



## Nesting construction and biophysical records of gestating sows under traditional free-range farming system inside mixed-semi forest of lowland West Papua

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### Abstract

Nest is the important compartment of the sows. The roles of nests are for giving birth and shelter. His research has been carried out in the lowland Prafi valley, Manokwari regency, West Papua province. The main parameters observed were the ecological characteristics of nesting sows in nests made by pigs for parturition. The findings were that sows' nesting material consist of 61.22% grass, 12.3 legumes, 12.3% trees component and 29.4% leaves. Average daily temperature of the nest is 26°C, humidity 81.87% and average pH is 6.8. The average altitude of the place is 43 mASL. The location of the nest built by the sows is under the canopy of oil palm plantation and river banks (Watershed), and under other trees such as durian and bamboo. The shape of the nest made is rectangular, triangular, and round.

**Keywords:** Sows nesting; Bio-physical nesting pigs; Oil palm habitat; Lowland West Papua

### 1. Introduction

World tropical farmers, particularly in West New Guinea Papua (WNGP), have relied their livelihood cycles on pig business [1-4]. This is done by the reasons that pigs have multiple purposes for the WNGP community. Like other communities all over the world, pigs have been kept in a simple manner. The keeping systems of pigs in WNGP and specifically in Manokwari have been identified by Iyai [5]. The recognized and huge applied systems are the systems of free-range and semi-penned pig productions. In a free-range system, pigs are released for free without fully managed and handled by the farmers, e.g. in offering the feeds and arranging the mating time. Pigs can easily search and find the food, when the places as a shelter and whatever pig prefers for. Besides, the pigs as well have free choices to select the nesting ground [6]–[9].

It was reported by several authors that during period of gestation, the gilts and sows can freely choose and build nests in their appropriate nesting ground to maintain their parturition time [6], [10], [11]. The mothers both young gilts and mature sows will compete and bargain to explore the feeding ground including nesting ground. By using their both experience particularly the mature sows, nesting will be built. How to design, what materials need, what physical environmental needs are still less being studied [6]. Nesting construction is utmost important to keep the new born piglets save and grow in the proper rate [6], [9], [12]–[15].

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People in the provinces of Papua and West Papua raise pigs in several areas in agroecology, namely the coast, islands, lowlands and mountains [16]–[18]. The technique of raising livestock that is cultivated is still traditional and has been carried out from generation to generation. Pigs have fulfilled family needs and also increased family income [19]. The excess of pigs can also consume all the food ingredients that are converted into meat and fat efficiently. In addition, pigs are used by the community in traditional events [20], [21].

Pigs have good market opportunities (agribusiness) [19]. However, the situation faced by farmers in Papua and West Papua is that the pattern of maintenance is still traditional [5]. The researchers of Marani [22] and Gobay [20] describe the system of raising pigs by the Arfak tribe by displaying it in the yard and in public places such as the market in the city of Manokwari. In addition, in rural areas, pigs are also displayed in garden areas and secondary forests and oil palm land [20]–[23]. This is done so that the pigs can find their own food to meet their nutritional needs. With this system, it will have an effect on the production of pigs which are still relatively which can be seen from the average number of piglets of approximately 6 pigs/parent low [16], [17], [24], [25] and [26].

The low *litter size* is due to the mortality and reproductive status of sows caused by low management, as well as the involvement of farmers in raising their livestock. This kind of maintenance model is more dominantly carried out by local Papuan breeders than non-Papuan breeders such as ethnic Toraja, Batak and Balinese. Only a small number of local Papuan farmers are already cultivating pigs using good management patterns. The mortality or mortality of piglets is very prominent. Therefore, limiting factors such as livestock discomfort from environmental aspects need to be well understood.

