# Influence Factors of Water Quality in Guanxin Algal Reef, NW Taiwan

## 觀新藻礁之環境水質因子探討

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# Outline

- Introduction
- Literature Review
- Motivation and purpose
- Methods
- Preliminary Results
- Future work

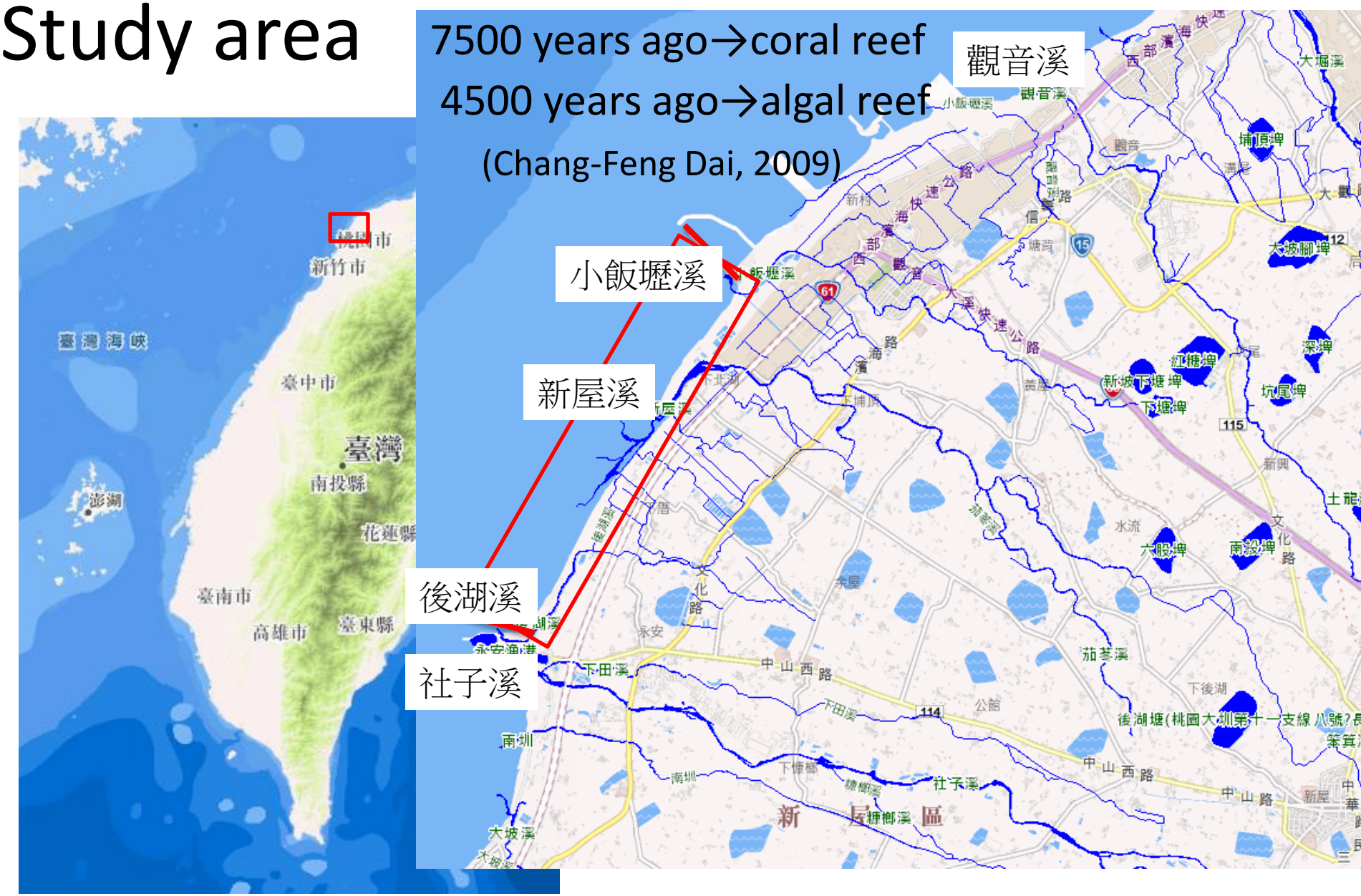
# Introduction

- What is algal reef ?

  →a kind of biotic reefs
- What is the difference between algal reef and coral reef ?

| | Algal reef | Coral reef |
|---|---|---|
| kingdom | plant kingdom | animal kingdom |
| growing rate | 0.1cm/year | 1cm/year |
| tolerance level | can bear a little dirty and cold water | clean and warm water |
| type and texture | layered and loose | hard and rough |

# Study area


7500 years ago→coral reef
4500 years ago→algal reef
(Chang-Feng Dai, 2009)
觀音溪
小飯壢溪
新屋溪
後湖溪
社子溪
臺灣海峽
新竹市
臺中市
臺灣
南投縣
澎湖
花蓮縣
臺南市
高雄市
臺東縣

# Literature Review

- Geology survey of biotic reefs on Holocene in Taoyuan (Wang, et al., 2008)
- Heavy metal contents of algal reefs in Guanyin coast of northwest Taiwan (Ching-Yu Liou, 2014)

# Motivation and purpose

- Datan wind power plant, Guantang industrial park and CPC 3rd natural gas station were nearby.
- To evaluate the growing environment of algal reef.

