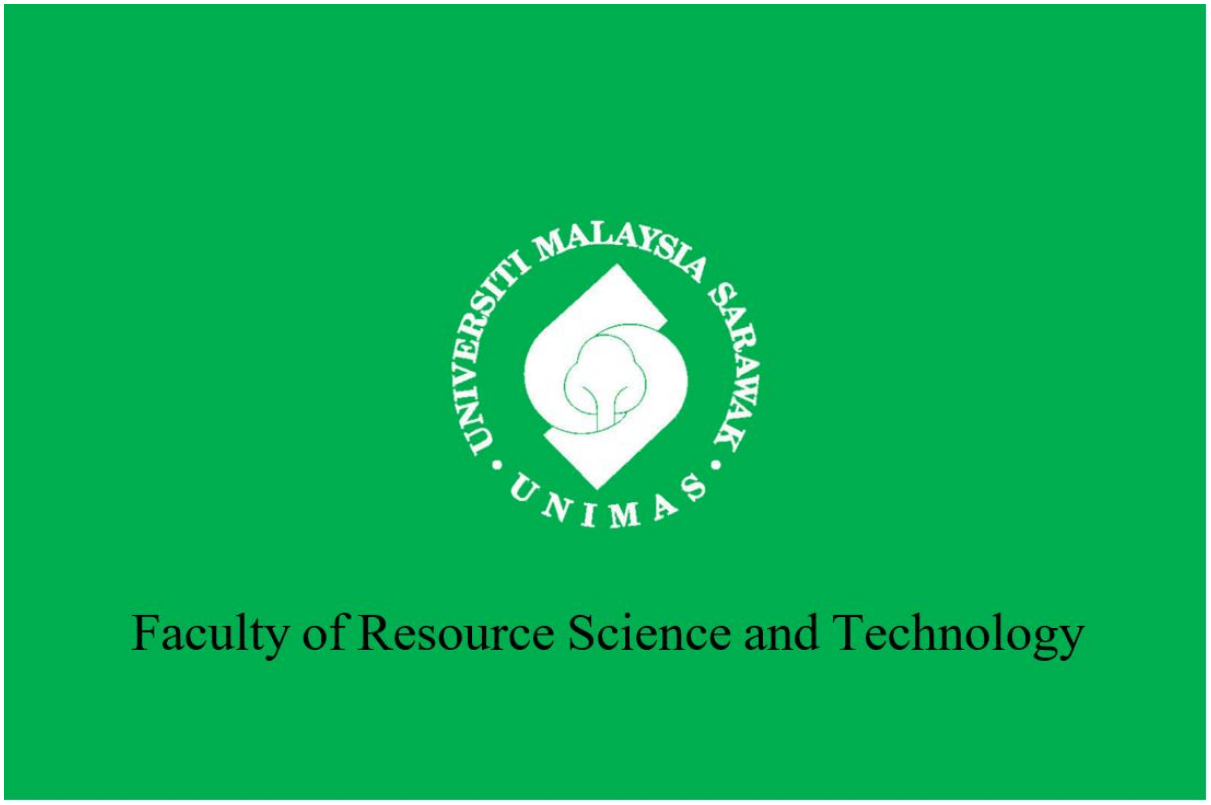

Study on Local Knowledge in Determining Site Suitability for Pepper Farm Establishment at Mongkos Area.

Azli Moni Anak Robbin (69192)

Bachelor of Science with Honours

(Plant Resource Science and Management)

2022

Study on Local Knowledge in Determining Site Suitability for Pepper Farm Establishment at Mongkos Area.

