CCFS (EP86/27/24/11-34) From Valley to Plain II: Architectural Rehabilitation for Integrated, Co-creative Eco-living Experience in Tin Sum Village, Kuk Po

Environmental & Ecological Assessment of Tin Sum (Jul-Dec 2024)

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Content

1.0 Background

Kuk Po is a Hakka village located at northeastern Hong Kong, next to Sha Tau Kok Frontier Closed Area. The predominant features of the coastal regions consist of brackish wetlands and mangroves, primarily populated by *Kandelia obovata*. Moving inland, one can find freshwater wetlands, streams, and well-established secondary forests. With such diverse habitats, the main river along the village basins, Kuk Po River is regarded as an Ecologically Important Stream (EIS), showing its importance in contributing its ecological functions such as providing habitats for diverse or rare animal or plant communities. Based on a preliminary ecological study conducted by Kadoorie Farm and Botanic Garden in 2003[1], several species with high conservation value were recorded, including Mangrove Skimmer (*Orthetrum poecilops poecilops),* Four-Spot Midget (*Mortonagrion hirosei)*, and *Mucuna championii Benth.*, etc, which arose our interest on conducting conservation-related research there.

This ecological study report is part of the project "From Valley to Plain II" organised by the School of Architecture, CUHK. The project site, Lee's Mansion in Tin Sum village, with a hill behind the mansion and a vast plain in front which used to be rice fields. Through restoring and rehabilitating the Lee's Mansion architectural cluster and introducing sustainable farming practices, the project team co-creates with stakeholders eco-living and cultural experiences workshop. This report acts as a baseline study on the properties of soil and water in Tin Sum village, and monitor the ecological changes after the application of sustainable farming practices. The results will help to determine suitable types of crops to grow in project site and assess the ecological improvements after the application of sustainable farming practices.

The objective of the environmental assessment is to:

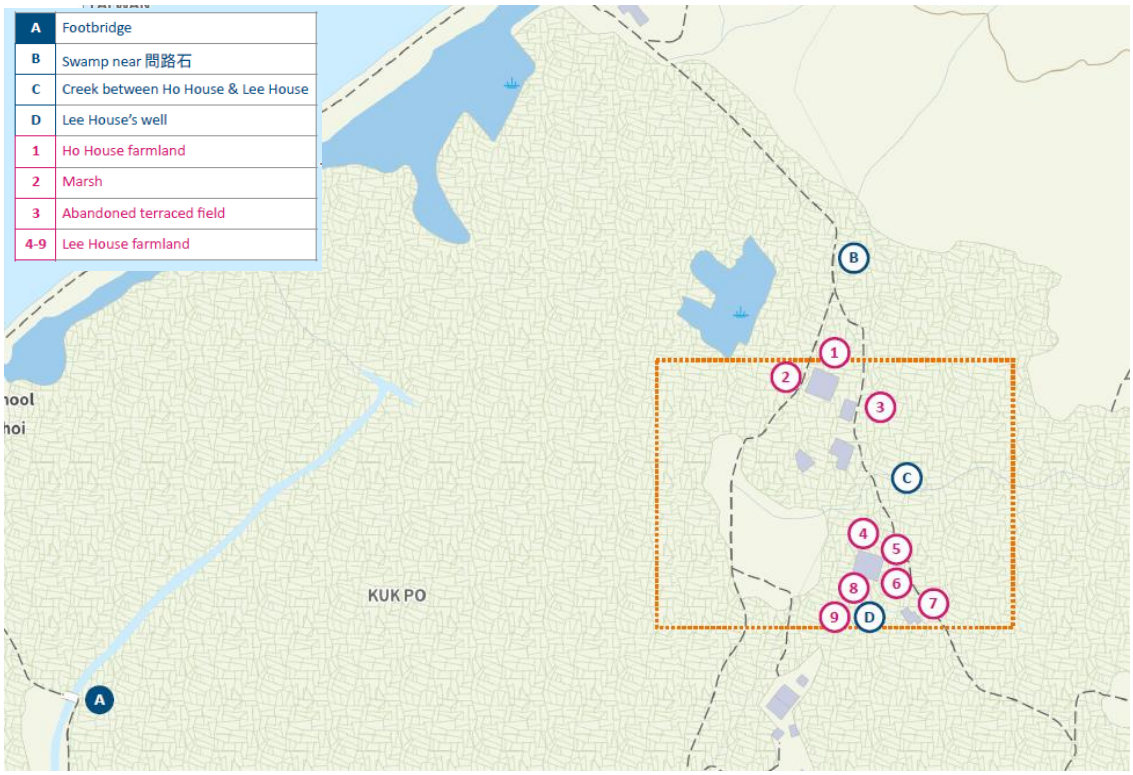
1. **Monitor the properties of the soil within the application of sustainable farming practices.**
    I. **Soil pH: To determine acidity or alkalinity, which affects nutrient availability.**
    II. **Organic Matter Content: To assess soil fertility and health**
2. **Monitor the properties of the surrounded water within the application of sustainable farming practices.**
    I. **Water Quality Indicators: pH, dissolved oxygen and turbidity**
3. **Monitor the ecological change after the application of sustainable farming practices.**
    I. **To assess species richness and abundance in the area**
4. **After assessment of the water profile, soil profile and biodiversity after the application of sustainable farming practices, by comparing the "before and after" practices after years, the success of the sustainable farming practices could be determined.**
5. **After assessment of the above properties, suggestions could be made for the sustainable farming practices to perform better for the environment and people to continue.**

