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海岸林学会誌 (*Journal of the Japanese Society of Coastal Forest*) 5(1) : 7－12, 2005

A Study on a Feng Shui Village and Layout of Habitat Embracing trees in Okinawa (I)

——A case study of Tonaki Island ——

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Abstract: Circled with *Garcinia subelliptica* habitat embracing trees on the property, houses in Tonaki Island are mostly south facing, which forms an ideal feng shui village structure. We observe that forest belts in the northern and eastern borderlines are much thicker than those inside the village, which is greatly attributed to the strong cold northern wind in winter and the destructive eastern wind during typhoon season. Stand trees of well-kept houses are arranged in a two storied structure, while trees around 2m in abandoned residences are an overwhelming majority. Tree density in well-kept houses is higher than that in abandoned houses. Seedling ratio for abandoned houses is bigger than that of well-kept houses, while it is opposite for sprout ratio. It is assumed that well-kept habitat embracing woodlands have been cleaned from time to time to weed out fallen ripe fruits and unwanted seedlings, while trees in the abandoned houses have not been maintained for a long time and forests have returned to a nearly natural situation.

Keywords: Feng Shui village, Tonaki Island in Okinawa, Fukugi habitat embracing trees

I. Introduction

On the Okinawa Islands, *Garcinia subelliptica* (Fukugi in Japanese) has been widely planted to encircle the houses and village to achieve a relative shelter on these small islands. *Garcinia subelliptica* plays a vital role as a windbreak and tidewater control forest in coastal regions. This unique landscape came into being during the Ryukyu Kingdom Period and is still well preserved on some islands today. Feng shui, first originated in Mainland China, was applied to establish traditional Ryukyu villages and in tree planting surrounding the villages, habitats, and around some key points the villagers named "Feng shui Spots." Inside the village it was strongly promoted in order to enclose the essential Living Energy. As is well-known, the Ryukyu Islands are constituted of lots of small islands, where the natural climate is somewhat inclement with frequent Typhoon occurrence. The flat topography provides little protection from the strong northerly wind in winter. It is obvious that the widely planted *Garcinia subelliptica* plays a vital role in shaping inhabitable shelter in Okinawa. At present, such habitat embracing tree landscapes only exist in scattered distribution on the Okinawa islands. In particular during the World War II, Okinawa became a battlefield and forests, including large areas of *Garcinia subelliptica* were cut and burned during the battle. Only habitat embracing trees in Bise village in the northern area of the main island of Okinawa and Tonaki Island are still in existence in a well preserved state. This paper focuses on Tonaki Island as a case study area. Bise Village will be focused on in later studies.

Previous studies (Nakamatsu 1963; Machida & Tsuzuki 1993; Shinjo 1993) based on document reviews show that currently existing ancient villages were built during the 18th century under the guidance and policy of the Ryukyu Kingdom and the direct instruction of feng shui masters to achieve a sound habitat environment. Tree planting named embracing forests was highlighted as one of the important factors in shaping a good feng shui village (Tsuzuki 1997). Recent studies on Tonaki Island on the compass direction of houses and wind direction (Sakamoto 1989; Paku & others 1997) show that most houses face south to welcome cool summer wind and keep the cold winter wind out. However, studies on the actual structure of habitat trees of *Garcinia subelliptica* in Okinawa islands are still rare.

The original purpose of this study is to present the actual layout and structure of residences and habitat embracing trees in a feng shui village. Tonaki Island is one of the best preserved sites of *Garcinia subelliptica* next to Bise village and accounts for 60% of the houses that are encircled with trees (Sakamoto 1989). With the rare well-kept habitat woodland, Tonaki Island is an ideal survey site to primarily comprehend how feng shui has been applied to build the habitat embracing trees and provides us a point for further comparative studies of the whole Okinawa Islands region.