Azli Moni Anak Robbin

A thesis submitted in partial fulfilment of the Requirement of The Degree Bachelor of Science with Honour

(Plant Resource Science and Management)

SUPERVISOR: ASSOC. PROF DR MOHD EFFENDI BIN WASLI

Programme of Plant Resource Science and Management

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UNIVERSITI MALAYSIA SARAWAK

2022

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Masters ☐

PhD ☐

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Study on Local Knowledge in Determining Site Suitability for Pepper Farm Establishment at Mongkos Area

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ABSTRACT

Ethnopedology is a branch of indigenous knowledge that studies local people's knowledge in assessing soil fertility and suitability for agricultural uses, as well as rural people's soil and land use knowledge systems. Black pepper, (*Piper nigrum L.*) is from the family of Piperaceae also known as "the king of spices," is one of the world's oldest and most extensively used spices. Sarawak Pepper has been chosen as the trade name and commercially used to promote Malaysian peppers globally. This study was carried out at Mongkos, Serian Sarawak. Most of the communities in this area are Bidayuh people and their main cultural activities are rice cultivation and cash crop farming (pepper, oil palm, rubber). There were two phase of data collection, phase 1 was interview with the farmers and phase 2 was soil sample collection. The interviews were conducted in the farm during farm visit before we collect the soil samples. Soil analysis consists of soil colour was determined by referred with Munsell Soil Colour Chart, soil texture by feel method, measurement of soil pH of H_2O and Soil electric conductivity and determination of soil organic matter by the dry combustion method. In this study, 14 farmers that have been interviewed. Based on the interview and sampling that was conducted on the site, the farmers knowledge was divided into two category which is bad and good soil. The farmer assessment is based on soil colour, texture, rocks, moisture and moisture. Overall, soil physical properties analysis shows that there is no significance different between the good and bad soil. In conclusion, farmers classified soils based on their understandings and surroundings.

Keywords: pepper, local farmers, farm, Sarawak, ethnopedology, soil suitability, soil analysis

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ABSTRAK

Etnopedologi adalah cabang pengetahuan pribumi yang mengkaji pengetahuan penduduk tempatan dalam menilai kesuburan tanah dan kesesuaian untuk kegunaan pertanian, serta sistem pengetahuan penggunaan tanah dan tanah penduduk luar bandar. Lada hitam, (Piper nigrum L.) berasal dari keluarga Piperaceae yang juga dikenali sebagai "raja rempah," adalah salah satu rempah tertua dan paling banyak digunakan di dunia. Lada Sarawak telah dipilih sebagai nama dagang dan digunakan secara komersial untuk mempromosikan lada Malaysia di peringkat global. Kajian ini dijalankan di Mongkos, Serian Sarawak. Kebanyakan masyarakat di kawasan ini adalah orang Bidayuh dan aktiviti kebudayaan utama mereka adalah penanaman padi dan pertanian tanaman tunai (pepper, kelapa sawit, getah). Terdapat dua fasa pengumpulan data, fasa 1 adalah temu bual dengan petani dan fasa 2 adalah pengumpulan sampel tanah. Wawancara telah dijalankan di ladang semasa lawatan ladang sebelum kami mengumpul sampel tanah. Analisis tanah terdiri daripada warna tanah ditentukan dengan merujuk kepada Carta Warna Tanah Munsell, tekstur tanah dengan kaedah rasa, pengukuran pH tanah H2O dan Kekonduksian elektrik tanah dan penentuan bahan organik tanah dengan kaedah pembakaran kering. Dalam penelitian ini, 14 petani yang telah diwawancarai. Berdasarkan temu bual dan persampelan yang dijalankan di tapak, pengetahuan petani dibahagikan kepada dua kategori iaitu tanah yang buruk dan baik. Penilaian petani adalah berdasarkan warna tanah, tekstur, batu, kelembapan dan kelembapan. Secara keseluruhan, analisis sifat fizikal tanah menunjukkan bahawa tidak ada kepentingan yang berbeza antara tanah yang baik dan buruk. Kesimpulannya, petani mengklasifikasikan tanah berdasarkan pemahaman dan persekitaran mereka.

