# Suitable Habitat and Environmental Conditions for Successful Edible Bird Nest Swiftlet Houses

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**Abstract.** Many entrepreneurs are very interested to start Edible Bird Nest (EBN) production. However, many of them lack knowledge in suitable habitat and environmental conditions for EBN swiftlets. They suffered losses because they are not concerned about providing the management of the suitable habitat and environmental conditions before building their EBN swiftlet house. This study aimed to identify and establish the list of habitat and environmental conditions for successful of edible bird nest swiftlet ranching. This study comprised of interview questions and field study. Questionnaires were distributed 100 players in EBN industry in Terengganu. For the field study, air and surface temperatures, relative humidity, light intensity, and sound level were recorded in nine EBN swiftlet houses in three different areas, the forested, the coastal and the town areas. From the questionnaires, we found that the most popular area (67%) to build EBN swiftlet houses was the forested area. This was followed by, the coastal area (26.7%) and town area (6.7%). Based on field study results, forested areas were the best and most productive to build EBN swiftlet house. The mean EBN and individual swiftlet population from the different areas were as follows: 78 nests and 263 individuals in forested, 51 nests and 133 individuals in the coastal and 25 nests and 65 individuals in the town area. From the environmental parameters collected it was shown that houses built in the forested area had the most suitable range for swiftlet adaptation. Air and surface temperatures were 31$^{o}$C, relative humidity was 82%, light intensity 0.16LUX, sound level 50dB (internal) and 65dB (external). The results showed that EBN production was significantly higher in swiftlet houses with suitable habitat and environmental conditions. In the management of swiftlet houses, only suitable habitat and environmental conditions can be assured to be productive and profitable ranching venture swiflet.

## INTRODUCTION

Edible Bird Nest (EBN) swiftlets are birds similar, but not closely related to, house swifts and swallows [1]. They have short, almost rudimentary legs and thus are definitely not ground birds [2]. They do not land on the ground or perch on wires like many other birds but cling vertically on surfaces or their nesting planks [3]. Currently, there are 24 species of swiftlets recorded in the world [4]. They are insectivorous, which feed on flying insects like hymenopterans and dipterans [5]. Swiftlet is believed to drink while flying [6], and originating from the Apodidae Family. This refers to a mixed-group of small-sized swifts [6]. The five most common species of swiftlets found in Malaysia and Borneo Island are *Hydrochus gigas*, *Collocalia esculent* (White Belly Swifts), *Cypsiurus balasiensis* (Asian Palm Swift), *Aerodramus maximus* and *Aerodramus fuciphagus* [4]. However, only EBN from *Aerodramus fuciphagus* is commercially harvested [7].

All over the world, the nests of these four species of swiftlet are widely harvested for human benefit [8]. These species produce 'White-nests', namely the Edible Nest Swiftlet (*Aerodramus fuciphagus*), Germain's Swiftlets (*Aerodramus germani*), the nest made almost entirely from saliva, *Aerodramus maximus* has which is made up about 10% of feathers [9], and the fourth nest is called *Aerodramus unicolor* are the mixture of feathers and some

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vegetation. The shape, positioning, and structure of the nests and the composition of materials used are distinctive of each species of swiftlet [6]. The birds use a glutinous secretion which is nest cement to bind together materials for nest building [10].

Swiftlet ranching promisses the potential to grow into a multi-million ringgit industry due to its relatively profitable, risk-return profile as well as a continuously growing demand for edible bird nests [11, 12]. The EBN swiftlets (*Aerodramus fuciphagus*) receives more attention nowadays as this species can produce EBN that possess high value in the international market [10]. Their natural nesting habitat is in limestone caves. EBN swiftlets are only found in the Southeast Asian Region [8]. Since approximately a hundred year ago, people of Java have been successfully ranching EBN swiftlets in man-made houses closely resembling their natural cave habitat [14]. Edible birds nests are very important in Chinese cuisine and medication [13]. They are both exotic or delicate food that can also be used as materials for physical strength enhancing medication [3].