II. Study area and study method

Tonaki Island is located at lat. 26° 22'N. and long. 127° 8'E., and is 58km northwest of Naha City (Fig.1). It has an area of 3.74km^2. Tonaki Island was originally separated into two islands but the accumulation of sand between the two islands has joined the two islands making it one. There are two hills on the island that have an elevation about 200m above sea level. They are located on the northern and southern sides of the island respectively. All residences extending from the east coast to the west port are clustered together in the small narrow plain between these two high hills. Tonaki Village is the second smallest village in Okinawa prefecture with a population of 502 in 2003. Since the 20th century, skipjack fishing has been the

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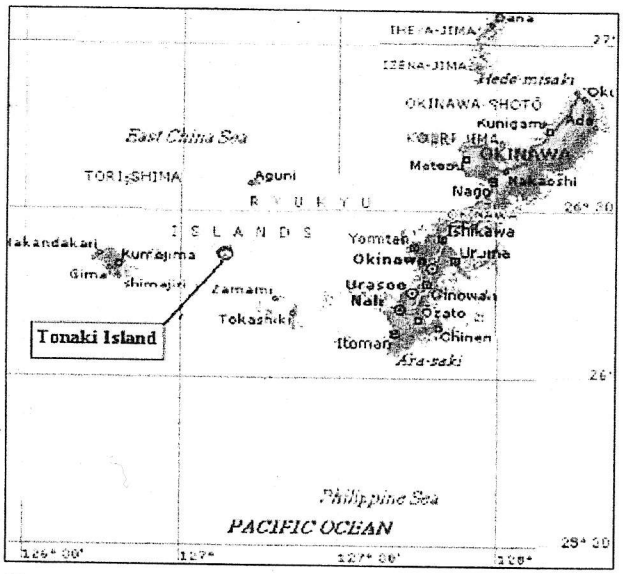

Fig.1: Location of Tonaki Island

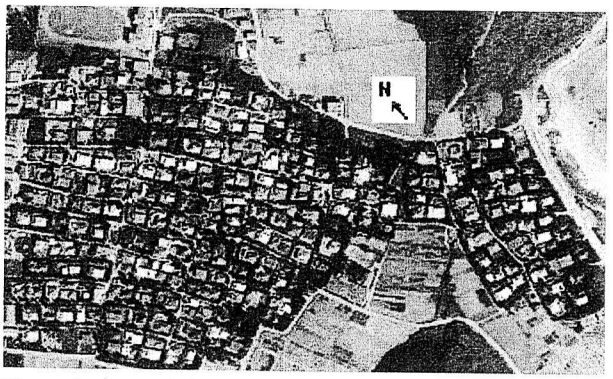

Photo 1: An aerial photograph of Tonaki village

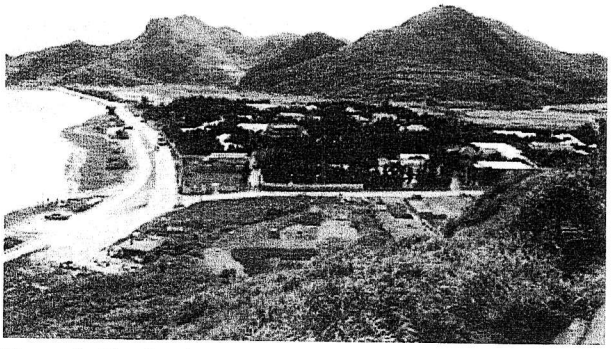

Photo 2: The landscape of Tonaki Village

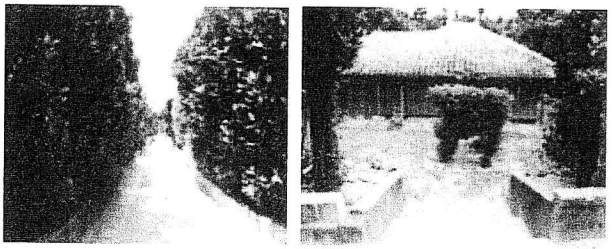

Photo 3: Habitat embracing tree lines along village roads (left) and their views from the entrance to the house (right)

main industry and coastal fishing is also popular. While millet is the most common agricultural product grown on this small island, various vegetables are also planted for self-consumption.

As shown in photo 1, the village houses are lined up in the center of the narrow plain with the roads traversing from east to west and north to south. Green *Garcinia subelliptica* forest belts surround the periphery of the village and encircle most of the houses inside the village to shape a unique village landscape. (see Photos 2, 3).

