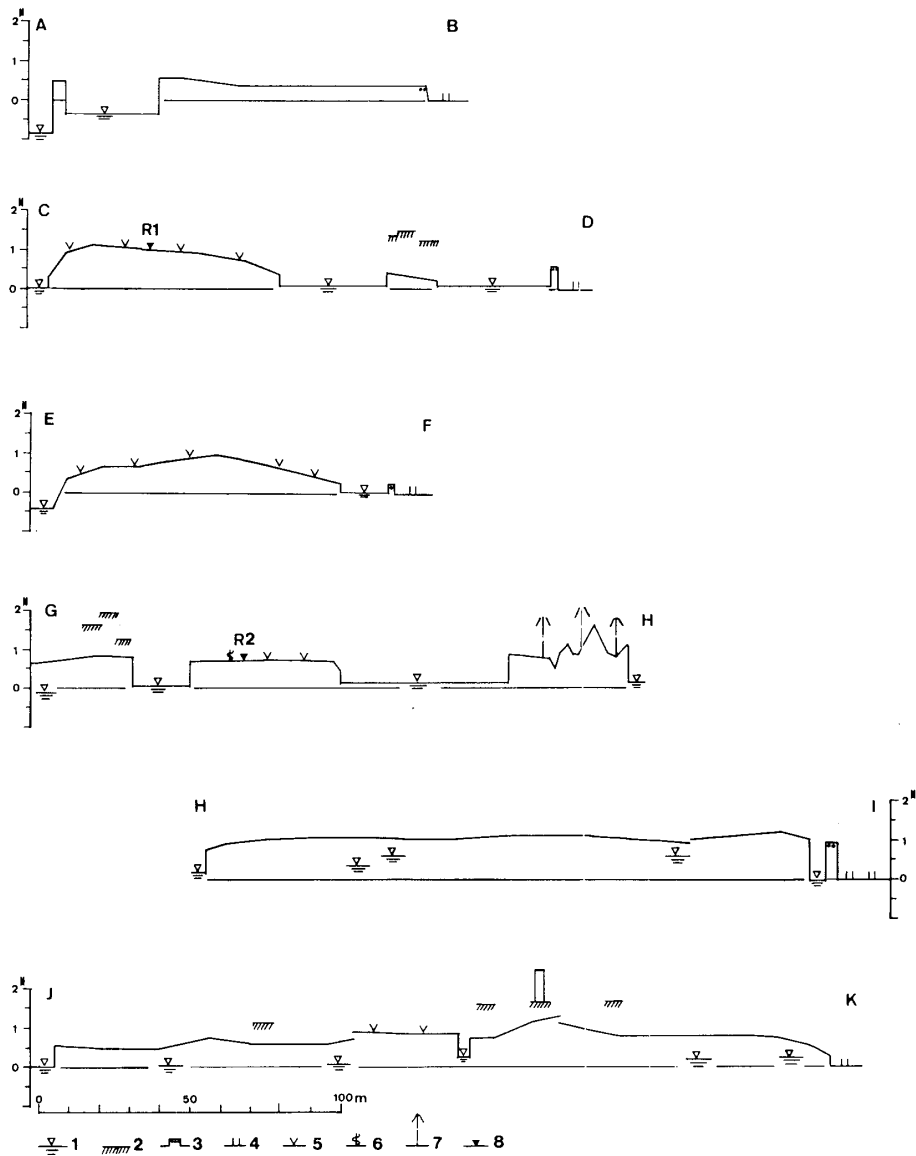


Fig. 3 Geomorphic profiles of Radhaballavpur

- |                         |               |                       |
|-------------------------|---------------|-----------------------|
| 1 water table           | 4 paddy field | 7 bamboo              |
| 2 base of house         | 5 field       | 8 spot of soil sample |
| 3 cross section of road | 6 betel field |                       |

1 m. In the central part, the width of highland is over 400m, and highland has a flat surface of whom the relative height is about 1 m. In the southern part, the highland is lower, and the relative height is from about 50cm to almost 1 m on maximum.

