Water Quality Monitoring

ILEC Secretary General
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Why Monitoring is Necessary

- To know the present state of the water (in the Lake, Sea)
- To know what is flowing in and flowing out (in the River)

- To judge whether the water quality is suitable for the water use.
- To predict what would happen in the future

Countermeasures taken

- To know the effect of the countermeasures

Categories of Monitoring

- Authorized Monitoring (Regular and Continuous)
  (in Japan, decided according to the Law)
  To grasp the current situation
  Program is decided by Prefecture Government
  Conducted by Local Governments, National Government, National Sectors etc.

- Research Monitoring
  For the purpose of special research

- Voluntary Monitoring
  By private sectors and organization
  to know what they can do or how to act

Environmental Standards in the Water Area in Japan

Health Items

mg/L

Item	Standard value	Item	Standard value
Cd	≦0.003	1,1,1-C2H3Cl3	≦1
CN (cyanide)	ND	1,1,2-C2H3Cl3	≦0.006
Pb (lead)	≦0.01	C2HCl3	≦0.01
Cr6＋	≦0.05	C2Cl4	≦0.01
As (arsenic)	≦0.01	1,3-C3H6Cl2	≦0.002
T- Hg (Mercury)	≦0.0005	Thiuram	≦0.006
Alkyl Hg	ND	Simazine	≦0.003
PCB	ND	Benthiocarb	≦0.02
CH2Cl2	≦0.02	Benzene	≦0.01
CCl4	≦0.002	Se	≦0.01
1, 2-C2H2Cl2	≦0.004	B	≦1
1, 1-C2H4Cl2	≦0.1	F	≦0.8
cis-1,2-C2H2Cl2	≦0.04	NO3 and NO2	≦10
ND : Should not be detected at all		1,4-Dioxane	≦0.05

Environmental Standards in the Water Area in Japan

Living Environment Items

Applied according to the defined category

Item	River	Lake	Coastal Zone
BOD	≦1～10mg/L	—	—
COD(Mn)	—	≦1～8mg/L	≦2～8mg/L
pH	6.0～8.5	6.0～8.5	7.0～8.3
SS	≦25～100mg/L	≦1～15mg/L	—
DO	2～7.5mg/L≦	2～7.5mg/L≦	2～7.5mg/L≦
DO at bottom	—	2.0～4.0mg/L≦	2.0～4.0mg/L≦
Total Coliform	≦50～5,000MPN/100mL	≦50～1,000MPN/100mL	≦1,000MPN/100mL
n-Hexane Extract	—	—	not detectided
Total Nitrogen	—	≦0.1～1mg/L	≦0.2～1mg/L
Total Phophorus	—	≦0.005～0.1mg/L	≦0.02～0.09mg/L
Total Zinc	≦0.03mg/L	≦0.03mg/L	≦0.01～0.02mg/L
Nonyl phenol	≦0.0006～0.002mg/L	≦0.0006～0.002mg/L	≦0.0007～0.001mg/L
LAS	≦0.02～0.05mg/L	≦0.02～0.05mg/L	≦0.006～0.01mg/L

Environmental Standards in the Water Area in Japan

Living Environment Items

Applied to Rivers in each Category

Category	Water Use	Standard Values				
		pH	BOD	SS	DO	Coliforms
AA	Water Supply Class 1 Conservation of Natural Environment	6.5-8.5	≦1mg/L	≦25mg/L	7.5mg/L≦	≦50MPN/100mL
A	Water Supply Calss 2 Fiwhery Class1 Bathing	6.5-8.5	≦2mg/L	≦25mg/L	7.5mg/L≦	≦1,000MPN/100mL
B	Water supply Class 3 Fishery Class 2	6.5-8.5	≦3mg/L	≦25mg/L	5mg/L≦	≦5,000MPN/100mL
C	Fishery Class 3 Industrial Water Class 1	6.5-8.5	≦5mg/L	≦50mg/L	5mg/L≦	-
D	Industrial Water Class 2 Agriculture Water	6.0-8.5	≦8mg/L	≦100mg/L	2mg/L≦	-
E	Industrial Water Class 3 Conservation of Living Environment	6.0-8.5	≦10mg/L	No flowting garbage	2mg/L≦	-