All residences in the village were built about 70cm lower than the traverse roads. First sandy soil was excavated when building the house in order to protect them from the frequent Typhoons on this small island. The excavated sand was used to make fences around the residences and then *Garcinia subelliptica* were planted in the sand fences (A record of the history of Tonaki Island Village, 1983). The long years of cultivation of these trees has resulted in the present pleasant habitat embracing tree landscape.

The ancient village was first set up on the eastern side of the island and extended to the west as the population increased. It is easy to see that the houses are newer and some concrete houses are scattered about instead of the traditional timberwork houses. The trees around the houses in the west part of the village are younger and fewer than the east part of the village. We chose seven houses in the east part of the village as our survey sites based on the assumption that habitat embracing trees were planted in accordance to traditional feng shui belief many decades ago and have been cultivated and managed to achieve an ideal habitat environment harmonizing human existence and nature. The survey houses include House No. 1877, 1952, 1943, 1944-1, 1953 and 1816 and were labeled from No. 1 to No. 7 (see Fig.2) respectively in order to make the following analysis easier to understand. All seven selected houses are located inside the village except No. 5, which is located on the east coast.

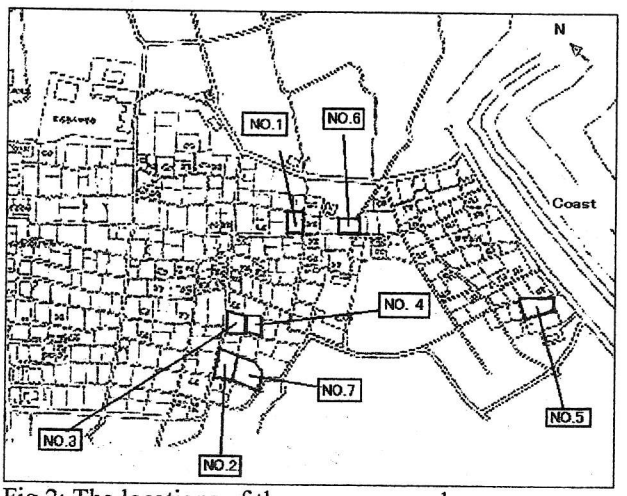

Fig.2: The locations of the seven survey houses

In order to comprehend the actual stand structure of habitat embracing trees, first every stand tree taller than

1m was numbered and then height and diameter at breast height (DBH) were measured and recorded. The numbers of sprouts and seedlings were also counted to analyze tree regeneration. Sprouts refer to those from the rootstock of trees taller than 1m and from stumps. Small trees less than 1m were counted as seedlings.

The aerial photo (see photo 1) shows the general distribution of habitat embracing trees. Figures drawn with CAD software (HO CAD Version 2.61) reproduce the actual structure and distribution and relative scale of stand trees of the sampling sites.

III. Result and Discussion

3.1 General layout of habitat embracing trees

From the aerial photo (Photo 1), we can observe that forest belts in the peripheral borderline are much thicker than those inside the village, in particular for those adjacent to the wide open plain in the north or exposed to the eastern coast. Such a forest belt layout is greatly attributed to the strong cold northern wind in winter and the destructive eastern wind during Typhoon season. Okinawa is dominated by typical monsoonal climate characterized with strong cold and dry northeasterly wind flows during winter and moist cool southwest winds during the summer. The period from July through to the end of October is known as the "typhoon season". Westerly winds are weak. They typically convolve around the islands of Okinawa for several days whereby they normally re-curve into very strong winds of great destruction. As Figs. 3 and 4 show, forest belts in northern line are twofold, while the other three sides are single line and thinner. Fig.5 shows the houses located next to the east coastline; thus, the eastern forest belt is very thick, while other sides are thinner due to the strong easterly winds that prevail during typhoon season.