In the southernmost part where is a railway, the highland is lower and narrower, and the relative height is almost equal to the paddy field. The small canal flows from the south to the north, and joins the north canal at a small sluice. Because the ground is

scarcely inclined to the south, the overland flow drains off to this small canal.

The central part on highland is higher than any other part, and its surface is flat and continues widely. Its land use consists of houses, tanks, fields, orchards and bushes. In the central part of the highland, the shallow water way which is presumably used for irrigation distributes itself on all sides.

According to these conditions, it is considered that this highland was formed by natural agency like a natural levee in delta or the limited mound of uplifted tidal flat. These surfaces of highland are well drained and prevent a flood. On the contrary, these surfaces occur a deficiency of water and crops often suffer from a drought.

On the other hand, on the marginal portion of highland near paddy field, the relative height is gradually lowered, and in particular, the houses and tanks are distributed densely. As mentioned later, almost bases of houses on this portion are heaped up with earth which is dug up from tanks.

For these reasons, the main body of this highland is a natural levee or limited upland in a tidal flat, and marginal portion consists of a natural landform and a man-made mound.

## **2. Tentleberia**

Tentleberia is bounded on the north by Hugli. Hugli has the wide range of tide (3-6 meters at Calcutta). It was observed that the small tidal bore occurred in Hugli. Because of these, although the embankment is made solid, it is eroded respectably.

The village is surrounded by the embankment of Hugli in the north, that of the canal in the east whose width is 100 m, and that of the small canal in the south whose width is 5 - 6 m. The relationship between the embankment and lives of villagers is important.

Three geomorphic profiles were measured and the soil on highland was sampled. The locations of profiles are shown on the map of the village (Fig. 4). The profiles are shown in Fig. 5.

The highest point in this village is the top of the embankment of Hugli. The relative height near paddy field is 3.8 m. Because the ground is scarcely inclined to the south, the overland flow drains off the southern small canal.

The area whose relative height exceeds 1 m is comparatively narrow. Shown in the geomorphic profiles, on the continuous highland the east-west is 300 m wide and the