The EBN swiftlets used to nest exclusively in caves [2]. As times go by, people started to put up building structures to create a cave-like atmosphere, conducive for the birds to built EBN away from caves [14]. These EBN swiftlet houses, as they are often referred to, were first set up close to the coast. However, as the bird population grows, they can now be found far inland [10].

Habitat and environmental factors are very important factors to be considered before building swiftlet house [15]. These factors should be taken seriously in order to prevent failure in swiftlet ranching [16].

Many entrepreneurs are interested to participate in EBN production, but they do not have sufficient knowledge in this area [13]. To be successfull in swiftlet ranching, in-depth knowledge about habitat and environmental are very important [17]. Being wild birds, EBN swiftlets are very sensitive towards conditions in their habitat and environmental. Conditions in their houses must be conducive for them to colonize and breed and should not be stressful to them. Failure to meet these two requirements will usually end up in failure. The successful EBN swiftlet operators have sufficient knowledge about swiftlet ranching [10].

Another important factor to consider is the location for a man-made habitat to build EBN swiftlet houses on [18]. This is to ensure that the houses will be fully colonized and the EBN producers will not lose money in their investment. Currently, the rate of success of EBN swiftlet ranching in Malaysia is just about 20-30% [19, 20]. Factors that have to be seriously taken into consideration before constructing EBN swiftlet houses [10] are the population congregation, feeding (garden, paddy-field, garbage collection), swiftlet track and easy-to-control swiftlet housing areas. If the EBN swiftlet population is too concentrated in one particular area, they will move to other less-crowded and more comfortable houses [21].

Furthermore, several factors must be closely controlled and monitored in order to create suitable environmental conditions to attract EBN swiftlets to come in and build their nests. Air (middle swiftlet house) and surface (wall swiftlet house) temperatures, relative humidity, air velocity, and light intensity are the most important factors in EBN swiftlet houses [4]. The inside of the house should be dimly lighted or preferably a complete darkness which provide similarities to the structure usually found in a dark cave. The main entrance, which is usually near the top of the structure, must be positioned in such a way to prevent direct sunlight entering deep inside the building [16]. Temperature ranging between 26 and 35 degrees Celsius are suitable for EBN production [4]. Temperature is controlled by ventilation in the buildings. This is often done by using L-shaped elbow pipes appropriately placed in the walls which allow air to flow in or out without admitting light. Humidity is also another very important factor in EBN swiftlet house [16]. Environmental very high in humidity can cause fungus built up and prevent EBN swiftlets from building their nests. On the other hand, low humidity causes nests not adhering to the wall surfaces. The best relative humidity in EBN swiftlet houses is in the range of 80 - 90% [16]. This can easily be controlled by installing a humidifier and construction of water pools inside the EBNswiftlet house [4].

## OBJECTIVES

To compare habitat and environmental conditions factors of three types of swiftlet houses in Terengganu and to establish the comparison of habitat and environmental conditions factors of three types of swiftlet houses in Terengganu.

## METHODOLOGY

This research was conducted in two research processes, namely through interview questions and field study. For the first research process, one hundred (100) EBN producers were interviewed. In the second part of the research process, field studies were conducted in nine swiftlet houses from three different areas namely, town, coastal and forested areas. The field study was conducted to measure environmental parameters such as air and surface temperatures, relative humidity, air velocity, and light intensity.

## INTERVIEW QUESTIONS

The interviews covered several issues related to EBN production and EBN production areas. Interview questions are used to explore the habitat and environmental factors of EBN production. The questionnaire was modified from 'Skim Amalan Ladang Ternakan' (SALT) for swiftlet ranching developed by the Department of Veterinary Services. Only those parts that are deemed relevant to this research were used. One hundred (100) EBN producers were interviewed to elicit the information on habitat and environmental factors of the industry.

## FIELD STUDY

The field study was conducted in nine swiftlet houses from three different areas (Kuala Terengganu, Marang, Setiu, and Dungun) in Terengganu with the highest swiftlet nesting houses. They included forested, town and coastal areas. Forested area refers to a large area of land covered with trees or other woody vegetation. Town area is an urban area consisting of cities and the region surrounding them. Most inhabitants of town areas have nonagricultural jobs. Coastal areas refers to the interface or transition areas between land and sea.