3.2 General layout of residences

In order to present the real layout of residences and the compass direction of houses, figures (see Figs.3, 4, and 5) were drawn based on the village map with HO CAD software. The locations and the size of DBH of all

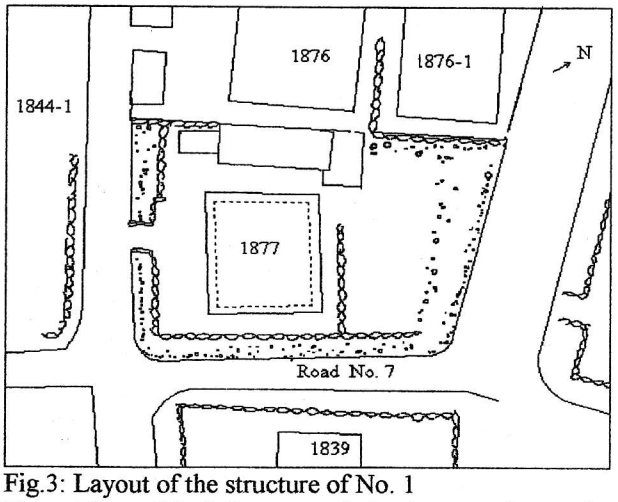

Fig.3: Layout of the structure of No. 1
Note: The solid circles around the house refer to the distribution of all stand trees

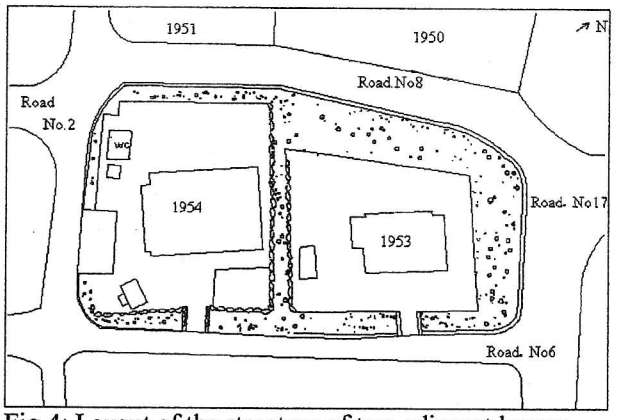

Fig.4: Layout of the structure of two adjacent houses of Nos. 2 and 7

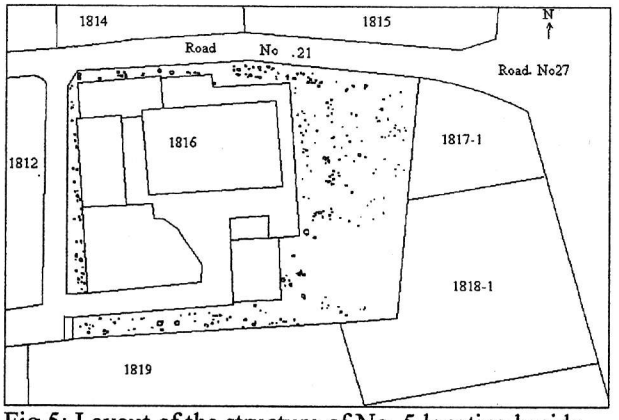

Fig.5: Layout of the structure of No. 5 locating beside the seashore at East

stand trees taller than 1m in the sand fence were measured and then plotted in a sketch map of every survey house to present a real picture of tree distribution and magnitude in the residence. Figs. 3, 4 and 5 were selected here to present the typical patterns of layout of houses in the village. The usual pattern is that two (see Fig.4) or more adjacent houses form a residence unit. Thus, there are always tree lines on one to three sides that are common with the neighboring houses, while the tree line in the south is always open to the road. It is worthy noting that perhaps trees on all sides have been originally planted in a certain density, however, the remaining forest belt on common sides is usually deplete. On the western side of the residence in particular only a short tree line remains (i.e. No. 1 see Fig.3) or the tree line totally disappears probably due to the change of lifestyle that has seen residents building wells, bathrooms and toilets on the western side of the houses.

Besides the above-mentioned elementary layout pattern of habitat trees that states that tree lines in the north are much thicker than the other sides, No. 5 (see Fig.5) represents an exceptional case in that the forest belt in the east is especially thicker to protect the residence from the strong easterly winds during the typhoon season.