# Influence Factors

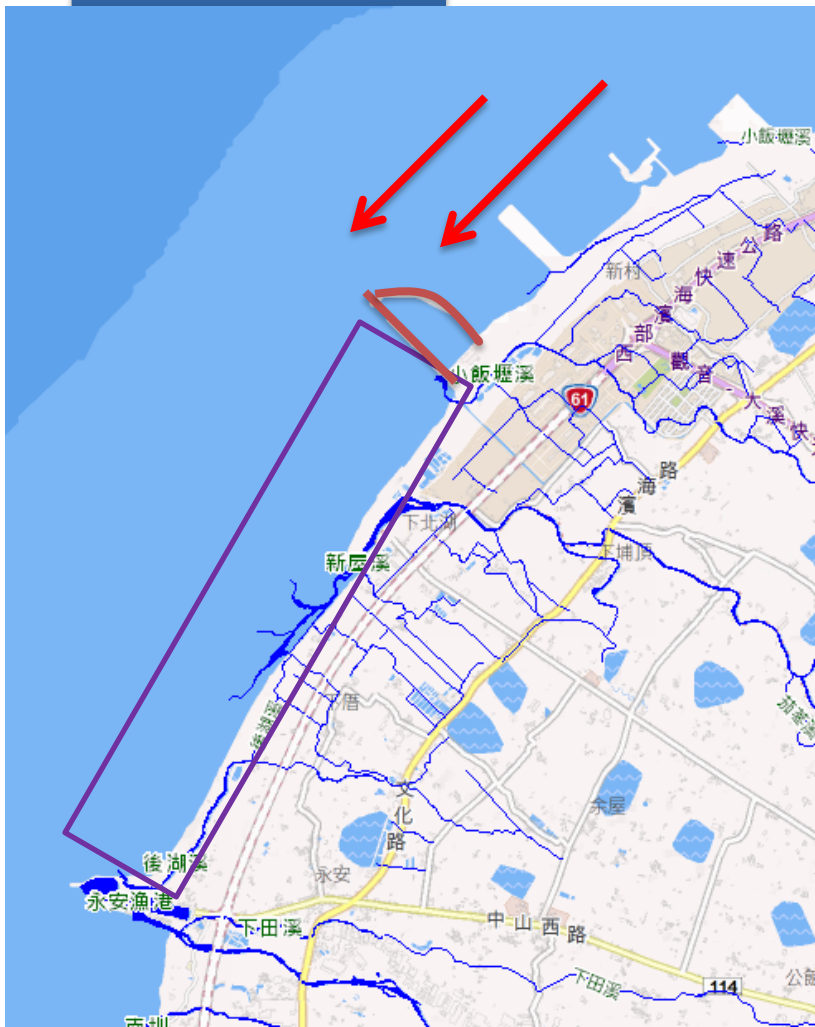
## physical

- Groin impact and drifting sand
- Rainstorm and wave
- Air settlement
- Monsoon and ocean current

## chemical

- Industry waste water
- Trace element concentration of sediment
- $CaCO_3$ corrosion
- Water quality