[1] Captain, Wong, Michael, L. A. U., Gary, Andes., Bosco, Chan., & NG, S. C. (Eds.). (2004). A Pilot Biodiversity Study of the eastern Frontier Closed Area and Northeast New Territories, Hong Kong, June-December 2003

2.0 Water Quality Monitoring

We had a total of 3 sampling points B, C and D *(map 1)* around Tin Sum village and Lee's Mansion, while point A in the EIS would be worked as a control point. The above points are selected from freshwater wetland, or the water used by the Lees for irrigation of crops. On-site water quality measurements have been done once a month for a duration 5 months, from August 2024 to December 2024. **ProDSS** Multiparameter Digital Water Quality Meter (YSI) was used for all water quality parameter measurements on site. As the streams in Tin Sum is seasonal, we can only measure the water quality of point B, C and D where there is waterflow. For those missing data in Table 1, water quality could not be measured due to the absence of waterflow.

Map 1: The water sampling points in Kuk Po marked in blue alphabets. Point A represents as a standard point for the natural water flow as it is under the EIS (Ecological Important Stream). Point D is the water well that is commonly used for irrigation by the Lees, while point B and C would be other water flow around Tin Sum Village.



2.1 Results

2.1.1 pH Value

Overall, the water around Tin Sum Village in Kuk Po was slightly acidic in the past 5 months (Aug-Dec 2024) compared to the pH data in Jan-June 2024. The pH value of the water in all the points is found lower than the standard of a natural stream or the standard of the irrigation water. It may cause negative effect for the survival of aquatic plants and aquatic animals. Also, by using acidic irrigation water, it will cause a poor growing condition of crops. The reason of acidic stream water around Tin Sum village is needed to be investigated.

2.1.2 Dissolved Oxygen

The dissolved oxygen in point D was found to be lower than standard. As point D is the water well with a weak water current, meaning that there is a reduction of refreshment of water in point D. The low dissolved oxygen indicates that the water in well may be slightly toxic. For example, as there is a weak water current, meaning that the organic matters, i.e. leaf litters, inside the well remain there and decay inside overtime. The decomposition of leaf litters requires dissolved oxygen leading to a low dissolved oxygen value in the well.

The water in the well used to be the main irrigation water source used by the houseowner of Lee's Mansion until mid-2024 where the water pump broke down. The Lees have then shifted to using collected rainwater or tap water for irrigation. Therefore, the low DO level will have little to no impact to the irrigation of Lee's farmland.