Environmental Standards in Japan

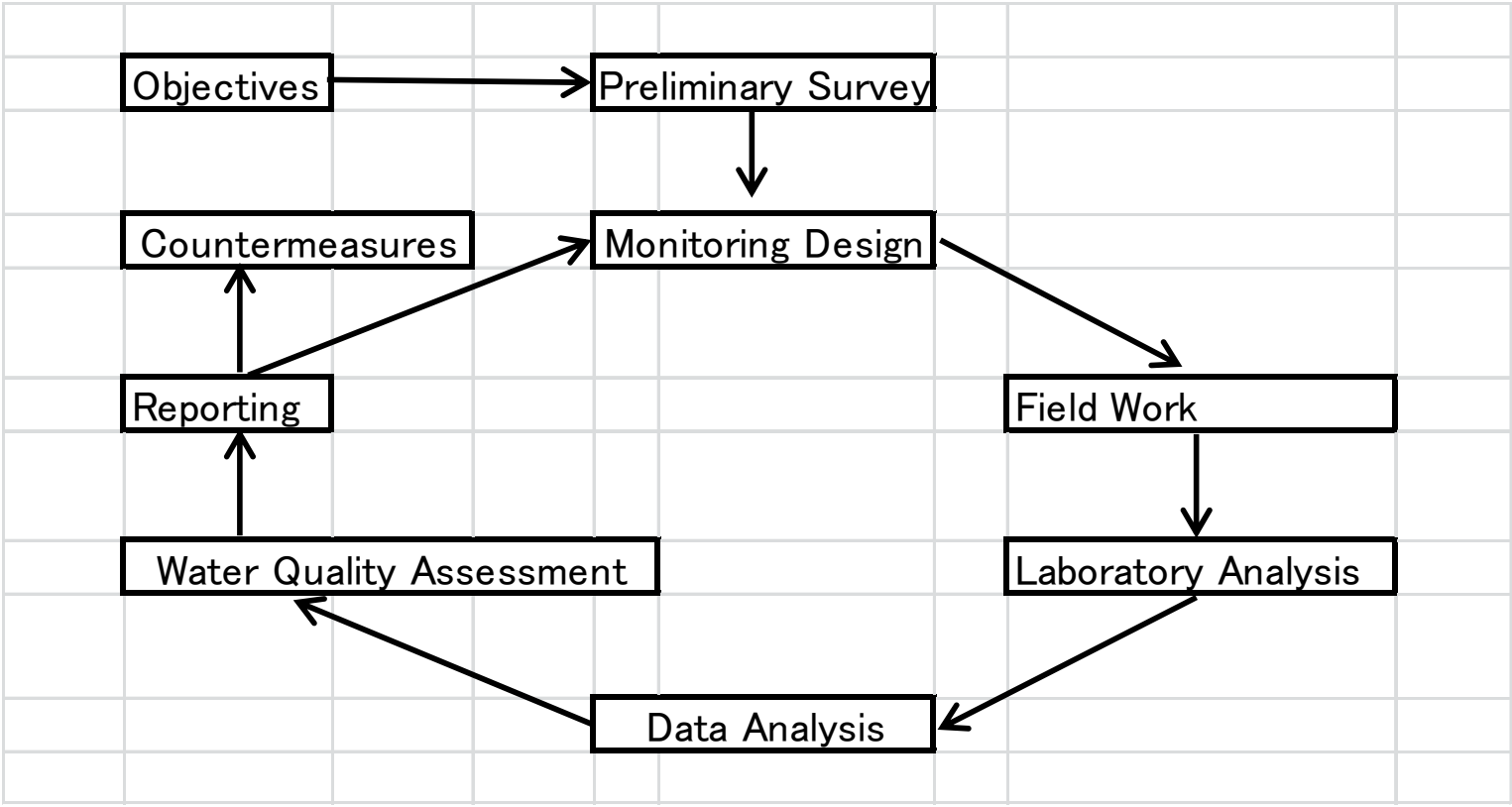
（Living Environment Items Applied to lake Biwa ）