Instead of relative diverse distribution of habitat embracing trees, most houses, 96 of the 103 (in 1987)

are facing south and with their back to the north, which is consistent with an ideal compass direction for a good feng shui house (Sakamoto 1989). Despite all the seven houses we surveyed facing south, the entrances to the residences is not always in the south due to the layout of rock fences and the location of surrounding roads. For example, No. 5 (see Fig.5) has the entrance in the west. But, the figure also shows that there is a big open space in the front of the house to welcome sunlight and warm wind from the south.

In a word, houses are always facing south with their backs to the north. On Tonaki Island, the *Garcinia subelliptica* habitat embracing forest belts in the northern and eastern borderline of the village are much thicker. Such a layout in the compass direction of houses and the structure of habitat embracing woods have been arranged to correspond to the natural conditions on Tonaki Island to block off the strong northern monsoonal wind, formidable revolving easterly winds in typhoon season. Lighting in the grounds of the houses is also emphasized.

3.3 Features of habitat embracing trees

Due to transportation inconvenience and inclement natural climate, small island inhabitants have immigrated to the mainland of Okinawa and some houses have been abandoned and the embracing woods left uncared for. It is not rare that owners of newly built concrete houses with embracing trees trim the embracing trees for the reasons such as difficulty in cleaning fallen leaves and the pungent smelling fruits that litter the grounds. Thus, how to manage the habitat woods becomes an urgent issue to maintain the typical feng shui village landscape. In order to understand the appropriate maintenance for *Garcinia subelliptica* habitat wood, data collected at each survey site was split into two types, which represent well-kept and abandoned forest belts respectively (See photo 4). It is supposed that well-kept house owners have planted the trees in accordance with feng shui tradition and maintained and kept an appropriate regeneration of the forest belts around the house to achieve a proper density and a pleasant living environment. While, abandoned houses refer to those deserted by the house owners over the past years or those that embracing trees are still too young to have proper management including thinning or selective cutting. Our survey House Nos. 1, 2, 3, and 4 are included in the former while Nos. 5, 6, and 7 in the latter type. Nos. 6 and 7 are houses totally deserted. While habitat embracing trees in No. 5 were assumed to be planted about 40 years ago which make them relatively young and in particular the eastern side is predominantly small trees. Thus No. 5 is also concluded to be an abandoned house.

Figures of frequency distribution curves for Height and DBH of trees taller than 1m (see Fig.6, 7) were created to observe the difference in the stand structure for well-kept and abandoned habitat trees. From table 1, we can see that mean value and standard deviation of Height for total samplings, well-kept house trees and abandoned house trees are 399.1cm, 234.6cm, 432.6cm

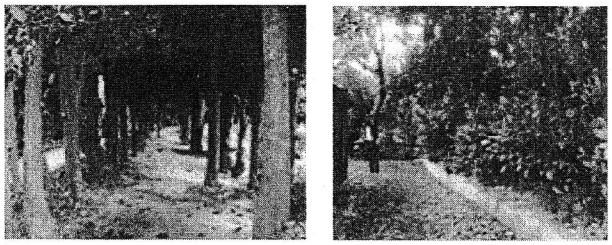

Photo 4: Well-kept (left) and abandoned forest belts (right) in the houses

Tab.1: Descriptive data for trees

	Total trees (cm)	Wk. Trees (cm)	Ab. Trees (cm)
Mean of Height	399.1	432.6	376.4
Std. Dev. of Height	234.6	193.7	256.7
Mean of DBH	9.6	10.6	8.9
Std. Dev. of DBH	8.2	7.3	8.7

Note: Wk. refers to Well-kept habitat embracing trees.
Ab. refers to abandoned habitat embracing trees.