Pigs in the villages of Manokwari are maintained with an extensive rearing system [5]. In this condition the farmer cannot control or know the pigs that are in a status of pregnancy (gestating period). The form of behavior changes occurs when the (prospective) female sow will prepare/build a nest before entering the parturition period (*breeding season*). After the sow gave birth, the piglet will be cared for a certain time in the nest [27], [28]. Then the sow will return home looking for swill feeds, crops leave over, that are usually given such as leaves, stems and tubers.

However, with this maintenance system, farmers suffer losses and livestock productivity becomes low. The impact on productivity is caused by the conditions of the nest environment that are not comfortable for piglets. This is due to the condition of the piglets that are still weak and in an uncomfortable environment such as high and low environmental temperature, humidity, and intensity of sunlight, availability and adequacy of feed and the presence of predators and other limiting factors.

The need for feed in sows cannot be measured or calculated so that the milk produced for piglet is reduced [29]–[31]. This has low impact on the health conditions of piglets and sows, including the farmers. In addition, the presence of free range pigs will cause farmers to unable to create gardens on these potential lands [26], [32]–[35]. For this reason, it is necessary to seek ways to handle gilts and sows that are still intensively reared outside the pig houses. One way that can be done is by seeking at the behavior and the needs of the parents in a parturition time period. To determine the need for nest conditions for female breed stock, it is necessary to study the nest conditions in a natural habitat, crop lands, and shrubs where sows carry out their gestation and parturition periods.

Information about the nesting of pregnant sows is not yet available regarding nest size, nest shape, nest area, and temperature, including humidity data. By knowing this nesting aspect, the imitation nests referred by pigs and by the community can be used by sows in an intensive livestock rearing system. The need for making a female sow's nest should be known in order to build a nest for the sows and the gilts. Therefore, pigs should have comfortable places to enter parturition period to avoid death of piglets. The way to provide artificial nesting in the pig houses is by constructing the nests that are similar and comfortable for the pigs. Therefore, this article was written to provide and share some findings of the biological and physical environment of the nesting built by the gestating female pigs.