Category*	Purpose of Usage	Item	Standard
AA	Water supply class 1 Fishery class 1	pH	6.5 - 8.5
		COD（Mn)	≦1mg/L
		SS	≦1mg/L
		DO	≧7.5mg/L
		Total Coliform	≦ 50MPN/100mL

Nitrogen and Phosphorus

Category*	Purpose of Usage	Item	Standard
Ⅱ	Water supply class 1,2,3 Fishery class 1 Bathing	T-N	≦0.2mg/L
		T-P	≦ 0.01mg/L

Monitoring PDCA Cycle



Monitoring of Water Quality in Lake Biwa

1 Development of the monitoring plan → (1) Fixed Stations

(2) Investigation frequency and items

↓

2 Enforcement → (3) Field work, chemical and biological analysis

↓

3 Count of the result → (4) Fixed stations, area and items

↓

4 Collection of related information → (5) The climate and quantity of discharge etc.

↓

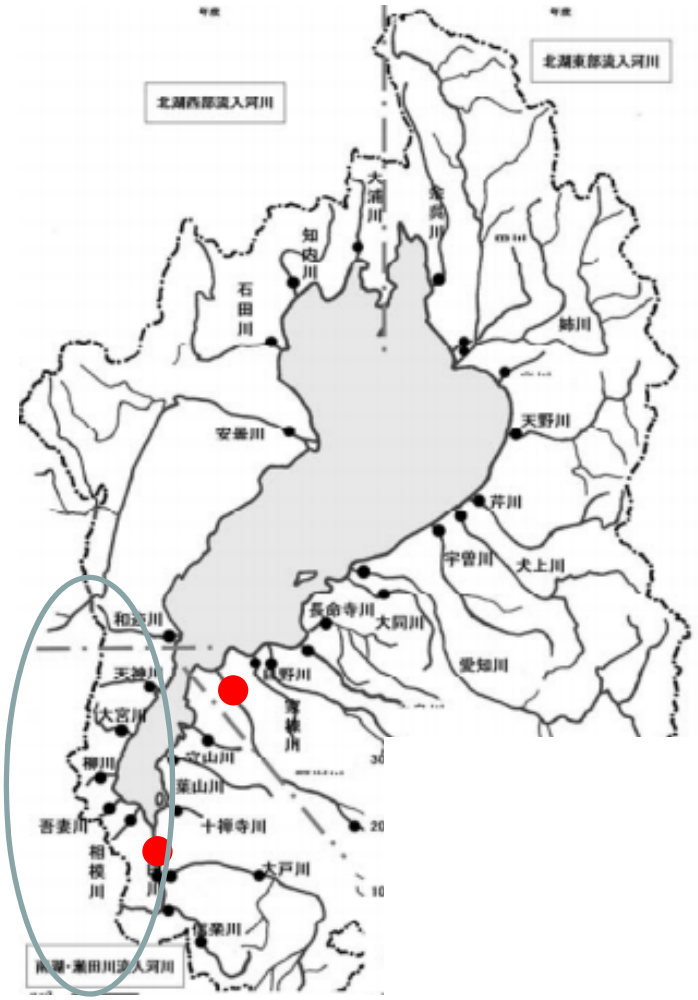
(6) Rearranging of the each item

5 Evaluation of each item → (7) A statistical analysis, ex. A yearly and a monthly average level

