

<b>Research name</b>	Plant Growth around Kaolin Mine		
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### Abstract

The results of Kaolin that was found in Ranong Province during the concession for excavation and mining of kaolin causing contamination of kaolin, water sources and the formation of white clay powder around the mine, in the Sub district, Hadsompan of Mueang District in Ranong Province. It was found that Kaolin can destruct pests and also prevents the skin from getting burnt through direct sunlight, because it looks like a thin film which is a result in more photosynthesis of plants, that helps to prevent heat from the sun on hot days and also protects the skin of the fruit from sunburn thus making the fruit have beautiful skin instead.

Get more productivity helps reduce the chance of anthracnose disease and Alternaria diseases. It is a new innovation that will help reduce chemical residues in agriculture. Residual kaolin can also be removed easily by washing it off with water. Kaolin does not cause soil pollution. The research team is therefore interested in studying the kaolin dust of the kaolin mine that affects plant growth and other factors,

by determining the survey area to be a replacement forest in the mine and natural forest that is far away from the mine, including the surrounding environment.

It was found that even though the area around the white clay mine was not suitable for plant growth, the plant could still grow well as close to the surrounding plant's area and allows the application to be enabled to the application of kaolin in agriculture. The Kaolin min can be developed to be an agricultural area.

## **Introduction**

Kaolin is white clay which can be found in Ranong especially in Hadsomepan district of this province. This caused that many mine industries developed in Hadsomepan. The dust from kaolin covered the local place nearby Hadsomepan district. This kind of dust is very beneficial to plants around the area. Associate Professor Dr.Kanapon Jutamanee and his team at department of Botany Kasetsart University Thailand studied and developed Kaolin, as spray to cover the leaves of fruit like with mango trees and dragon fruits. He found that the spray of Kaolin can protect the trees and destroy the pests, because kaolin can cover the fruits' skin so it makes the fruit surface beautiful and can produce more fruits, reduced the anthracnose in mango trees and reduced the Alternaria diseases on dragon fruit, otherwise there was a report of experiment in apple plots that showed. The kaolin film on leaves and fruit help increasing photosynthesis, because the kaolin film worked as the wax for protecting leaves from sunlight and sunburn The Kaolin film is the innovation for reducing agricultural residue. The Kaolin is easy to eliminate with water and it doesn't pollute the land.

The researcher intended to study the effects of tree growth around Kaolin mine by collecting growth data, type and the size of the environment; weather, soil, groundcover, tree height and tree circumference on the area received effect from Kaolin mine for comparing the growth of the trees around the Kaolin mines.

## **Objectives of the study is to**

1. study the effects of kaolin dust towards the growth of plants in Ranong Kaolin mine and
2. to compare the growth of plants in kaolin mine and those around the mine

## **Research questions**

1. Is Kaolin dust of Kaolin mine affecting plant growth?
2. Are the plants in the kaolin mine area growing close to the surrounding plants?