***Kata kunci**: lada, petani tempatan, ladang, Sarawak, etnopedologi, kesesuaian tanah,analisis tanah*

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LIST OF ABREVIATION

˚C	Degree Celsius
%	Percentage
mm	millimetre
km	kilometre
Ca	Calcium
K	Potassium
Mg	Magnesium
N	Nitrogen
P	Phosphorus
GAP	Good Agriculture Practice
UV	Ultraviolet
µs	Microsecond
EC	Electric conductivity
SOM	Soil organic matter

CHAPTER 1: INTRODUCTION

Soil is the result of pedogenic processes that occur during and after the weathering of rocks, resulting in a dynamic natural body composed of mineral and organic constituents with unambiguous chemical, physical, mineralogical, and biological properties that exist at varying depths across the earth's surface and provide a medium for plant growth for land plants (Biswas & Mukherjee, 1994). The factor of soil selection is to produces plants that provide a good yield.

Black pepper, (*Piper nigrum* L.) is from the family of Piperaceae also known as "the king of spices," is one of the world's oldest and most extensively used spices. Black pepper is a perennial climbing vine endemic to India, with its origins in the Malabar region of Kerala. Many tropical countries, including Malaysia, Brazil, Indonesia, and Vietnam, grow black pepper. *Piper nigrum L*. is known as *Kali Mirch* in Urdu and Hindi, *Pippali* in Sanskrit, *Milagu* in Tamil, and peppercorn, white pepper, green pepper, black pepper, and Madagascar pepper in English. The entire peppercorn of black pepper, or its active components, are utilised to flavour a broad range of foods and cuisines across the world. Black pepper and its secondary metabolites are use as drugs, medicine, preservatives, insecticides, and larvicidal control agents. It's widely used to flavour confectionary baked products, condiments, sauces, curry powders, and masala powders.

Ethnopedology is a branch of indigenous knowledge that studies local people's knowledge in assessing soil fertility and suitability for agricultural uses, as well as rural people's soil and land use knowledge systems. Thus, ethnopedological studies are often used to describe local soil knowledge, soil evaluation, and land management. As mentioned by Brady (1990), two fundamental sources that gained from soil knowledge are farmer experience, which is founded on centuries of trial and error, and scientific examinations of soil and their management. The farmer refers to the area of the earth's surface known as the soil as being where they can cultivate and grow crops to feed their families (Biswas & Mukherjee, 1994). The knowledge acquired by the

previous generation is handed on to the current generation, which then develops it into a framework for comprehending natural resources and pertinent ecological processes (Pawluk et al., 1992). Traditionally, the knowledge obtained by past generations is passed down to the next generation, which is then processed into a system of natural resource understanding and applicable ecological processes (Pawluk et al., 1992).

While researchers from other nations conducted the majority of the ethnopedology studies, there was much less research done in Sarawak than in Africa, China, Egypt, India, and Mexico. Currently, many scientists and extension workers in developed nations have come to the realisation that rural people have a deep grasp of local resources in ethnopedology investigations. Studies of local environmental knowledge, or ethnoecology, are more and more recognised as being essential to the preservation of agriculture and biodiversity as well as the improvement of sustainable land use (Berkes, et al. 2000). In Sarawak, Malaysia, the majority of the population relies heavily on agricultural activities for their living. The amount of information on indigenous knowledge used by the native tribes of Sarawak to comprehend their surroundings is still scarce.

Despite the fact that local farmers in Sarawak frequently sought advice from extension workers and Department of Agriculture experts on appropriate farming techniques, they continue to rely on indigenous knowledge to maintain soil fertility and managing their soil resources. Nonetheless, to ensure the fertility of their soils for better crop production, the majority of local farmers rely on fertiliser applications subsidised by the local government. Considering farmers' opinions and perceptions of their existing management practises is a starting point for developing indigenous knowledge of soil management targeted at enhancing pepper cultivation yield output at this community.

Hence, this research was conducted to document the smallholder farmers knowledge in determining land suitability and their management practices for pepper cultivation and to document the specific soil criteria when in pepper cultivation.