## biological



# Water quality

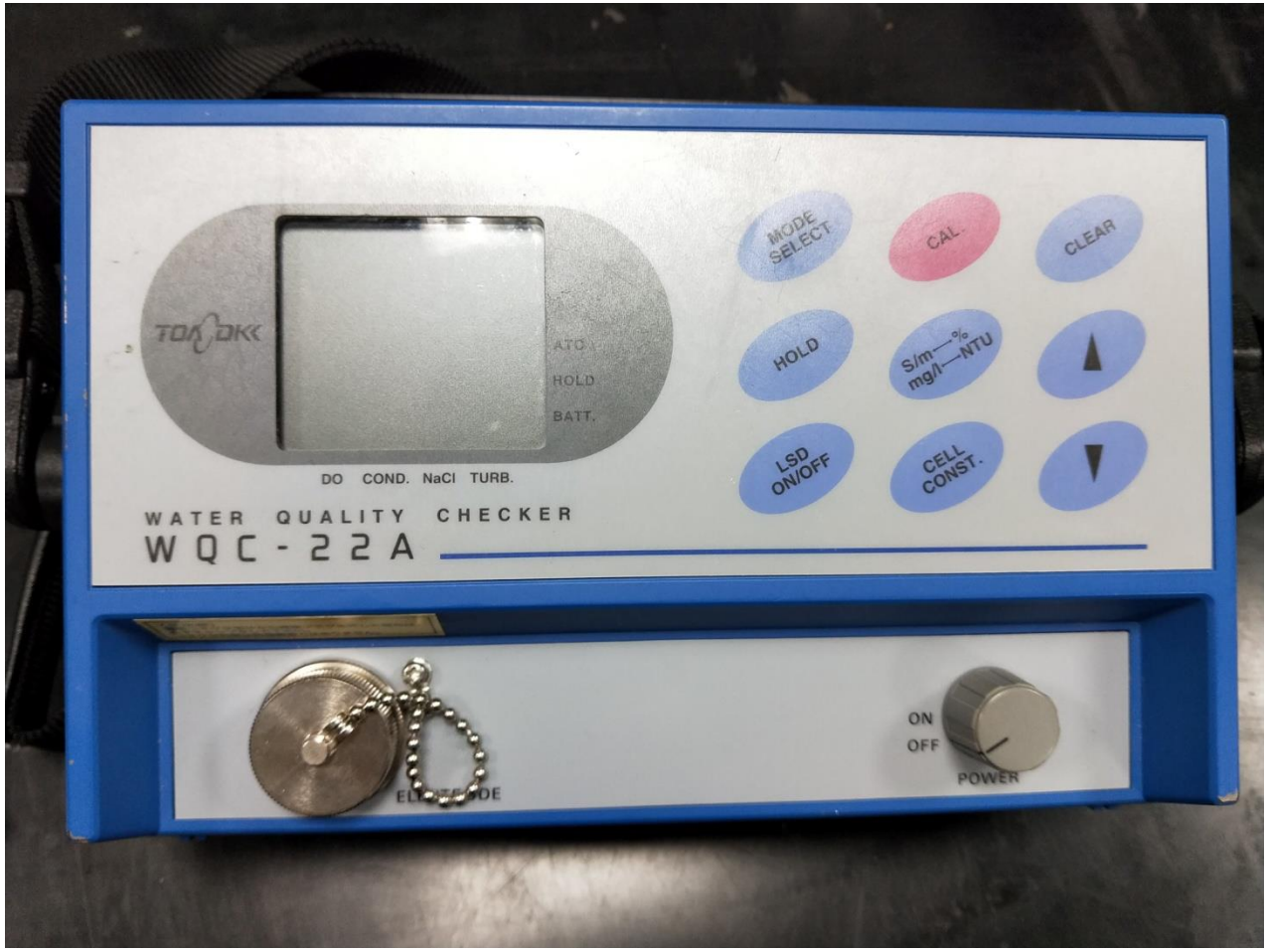
## Seawater quality

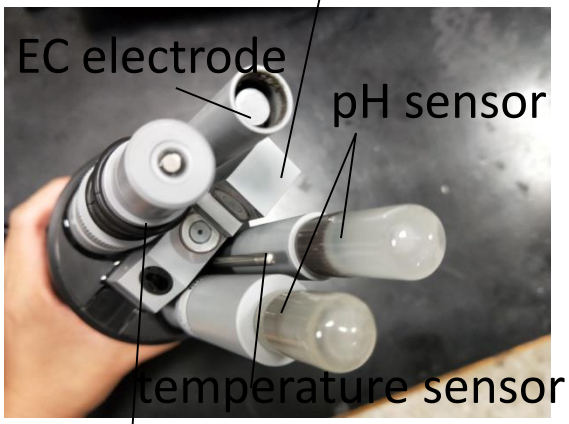
- pH value
- Electrical conductivity (EC)
- Turbidity
- Dissolved oxygen (DO)
- Temperature

## River water quality

- pH value
- Dissolved oxygen (DO)
- Temperature
- Suspended sediment (SS)
- Heavy metals