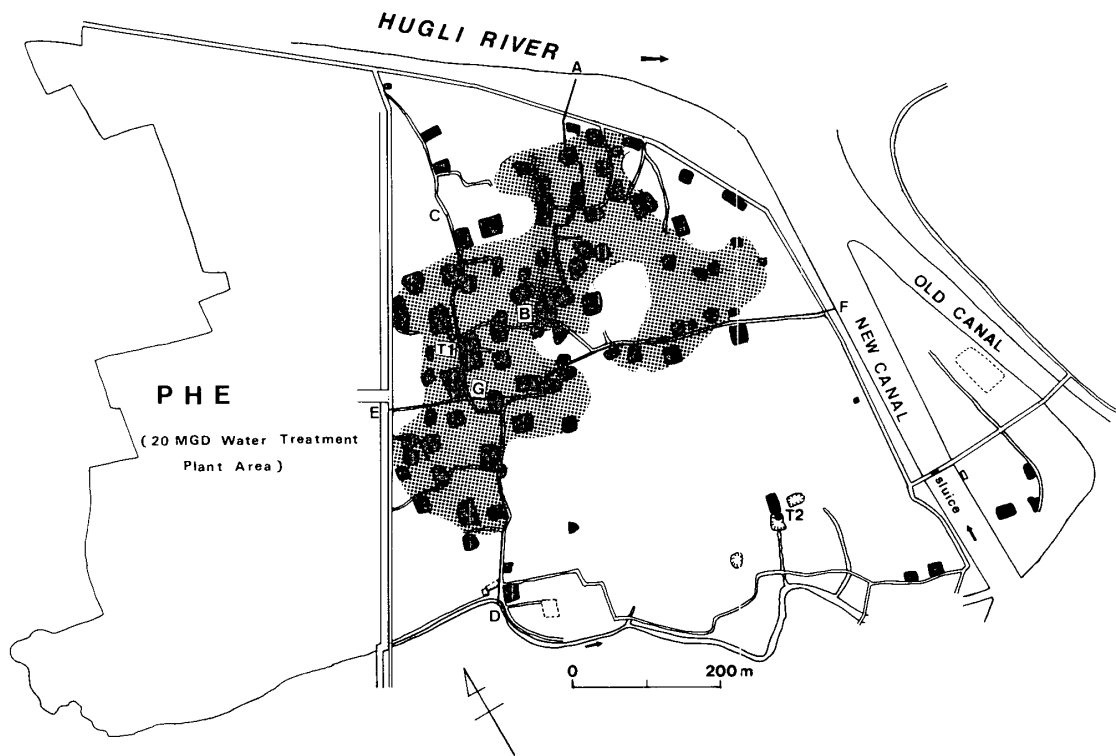


Fig. 4 Locations of tanks and geomorphologic profiles in Tentleberia  
\* illustration indices are same of Fig. 2

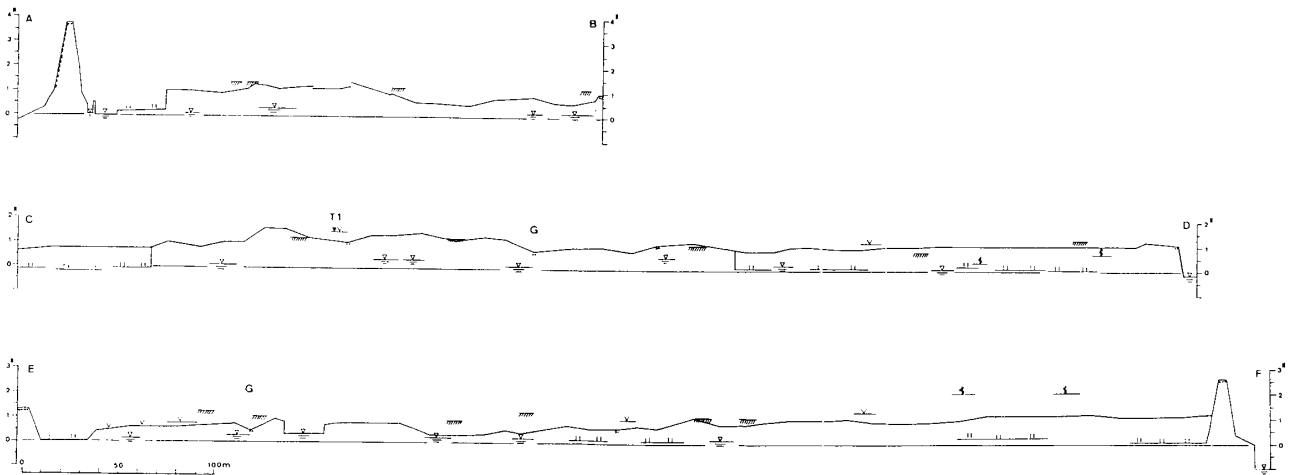


Fig. 5 Geomorphologic profiles of Tentleberia  
\* illustration indices are same of Fig. 3

north-south is 200 m wide. This highland where houses, tanks and fields are densely located forms an irregular shape.

Almost all the village is lower than high tide level. According to the observation of Landsat satellite image, an old channel extends between Tamruk and Mahishadal.

Therefore, it is considered that the landform of this village is the uplifted or emerged tidal mud flat. The settlement is located mainly on limited upland in the tidal mud flat. The bases of houses are heaped up with earth which is dug up from tanks. On the other hand, it is considered that the landform of eastern channel is an uplifted or emerged fairway.

All samples of soil are classified in light clay. In comparison with Radhaballavpur (R1 and R2), the grain size of Tentleberia is finer (Fig. 6). The color of dry soil in Tentleberia (T1 and T2) is light gray and in Radhaballavpur (R1 and R2) is grayish yellow.