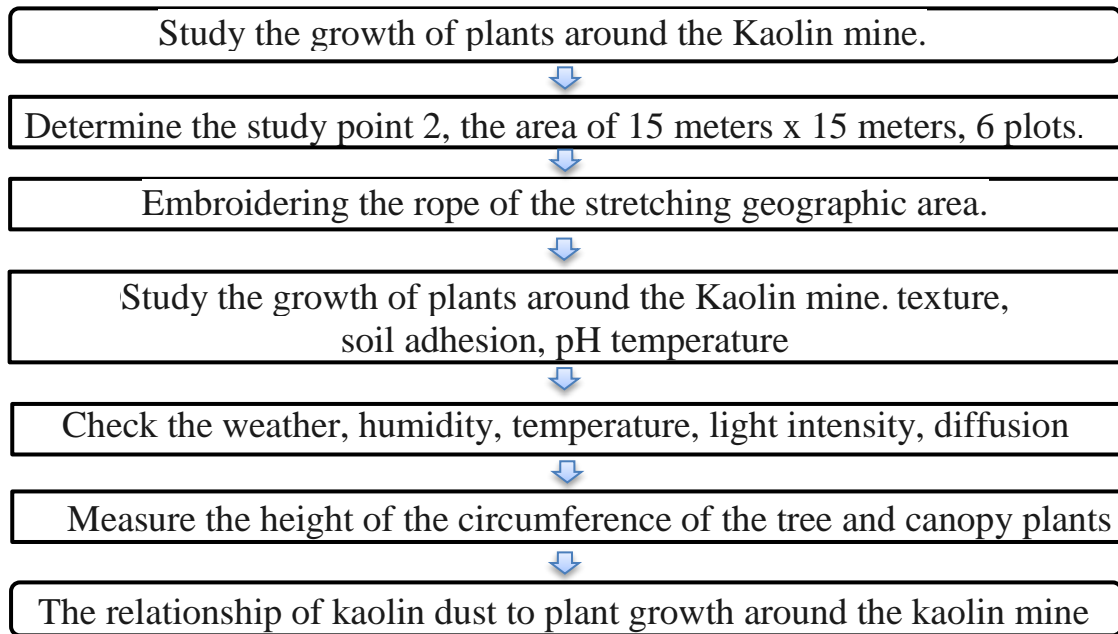
## Materials and methods of research

### Materials and equipment

- |                                     |                   |                |
|-------------------------------------|-------------------|----------------|
| 1. Meter tape, measuring line, rope | 4. Moisture meter | 7. Thermometer |
| 2. Compass                          | 5. Lux meter      | 8. pH meter    |
| 3. Clino meter                      | 6. Densio meter   |                |

### Method

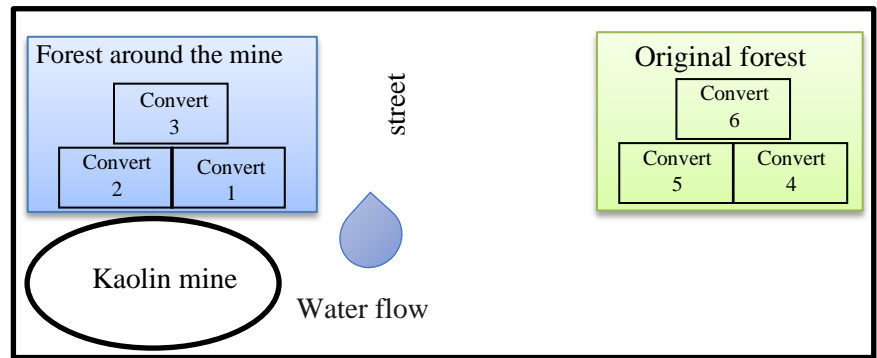
#### 1. Steps for conducting research



#### 2 Research methods:

1. Determine the study point of the white clay mine, Mineral Resources Development Co., Ltd. hadsompan, Mueang District, Ranong Province, in the Kaolin mine area with the excavation of the kaolin point with plants around the kaolin mine which has a restoration area that has planted forests to replace the mining areas that are still affected by dust, kaolin covered and areas with original natural forests from the old mines around the mine, about 1 kilometer away from the mining area, by comparing the two study areas in 3 adjacent areas, totaling of 6 plots. 15 meters x 15 meters away from the water flow 50 meters

As the study area diagram.



2. Collect soil samples to study soil structure, soil color, soil texture, soil adhesion Measure temperature and pH with pH meter.

3. Check the weather, Measure the temperature by using a moisture meter pH with a digital moist meter and light intensity with a Lux meter in the weather conditions in each survey area.

4. Measure the covering of the canopy through density meters. Explore the cover plants in the soil. Measure the height with a Clino meter. Measure the diameter of the tree and count the number of trees to determine the density in each plot studied.

5. Conclusion Comparison of the study of plants in a restored forest kaolin mine, which has dust, covered by kaolin and original plants in the surrounding area, 1 km away.

Note: Use the environmental measurement method according to Globe's guide on soil cover and use other measuring instruments.

## Research result

Kaolin mine Mineral Resources Development Co., Ltd. Hadsompan Muang District Ranong.

The area in the Kaolin mine 2, storage area at 11.00 hrs.

1. Reforestation areas that have planted forests to replace the mining areas that have been planted for 10 years, are still affected by dust, white clay and covered by 3 plots adjacent to each other, 50 meters away from the water flow x 15 meters with 4 angles measuring a total of 4 points as shown in Table 2.