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## 2. Material and methods

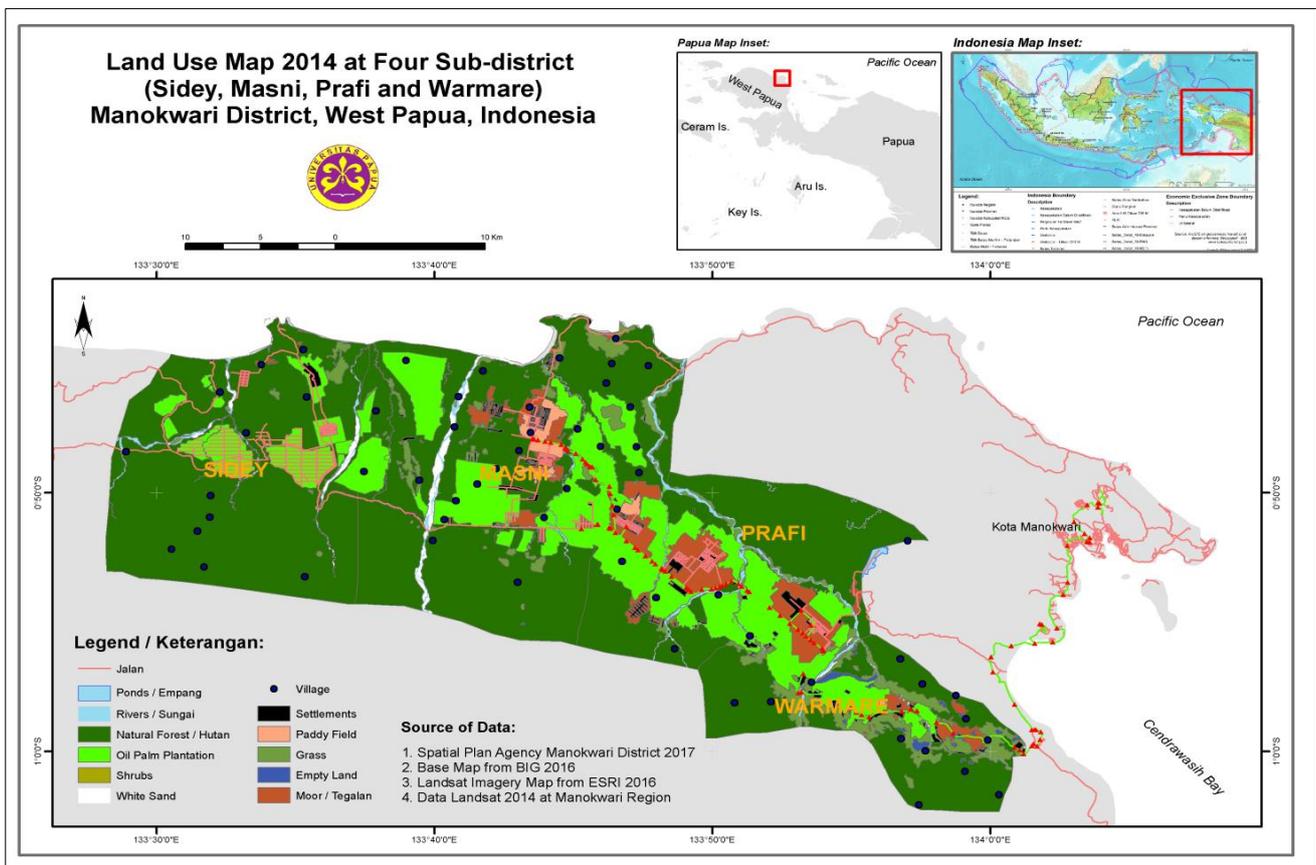
### 2.1. Sites

This research has been carried out in the lowland Prafi valley, Manokwari regency, West Papua province. The Prafi valley was chosen to represent lowland habitat and is a place dominated by pig farms with a pattern of free-range (scavenging) in Manokwari [5]. This study done for 2 months since February 9<sup>th</sup> to March 28<sup>th</sup> 2021. The tools used were questionnaires, digital camera, roll meter, hygrometer, thermometer, pH meter, scale, raffia rope, plastics and writing instruments. The materials used and collected were nest material, types of grass, wood and leaves. This material is used for the process of identifying the types of nesting material and vegetation around the nest. Sampling of farmers was

carried out in a purposive manner in three villages, namely Lisna Unggu, Waseki and Mantet. Pigs' nest samples owned by farmers are purposely stabilized until 10 nests are obtained. As many as 6 nests were obtained in Lisna Unggu village, Waseki as many as 1 village and 3 nests were obtained from Mantet. The respondents interviewed in this study were 4 families. The primary data was obtained through direct observation of the nest of sows in their habitat.

## 2.2. Measured parameters

The main variables observed in this study were the ecological characteristics of nesting female pigs in nests made by pigs for parturition. The observed ecological nesting defined by physical aspects consisted of nesting ecology, namely nest temperature or temperature (°C) is the daily temperature of the nest measured by a thermo hygrometer from 09.00 to 11.00 WIT (Eastern Indonesia Time) as many as three times, i.e. in the morning, afternoon and night. Humidity (%) defined by the condition of the content/moisture content in the air measured by a thermo-hygrometer from 09.00 to 11.00 WIT. Soil quality includes pH is the degree of acidity of the soil if  $pH > 7$ , then the soil conditions are alkaline and if  $pH < 7$ , then the soil conditions are acidic. Biological aspects defined by the percentage of nest material (BPS,%), i.e. the proportion of the number of plant species in the form of grass and trees that are either still alive or have dried. The components of the nest constituent calculated by  $BPS (\%) = (\text{number of each ingredient}) / (\text{total number of hives}) \times 100\%$ . Nest vegetation is a plant that is around the nest (Figure 1), which measured using sampling plots calculated following Fachrul (2006). Sample plots measuring  $20 \times 20 \text{ m}^2$  used at the tree level ( $> 20 \text{ cm}$  tree diameter), liaeofite, parasite, and host tree. Sample plots measuring  $10 \times 10 \text{ m}^2$  used for pole level (tree diameter  $10 \times 20 \text{ cm}$ ). Sample plot of  $5 \times 5 \text{ m}^2$  used for the stake level (diameter of the diameter tree  $< 10 \text{ cm}$  high  $> 1.5 \text{ m}$ ).