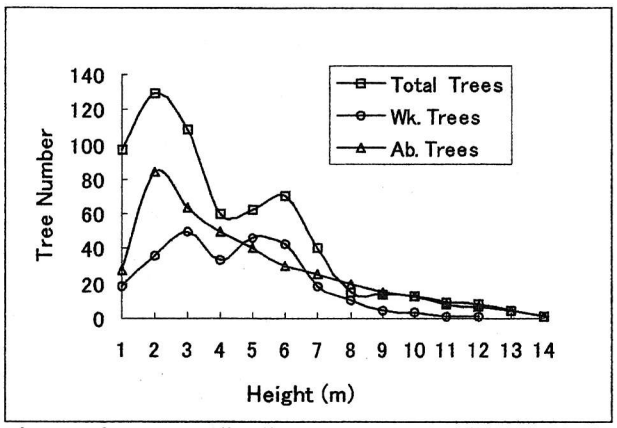

Fig.6: A frequency distribution curve of Height of Habitat Embracing Trees

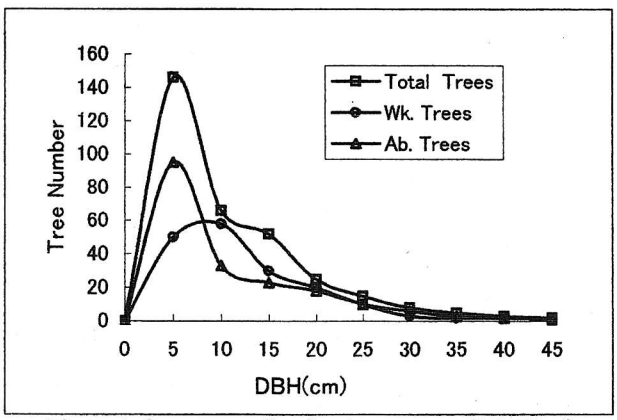

Fig.7: A frequency distribution curve of DBH of Habitat Embracing Trees

and 193.7cm, 376.4cm and 256.7cm respectively. Mean value and standard deviation of DBH for 3 groups are 9.6cm, and 8.2cm, 10.6cm and 7.3cm, 8.9cm and 8.7cm respectively (see Tab.1). From Figs. 6 and 7, we can see that tree height of well-kept house trees mostly vary

from 2m to 7m. While, trees around 2m for abandoned houses are an overwhelming majority. Fig.6 shows that the frequency distribution of the height of the total data has two peaks due to distribution of well-kept habitat trees. Well-kept habitat trees show two frequency peaks around 3m and 5.5m respectively. Based on the above mentioned supposition, we know that those well-kept house owners have cultivated the forest belts into two layers when the first planted trees have grown to a certain height, some mature trees were cut for various uses such as building houses, and at the same time saplings and new-born sprouts were kept to grow up into the lower storey of the forest belt. That the majority of trees in abandoned houses are around 2m shows that small trees occupy the deserted forest belt where no selective cutting or cleaning has been arranged and that seedlings have grown up and formed a clustered lower storey.

Accordingly, Fig.7 shows that DBH of trees for well-kept and abandoned houses are concentrated around 10cm and 5cm respectively. For trees with a DBH greater than 15cm, the frequency is similar for both well-kept and abandoned houses. With selective cutting and periodic cleaning of the residence, trees of well-kept houses have reached a certain magnitude with a majority of DBH at 10cm. However, in the abandoned residences, clustered lower storey trees are found and without maintenance of the habitat for a long period the forest has nearly returned to its natural state.

Fig.8 shows the strong correlation between height and DBH for trees taller than 1m (R=0.703).

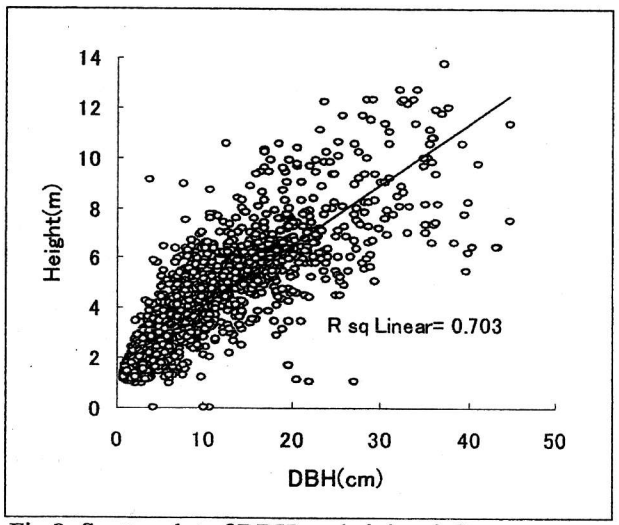

Fig.8: Scatter plot of DBH vs. height of all survey trees taller than 1m overlaid with the fitted line