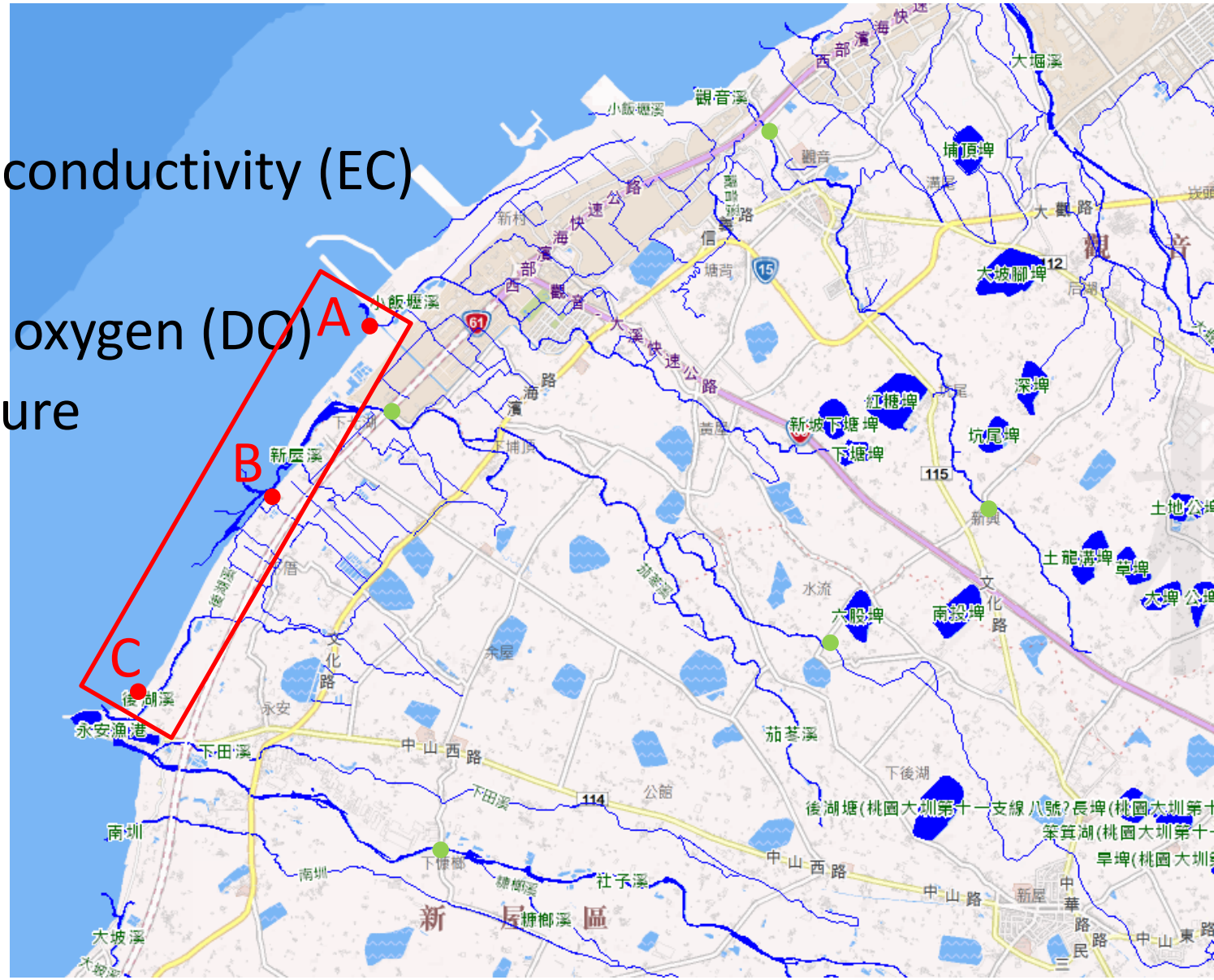
# Methods




TOA-DKK Water quality meter WQC-22A

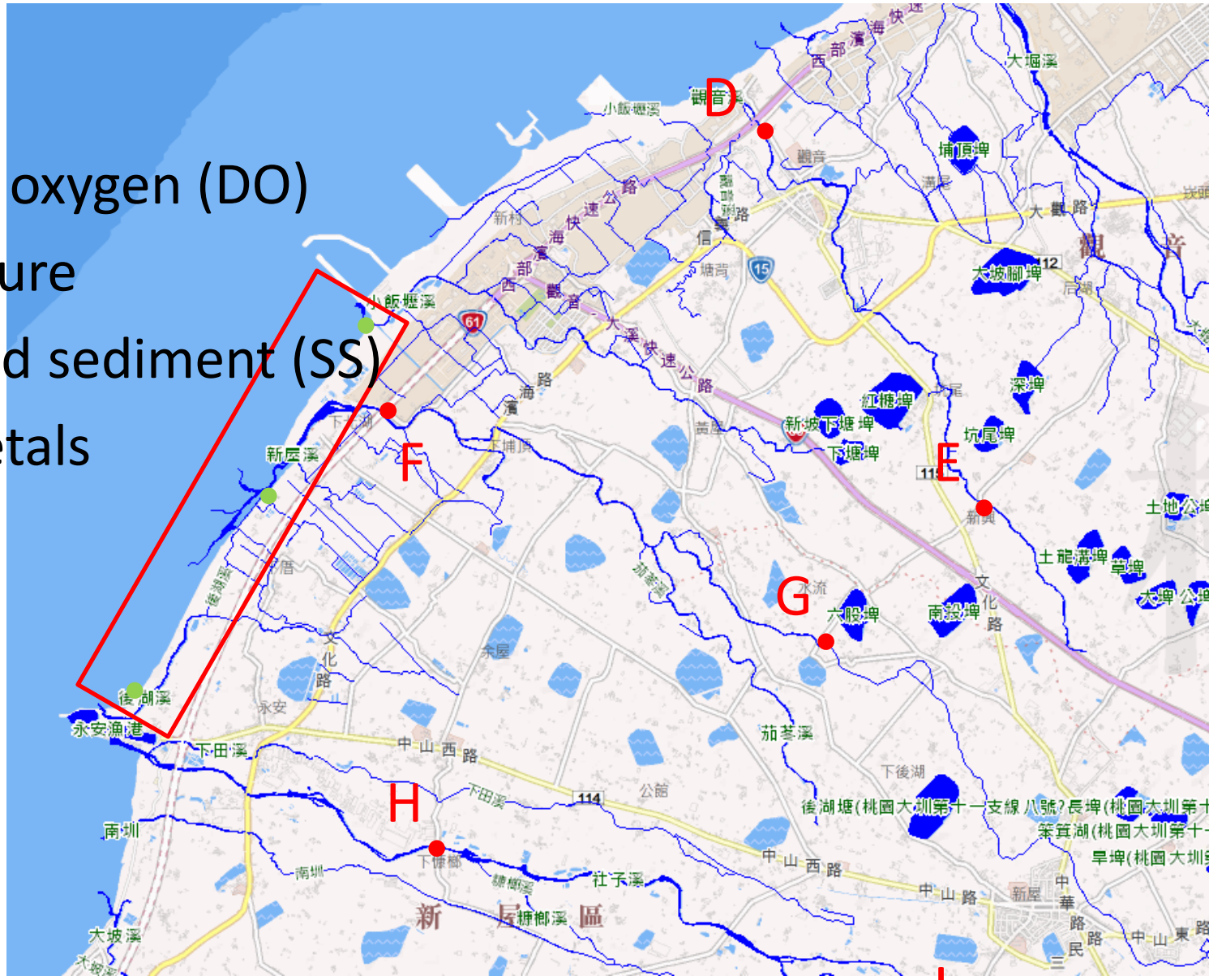
- pH value
- Electrical conductivity (EC)
- Turbidity
- Dissolved oxygen (DO)
- Temperature