Study conversion	Geographic coordinates (Lat: )				Geographic coordinates (Lng: )			
	Point1	Point2	Point3	Point4	Point 1	Point 2	Point 3	Point 4
1	9.9525	9.9475	9.9475	9.9475	98.6869	98.6914	98.6914	98.6914
2	9.9475	9.9475	9.9475	9.9475	98.6914	98.6914	98.6914	98.6914
3	9.9475	9.9475	9.9475	9.9475	98.6914	98.6914	98.6914	98.6914

**Table 1 Geo-forest substitution coordinates in kaolin mines**

The geographical coordinates of the study area Lat: 9.9475 Lng: 98.6914

2. Areas with natural forests from old mines around the mine, about 1 kilometer away from the mining area, 3 plots, each study area converted to an area of 15 meters x 15 meters.

Geographic coordinates of the study area Lat: 9.94596 Lng: 98.68712

Study the surrounding environment that affects plant growth, including air, soil and water nearby. Of the 6 study plots and the average value to sum up is the overall environment of both study areas which was measured at the center of the plot 3 times.

At the soil condition inspection we used the soil above and below the base 10 cm, 3 points, mixed together with the 6 study plots, and find the mean to sum up as the overall environment soil structure measurement and Soil texture with soil and soil structure testing kits. Measure soil temperature and measure pH with pH meter. From soil quality testing, the results of the experiment are shown in Table 3 by soil from replacement forest in Kaolin mine And the soil from the original natural forest have some similar features Such as the structure of the soil is the same grain The seizure of similar soil is quite crumbly. At the same survey, the temperature of the soil is similar. However there are some properties that are different: soil color, soil texture characteristics. In addition, the pH of the soil in the replacement forest in the kaolin mine is quite a base, while the pH of the soil in the original natural forest is quite neutral.

**Table 2 soil inspection**

<b>Soil inspection</b>	<b>Forest around the mine</b>			<b>Original forest</b>		
	Convert 1	Convert 2	Convert 3	Convert 4	Convert 5	Convert 6
Soil structure	Granular	Granular	Granular	Granular	Granular	Granular
Soil color	White	White	White	Red, yellow	Red, yellow	Red, yellow
Soil retention	Loamy	Loamy	Loamy	Loamy soil	Loamy soil	Loamy soil
Soil texture	Sandy loam	Sandy loam	Sandy loam	Sandy soil	Sandy soil	Sandy soil
Soil temperature °C	28.5	28.0	28.0	28.0	28.5	28.5
pH	7.59	8.00	7.41	7.09	7.01	7.15

Average soil temperature Renewable °C forest in kaolin mine is 28.17 °C. The original natural forest is 27.43 °C.

The average pH Forest around the mine is 7.67. The original forest is 7.08.

Weather monitoring Measured from a 1 meter high ground by measuring the °C temperature and humidity (RH) with an air humidity meter. The light intensity measurement (LUX) is measured by a light meter. Repeated measurements are also performed. In addition, the diffusion of kaolin on the leaves is observed. The area with kaolin follows the leaves of the ground cover and dominant plants with tall trees. From checking the properties of the air obtained results as shown in Table 4 by the air of the area studied in the replacement forest in the original clay mine and natural forest. There are similar properties that have similar moisture, temperature and light intensity but the diffusion value of the kaolin on the tree is not the same, the replacement forest in the kaolin mine is dispersed of kaolin along the trees and plants covering the ground from mining. Kaolin trapped in trees and leaves

**Table 3 Air Monitoring**

Air monitoring	Forest around the mine				Original forest			
	Convect 1	Convert 2	Convert 3	Average	Convert 4	Convert 5	Convert 6	Average
Moisture (RH) (%)	57	60	55	57.33	56	57	58	57.0
Temperature (°C )	28.5	29.0	29.0	28.83	30.0	29.0	30.0	29.67
Light Intensity (LUX)	2210 2250 2239	1782 1790 1776	1880 1894 1870	1943.4	2036 2050 2046	2001 2011 2004	2059 2051 2039	2033.0
Average	2166.3	1782.7	1881.3		2044	2005.3	2049.7	
Diffusion of kaolin on leaves	Cover plant leaves and ground	Cover plant leaves and ground	Cover ground	-	-	-	-	-



Measure height with a Clino meter. Measure the diameter of the tree by randomly dividing 10 trees per plot in each plot. Each of the 2 types of studies were substituted forests in the original white clay and natural forest mines, each with a total of 6 plots. Results as shown in Table 5 by replacement forest in Kaolin mine There is a circumference of the tree and the height is higher than the original natural forest Because the replacement forest is planted by the Kaolin Mine Company which has a nursery and has a consistent planting period, causing the tree to have a similar size and height because it is planted together at the age of 10 years. There is a local tree that grows naturally from the old abandoned mines that have been abandoned for a long time. The age of the trees varies naturally.