**Figure 1** The study sites of pig production in Manokwari, WNGP

Sample plots measuring  $2 \times 2 \text{ m}^2$  used for semi (seedling) for plant height  $< 1.5 \text{ cm}$  and under cover of vegetation. The sample plot measuring  $1 \times 1 \text{ m}^2$  is used for the grass level. Measuring the diameter done at an altitude of approximately breast height or  $1.3 \text{ m}$  above the ground level. The parameters that are defected are the name of the plant stem diameter, the number of species and the number of plots found in a plant species (frequency). Nest volume ( $\text{cm}^2$ ) is the size of the nest space used by sows for calving or parturition calculated using the formula. Tubular  $\text{cm}^3$  nests volume is a measure of nest capacity used for parturition. Nest volume is calculated using the mathematical formula as follows:  $V_s = V_s = \pi r^2 \times t$  where:  $V_s$  = nest volume,  $r$  = radius and  $t$  = nest length. However, if the nest found is triangular, the nest area is calculated using the formula  $L = \frac{1}{2} \times W \times H$ ,  $V = \frac{1}{2} \times T \times L \times X$  In,  $H$  = Height = Height,  $W$  = Width = Width,  $L$  = Length =

Length The shape of the nest is a plot/shape of a nest that is designed by female pigs for the production process. The shape of the nest collected into round shapes, prisms, tubes, triangles and rectangles. The location of the nest is the location where the pig's nest is chosen, which includes: location of primary forest gardens secondary forest oil palm area near the ripening of the rice fields. Each habitat found was described in descriptive narrative. The nest distance from the house (m/parent) is the size of the nest near the nest of the farmer's house that has a sow with a nest made. The number of nests (fruit) is the number of nests that made actively and used by female pigs. The number of piglets born (head/parent) is the number of piglets born from the mother per birth.

### 2.3. Data analysis

The data obtained were analyzed descriptively statistically which included average, percentage, standard deviation (SD), range, and statistic inferential which including a linear regression. Data displayed in the form of tables and graphs.

## 3. Results and discussion

### 3.1. Characteristics of Pig Farms

The results of research on pig nest in Manokwari Regency, Prafi district. People have around 15 years of experience. It was also found by Iyai [5] and Iyai [3] that the "umbar" system (free range pig farming system) is still carried out by Papuan farmers in the Prafi valley [21], [36]–[38]. The number of parents and piglet is presented in Table 1.

**Table 1** Profiles of pig farmers characteristic

| No.     | Age (yr) | Experience (yr) | Distance of nest to house (m) | Number of Sows (head) | Number of piglets (head) |
|---------|----------|-----------------|-------------------------------|-----------------------|--------------------------|
| 1       | 39       | 15              | 350                           | 2                     | 7                        |
|         |          |                 | 30                            |                       | 6                        |
| 2       | 46       | 20              | 100                           | 5                     | 5                        |
|         |          |                 | 80                            |                       | 7                        |
|         |          |                 | 210                           |                       | 9                        |
|         |          |                 | 40                            |                       | 13                       |
|         |          |                 | 30                            |                       | 7                        |
| 3       | 38       | 10              | 20                            | 2                     | 7                        |
|         |          |                 | 50                            |                       | 6                        |
| 4       | 38       | 15              | 15                            | 1                     | 5                        |
| Average | 40.25    | 15              | 120                           | 2.5                   | 7.5                      |