Equipment used in this research were Data logger thermometer (TES1315), to measure air (in middle swiftlet house) and surface (wall swiftlet house) temperatures; Thermal hygrometer (ATM, HT-92130) to measure relative humidity; Light meter (TES 1336A), to measure light intensity and finally sound level meter (TES 1351B), to measure sound level internal and external the swiftlet houses.

The equipments were placed in three different locations in each swiftlet house for data collection during the experimental works as recommended by Ibrahim *et al*. (2009). For identifying the environmental factors that affect habitat and environment in swiftlet houses, several different monitoring configurations were undertaken. Data on the swiftlet houses that were related to habitat and environmental factors were collected and analyzed based on each swiftlet house.

The suitable time to record the data on air and surface temperatures, relative humidity, air velocity, and light intensity was between 10.30 a.m. to 3.30 p.m. [3]. The swiftlet house is vacant and the swiftlets are out searching for food and would only come back around 3.30 p.m. [3]. Swiftlets will be scared away if the inside of the houses were frequently disturbed and visited [10]. Therefore, the best time should be chosen to refrain from entering the swiftlet house unnecessarily. The time that was chosen for this study was around 11.00 a.m.

## STATISTICAL ANALYSIS

Data were analyzed using t-Test statistical analysis to compare the production of swiftlet nest between swiftlet house that possesses suitable habitat and environment factors and that without.

## RESULTS HABITAT LOCATION FOR EBN SWIFTLET HOUSING AREAS

From 100 swiftlet houses that were studied, the majority (66.7%) of EBN swiftlet housing were situated in forested areas shown in Fig.1. Coastal areas were the second most available areas for building EBN houses with 26.7% and town areas were the least available with only 6.7%.

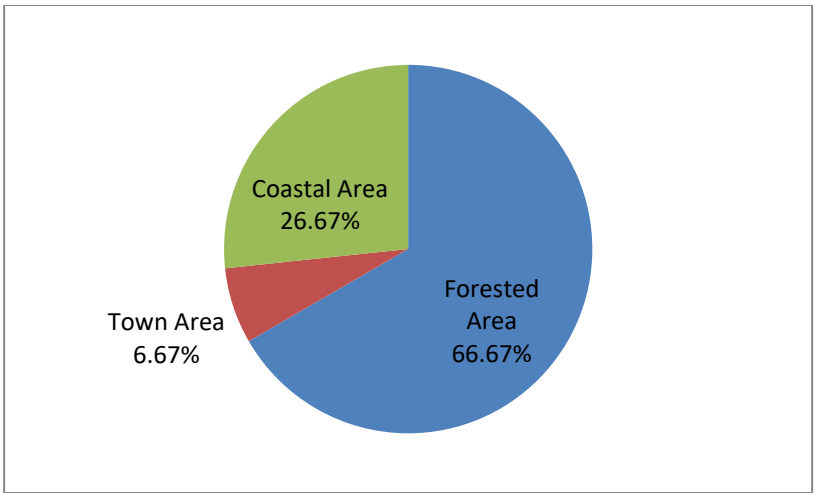


**FIGURE 1.** Habitat location of EBN Swiftlet Houses

## ENVIRONMENTAL FACTORS FOR FIELD STUDY RESULTS

### Mean Surface Temperature

EBN houses in the forested area recorded the highest mean surface temperature with 31ºC. This was followed by EBN houses in the coastal area with 29ºC. Houses in the town area recorded the lowest mean surface temperature of 28ºC.