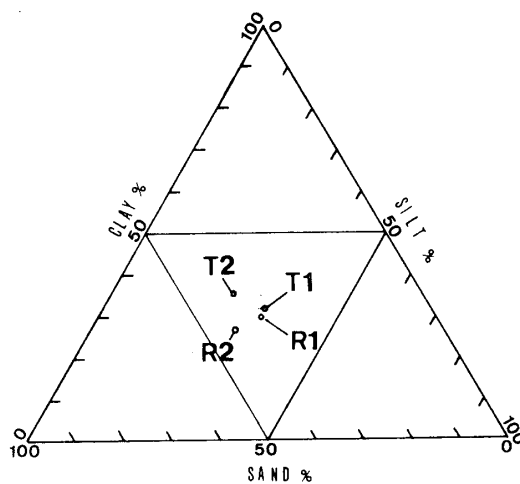


Fig. 6 Composition of soil

### III. Estimating the shift of earth

According to our questionnaire, 97 tanks are private in Radhaballavpur, and 78 tanks in Tentleberia. From the map and our field work, there were 116 tanks in Radhaballavpur, and 90 tanks in Tentleberia.

The total area of tanks accounts for 26 - 27 percent of the highland. The tanks are used for bath, washing bodies, clothes and dishes, irrigation, fish farming, and so on. Therefore no one can do without tanks in this district.

In this area it is necessary to prevent the houses from flood in the rainy season and from a storm tide, therefore the bases of houses are uplifted with earth. In the same reason, almost all railways and roads have tanks on a parallel with them. Because this area is extremely flat and is muddy, it is difficult to get stone and sand nearby. So almost all villagers get the earth from tanks. The higher class villagers get bricks,



sand and stone far from here.

The author estimated an amount of earth that was dug up from tanks and an amount of work digging tanks (Table 1, Fig. 7). On average the depth of tanks is estimated 1.5m. As a result, in Radhaballavpur the total amount of earth that was dug up from tanks, is 94,275m<sup>3</sup>. If this amount of earth were heaped up on the highland except for the tanks' area, its height would have increased by 55cm. The laboring amount per person per day is estimated to be 1.5m<sup>3</sup>. The total laboring amount is estimated to be 62,850 days per person (or about 21 years by 10 persons).

In the same way, the total amount of earth is 48,285m<sup>3</sup> in Tentleberia, its height would have increased by 52cm. The total laboring amount is estimated to be 32,190

Table 1 The estimation of amount of earth of tanks

Radhaballavpur		total	highland	lowland
area	m <sup>2</sup>	561,240	234,050	327,190
number of tanks		116 <sup>1)</sup>	94	19
total area of tanks	m <sup>2</sup>	77,560	62,850	6,960
total volume of tanks <sup>2)</sup>	m <sup>3</sup>	116,340	94,275	10,440
total amount of work/person <sup>3)</sup>	days	77,560	62,850	6,960
total amount of work/10persons <sup>4)</sup>	years	25.9	21.0	2.3
mean area/tank	m <sup>2</sup>	669	669	366
mean volume/tank	m <sup>3</sup>	1,003	1,003	549
mean work/person/tank	days	669	669	366
mean depth of earth	cm	24.1	55.1	3.3
Tentleberia		total	highland	lowland
area	m <sup>2</sup>	883,440 <sup>5)</sup>	124,350	388,070
number of tanks		90	67	23
total area of tanks	m <sup>2</sup>	40,320	32,190	8,130
total volume of tanks <sup>2)</sup>	m <sup>3</sup>	60,480	48,285	12,195
total amount of work/person <sup>3)</sup>	days	40,320	32,190	8,130
total amount of work/10persons <sup>4)</sup>	years	13.4	10.7	2.7
mean area/tank	m <sup>2</sup>	448	480	353
mean volume/tank	m <sup>3</sup>	672	721	530
mean work/person/tank	days	448	480	353
mean depth of earth	cm	7.2	52.4	3.2

Notes: 1) Including 3 tanks for railway

2) Mean depth of tank = 1.5m

3) Mean work load = 1.5m<sup>3</sup>/day/person

4) 1 year = 300 laboring days

5) Including PHE (339,540m<sup>2</sup>) and excluding new canal (31,480m<sup>2</sup>)