From Table 1, the average age of breeders is 40.25 years old with farming experience for  $\pm 15$  years. The number of parent averages owned by livestock is  $\pm 2.5$  heads/ breeders with an average number of piglet/sow is  $\pm 7.5$  heads and average distance of sows' nests from the farmers' house is 120 m. Information on breeders raising pigs by releasing them makes it easier to maintain livestock and facilitate the activities of farmers during the day. Reducing the usual food requirements given to pigs. With this system it is proven that farmers rarely know the mortality rate of piglets during this time directly. This supports the statement of Iyai [5] which states that high mortality rates are experienced in extensive maintenance systems (free-range) in the Prafi valley, Manokwari.

### 3.2. Characteristics of Habitat Pig nest

The results of the study of the characteristics of the location of sows' nest in the Prafi Valley plain are presented in Table 2.

On Table 2. The locations of the nests made by pigs during parturition period are by no consideration of the type of vegetation, grass and legumes. The 1<sup>st</sup> pig nest under the palm trees cover made from ferns. The 2<sup>nd</sup> pig nest made from legume, grass, and bamboo leaves. The 3<sup>rd</sup> pig's nest made from legume and grass (*Stenotaphrum secundatum*). The 4<sup>th</sup>

pig nest made from oil palm branches, grass and legumes (*Stenotaphrum secundatum*). The 5<sup>th</sup> pig nest made from leaves and legumes (*Grapedia* sp). The 6<sup>th</sup> pig nest made from grass and legumes (*Graviola*). The pig nest no. 7<sup>th</sup> made from grass and legumes, ferns and stems legumes (*Stenotaphrum secundatum*). The 8<sup>th</sup> pig nests made from grasses (*Stenotaphrum secundatum* and *Imperata cylindrica*). The pig nest of no 9<sup>th</sup> made from grasses (*Imperata cylindrica*, *Stenotaphrum secundatum*). The 10<sup>th</sup> pig nest found was made from *Imperata cylindrica*, *Durio durio*, and *Stenotaphrum secundatum*.

**Table 2** Description of the sites, villages, altitude, and nest shapes

| No. of Nest | Sites of Nest                      | Villages   | Places of Nest              | Altitude (mASL) | Shapes of Nest |
|-------------|------------------------------------|------------|-----------------------------|-----------------|----------------|
| 1           | Under canopy of Palm oil tree      | Lisnaunggu | Shade of oil palm trees     | 60              | Rectangular    |
| 2           | Under canopy of bamboo             | Lisnaunggu | Left crop land              | 67              | Triangle       |
| 3           | Under canopy of Palm oil tree      | Lisnaunggu | Shade of oil palm trees     | 69              | Rectangular    |
| 4           | Under canopy of Palm oil tree      | Lisnaunggu | Shade of oil palm trees     | 72              | Triangle       |
| 5           | Under canopy of Palm oil tree      | Lisnaunggu | Shade of oil palm trees     | 68              | Rectangular    |
| 6           | Under canopy of Palm oil tree      | Lisnaunggu | Shade of oil palm trees     | 40              | Long round     |
| 7           | Side of river stream               | Waseki     | Shrub of river              | 78              | Rectangular    |
| 8           | Side of river stream               | Mantet     | Shrub of river              | 43              | Round          |
| 9           | Side of river stream               | Mantet     | Left crop land              | 42              | Round          |
| 10          | Under canopy of durian fruit trees | Mantet     | Stack of branches of Durian | 43              | Rectangular    |

The nest of female sows was found in three villages, namely Lisnaunggu Village, Waseki and Mantet. These villages have many pigs which are kept by farmers in traditional ways or ground under oil palm and in the wild. The type of vegetation found is not the same and the place or location of the piglets. Piglets also vary under the trees and on the banks of rivers and former farms. Pig nests are found at an average altitude of 40-80 mASL in all nest points of female pigs taken in the Prafi valley plain. The forms of pig nest found are rectangles, triangles and rounds. Thus the pig's nest made by the herd of pigs varies. Factors that influence the forms of pig's nest of female pigs have not been known so that it needs further study whatever affects the making of nest forms. Indeed, from the results of this study it was revealed that 50% of nests are rectangular in shape, but whether there is a selection trend of nest shape, further research is needed.