**Table 4 the circumference of the trees around the kaolin mine**

<b>Tree</b>	<b>Forest around the mine</b>			<b>Original forest</b>		
	Circumference (cm)			Circumference (cm)		
	Convert 1	Convert 2	Convert 3	Convert 4	Convert 5	Convert 6
1	72	56	82	79	61	76
2	80	86	61	46	39	42
3	68	80	64	53	39	50
4	59	62	73	41	71	38
5	61	66	83	68	42	41
6	92	68	94	45	67	70
7	71	58	64	67	54	54
8	63	81	75	80	39	61
9	69	72	79	62	56	56
10	61	75	58	47	54	64
Average	<b>69.6</b>	<b>70.4</b>	<b>73.3</b>	<b>58.8</b>	<b>52.2</b>	<b>55.2</b>
Average	Circumference (cm) = <b>71.1</b>			Circumference (cm) = <b>55.4</b>		

**Table 5 The height of the trees around the kaolin mine**

Tree	Forest around the mine			Original forest		
	Height (m)			Height (m)		
	Convert 1	Convert 2	Convert 1	Convert 2	Convert 1	Convert 2
1	26.7	22.6	26.7	22.6	26.7	22.6
2	35.2	38.0	35.2	38.0	35.2	38.0
3	34.7	36.4	34.7	36.4	34.7	36.4
4	23.6	24.3	23.6	24.3	23.6	24.3
5	24.5	24.5	24.5	24.5	24.5	24.5
6	37.1	28.0	37.1	28.0	37.1	28.0
7	28.1	22.6	28.1	22.6	28.1	22.6
8	26.3	37.3	26.3	37.3	26.3	37.3
9	27.3	26.5	27.3	26.5	27.3	26.5
10	25.2	27.3	25.2	27.3	25.2	27.3
Average	<b>28.87</b>	<b>28.75</b>	<b>28.87</b>	<b>28.75</b>	<b>28.87</b>	<b>28.75</b>
Average	Height (m) = <b>29.2</b>			Height (m) = <b>22.73</b>		

In addition, the number of trees that are taller than 2 meters in the area of 225 square meters is calculated to calculate the density of all 6 study plots, which are transformed in replacement forests in 3 clay kaolin mines and converted into original natural forests. 3 plots

From the number and density of trees as shown in Table 6, in the replacement forest area in the clay mine is denser than the original natural forest, because the forest is a forest that is grown by the clay mining company.

White, mostly natural forest areas covered soil with a height of less than 2 meters.

**Table 6 Number and density of trees 15 meters x 15 meters**

Number of trees higher than 10 m	Forest around the mine			Original forest		
	Convert 1	Convert 2	Convert 3	Convert 4	Convert 5	Convert 6
Number (tree)	35	30	25	19	15	16
Density (tree/m <sup>2</sup> )	0.16	0.13	0.11	0.08	0.07	0.07
Average density (tree/m <sup>2</sup> )	0.13			0.07		

Explore the types of trees With emphasis on outstanding plants with the highest number of secondary plants and ground cover plants Addressing the replacement forest area in the Kaolin mine Which has been planted by the mines after 10 years of not being mine in the planting, do not take special care, care for the kindergarten, the young tree in the first year and let it grow naturally. The soil layer is still more than 20 cm deep kaolin. The other area is the original natural forest area. This is a forest that plants itself naturally, from an abandoned mine with a rock structure below, about 1 kilometer away from the mine, as shown in Table 7

**Table 7 Distinct plants, secondary plants and ground cover plants found**

<b>Plant type</b>	<b>Forest around the mine</b>			<b>Original forest</b>		
	Convert 1	Convert 2	Convert 3	Convert 4	Convert 5	Convert 6
Primary plants	Acacia thepa Yangna	Acacia thepa Yangna	Acacia thepa Yangna	Yangna	Acacia thepa	Acacia thepa
Secondary plants	Payom	Mangke	Payom	Payom	Payom	Payom
Tertiary plants	Reed	Reed	Reed	Reed	Reed	Reed