○The achievement situation of the standard and the target

○The formation mechanism of the water quality

Monitoring Stations of Rivers in Shiga Who is Responsible



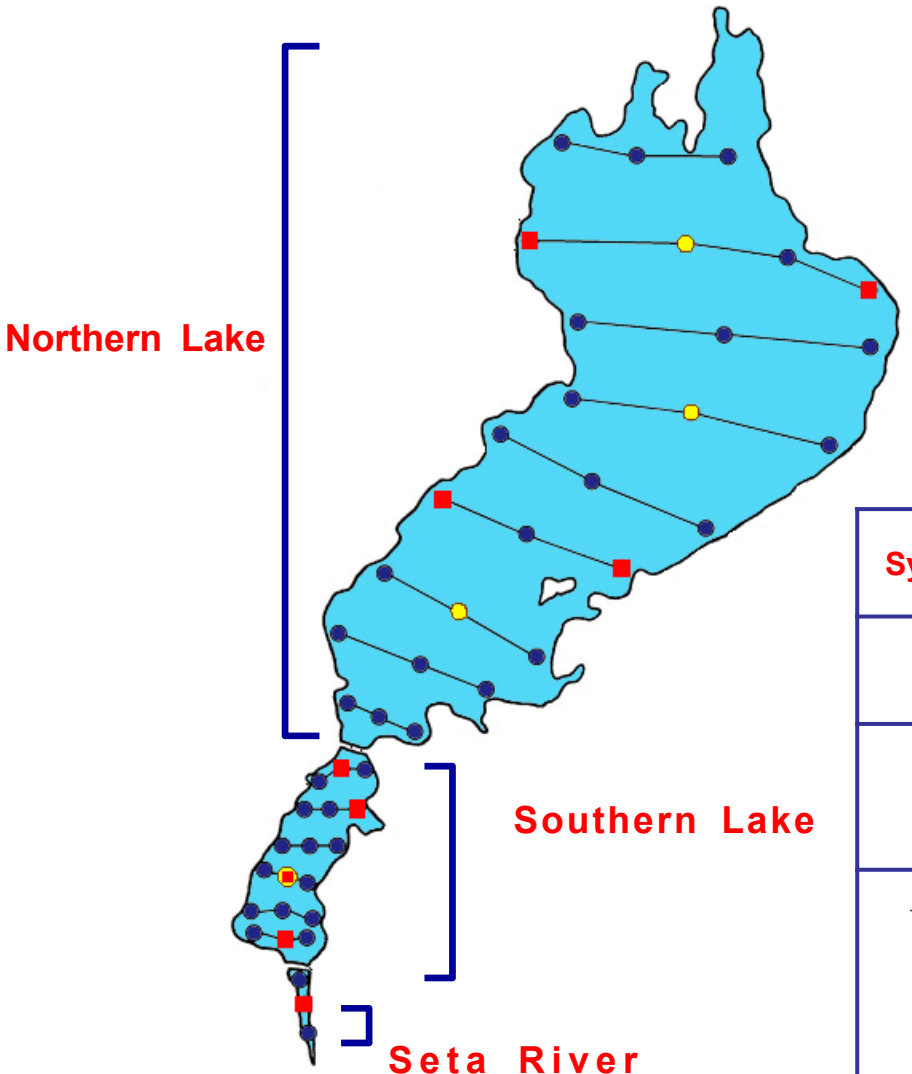
In Lake Biwa:
by Shiga prefecture,
National Government (MLIT),
Japan Water Agency

In Rivers
Otsu City Area :
by Municipality

National Government Managing River

Others
by Prefecture

Fixed Stations for Water Quality Survey



Surface Water Monitoring (once a month)

Monitoring Points: Northern Lake 28, Southern Lake 19 and Seta River 2 (Co-operation with Central Government)

Symbol	Point	Measured by
■	Environmental reference point	Shiga Prefecture
●	Environmental reference point for nitrogen and phosphorus	
●	Research point	Ministry of Land,Infrastructure,Transpot and Tourism Japan Water Agenecy