### 3.3. Physical and Chemical Aspects

Physical and chemical aspects which include temperature (°C), humidity (%) and soil pH can be seen in Table 3. Average Temperature (°C), Humidity (%) and soil pH respectively are  $26.78 \pm 2.77$  °C,  $81.87 \pm 8.52\%$  and  $6.8 \pm 0.92$ . The temperature in the nest of many female pigs is influenced by the state of the nest made by female pigs.

According to BMKG office of Manokwari regency, the temperature or temperature is 27-32°C, and humidity is 63-96%. The humidity in the nest is strongly influenced by the condition of the vegetation, i.e. the level of canopy or canopy closure [14], [39], [40]. Pig nests' pH are in the neutral range of 6-8. In neutral pH conditions (pH = 7), the environment has many advantages[6], [13], [41]–[43]. Plants in the form of trees, crops, non-crops, and shrubs can grow sufficiently, so that production can be reached optimal. Plants can absorb nutrients properly because nutrients dissolve easily in the water, especially in the productive plants.

**Table 3** Temperature (°C), humidity (%) and soil pH around nesting sites

| No. of Nest | Temperature (°C) | Humidity (%) | Soil pH  |
|-------------|------------------|--------------|----------|
| 1           | 27.37±1.79       | 83.00±5.20   | 7        |
| 2           | 27.93±2.85       | 82.00±4.36   | 8        |
| 3           | 25.15±1.91       | 77.67±15.18  | 7        |
| 4           | 24.45±1.06       | 78.00±5.20   | 5        |
| 5           | 30.60±0.12       | 78.33±2.89   | 6        |
| 6           | 24.73±1.56       | 82.67±18.88  | 8        |
| 7           | 26.63±3.21       | 75.00±5.57   | 6        |
| 8           | 28.10±0.92       | 87.33±5.51   | 7        |
| 9           | 25.17±2.57       | 91.00±1.00   | 7        |
| 10          | 27.63±5.16       | 83.67±2.52   | 7        |
| Average     | 26.78±2.77       | 81.87±8.52   | 6.8±0.92 |

### 3.4. Biological aspects

The biological aspects that can be used by the surrounding grass, legume grass, and trees, which are in the environment of hive vegetation, are vary greatly. The vegetation found is dominated by grass species and legumes such as *Pteredophyta* Sp, *Gymnosperm* Sp, *Stenotaphrum secundatum*, *Graviola* Sp, *Imperata cylindrica*, *Dondrocolomius* Sp, *Bidens pilosa* Sp. Thus the types of grasses and legumes used by the sows and including gilts are relatively vary in the nest of pigs (Table 4.).