- Environmental conservation: DO>2.0mg/L, pH:7.0-8.5

(Environmental Protection Administration Executive Yuan, Taiwan, 2007)

- pH value
- Dissolved oxygen (DO)
- Temperature
- Suspended sediment (SS)
- Heavy metals

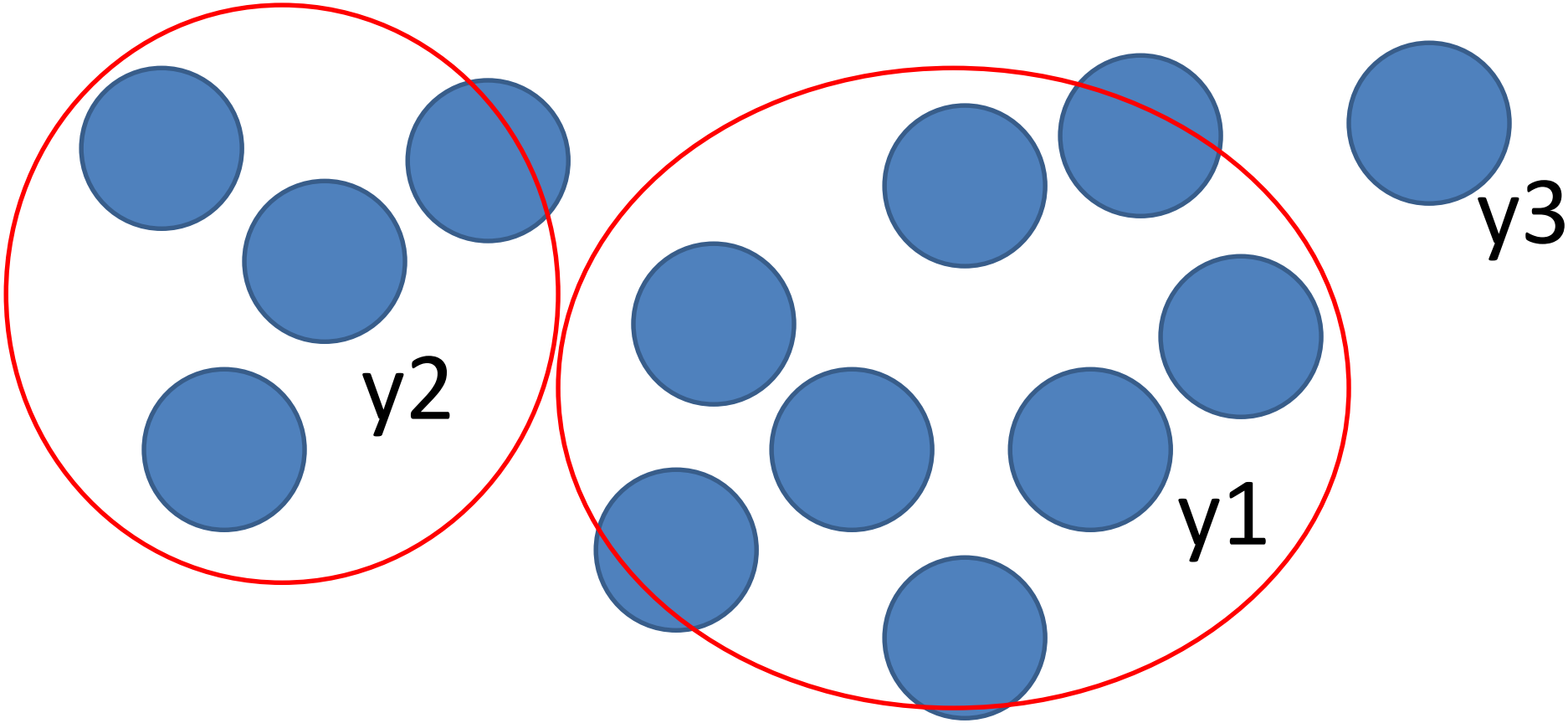



- Environmental conservation: DO>2.0mg/L, pH:7.0-8.5

(Environmental Protection Administration Executive Yuan, Taiwan, 2007)

# Methods

- Factor analysis: Variables were classified into a few groups and offered a new factor name.