To solve this issue for future well water use, it is recommended that the large organic matters should be taken out using a bait well net. Then add a water pump to increase water flow within the well.

2.2 Conclusion

To conclude, the sampling points show a good water quality regarding the temperature, dissolved oxygen (DO), salinity (SPC and SAL) and turbidity (NTU). The dissolved oxygen of point D (the well) is lower than standard. The pH value for the water around Tin Sum decreases gently (Figure 1), representing the water is becoming more acidic and less suitable for aquatic life to live. Acidic water may also cause the sedimentation in soil which will lead to the lack of absorption of plant root organic matter which cause a slow or lack of growth for crops. It is recommended to add baking soda to the well to neutralize acidity. Due to the little to lack of water flow in point B, C and D, it is recommended to grow crops that require less water. Suitable crops such as Aloe Vera, Pentas lanceolata, etc. which were already grown in project's farmland.

Table 1 Water quality parameters (based on the past 6 months)

Date	Point	Temperature (°C)	DO mg/L	SPC-uS/cm	SAL-ppt	pH	NTU
20/9/2024	A	26.1	8.38	46.2	0.02	7.07	7.81
22/10/2024	A	24.8	8.47	47.9	0.02	6.37	3.26
25/11/2024	A	20	9.23	49.2	0.02	6.51	3.07
6/8/2024	B	27.2	7.67	42	0.02	6.19	4.61
22/10/2024	B	30.2	6.17	86.5	0.04	6.33	152.65
25/11/2024	B	22.2	7.85	48.5	0.02	6.44	25.25
6/8/2024	C	25.6	4.67	35	0.01	5.57	3
6/8/2024	D	24.7	3.22	48.8	0.02	5.25	36.25
20/9/2024	D	25	2.1	49.3	0.02	5.97	15.11
22/10/2024	D	24.9	3.6	47.6	0.02	5.09	3.14
25/11/2024	D	24	4.76	49.2	0.02	5.22	3.96
Standard of a Natural Stream		*5-25°C*	*4-11 mg/L*			*6.5-8.5*	*< 50 NTU*
Standard of Irrigation Water[2]		*< 35°C*	*< 80 mg/L*			*5.5-8.5*	*< 100 mg/L*

Table 2: Suggested values of all water quality parameters from the literature

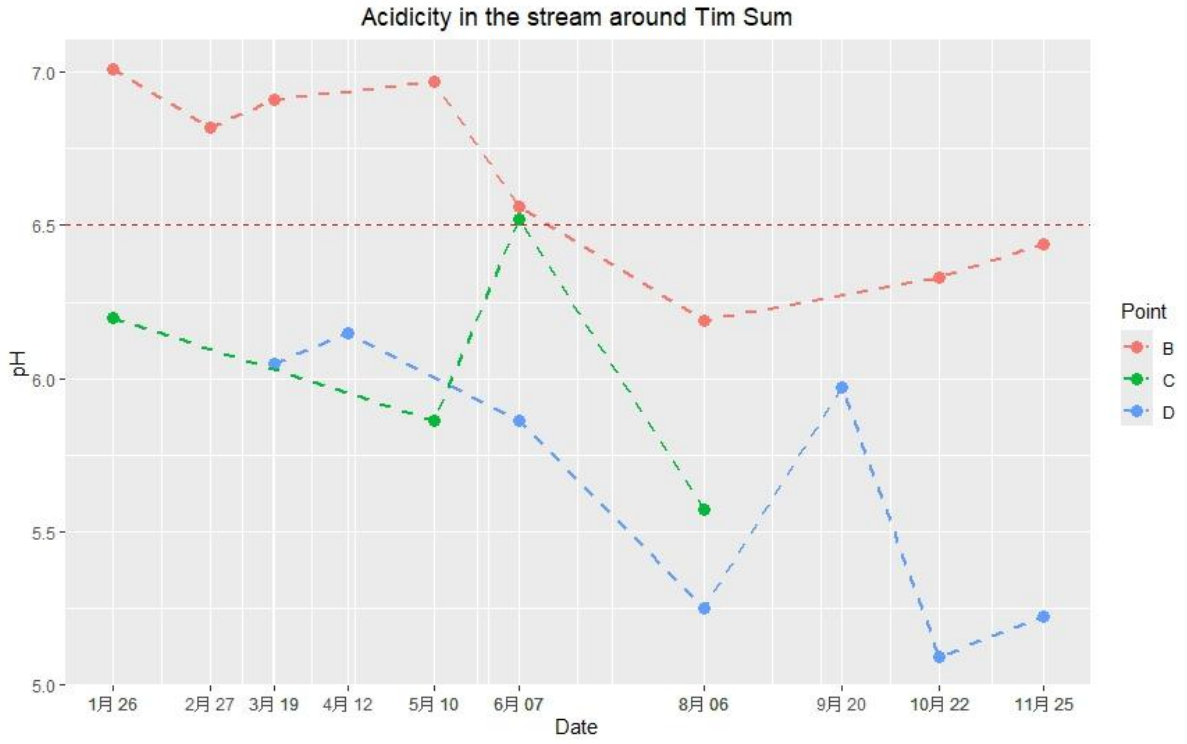
Water Quality Parameters	**Suggested Value**
Temperature	5-25°C optimal for most aquatic organisms[3]
Dissolved Oxygen	4–11mg/L good for aquatic organisms[4]
pH	6.5-8.5 optimal for most aquatic organisms (U.S. EPA)
Turbidity	<50 NTU in streams acceptable for aquatic organisms (Interstate Commission on the Potomac River Basin)