Measure the covering of the canopy through density meters to see the light transmission characteristics of the 6 experimental plots and indicates the density of the plant by measuring 4 points from the center in 4 directions in the six plots of study, which are converted in the replacement forest in 3 kaolin mines and converted into the original natural forest 3 plots, as shown in Table 8 it was found that the replacement forest in the Kaolin mine had more canopy than the tree because the trees were planted at a similar distance and were similar in age.

**Table 8 Canopy and soil cover plants**

Canopy	Forest around the mine			Original forest		
	Convert 1	Convert 2	Convert 3	Convert 4	Convert 5	Convert 6
1	++++	+ - ++	++ - +	+ - ++	+ - - +	- + + +
2	++ - +	++ - +	- + - +	+ - ++	++ - +	- + - +
3	+ - - +	+ - - +	+ - ++	+ - + -	+ - ++	+ - ++
4	- + + +	- + - +	- + + +	+ - + -	- + - +	- + + +
percent	75	62.5	68.75	62.5	62.5	68.75
Average %	68.75			64.58		

## **Results of Research**

### **Conclusions**

1. The kaolin dust of the kaolin mine covered the ground cover and the plants in the kaolin mine had no effect on the growth of plants around the kaolin mine. Plants grow normally, unlike plants that are far away.
2. Most dust in the additional plant environment is not very different around the mine without kaolin in the air of the forest and traditional natural forests.

### **Discussion of research results**

The clay dust of kaolin-like soil covered the ground cover and the plants in kaolin do not affect the growth of the plants around the kaolin mine. That the plants grow normally, not unlike plants that are far away. From the survey of plants in the replacement forest that is in the forest around the mine can grow well with an average circumference of 71.1 cm, an average height of 29.2 m, an average density of 0.13 trees / m<sup>2</sup>, which is different from natural plants that are not far away from the clay mine that is not found. With an average circumference of 55.4 cm, an average height of 22.73 m., And an average density of 0.07 trees / m<sup>2</sup> which shows that the plants in the kaolin mine are growing close to the surrounding plants.

Plant environment, in addition to dust, kaolin powder in the air of renewable forest areas, in the mine and original forest mines that are far away Most are not very different, is soil properties With soil structure Soil retention and similar soil temperature Even though different from, for example, the pH of the forest around the mine is pH 7.67 and the original forest is pH 7.08 because the forest around the mine is substituted with a lot of soil that is kaolin For air properties With similar values such as humidity, temperature and light intensity In addition, primary plants are still the same *Acacia thepa* but the canopy cover is different, the forest around the mine has a greater amount of coverage, because the plant is larger than the soil that covers plants in the original forest, as previously, have more green plants because they have more ground covered plants.

The clay layer in the clay mine area is hard rock, because the mining mountains are Rocky Mountains and the plants are not cared for. Most plants are local plants. Ranong is a city with the weather is more rain than sunlight. During the rainy season, the white clay that followed the stems and leaves of the plant reduce temperature and heat, although the soil characteristics are sandy soil, but the plants still receive water regularly due to the long rainy season including pH neutral soil, because kaolin has pH adjustment properties still has a moisture content of more than 50%, the temperature of the tree is not very high the light intensity is quite large, because the tree is airy, with grass and small trees, mostly with soil covered plants, because most areas had drilling, mining causing lesser tree area and the area is not very large.

Making the kaolin mine rarely affect the growth of plants around the Kaolin mine, due to the rainy season in mostly all year around Ranong province. Even though there is dust, kaolin, island-based plants do not cause the tree to stop growing compared to trees outside the kaolin mine area. Therefore, there may be development of the area around the kaolin mine that is rarely excavated to develop into a green area which is used to grow trees or agricultural areas, even though the white clay mine is a rocky mountain, but the plant can still grow close to the area that is not part of the kaolin mine yet, which, if it does develop the areas around kaolin mines to be agricultural areas, rather than being a residential area, it will reduce concerns and understand the communities surrounding the kaolin mine to affect the surrounding area of the kaolin mine.