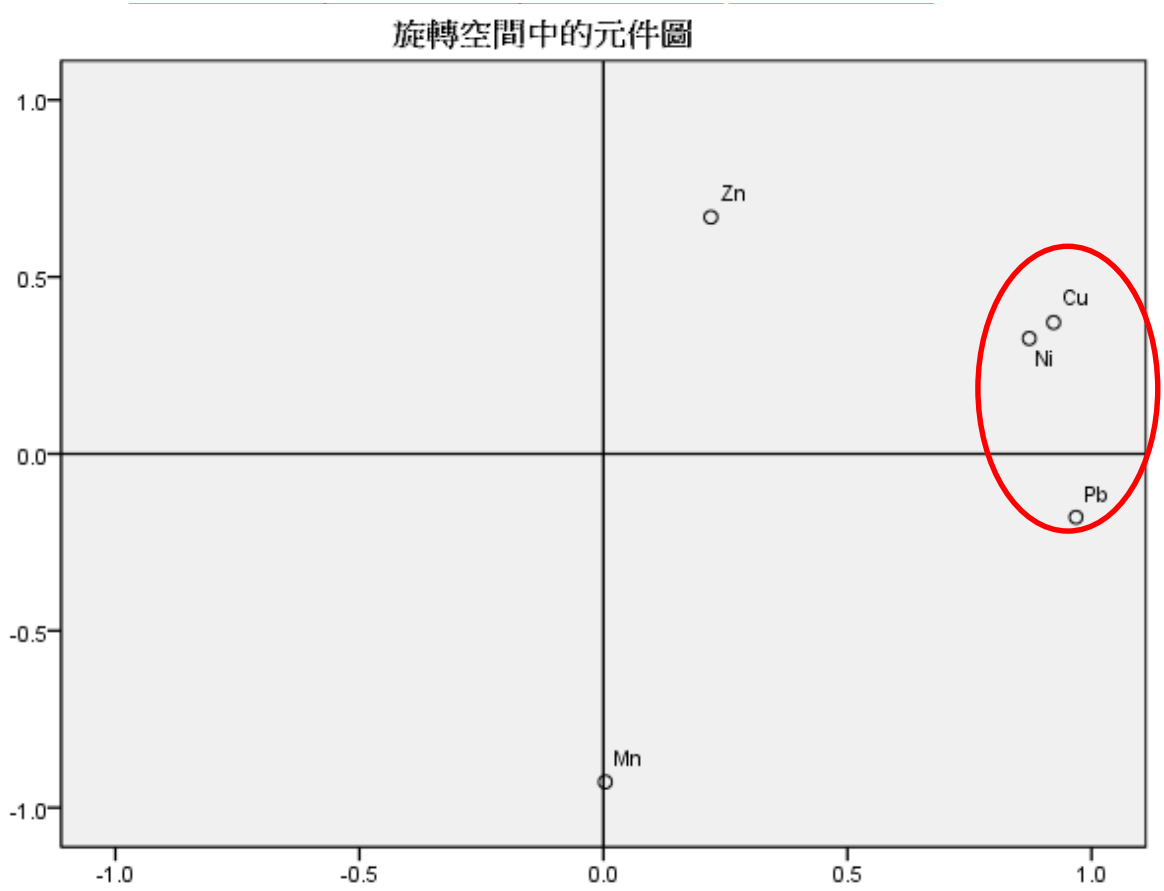


| time | Cd | Pb |
|---|---|---|
| 10604 | .00100 | .00500 |
| 10607 | .00100 | .00300 |
| 10610 | .00100 | .00300 |
| 10701 | .00100 | .00900 |
| 10704 | .00100 | .00700 |

說明元件y2

| 元件 | 起始特徵值 | | | |
|---|---|---|---|---|
| | 總計 | 變異的 % | 累加 % | 總計 |
| y1 | 2.873 | 57.470 | 57.470 | 2.8 |
| y2 | 1.307 | 26.140 | 83.609 | 1.3 |
| y3 | .793 | 15.862 | 99.471 | |
| y4 | .026 | .529 | 100.000 | |
| y5 | 4.724E-16 | 9.449E-15 | 100.000 | |

擷取方法：主體元件分析。




| | y1 | y2 |
|---|---|---|
| Pb | .803 | .569 |
| Cu | .993 | .051 |
| Zn | .481 | -.514 |
| Ni | .929 | .070 |
| Mn | -.386 | .843 |

擷取方法：主體元件分析。

a. 擷取 2 個元件。

| | y1 | y2 |
|---|---|---|
| Pb | .968 | -.179 |
| Cu | .922 | .371 |
| Zn | .220 | .669 |
| Ni | .872 | .326 |
| Mn | .004 | -.927 |