Table 3: River Water Quality in Hong Kong 2022 from EPD

Location	**Dissolved Oxygen (mg/L)**	**pH**
Freshwater wetland Tin Sum village in Kuk Po	0.35 – 14.48	5.86 – 7.47
Lam Tsuen River[5] (another EIS[6])	4	7
Tai Po Kau Stream[4]	5	7.5
Yuen Long Creek[4]	4	7.5
Tuen Mun River[4]	4	7.5
Fo Tan Nullah[4]	8.15	8.4

[2] 農田灌溉水質標準，中華人民共和國國家標準
https://english.mee.gov.cn/Resources/standards/water_environment/quality_standard/200710/W020061027512919898588.pdf
[3] *Testing the Waters: Chemical and Physical Vital Signs of a River* by Sharon Behar. Montpelier, VT: River Watch Network, 1997. ISBN 0787234923
[4] Behar, S. 1997. *Testing the Waters: Chemical and Physical Vital Signs of a River.* River Watch Network, Montpelier, VT.
[5] River Water Quality in Hong Kong 2022, Environmental Protection Department, HKSAR
[6] Ecologically Important Streams, Agriculture, Fisheries and Conservation Department, HKSAR

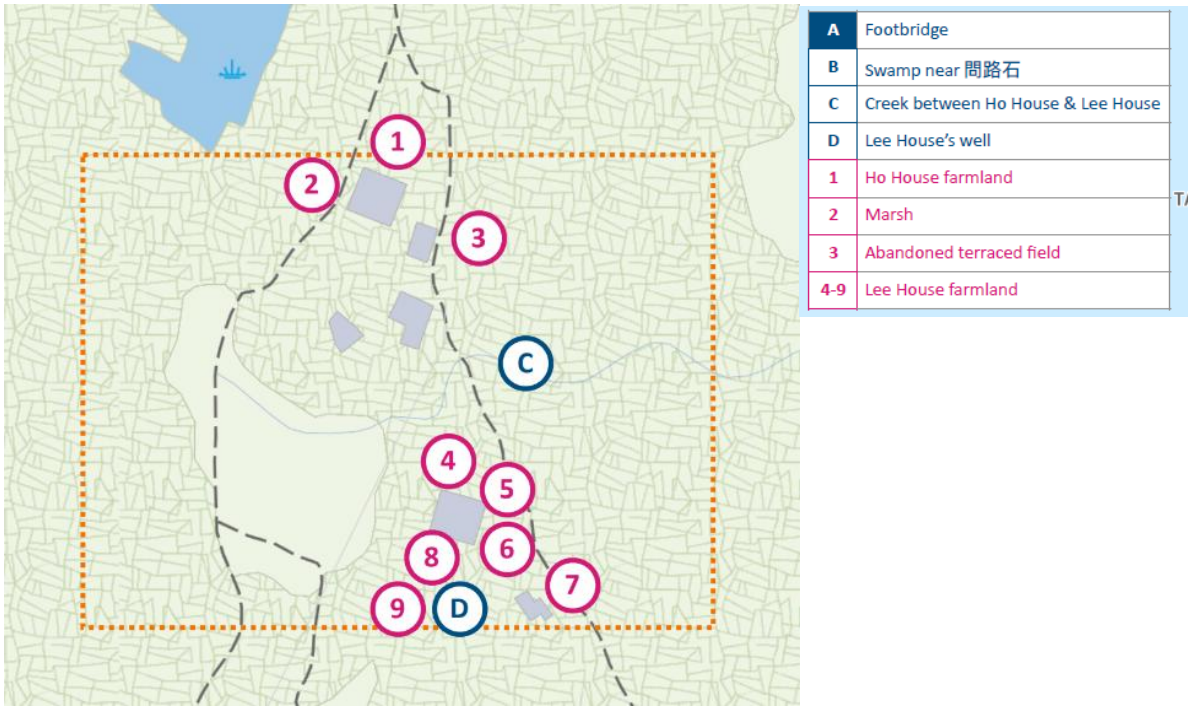
Figure 1: Graph of acidity in the stream around Tin Sum in Jan- Nov 2024



3.0 Soil Quality Monitoring

Research on the soil quality in Tin Sum Village, around Lee's Mansion and Ho's Mansion was carried out. Soil samples were collected for background study *(map 2)*. The research team monitored soil quality by Loss on ignition (LOI) and Total Mercury (THg).