Water quality monitoring plan

水域名	調査地点区分	気温	水温	透明度	pH	DO	BOD	COD	SS	大腸菌群数	全窒素	全りん	全亜鉛	ノニルフェノール	LAS	カドミウム	全シアン	[illegible]	六価クロム	砒素	総水銀	アルキル水銀	PCB	ジクロロメタン	四塩化炭素	1,2-ジクロロエタン	1,1-ジクロロエチレン	シス-1,2-ジクロロエチレン	1,1,1-トリクロロエタン	1,1,2-トリクロロエタン	トリクロロエチレン	テトラクロロエチレン	1,3-ジクロロプロペン	チウラム	シマジン	チオベンカルブ	ベンゼン	セレン	NO3-N	NO2-N	ふっ素	ほう素	1,4-ジオキサン	測定実施機関
		一般項目			生活環境項目											健康項目																												
今津沖	◎■	12	12	12	12	12	12	12	12	12	12	12	12	4	4	4	4	4	4	4	4	4	1	4	4	4	4	4	4	4	4	4	4	3	3	3	4	4	12	12	4	4	4	滋賀県
長浜沖	◎■	12	12	12	12	12	12	12	12	12	12	12	12	4	4	4	4	4	4	4	4	4	1	4	4	4	4	4	4	4	4	4	4	3	3	3	4	4	12	12	4	4	4	滋賀県
北小松沖	◎■	12	12	12	12	12	12	12	12	12	12	12	12	4	4	4	4	4	4	4	4	4	1	4	4	4	4	4	4	4	4	4	4	3	3	3	4	4	12	12	4	4	4	滋賀県
[illegible]	◎■	12	12	12	12	12	12	12	12	12	12	12	12	4	4	4	4	4	4	4	4	4	1	4	4	4	4	4	4	4	4	4	4	3	3	3	4	4	12	12	4	4	4	滋賀県
[illegible]		12	12	12	12	12	12	12	12	12	12	12																											12	12				水資源機構
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[illegible]		12	12	12	12	12	12	12	12	12	12	12																											12	12				国土交通省
[illegible]	●	12	12	12	12	12	12	12	12	12	12	12																											12	12				[illegible]
姉川沖		12	12	12	12	12	12	12	12	12	12	12																											12	12				[illegible]
外ケ浜沖		12	12	12	12	12	12	12	12	12	12	12																											12	12				[illegible]
外ケ浜沖中央		12	12	12	12	12	12	12	12	12	12	12																											12	12				[illegible]
天野川沖		12	12	12	12	12	12	12	12	12	12	12																											12	12				[illegible]
安曇川沖		12	12	12	12	12	12	12	12	12	12	12																											12	12				水資源機構
安曇川沖中央	●	12	12	12	12	12	12	12	12	12	12	12																											12	12				滋賀県
彦根港沖		12	12	12	12	12	12	12	12	12	12	12																											12	12				水資源機構
大溝沖		12	12	12	12	12	12	12	12	12	12	12																											12	12				水資源機構
大溝沖中央		12	12	12	12	12	12	12	12	12	12	12																											12	12				国土交通省

Items

Stations

Frequency

Executor

Monitoring Items

- Water Quality (Inorganic, Organic Chemical Substances)
- Plankton (Phyto-, Zoo-)
- Microorganisms
- Macrophytes
- Bentos
- Fish Community

For each Item, Laboratory and/or Experts are Essential

Field Survey and on site Measurement

- Measured on site

  Transparency, Water color by eyes

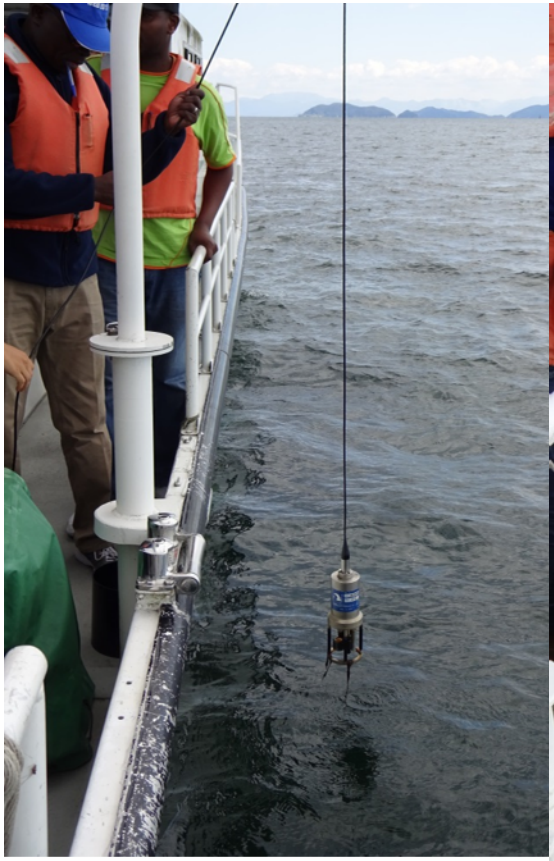
  Water temp, DO, Conductivity, (Turbidity)