**TABLE 1.** Environmental Factors Recorded inside EBN Swiftlet House

| **Environmental Factors** | **Forested Area (Mean ± SD)** | **Coastal Area (Mean ±SD)** | **Town Area (Mean ±SD)** |
|---|---|---|---|
| Air temperature | 31ºC ±2.94 | 29ºC ±0.82 | 28ºC ±2.16 |
| Surface temperature | 31ºC ±2.94 | 29ºC ±0.82 | 28ºC ±2.16 |
| Relative humidity | 82% ±2.83 | 81% ±1.63 | 99% ±0.82 |
| Darkness | 0.16 LUX ±0.02 | 0.10 LUX ±0.0082 | 0.15 LUX ±0.03 |
| Sound Level | 50dB ±4.08 (Internal) | 67dB ±9.8 (Internal) | 85.3dB ±2.63 (Internal) |
| | 65dB ±4.08 (External) | 73dB ±3.27 (External) | 76dB ±5.72 (External) |
| Number of Nests | 78 nest ±7.79 | 51 nest ±3.27 | 25 nest ±2.94 |
| Swiftlet Population | 263 individuals | 133 individuals | 65 individuals |
| Etimated Value of Raw EBN | RM2925.00 | RM1912.50 | RM937.50 |

## Mean Relative Humidity

The highest mean relative humidity was recorded in EBN houses in the town area with a value of 99%. This was much higher than the values recorded in EBN houses in the forested and coastal areas with the values of 82% and 81% respectively (Table 1).

## Darkness in Swiftlet Houses

There was not much difference in the darkness between EBN houses in the three localities studied. The mean light intensity values recorded in EBN houses in forested, coastal and town areas were 0.16 LUX, 0.10 LUX, and 0.15 LUX respectively (Table 1).

## Mean Sound Level

We found that, except in the town area, the mean external sound level was louder than that of the internal in all the other two EBN houses locations. The houses in the town areas recorded the loudest mean external sound level with the value of 76.0 dB, closely followed by a coastal area with the value of 73.0 dB and forested area 65.0 dB.

The highest internal mean sound level was recorded in houses in the town area with a value of 85.3 dB. This was followed by coastal and forested areas with values of 67.0 dB and 50.0 dB respectively (Table 1)

## Mean Number of EBN

During the period of study, the EBN houses located in the forested areas recorded the highest mean number of nests (78), followed by coastal (51) and the least number of nests were recorded in the town area (25) (Table 1).

## EBN Swiftlets Population

We found that the houses in the forested area attracted the highest population of EBN swiftlets with 263 individuals. The second highest population was the houses in the coastal area with 133 individuals and the houses with the least population was those of the town area with only 65 individuals (Table 1).

## Estimated Value of Raw EBN

The estimated value of raw EBN in the forested area was the highest (RM2925.00) followed by coastal area (RM1912.50). Town area showed the lowest estimated value of raw EBN (RM937.50) (Table 1).

## Effects of Number of Floor and Size Premise of Swiftlet House on EBN Production

Table 2 shown location of swiftlet house, number of floors, square feet and number of the nest for each swiftlet house at three different location area.

**TABLE 2.** Data on the Location of Swiftlet House, Number of Floors, Size Premise, and Number of Nest.

| Location of Swiftlet House | Number of Floors | Square Feet | Number of Nests |
|---|---|---|---|
| F 1 | 3 | 20x45=900 | 89 |
| F 2 | 4 | 6x10=60 | 73 |
| F 3 | 2 | 20x40=800 | 72 |
| C 1 | 3 | 20x40=800 | 56 |
| C 2 | 2 | 16x40=640 | 49 |
| C 3 | 2 | 30x18=540 | 48 |

**TABLE 2.** Data on the Location of Swiftlet House, Number of Floors, Size Premise, and Number of Nest (Continued...).

| Location of Swiftlet House | Number of Floors | Square Feet | Number of Nests |
|---|---|---|---|
| T 1 | 3 | 12x36=432 | 21 |
| T 2 | 3 | 18x30=540 | 28 |
| T 3 | 3 | 15x50=750 | 26 |

Note: F = Forested Area
C = Coastal Area
T = Town Area

Based on Table 2 it was found that a 900 (20 X 45) square feet 3-floor house from the first forested area produced the highest number of nests (89 nests), whereas the lowest number of nests harvested were from the first house in the town area, that was a 3-floor 432 (12 X 36) square feet house. Strangely, the second house from the forested area, the smallest house consisting of 4 floors and the size of 60 (6 X 10) square feet house produced the second highest number of nests (73 nests).