Map 2: The soil sampling points in Kuk Po marked in red numbering

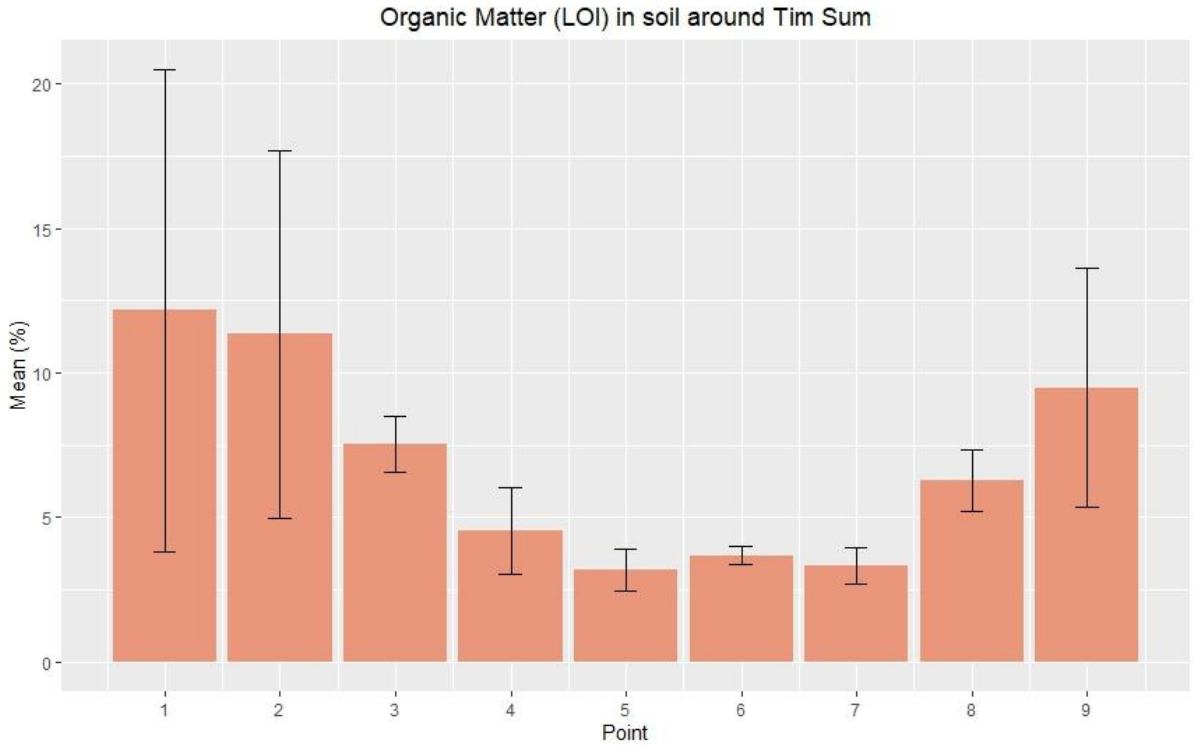


3.1 Loss on Ignition (LOI)

Loss on Ignition (LOI) assesses the amount of organic matter present in the soil. Organic matter significantly impacts soil's physical and chemical properties, enhancing its ability to regulate ecosystem services. Increasing soil organic matter can improve soil fertility and be a reserve of plant nutrients, but too much organic matter in soil may cause waterlogged soil and anaerobic soil, leading to the decrease in growth rate of plants. It will also affect the concentration of mercury (Hg) in the soil. The LOI methodology is adequate for monitoring changes in organic matter over time. Loss on Ignition (LOI) analysis determines a soil sample's organic matter content (%OM).

$$\%OM = \frac{pre\text{-}ignition\ weight\ (g) - \ post\text{-}ignition\ weight\ (g)}{pre\text{-}ignition\ weight\ (g)} \cdot 100$$

Figure 2: Bar chart of Organic Matter (LOI) in soil around Tin Sum



In general, the standard %OM of farming soil published by the Republic of China is 2%- 25%. The average in %OM of the sampling points is about 6.1%. The higher %OM in the soil, the better the soil quality. However, if the %OM is higher than standard, soil quality becomes anaerobic and is considered bad.

From figure 2, point 1 is the farmland of Mr. Ho around Ho's Mansion, point 2 is abandoned farmlands, point 3 and 9 and wetland area, point 4-7 are farmlands of the Lees and point 8 is the experimental area for the sustainable farming practice. Among Lee's farmlands, point 8 has a higher %OM than point 4, 5, 6 and 7, showing that the sustainable farming practice has raised the %OM in the farm, which leads to a rise in soil quality in the experimental area.

During the reporting period, the findings show that the organic matter of soil in Kuk Po has been in normal condition.

3.2 Total Mercury (THg)

THg content in soil is another soil quality analysis in this study. Mercury pollution in farm soil can have detrimental effects on human health. Exposure to mercury-contaminated food crops grown in such soil can lead to acute or chronic mercury toxicity. Mercury can damage the central nervous system, gastrointestinal tract, and kidneys, causing widespread dysfunction in the body. However, the health risks associated with mercury in farm soil vary, depending on the location and concentration of mercury contamination. The lower the THg content in the soil, the better the soil quality.

In general, the standard THg of farm soil published by the Republic of China should be lower than *300ng/g*. Most of the samples collected in Tin Sum village around Lee's Mansion meet the standard. As seen from values highlighted in yellow *(table 4)*, 2 data in different months and sampling points exceed the limit.

During the reporting period, the findings show that the THg content of soil in Kuk Po is relatively normal.