  by Electrode
- Measured in the Laboratory

  Chemical Substances, Plankton,

  Microorganisms

Field Survey on the Boat

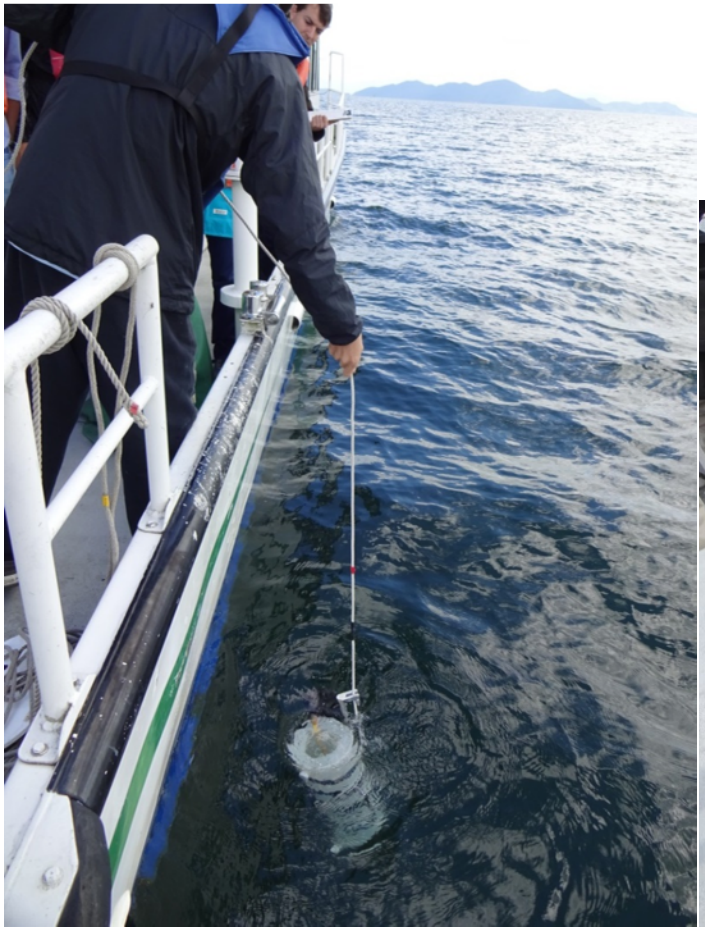


Multisensor

Secchi Disc Transparency

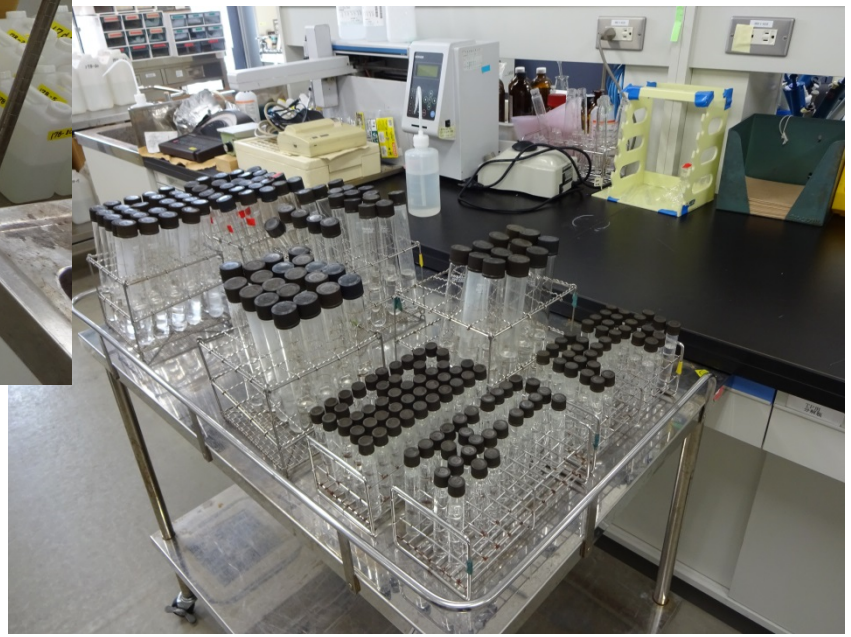
Plankton Sampling

Water Sampling from the Deep Layer



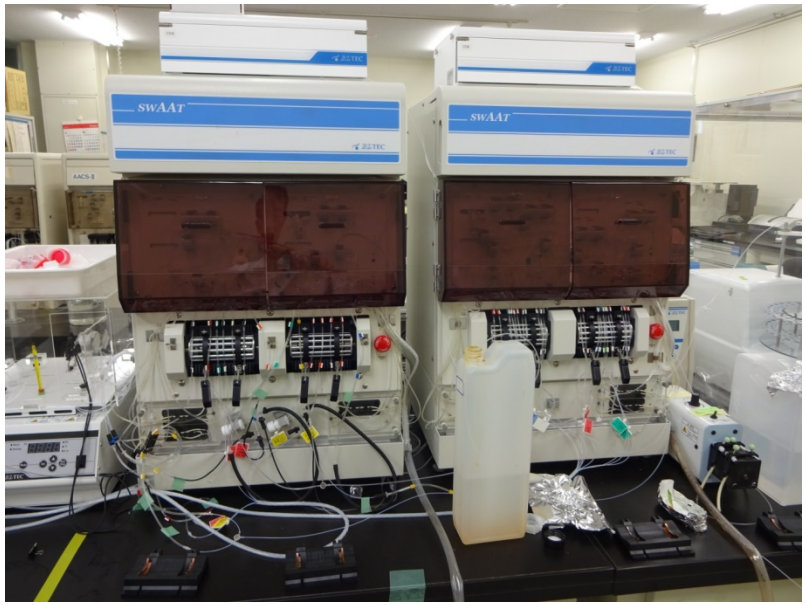
During the stratified period, the water quality of the deep layer differs much from the surface layer

Samples taken into Laboratory



Measurement of Inorganic Ions

In chemical analysis, the analysis method differs depending on the characteristics of the substance, but any method requires instruments and a skilled technician.