**Table 4** Vegetation composition of grass, legume, trees and leaves

| No. of Nest | Composition of Vegetation |       |        |       |       |       |        |       |
|-------------|---------------------------|-------|--------|-------|-------|-------|--------|-------|
|             | Grass                     |       | Legume |       | Trees |       | Leaves |       |
|             | G                         | %     | g      | %     | g     | %     | g      | %     |
| 1           | 80.2                      | 61.55 | 30.10  | 23.10 | 20.00 | 15.35 | 0.00   | 0.00  |
| 2           | 80.2                      | 76.13 | 25.15  | 23.87 | 0.00  | 0.00  | 0.00   | 0.00  |
| 3           | 70                        | 65.98 | 20.20  | 19.04 | 0.00  | 0.00  | 15.90  | 14.99 |
| 4           | 80.2                      | 66.39 | 30.30  | 25.08 | 10.30 | 8.53  | 0.00   | 0.00  |
| 5           | 60.5                      | 59.66 | 15.60  | 15.38 | 0.00  | 0.00  | 25.30  | 24.95 |
| 6           | 70                        | 57.85 | 0.00   | 0.00  | 20.70 | 17.11 | 30.30  | 25.04 |
| 7           | 60.5                      | 49.67 | 0.00   | 0.00  | 20.70 | 17.00 | 40.60  | 33.33 |
| 8           | 40.1                      | 28.38 | 0.00   | 0.00  | 30.60 | 21.66 | 70.60  | 49.96 |
| 9           | 0                         | 0.00  | 0.00   | 0.00  | 20.60 | 20.36 | 80.60  | 79.64 |
| 10          | 70.5                      | 69.73 | 0.00   | 0.00  | 0.00  | 0.00  | 30.60  | 30.27 |
| Average     | 61.22                     | 53.53 | 12.14  | 10.65 | 12.29 | 10.00 | 29.39  | 25.82 |

The types of grasses made in the pig's nests are based on the types of grasses or legumes found around and reachable. Then the nests of the pigs also varies according to the existing vegetation in the design of making nests by the gilts and sows, namely *Pteredophyta* sp, *Imperata cylindrical*, *Graviola* sp., *Stenotaphrum secundatum*, *Dondrocolomius* Sp, *Bidens pilosa*. By building nests, female herds use the types of vegetation found near the nest area to protect and build their nests [6], [8], [9], [14], [44].

**Table 5** Size of length, height, width, shapes and volume of sows' nests

| No. of Nest | Diameter (Cm) | Length (cm) | Height (cm) | Width (cm) | Shapes           | Volume (cm <sup>3</sup> ) |
|-------------|---------------|-------------|-------------|------------|------------------|---------------------------|
| 1           | 0             | 113         | 21          | 75         | Cube             | 177975                    |
| 2           | 0             | 123         | 21          | 63         | Triangular Prism | 81364.5                   |
| 3           | 0             | 85          | 22          | 75         | Cube             | 140250                    |
| 4           | 0             | 57          | 33          | 52         | Triangular Prism | 48906                     |
| 5           | 0             | 79          | 21          | 62         | Cube             | 102858                    |
| 6           | 86.28         |             | 23          |            | Cone             | 67270.9                   |
| 7           | 0             | 57          | 12          | 46         | Cube             | 31464                     |
| 8           | 0             | 87          | 21          | 63         | Sphere           | 115101                    |
| 9           | 140.06        | 0           | 21          | 0          | Sphere           | 1294788                   |
| 10          | 129.27        | 0           | 21          | 0          | Cube             | 1102992                   |

In Table 5, the size of the hive above mentioned is quite varied in the shape and size of the hive. The same thing is found in pig's nest, length and width. The nest form that each nest can be very different according to the location and location of the nest. The nest height is relatively not varied. Each female pig is ready to make a nest. After production the sows will go back to the farmers' houses for 1-4 weeks by showing the piglets born. Draw a pig's nest below. There are four types of nesting shapes, namely cube, cone, sphere, triangular prism. So the distance of the hive above is not the same because the parent pig is not necessarily close to the other mother, so look for a place that can be comfortable in production when doing activities in the nature. The piglet moves in the womb and will get mud while looking for a place that can be present. The parent pig after serving will take care of the child for the new born piglets of 1-2 weeks' ages will bring it closer to making a new nest until it is gone. Breeders see when the first session then controls the parent pig with the child born. The way to mate a female pig in the nature is a natural mating where a sow and/or gilts had similar activities together with a male pig.