CHAPTER 2: LITERATURE REVIEW

2.1 Sarawak pepper Cultivation

Pepper (*Piper nigrum L*) is one of the world's oldest commodities, and it is regarded as the most precious and sought-after spice. It is considered to have medicinal properties, which adds to its allure and worth as a spice. It became one of the most significant crops farmed by the Hakka Chinese community in Bau district in Sarawak in the 1840s (Sim & Paulus, 2011). The smallholder farmers primarily normally planted pepper in fertile hill slopes (Kamarulzaman et al., 2013). There are many peppers cultivar. Chinese farmers were the first to cultivate pepper in the early years. 'Kuching' is the most extensively grown variety in Sarawak. Based on Department of Agriculture Sarawak, two cultivars, 'Semongok perak' and 'Semongok emas,' have been released to farmers as a result of research. Pepper is grown in Sarawak as a monoculture with no shade, primarily on gentle to steep slopes. If the holdings are in a low-lying area, field drains must be installed. After cleaning the area, vines are planted on mounds. Before, farmers always weeded their fields that resulted in significant soil erosion. However, nowadays, pepper growers are being encouraged to use ground cover in their operations (Department of Agriculture Sarawak, 2021).

Pepper normally planted by cuttings. Cuttings that have been pre-rooted, polybag-nursery, or are unrooted must be shaded until they have established themselves. Young vines are taught to climb along a support structure such as ‘belian’, *Gliricidia sepium* and *Erythrina indica*. The vines must be trimmed to the desired canopy. The first round must be done 6 months after planting to allow three leader shoots to sprout, and the second must be done when the vine has passed half post, which should be 12–14 months after planting. The last trimming is done after the terminal shoots have reached the top of the post. The last cycle usually takes place around the time of the first berry harvest. Chemical fertilisers must be employed to keep the pepper production high. The key plant nutrients N, P, and K must be provided on a regular basis to young vines. Liming with

dolomite is required to increase the Ca and Mg nutrition of the vines while also raising the pH of the soil.

In Sarawak, pepper production is still one of the most important rural economic activities. Due to its market and export potential, pepper farming has been one of the most important agricultural activities done by rural people and one of the commodities capitalised by the government to lessen poverty rates among rural regions. Currently, the business attracts roughly 33,695 smallholder pepper growers across the country, with Sarawak accounting for nearly all of them (Entebeng et al., 2020). Native farmers, predominantly Ibans and Bidayuhs, currently account for roughly 87 percent of pepper producers, due to the Department of Agriculture's planting plans, which have been in place since 1972. Sarawak exports over 70 percent of its pepper as whole black pepper, with the rest as white pepper, green pepper in brine, value-added pepper, and pepper products. Black pepper is formed by sun-drying fresh berries plucked off spikes that are just beginning to mature. The pericarp of white pepper is removed by immersing the berries in clear running water and then sun-drying them. Farmers in rural areas sell their pepper to village merchants, who then sell it to town dealers. Farmers sell directly to town merchants or exporters in locations closer to towns (Department of Agriculture Sarawak, 2021). Notably, 90 percent of the pepper produced is destined for export, despite a minor increase in local pepper consumption, therefore, Sarawak Pepper has been chosen as the trade name and commercially used to promote Malaysian peppers globally. Sarikei, Betong, and Serian are the three largest pepper-producing divisions in Sarawak, accounting for around 61 percent of the overall production area of 17,087 acres in 2017 (Entebeng et al., 2020). Despite all the effort and achievement in pepper cultivation, In the rural communities, pepper cultivation remains a difficult farming practise. This is because low yield and uncertain revenue, an ageing population and a lack of enthusiasm among the younger generation, greater farm input costs, poor extension services, pepper-related diseases, and limited subsidy and support are still only a some of the difficulties cited.