Table 4: Raw data in Soil quality parameters (based on the past 6 months)

Date	Point	Total mercury (ng/g)	LOI (%)	pH
06/08/2024	2	139.8129303	18.14672	5.03
	3	540.8290759	8.492569	5.69
	4	106.2129391	6.195547	5.44
	5	56.49588941	4.313725	5.55
	6	97.2164383	3.972868	6.24
	7	91.74374726	2.7833	5.91
	8	**75.84486536**	**6.771344**	**5.77**
	9	75.80598336	9.960159	7.06
20/09/2024	1.1	63.8594798	8.682927	6.72
	1.2	99.51736577	9.79021	6.88
	3	64.88003578	8.333333	5.79
	4	72.22070952	-	5.63
	5	48.45715773	3.286385	5.79
	6	92.36899739	3.76203	6.33
	7	85.34614857	4.322527	5.71
	8	**79.33868006**	**6.908463**	**5.86**
	9	119.4559525	7.028112	6.94
22/10/2024	1	108.152637	21.5475	4.89
	2	191.5499208	10.36468	7.82
	3	98.91711709	7.744681	5.97
	4	91.51445234	5.353902	5.9
	5	52.49317688	2.713178	5.51
	6	90.57748327	3.365385	6.52
	7	78.16389495	3.424658	6.5
	8	**77.89464071**	**7.067813**	**6.04**
	9	425.7110865	16.41256	6.12
25/11/2024	1	-	5.682951	5.9
	3	69.21690633	6.744868	5.92
	4	-	3.10219	6.23
	5	43.9462504	3.119093	6.06
	6	76.41688196	3.3241	6.11
	7	-	3.382563	6.04
	8	**76.88995577**	**4.483074**	**6.34**
	9	117.8521437	7.946429	6.53
18/12/2024	2	47.47623977	5.53328	5.32
	3	84.66188104	6.296992	5.78
	4	74.56377124	3.454086	6.7
	5	64.77374378	2.477876	6.15
	6	94.25237923	3.934426	6.14
	7	78.65799688	2.734731	6.05
	8	**78.44846643**	**6.103679**	**5.78**
	9	-	6.088751	5.32
	Standard of farm soil	300[7]	2-25%	6-7.5[9]

[7]农用地土壤环境质量标准（試行），中華人民共和國生態環境局
https://www.mee.gov.cn/gkml/hbb/bgth/201603/W020160315362776673500.pdf
[9] Soil Health- pH
https://www.nrcs.usda.gov/sites/default/files/2022-11/pH%20-%20Soil%20Health%20Guide_0.pdf

3.4 Conclusion

To conclude, the soil quality around Lee's house is in normal condition, referencing to the previous guidelines on Agricultural Land Soil Environmental Quality Standards（農用地土壌環境品質標準）, some of the soil content has exceeded 300 ng/g in total mercury content, telling the soil is not the best quality.

For yellow highlighted pH values, we suggest that more slaked lime, $Ca(OH)_2$ could be added to the farm to conserve the pH value suitable for farming. Reference to Table 4, we may observe that the pH value of soil is quite below the standard for the whole Tin Sum area, and a low pH value may impact on the nutrient or minerals absorption mechanisms in crops. Adding slaked lime is a common method to raise the pH value in soil in farming such that we suggest adding slaked lime into the soil for improving the soil.

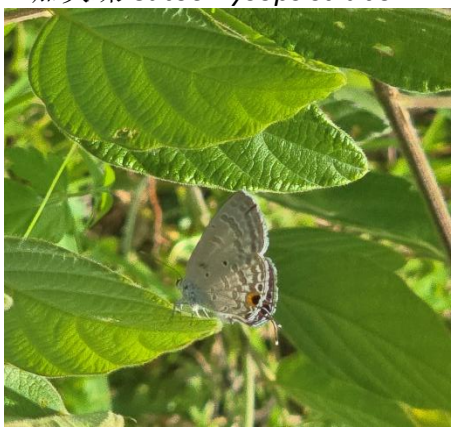
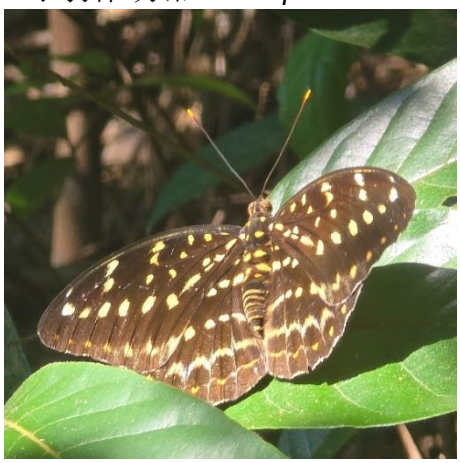
Point 8 (highlighted in blue) is the soil of the application sustainable farming practices. The level of THg stays in a healthy range, showing that the crops are safe and edible. Among point 4-8 which are the farming sites within the Lee's care, the organic matter of point 8 shows the highest amount of organic matter present in the soil, showing the effectiveness in improving soil of sustainable farming practices. The soil pH ranges from 5.77-6.34.