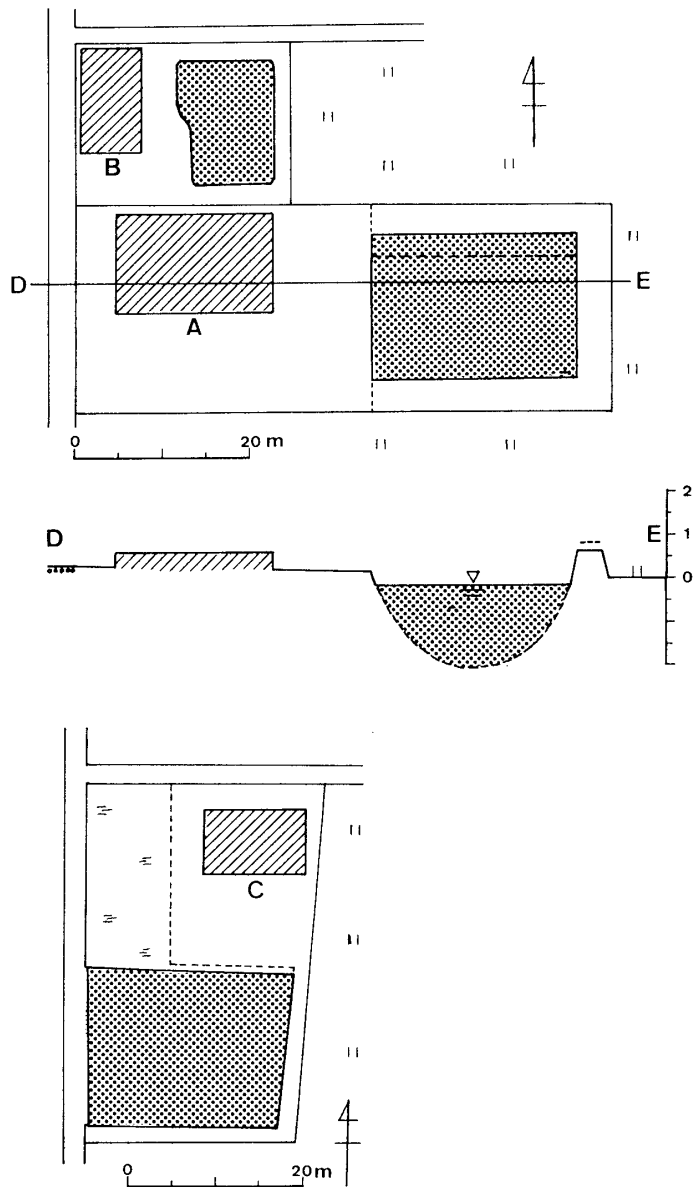


Fig. 7 Plan of tank and base of house

days per person (or about 11 years by 10 persons).

In this district flooding in the rainy season is shallow (well drained area), and the depth of the flood is below 1 m. Therefore the height of bases of many houses in two villages is higher than the annual flood height by twenty to fifty centimeters.

#### IV. Concluding remarks

The morphological characters of these two villages can be summarized as follows:

1) The settlements in Radhaballavpur are located on highland that is a natural levee or limited upland in a tidal flat. The marginal portion of the highland is consists of a

natural landform and the man-made mound which is heaped up with earth from tanks.

2) The landform of Tentleberia is the uplifted or emerged tidal mud flat. The settlement is located mainly on limited upland in uplifted or emerged tidal mud flat. The bases of houses are heap up with earth which is dug up from tanks.

3) In this area the significance of tanks' existence is extremely important.

The total area of tanks accounts for 26 - 27 percent of the highland. In Radhaballavpur total amount of earth that was dug up from 94 tanks, is estimated to be 94,275 m<sup>3</sup> and in Tentleberia 48,285m<sup>3</sup> (68 tanks). This amount of earth is equivalent to heap the highland up 55 cm in Radhaballavpur and 52 cm in Tentleberia.

The total laboring amount in Radhaballavpur is estimated to be 62,850 days per person (or about 21 years by 10 persons) and in Tentleberia 32,190 days per person (or about 11 years by 10 persons).

In these two villages the large quantity of earth shows that the greater part of the highland is heightened by a human work for a long time.

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