2.2 Local Knowledge on Soil for Agriculture

Sarawak, Malaysia's largest state, is home to a diverse population of indigenous peoples including the Iban, Chinese, Malay, Bidayuh, Melanau, and Orang Ulu. Due to the fact that indigenous soil knowledge has little information and there are requirements, people continue to rely on indigenous knowledge to maintain soil fertility. Traditional knowledge studies have been found to be beneficial in a range of elements of tropical natural resource management, including biological diversity preservation, biological crop pest control strategies, soil fertility management, and soil and water conservation. Farmers have their own ideas on how to classify soil based on their local knowledge. Colour, texture, consistency, and usefulness appear to be common criteria in soil ranking or classification; on the other hand, humidity, drainage salinity, fertility, and workability are also recognised in other systems (Osunade, 1989). Apart from that, farmers utilised soil colour and texture as a method for evaluating soil quality and distinguishing soils. They also picked a range of plant species to represent soil, which is one of the most crucial components of soil classification in many cultures.

Furthermore, the yield of the pepper produced will be influenced by the fertility of the land. The Malaysian pepper sector will face a big challenge of diminishing production unless there is a major breakthrough in pepper cultivation employing innovative technologies and effective research to address pepper-related diseases (Entebeng et al., 2020). Limited land availability, and a lack of knowledge are just a few of the issues that have made agricultural activities less economical. Aside from land scarcity, there are also shortages of high-quality seeds, tools, fertiliser, and other agricultural necessities. Farmer’s income is positively correlated with the size of their land, fertiliser, and educational standing, according to the findings. Because of these constraints, most farmers in rural regions plant and sustain crops just for survival.

2.3 Sarawak Agronomic Practices (GAP)

In order to invigorate the agricultural activities in Sarawak, the Department of Agriculture Sarawak has introduced SALM (Skim Akreditasi Ladang Baik Malaysia). SALM is a national programme started in 2002 by the Sarawak Department of Agriculture to accept and accredit farms that use good agricultural practises (GAP), operate in an environmentally friendly manner, are concerned about worker welfare, and produce high-quality, safe, and suitable for human consumption products. It was designed particularly for farms that produce fresh fruits and vegetables. Because SALM's implementation is based on minimum criteria, the strategy is progressive in character and involves the element of ongoing improvement. The scheme's purpose is to encourage farmers to adopt GAP as a work culture or a standard on their farms. This programme is built on the concept of inspectors and auditors inspecting and evaluating agricultural and farming activities for compliance with accepted and specified procedures, national guidelines, standards, legislation, and GAP policies. SALM includes field inspections, observations, interviews, and auditing, as well as pesticide residue and heavy metal analyses on harvested vegetables.

Smallholders pepper farmers in Sarawak practise an intense pepper farming approach. The yields are pretty high under this approach, but the manufacturing expenses are equally large. Physical properties of the soil have a significant impact on pepper output. To minimise or improve soil physical limits, a variety of arrangement strategies can be used. Because pepper is grown on soils that are naturally poor in fertility, fertiliser treatments are critical for quick development and good yields. Investigations into the nutritional characteristics have yielded fertiliser recommendations for this crop, especially when grown on shale-derived clay to clay loam soils. To increase fertiliser efficiency, soil type, manurial history, vine age, and cropping level should all be considered when making fertiliser recommendations. However, according to Entebang et al. (2020), Gap practices for pepper farm is still lack. Even though the Standard for Industrial

Research Institute (now known as SIRIM Berhad) certified the GAP standard for pepper on January 19, 2006, there is no standard on GAP implementation at pepper farms, despite regular deployment of training and extension services over the years (Eng & Gumbek, 2007). This shows that pepper producers may not follow GAP guidelines in food production, putting the quality and safety of the food supply at risk.

CHAPTER 3: MATERIALS AND METHODS

3.1 Study Area

This study was carried out at Mongkos, Serian Sarawak (as shown in Figure 1) with latitude 00˚ 55’ 19” N and longitude 110˚ 29’ 04” E. The distance from Kuching to this area is about 105 km and the distance from Serian Township to the area is about 47 km. The average annual temperature for Mongkos area is 32˚C, about 3754 mm of rain in a year, humidity average is 86% and UV index is 6 (Meteorological Department Malaysia). Most of the communities in this area are Bidayuh people and their main cultural activities are rice cultivation and cash crop farming (pepper, oil palm and rubber).