擷取方法：主體元件分析。
轉軸方法：具有 Kaiser 正規化的最大變異法。

a. 在 3 疊代中收斂循環。

# Upstream of Shinwu river

(Department of Environmental Protection, Taoyuan, 2017, 2018)

| time | Cd | Pb | Cr | Ni | Cu | Zn | Ag | Mn |
|---|---|---|---|---|---|---|---|---|
| 10604 | .00100 | .00300 | .00400 | .00700 | .01900 | .02800 | .00300 | .10800 |
| 10607 | .00100 | .00300 | .00400 | .01000 | .03000 | .02800 | .00300 | .08000 |
| 10610 | .00100 | .00300 | .00400 | .01600 | .03900 | .02400 | .00300 | .11700 |
| 10701 | .00100 | .00300 | .00400 | .01000 | .02600 | .01500 | .00300 | .06900 |
| 10704 | .00100 | .00300 | .00400 | .01000 | .03200 | .00700 | .00400 | .18300 |

**說明的變異數總計**

| 元件 | 起始特徵值 | | | 擷取平方和載入 | | | 循環平方和載入 | | |
|---|---|---|---|---|---|---|---|---|---|
| | 總計 | 變異的 % | 累加 % | 總計 | 變異的 % | 累加 % | 總計 | 變異的 % | 累加 % |
| y1 | 2.105 | 52.637 | 52.637 | 2.105 | 52.637 | 52.637 | 1.920 | 47.993 | 47.993 |
| y2 | 1.444 | 36.101 | 88.739 | 1.444 | 36.101 | 88.739 | 1.630 | 40.746 | 88.739 |
| y3 | .401 | 10.031 | 98.769 | | | | | | |
| y4 | .049 | 1.231 | 100.000 | | | | | | |

擷取方法：主體元件分析。

# Downstream of Shinwu river

(Department of Environmental Protection, Taoyuan, 2017, 2018)

**元件矩陣[a]**

| | 元件 | |
|---|---|---|
| | y1 | y2 |
| Ni | .277 | .951 |
| Cu | .529 | .834 |
| Zn | -.828 | .260 |
| Ag | .924 | -.356 |
| Mn | .891 | -.181 |

擷取方法：主體元件分析。

a. 擷取 2 個元件。

**旋轉元件矩陣[a]**

| | 元件 | |
|---|---|---|
| | y1 | y2 |
| Ni | -.071 | .988 |
| Cu | .206 | .966 |
| Zn | -.866 | -.044 |
| Ag | .990 | -.013 |
| Mn | .898 | .140 |

擷取方法：主體元件分析。
轉軸方法：具有 Kaiser 正規化的最大變異法。

a. 在 3 疊代中收斂循環。

# 201704-12

| site | Cd | Pb | Cr | Cu | Zn | Ni | Mn | Ag |
|---|---|---|---|---|---|---|---|---|
| Shetz1 | .00100 | .00300 | .00400 | .00500 | .03500 | .00500 | .09900 | .00300 |
| Shetz2 | .00100 | .00500 | .00400 | .00500 | .02300 | .00700 | .12700 | .00300 |
| Guanyin1 | .00100 | .00300 | .00400 | .00400 | .01800 | .00300 | .08600 | .00300 |
| Guanyin2 | .00100 | .00300 | .00400 | .00400 | .03600 | .00300 | .09800 | .00300 |
| Shinwu1 | .00100 | .00300 | .00400 | .01800 | .01700 | .00300 | .11000 | .00300 |
| Shinwu2 | .00100 | .00300 | .00400 | .01900 | .02800 | .00700 | .10800 | .00300 |
| Shetz3 | .00100 | .00300 | .00400 | .00400 | .03600 | .00300 | .06900 | .00300 |
| Shetz4 | .00100 | .00300 | .00400 | .00500 | .03400 | .00300 | .11800 | .00300 |
| Guanyin3 | .00100 | .00500 | .00400 | .00400 | .05100 | .00400 | .10400 | .00300 |
| Guanyin4 | .00100 | .00400 | .00400 | .00500 | .03700 | .00300 | .08400 | .00300 |
| Shinwu3 | .00100 | .00300 | .00400 | .00500 | .04200 | .00400 | .20400 | .00300 |
| Shinwu4 | .00100 | .00300 | .00400 | .03000 | .02800 | .01000 | .08000 | .00300 |
| Shetz5 | .00100 | .00300 | .00400 | .00500 | .02200 | .00300 | .10200 | .00300 |
| Shetz6 | .00100 | .00300 | .00400 | .00400 | .01300 | .00600 | .19100 | .00300 |
| Guanyin5 | .00100 | .00400 | .00400 | .00400 | .02400 | .00300 | .11600 | .00300 |
| Guanyin6 | .00100 | .00700 | .00400 | .00500 | .12100 | .00800 | .12500 | .00300 |
| Shinwu5 | .00100 | .00800 | .00400 | .00500 | .02900 | .00400 | .11700 | .00300 |
| Shinwu6 | .00100 | .00300 | .00400 | .03900 | .02400 | .01600 | .11700 | .00300 |

(Department of Environmental Protection, Taoyuan, 2017, 2018)