## STATISTICAL ANALYSIS RESULTS

The results are significant in the value of t is more than the value of t critical and p-value is less than 0.05. The results are not significant if the value of t is more than the value of t critical and the p-value is more than 0.05.

Based on t-Test statistical analysis using t-Test (Two-Sample Assuming Equal Variances), the result showed that EBN production from EBN swiftlet houses with suitable habitat and environmental factors was significantly higher than those houses without. t value (9.0016) is more than t critical (2.7764). P value (0.000422) is less than 0.05.

## DISCUSSION

### Habitat for Location selection of Swiftlet House

There are three main reasons why EBN producers in the study area preferred to build their swiftlet house in the forested area. Firstly, the forested area provides quietness and less disturbance compared to the other locations. Secondly, forested areas, due to their almost untouched by any kind of industry, are usually less polluted, either from chemicals or noise. This has a very positive effect on swiftlet adaptation [11, 12]. Lastly, the forested area also provides a readily available source of food for the swiftlets [15]. They do not have to fly over great distances to find food [6].

Swiftlet feeds on flying insects (Odoptera, Diptera, Coleoptera, Ephemeroptera, Homoptera, and Hymenoptera) [5]. They will be out of their swiftlet house in search of food. They will be searching for flying insects on a garden near to their swiftlet house. Besides the garden area, swiftlets also search their food in town and paddy fields. Many flying insects can be found in these areas. Many farmers use pesticide to prevent them from damaging their crop in doing so, harmless flying insects that are normally consumed by EBN swiftlets are also killed. Birds consuming poisoned insects will themselves be poisoned.

Owners of EBN swiftlet house in the garden area should plant tree species that can attract insect species as a source of food for swiftlet. There are *Ficus carica*, *Casuarina nobile*, *Leucaena leucocephala* [8].

Suitable location selection to build a swiftlet house plays an important role in high EBN production [10]. Everyone involved in EBN production wants their swiftlet house full of swiftlets and nests [8]. There are several important factors considered a priority when selecting a suitable location to build a swiftlet house. Swiftlet house must be located far from an industrial area. It is desirable to have a swiftlet house in areas rich in insects such as paddy fields, fruit orchards, vegetable garden or areas close to natural water bodies such as rivers and lakes. The recommended distance from one swiftlet house to the others should not exceed 5 kilometers [22]. This is important to make sure the swiftlet house that we built is on the swiftlet population.

*Temperature and Relative Humidity*

The highest mean relative humidity was recorded in EBN houses in the town area with a value of 99%. This was much higher than the values recorded in EBN houses in the forested and coastal areas with the values of 82% and 81% respectively. Suitable relative humidity in swiftlet house is 80-90% [4].

Temperature is a very important factor that should be concerned in the swiftlet house [8]. The temperature in swiftlet house should similar with temperature in swiftlet natural habitat, which is in limestone caves [16]. The suitable temperature for swiftlet house is 26-35$^{O}$C [4].

Temperature and relative humidity in swiftlet house functioned as an important role in the production of swiftlet nest. Temperature and relative humidity very important for easier swiftlet nesting, to make sure swiftlet nest not cracking on their nesting planks, produce a high rate of hatching of swiftlet eggs and produce high quality of swiftlet nest [22].

Naturally, swiftlet will first observe first on swiftlet house design as they enter. If the temperature and relative humidity in the swiftlet house were suitable for them, they will nest on the nesting plank. Sometimes, swiftlet will move from one nesting plank to another until they find their suitable nesting plank for nesting [6]. If temperature and relative humidity are not suitable for them, they will move to another swiftlet house. Production in swiftlet house that does not have suitable temperature and relative humidity will be slower compared to swiftlet house that has suitable temperature and relative humidity [10].

There are several methods that can be used to stabilizing temperature and relative humidity in swiftlet houses. Normally, a ventilation hole, use sprayer, painting external wall, fan and pool, use humidifier and mist cooling system.