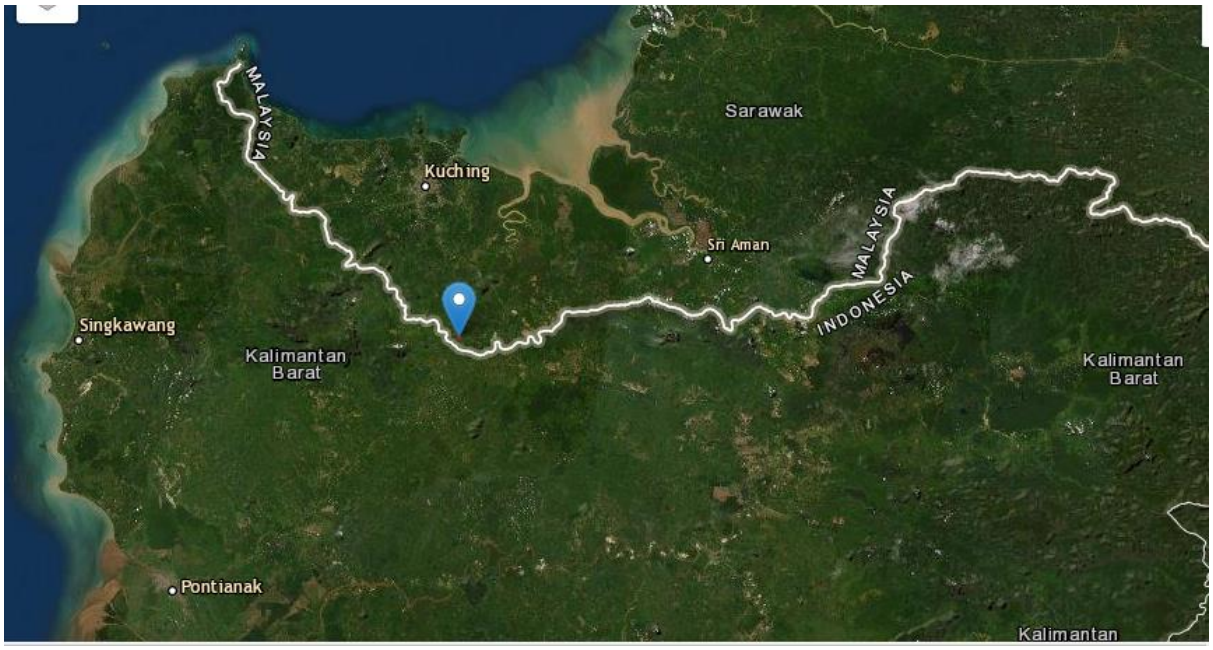

Figure 1. Location map of Mongkos area

3.2 Data Collection

There were two phase of data collection, phase 1 is interview with the farmers and phase 2 is soil sample collection.

The interviews were conducted in the farm during farm visit before we collect the soil samples. The location for soil sampling were determined by the farmers in their farm and the

information that were gained from the interview and analyses were used for data analysis The soil sample was collected at a specific location at the farm based on the 14 respondents that has been interviewed. The soil sample taken is hoed by the farmer themself and only the surface soil is taken which is approximately in 0 to 10 cm. For every farm, only one soil sample were collected. The soil samples were brought back to the Environmental Soil Laboratory, Department of Plant Science and Environmental Ecology, Faculty of Resource Science and Technology (FRST), Universiti Malaysia Sarawak (UNIMAS) for identification.

3.3 Method of Soil Analysis

3.3.1 Soil colour

The soil colour was determined by referred with Munsell Soil Colour Chart that used to classify soil colour. The Munsell Colour Chart has three simple variables that are hue, value and chroma (used to specify colours). The Hue notation of a colour indicates its relation to the spectral colours such red, yellow, green, blue and purple. For value, indicates the lightness of the colour; and chroma the strength, or departure of the colour from a neutral colour of the same lightness.