# 201801-06

| site | Cd | Pb | Cr | Cu | Zn | Ni | Mn | Ag |
|---|---|---|---|---|---|---|---|---|
| Shetz7 | .00100 | .00700 | .00400 | .00800 | .02700 | .00600 | .07700 | .00300 |
| Shetz8 | .00100 | .00900 | .00400 | .01000 | .02900 | .01600 | .08800 | .00300 |
| Guanyi7 | .00100 | .00300 | .00400 | .00400 | .01300 | .00300 | .04500 | .00300 |
| Guanyi8 | .00100 | .00300 | .00400 | .00400 | .03200 | .00300 | .07900 | .00300 |
| Shinwu7 | .00100 | .00300 | .00400 | .00700 | .01500 | .00600 | .06500 | .00300 |
| Shinwu8 | .00100 | .00300 | .00400 | .02600 | .01500 | .01000 | .06900 | .00300 |
| Shetz9 | .00100 | .00300 | .00400 | .02000 | .03400 | .00400 | .17200 | .00400 |
| Shetz10 | .00100 | .00700 | .00400 | .00500 | .02100 | .00400 | .58500 | .00400 |
| Guanyi9 | .00100 | .00300 | .00400 | .00500 | .01000 | .00400 | .07300 | .00400 |
| Guanyi10 | .00100 | .00300 | .00400 | .00500 | .02200 | .00400 | .13300 | .00400 |
| Shinwu9 | .00100 | .00300 | .00400 | .00500 | .00600 | .00400 | .13900 | .00400 |
| Shinwu10 | .00100 | .00300 | .00400 | .03200 | .00700 | .01000 | .18300 | .00400 |

(Department of Environmental Protection, Taoyuan, 2017, 2018)

# 2017

**說明的變異數總計**

| 元件 | 起始特徵值 | | | 擷取平方和載入 | | | 循環平方和載入 | | |
|---|---|---|---|---|---|---|---|---|---|
| | 總計 | 變異的 % | 累加 % | 總計 | 變異的 % | 累加 % | 總計 | 變異的 % | 累加 % |
| y1 | 1.918 | 38.362 | 38.362 | 1.918 | 38.362 | 38.362 | 1.819 | 36.380 | 36.380 |
| y2 | 1.508 | 30.151 | 68.513 | 1.508 | 30.151 | 68.513 | 1.593 | 31.856 | 68.236 |
| y3 | 1.014 | 20.284 | 88.798 | 1.014 | 20.284 | 88.798 | 1.028 | 20.562 | 88.798 |
| y4 | .461 | 9.211 | 98.008 | | | | | | |
| y5 | .100 | 1.992 | 100.000 | | | | | | |

擷取方法：主體元件分析。

**旋轉元件矩陣[a]**

| | 元件 | | |
|---|---|---|---|
| | y1 | y2 | y3 |
| Pb | -.099 | .867 | .024 |
| Cu | .937 | -.228 | -.140 |
| Zn | .019 | .881 | .007 |
| Ni | .965 | .116 | .105 |
| Mn | -.015 | .016 | .998 |

擷取方法：主體元件分析。
轉軸方法：具有 Kaiser 正規化的最大變異法。

a. 在 4 疊代中收斂循環。

# 2018

**說明的變異數總計**

| 元件 | 起始特徵值 | | | 擷取平方和載入 | | | 循環平方和載入 | | |
|---|---|---|---|---|---|---|---|---|---|
| | 總計 | 變異的 % | 累加 % | 總計 | 變異的 % | 累加 % | 總計 | 變異的 % | 累加 % |
| y1 | 1.748 | 34.951 | 34.951 | 1.748 | 34.951 | 34.951 | 1.680 | 33.593 | 33.593 |
| y2 | 1.519 | 30.374 | 65.325 | 1.519 | 30.374 | 65.325 | 1.587 | 31.732 | 65.325 |
| y3 | .985 | 19.697 | 85.022 | | | | | | |
| y4 | .679 | 13.574 | 98.596 | | | | | | |
| y5 | .070 | 1.404 | 100.000 | | | | | | |

擷取方法：主體元件分析。

**旋轉元件矩陣[a]**

| | 元件 | |
|---|---|---|
| | y1 | y2 |
| Pb | .899 | .291 |
| Cu | -.332 | .776 |
| Zn | .679 | -.045 |
| Ni | .250 | .926 |
| Mn | .488 | -.205 |

擷取方法：主體元件分析。
轉軸方法：具有 Kaiser 正規化的最大變異法。

a. 在 3 疊代中收斂循環。

# Preliminary Results

- pH value >7.0 → Alkaline, no $CaCO_3$ corrosion
- Cd always <0.01mg/L, Cr <0.004mg/L,
  Ag <0.004mg/L in three rivers
- Pb <0.003mg/L in Shinwu river
- Shinwu river, Factor y1: Pb, Cu, Ni on upstream
  Factor y1: Zn, Ag, Mn on downstream
- 2017, Factor y1: Cu, Ni
- 2018, Factor y2: Pb, Zn

# Future work

- Detect water quality every month.
- Finish factor analysis.
- Explain the result of factor analysis.
- Evaluate water quality synthetically.

Thanks for listening !