The advantages of using ventilation hole are having a lower temperature inside the swiftlet house than that of the outside whereas the disadvantage is that the temperature inside the swiftlet house depends on the environmental temperature. Therefore in the dry season, the temperature inside the swiftlet house is always higher than outside [22].

A sprayer is used to form artificial rain. The external wall of the swiftlet house is better painted with a bright color. This is important to reflect sunray on the walls of swiftlet house. Mist cooling system is the best method for stabilizing temperature and relative humidity in swiftlet house. Mist cooling system will produce a cloud in swiftlet house.

*Darkness in EBN Swiftlet Houses*

According to Nasir (2009), lighting in EBN swiftlet houses are influenced by the size of entrance hole, colour of wall and floor and height of space that enable light to enter. Decreasing the size of entrance hole will decrease the entering light while a increase of width and height, will increase the amount of light [22].

According to Ibrahim *et al*. (2009), the light intensity in the EBN swiftlet house play important role to create darker environment with low light intensity. Besides that, swiftlets prefer the dark for safety for them in term of predator disturbance due to most predators are blind in darkness while swiftlets can survive in total darkness using their echolocation (Manchi & Sankaran, 2009).

*Sound System in EBN Swiftlet House*

The highest internal mean sound level was recorded in houses located in the town area with a value of 85.3 dB. This was followed by houses in coastal and forested areas with values of 67.0 dB and 50.0 dB respectively. According to Ibrahim et al., suitable external sound for EBN swiftlet is around 60-80dB.

Swiftlets were very responsive towards the sound that was similar to their voice [8]. When swiftlets were flying, they would look for a sound that was similar to their voice [17]. This has lead the majority of EBN producers to use swiftlet sound from cassette or compact disk (CD) to attract swiftlet to enter swiftlet house [16]. The potential to succeed is high when producers use swiftlet sound as an attraction [10] and majority of swiftlet will reproduce in swiftlet house using a sound similar to their voice [18]. The best time to install the sound system is from 5.30 a.m to 9.30 a.m and 4.00 p.m to 6.30 p.m [16].

*Size of EBN Producing Premises*

Size of premise will also influence the production of EBN. Swiftlet will feel more comfortable in a bigger house. Therefore, they will move to another swiftlet house if their current house is rather crowded [14].

## Swiftlet Population

The swiftlet houses in the forested area produce the highest population of EBN due to the environmental factors such as air and surface temperature, relative humidity, light intensity, and suitable range sound level. Swiftlet will adapt in swiftlet house that possesses environment factors similar to their natural habitat which is in limestone caves [4].

The swiftlet house in town area produce the lowest production of EBN because on that area relative humidity and the sound level is high compared to their suitable range.

# CONCLUSION

Based on the survey, most EBN producers (66.7%) choose forested areas as the location for their swiftlet house. Meanwhile, the second most popular site is the coastal areas whereby 26.7% of the producers choose to built their swiftlet house there. The least popular site for EBN is the urban locality with only 6.7% of the swiftlet operation housed in the area. Based on field study results, swiftlet houses built in forested areas are the most swiftlet friendly and conducive artificial environmental and thus, the best and most productive EBN producing areas. The mean number of nests of the EBN houses located in forested areas recorded at 78, followed by coastal 51 sites and in the town area 25 nest respectively. For the individual houses, the forested area attracted the highest population of EBN swiftlets with 263 individuals. The second highest population was the houses in the coastal area with 133 individuals and the houses with the least population was those in the town area with only 65 individuals. Environmental parameters for successful EBN swiftlet house with air and surface temperatures were 31$^{o}$C, relative humidity was 82%, light intensity 0.16LUX, sound level 50dB (internal) and 65dB (external). Unsuitable location for EBN swiftlet house as man-made habitat for swiftlet adaptation and survival, most often than not, was the main cause of failure in the swiftlet ranching business. For swiftlets to flourish, they need just the right environmental parameters that make them comfortable and unthreatened. This is very important, because comfortable swiftlets are the most productive ones. As a conclusion, to be successful in this industry, the right habitat and environmental are some of the crucial factors that need to be taken seriously before building any EBN swiftlet house.

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