### 3.5. Vegetation of the Nesting Sow

Based on the results of the identification of the type of vegetation that grows around the pig's nest is very varied but is dominated by the type of grass of Pteridophyta Sp., *Imperata cylindrica*, *Graviola* sp., and *Stenotaphrum secundatum*. Pigs build their nests by utilizing the types of vegetation around living ground. The pigs make nests for the place of production/breeding period and/or as a shelter as long as pigs are still in the wild environment [7]–[9], [12], [14], [39], [45]. According to information from breeders, pig always make a nest for shelter 3 times during the first stage of production, the second stage of jasmine is the third stage during activities in nature. The nest form of the sows that were found varied, round and three quarter nest of pigs was also designed by the cows of pigs that want to produce. Female pig is not far from the farmer's house. The location of the pig's nest is not far from the farmer's rumors of the former oil palm plantation area and in the river bank. The distance of the pig's nest is found 100-300 m which can be found in the nest of female pigs. Although a lot of literature states that home range (roaming region) is quite extensive. The number of pig nests 10 pig nests that can be found 7 active hives, not active 3 pig nests that are used for comparison of pig nests. The number of 6-13 piglets born by each female pig parent. The behavior of making a parent pig's nest is bitten by a grass gathered in a targeted place until it is finished entering the nests or pruned with a new head entering the nest in the nest for the production process inside. The number of crossbred piglet was not found. What was found was the native *Sus papuensis* pig which found 100% from native Papuan pigs or *Sus papuensis*.

### 3.6. Characteristics of nesting behavior

One aspect that will be explained below is to understand the relationship between the behaviors of nesting animals of female parent animals. The relationship between the number of piglets' born with the location of the selection of nests is interesting to observe. It is assumed that there is a positive relationship between the distance of the nest location and the number of piglet to be born. The relationship between the number of piglets born with nesting distance is calculated and obtained by the linear regression formula  $Y = 7.0532 + 0.0016 * D$  (Test F = 0.04; p = 0.84), where D is the distance (distance) from the nest to the farmer's house. It is suspected that the selection of a nest with a certain distance is

influenced by the small number of fetuses/embryos of pigs that are in the uterus of female pigs and environment [6], [46], [47].

The results of this study indicate that the selection of nest distance is at least related to the number of piglets to be born [6], [8], [14]. However, this relationship is very small. Thus the relationship is very weak. There are other factors that are thought to influence the selection of nest distances such as the abundance of food ingredients, the comfort of nests and habitat and the reproductive experience of animals (age) and other unknown factors. The farrowing rate also determines the reproductive maturity of the female parent [13], [48], [49]. Thus, the older the more mature and feel more secure in childbirth and the closer the distance needed for reproductive purposes.

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#### 4. Conclusion

Pig nesting material consists of 61.22% grass, 12.3 legumes, 12.3% trees component and 29.4% leaves. Average daily temperature of the nest is 26°C, humidity 81.87% and average pH is 6.8. The average altitude of the place is 43 mASL. The location of the nest built by the sows is under the canopy of oil palm plantation and river banks (Watershed), and under other trees such as durian and bamboo. The shape of the nest made is rectangular, triangular, and round. It is necessary to examine further techniques of making female hives in natural habitats. It needs to be investigated further about the design of pig nests in the free-range pig farming systems.

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#### Compliance with ethical standards

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##### *Disclosure of conflict of interest*

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

##### *Statement of ethical approval*

Consent has been obtained from all the participants for this research and the Animal Ethics Committee of Animal Science Faculty, The University of Papua coordinated by Budi Santoso (No. of Reference letter: SP-004/UN42.3/PP/2022).

##### *The novelty of the study*

- The natural pig nesting material consists of 61.22% grass, 12.3 legumes, 12.3% trees component and 29.4% leaves.
- Average daily temperature of the nest is 26°C, humidity 81.87% and average pH is 6.8. The average altitude of the place is 43 mASL.
- The location of the nest built by the sows is under the canopy of oil palm plantation and river banks (Watershed), and under other trees such as durian and bamboo.

The shape of the nest made is rectangular, triangular, and round.

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