Colorimetry, which measures the color density of a substance produced by the reaction of a substance of interest with a reagent, is a classic but basic analysis method.



Auto Analyzer, a flow method for colorimetry

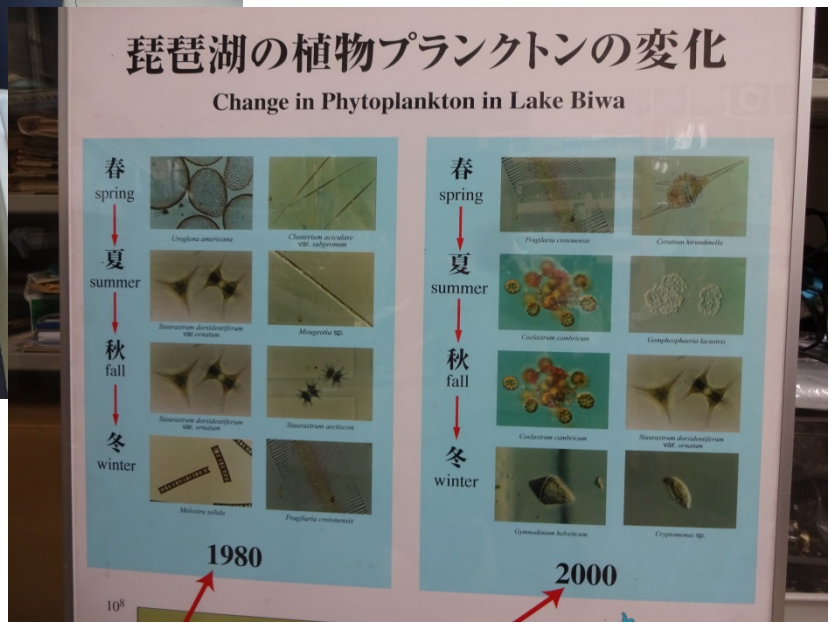
Measurement of Heavy Metals

For substances in the ionic state, there are methods such as ion chromatography.
For heavy metals, atomic absorption, ICP emission spectroscopy, ICP-MS.
For organic substances, there are methods such as liquid or gas chromatography combined with mas-spectroscopy. It is necessary to select the method according to the concentration of the substance to be measured.