3.3.2 Soil texture

Soil texture is the property of a soil which refers to the relative amounts of different sized particles present in a soil. Soil texture is described using terms such sand, silt, loam and clay which indicates the relative proportions of different-sized particles present. The soil texture was determined using feel methods. Interpretations are as follow, if soil will not cohere into ball, it is sand but if the soil form ball and falls apart, it is loamy sand. When the soil ball can be roll into cylinder and threads it is sandy loamy (sandy feel predominate) or silt loam (silky soap feel predominate). Then, if the thread can be bent into U shape and the U is cracked, it can be sandy clay loam (significantly silky soap feel and significantly sandy feel) or silty clay loam (significantly silky soapy feel). Continue, if the threads roll into ring and the ring cracked, it is

clay loam (significantly silky soapy feel). If the ring is not cracked, the texture can be sandy clay (significantly sandy feel), silty clay (significantly silky soapy feel) or clay (if no sandy and silky soapy feel).

3.3.3 Soil pH of H_2O and Soil Electric Conductivity (EC)

Measurement method of pH of H_2O and Soil Electric Conductivity (EC) were as follow, first, 5.00 g of each soil sample weigh. Next, 25 mL of deionized water add and shake for 1 hour at 120 minutes. Then, EC measure with EC meter first and then pH measure with calibrated pH meter using water suspension (the suspension shakes by hand immediately before measurement).

3.3.4 Soil organic matter (SOM)

The soil samples obtained from field were air-dried for one week and sieve with 2mm mesh sieve for soil physicochemical analysis. Determination of Soil Organic Matter by the Dry Combustion Method (Loss on Ignition Method) are as follow, the sample was place in an oven to dry at 60°C for 24 hours, and cool it in a desiccator. The initial weight of the silica or porcelain dish (crucible) is taken. Then, place 5g of this sample into a silica or porcelain dish (crucible) and take the weight of the silica or porcelain dish (crucible) plus the sample. Then, placed the sample in a muffle furnace and initially ash at 300°C for 1 hour. The temperature of furnace raised to 550°C and continue with the ashing for 8 hours and allow the sample to cool down before inspection and take the weight of sample and crucible after ashing.

Calculation of the organic matter (SOM, %) are as follow:

$$Soil\ Organic\ Matter\ (\%) = \frac{Weight\ of\ soil\ after\ oven(g)\ -\ weight\ of\ soil\ after\ furnace\ (g)}{Weight\ of\ soil\ after\ oven(g)}\ x\ 100$$

3.4 Data Analysis

The interview result and all the result obtain from the laboratory analysis were analyse and interpret into analysis using Student Pair t-test on Microsoft Excel.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Local pepper cultivation in the study area

Pepper cultivation in this area is practically large and very influential to the agricultural activities of the population. This is because, almost all the families or houses of the residents have pepper plantations and are one of their sources of income. The people around the area are mostly farmers. Their main agricultural activities are rice and pepper or oil palm cultivation. In total, the pepper farm are less than 1 acre or 100 to 700 pepper trees. As for the pepper cultivation area, usually, the residents will plant paddy in the area before turning the area into their pepper garden. Also, majority pepper farmers planted their pepper in slope or hills area. The government also provides agricultural courses for the residents of the area but in small groups. Usually, 10 to 20 farmers in the area are selected to take basic agricultural courses such as pepper cultivation, oil palm and fruit such as durian. Farmers in this area grow peppers because they are exposed by the government to pepper cultivation and the residents are given subsidies such as fertilisers, herbicised and insecticides for their cultivation of rice and peppers. Besides that, there are also pepper farmers who not only adhere to subsidized fertilizers from the government but they buy their own fertilizer. In addition, farmers sell their pepper to village merchants, who then sell it to town dealers or farmers sell their pepper directly to town merchants or exporters.

in locations closer to towns

In this study, there are 14 farmers that have been interviewed. The farmer’s age is between 40 to 67 years old. All the farm area size is less than 1 acre with the range 200 to 650 number of pepper vine. The farm age is between 1 to 13 years old.