3.4 Tree density

Stand density of habitat embracing *Garcinia subelliptica* woods is also given to present the actual distribution of woods in the residence. Estimation of stand density is defined as a ratio of the number of trees per unit area. We calculated the total number of trees taller than 1m and the total area of sandy woodlands inside the rock wall fences for each survey house. Stand density was measured as 1.9, 1.8, 1.5, 1.3, 1.2, 1.2 and 1.5 trees per m^2 for houses from No. 1 to No. 7 (see Fig.9). We can read from the figure that density ranges from 1.2 to 1.9 for all survey trees. As mentioned above, Nos.1 to Nos. 4 are defined as well-kept houses and Nos. 5 to Nos. 7 are abandoned houses. We found that density for abandoned houses is comparatively lower than well-kept houses due to the enlargement of the area of the sandy woodland (see Fig.4, 5) caused by some parts of the rock walls collapsing and the trees sprouting in the grounds of deserted residences. For No. 1 and No. 2 (see Fig.3, 4), trees are lined up in an orderly fashion inside the sandy woodlands and thus the woodland areas are relatively narrow and still leave a wide space surrounding the houses. But density of House No. 3 and No. 4 is exceptionally low, only accounting for 1.5 and 1.3 respectively. That is perhaps because No. 3 has two common tree lines including that in the rear and the west line is very short. Except for the south tree line, No. 4 has three tree lines common with the adjacent houses. Density for common tree lines is relatively low due to the consideration of lighting and ventilation.

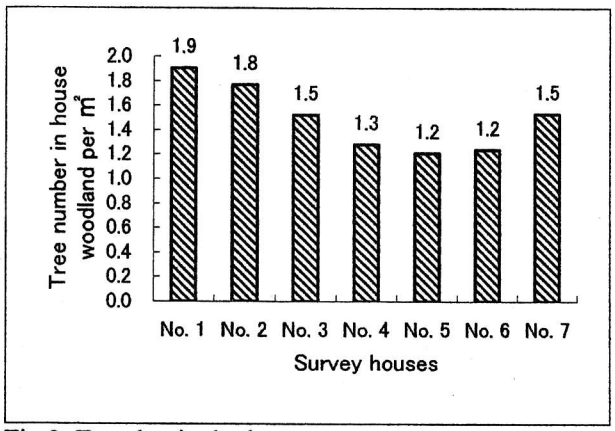

Fig.9: Tree density by house
Note: Tree density refers to number of trees taller than 1m in per m^2 of house woodland

3.5 Regeneration of habitat embracing house trees

Tree sprouts and seedlings (See Photo 5) were tallied in order to comprehend the regeneration management for habitat embracing trees. Sprouts from the rootstock were counted as the total number of sprouting. Tree seedlings (<1m height) were also counted to record seedling abundance. Ratios of sprouting and seedlings are calculated here to index the comparative magnitude of sprout and seedling numbers. Ratio of sprouting and seedlings refer to the index value of total number of sprouting and seedlings divided by the total stand tree number (≥1m height) respectively. In this paper, we totaled the numbers of sprouts and seedlings in all surveyed well-kept and abandoned houses respectively. The measurement results are shown in Fig.10. We can see that the number of seedlings in abandoned houses is much bigger than that of well-kept houses, accounting for 0.7 and 0.3 respectively. It is supposed that well-kept house owners have swept the house embracing woodlands from time to time to clean the

fallen down fruits and unwanted small seedlings were also cleared to maintain a ventilated lower storey. There are significantly more seedlings at the abandoned houses. This combined with the above-mentioned fact that stand trees lower around 1m-2m are the overwhelming majority, it is obvious that deserted woodlands have a thick lower storey in the absence of maintenance.