4.0 Ecological Studies

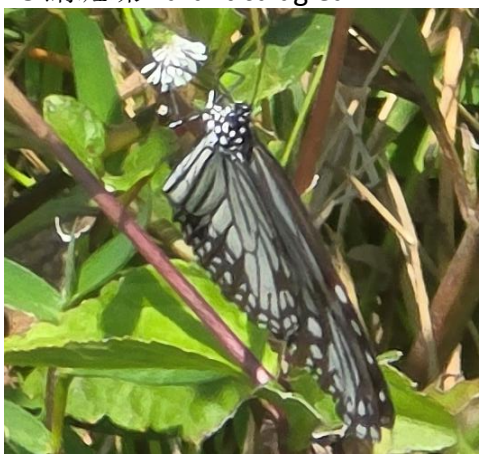
Our study found that Kuk Po is rich in biodiversity, which contains a large variety of organisms. With the increase in agricultural activities by villagers and the project in the study area, this field study recorded more different dragonflies and damselfly species near the Kuk Po River and the wetland area compared to the last report.

Table 5: Photo records of organisms found near the Kuk Po River and the wetland

1 紅斑翠蛺蝶 *Euthalia lubentina*  20240806	2 黛眼蝶屬 Lethe sp.  20240806
3 蜂 Bee  20240806	4 擬旖斑蝶 *Ideopsis similis*  20240920
5 美眼蛺蝶 *Junonia almana*  20240920	5 美眼蛺蝶 *Junonia almanac*  20240920

6 波紋眼蛺蝶 *Junonia atlites*  20240920	7 咖灰蝶 *Catochrysops strabo*  20240920
8 牛背鷺 *Bubulcus coromandus*  20240920	9 小豹律蛺蝶 *Lexias pardalis*  20241022
10 波紋眼蛺蝶 *Junonia atlites*  20241022	10 波紋眼蛺蝶 *Junonia atlites*  20241022

11 白鶺鴒 *Motacilla alba*  20241022	12 大白鷺 *Ardea alba*  20241022
13 翠藍眼蛺蝶 *Junonia orithya*  20241022	14 雀形目 Passeriform  20241022
15 雀形目 Passeriform  20241022	16 毛眼灰蝶 *Zizina otis*  20241022

17 幻紫斑蝶 *Euploea core*  20241022	18 絹斑蝶 Parantica aglea  20241022
19 優草螽 *Euconocephalus sp.*  20241022	20 萊灰蝶 *Remelana jangala*  20241022
21 小眉眼蝶 *Mycalesis mineus*  20241022	22 蜻蜓目 Odonata  20241022

16 毛眼灰蝶 *Zizina otis*

20241022

8 牛背鷺 *Bubulcus coromandus*

20241125

23 北紅尾鴝 *Phoenicurus auroreus*

20241125

24

20241125 琉璃蛺蝶 *Kaniska canace*

25 蜂 Bee

20241125

26 黑尾灰蜻 *Orthetrum glaucum*

20241125

27 紅耳鵯 *Pycnonotus jocosus*  20241125	28 雅灰蝶屬 *Jamides* sp.  20241125
29 菜粉蝶屬 *Pieris*  20241125	29 菜粉蝶屬 *Pieris*  20241125