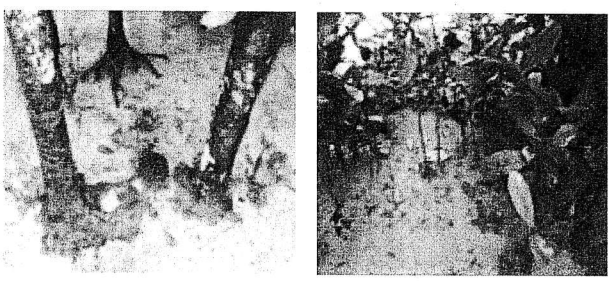

Photo 5: Sprouts grown from the stump (left) and seedlings less than 1m (right)

While, ratio of sprouts in well-kept habitat embracing woods is higher than the abandoned residences accounting for 1.9 and 1.5 respectively (see Fig.10), the difference is not so distinct. Sprouts can be divided into two types, one from the stumps and the other from the rootstock of stand trees taller than 1m. The former is connected strongly with regeneration, while it is difficult to tell any regeneration relationship for the latter. A higher sprout ratio for the well-kept houses shows that some mature trees have been selectively cut to build houses, which is why many sprouts are coming up from the stumps. It is suggested that well-kept residence woods have kept a good balance between the maintenance and utilization.

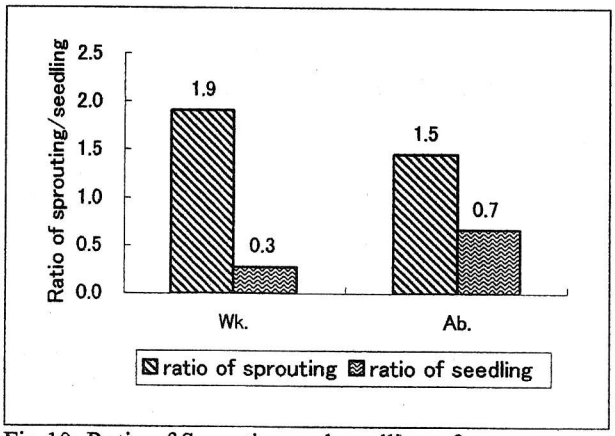

Fig.10: Ratio of Sprouting and seedling of trees
Note: ratio=number of sprouting or seedling÷number of trees taller than 1m

IV. Conclusion

We found that houses encircled with *Garcinia subelliptica* habitat embracing trees in the residence, are mostly south facing, which forms an ideal feng shui village structure on Tonaki Island. We observe that forest belts in the northern and eastern borderline are much thicker than those inside the village, which is greatly attributed to the strong cold northern wind in winter and the destructive eastern wind during typhoon season. In general, two or more adjacent houses transverse roads shape a habitat unit. Thus, usually there are one to three tree lines with the exception of the southern line that are common with the neighboring house.

Mean value and standard deviation of well-kept house trees and abandoned house trees are 432.6cm and 193.7cm, 376.4cm and 256.7cm respectively. Mean value and standard deviation of DBH for well-kept houses and abandoned houses are 10.6cm and 7.3cm, 8.9cm and 8.7cm respectively. Stand trees for well-kept houses appear as two storied structures with two frequency peaks around 3m and 5.5m, while trees around 2m in abandoned residences are an overwhelming majority. DBH for the majority of trees in well-kept and abandoned houses are 10cm and 5cm respectively. The difference in the distribution of trees in the two types suggests that trees have been selectively cut for several uses when the forests became mature and seedlings have been cultivated into a lower story in the well-kept house woodlands. It appears that there has been no thinning or cleaning arranged in the past decades in those abandoned house embracing trees.

We found that tree density in well-kept houses is higher than that in abandoned houses. Because trees in well-kept houses are lined up in an orderly fashion inside the sandy woodlands, the woodland areas are relatively narrow and leave a wide space surrounding the houses. Abandoned residences have a relatively lower density due to an expanding woodland area with the desertion of the residence and collapse of some rock walls. Seedling ratio for abandoned houses is higher than that of well-kept houses, while it is opposite for sprout ratio. It is assumed that well-kept habitat embracing woodlands have been cleaned from time to time to weed out fallen ripe fruits and unwanted seedlings, while trees in the abandoned houses have not been maintained for a long time and the forests have returned to a nearly natural state.

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[Received June 10, 2005 Accepted December 20, 2005]