ICP –MS

Measurement of Plankton

Identification
Quantity



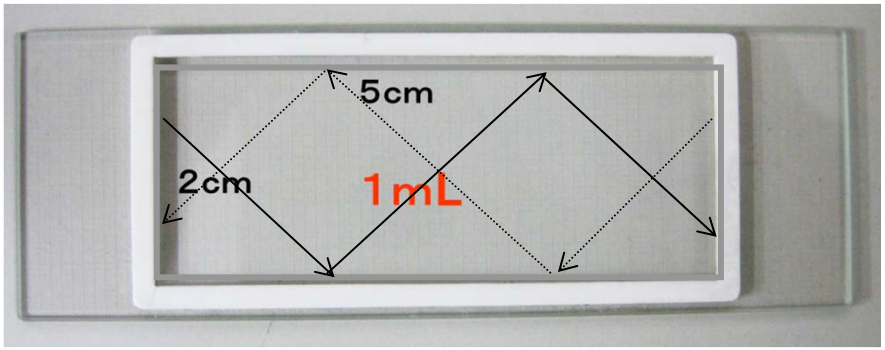
Microscope and Experts

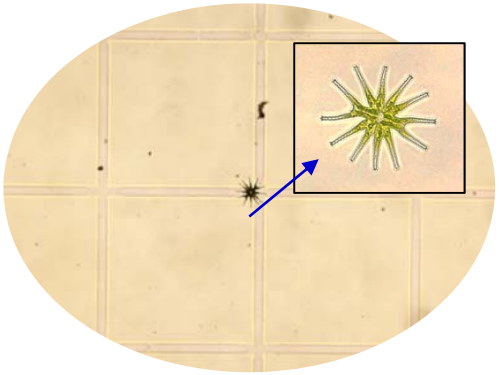
Counting of phytoplankton

Counting

1 mL of water is used on the plankton counting plate.

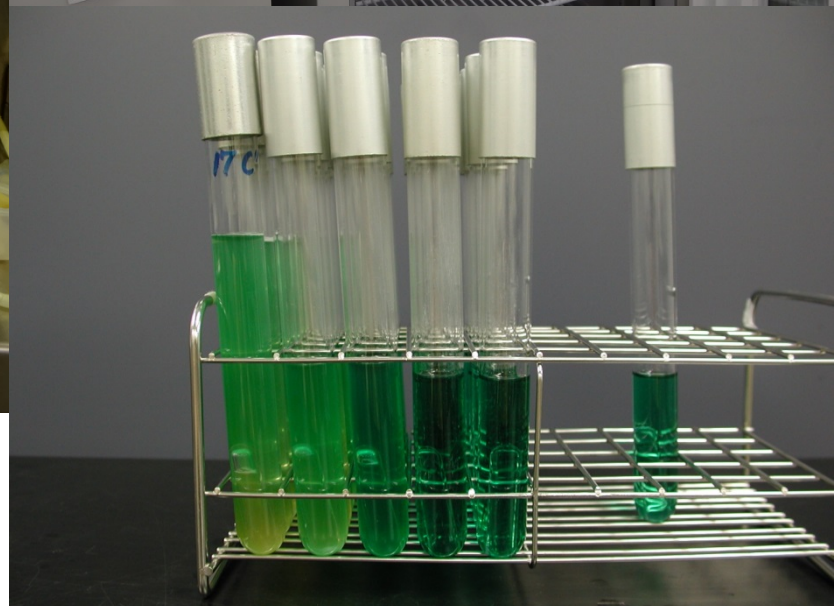
Identification and counting are performed under a biological microscope.





Lake water under x40 biological microscope

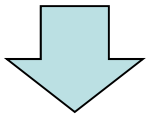
Measurement of Microbiology



Clean room and Cultivation chamber

Automated Water Quality Monitoring Station

Very effective for grasping the current situation because continuous measurement is possible.
Items that can be measured are limited to items that can be automated.
Maintenance costs are large.

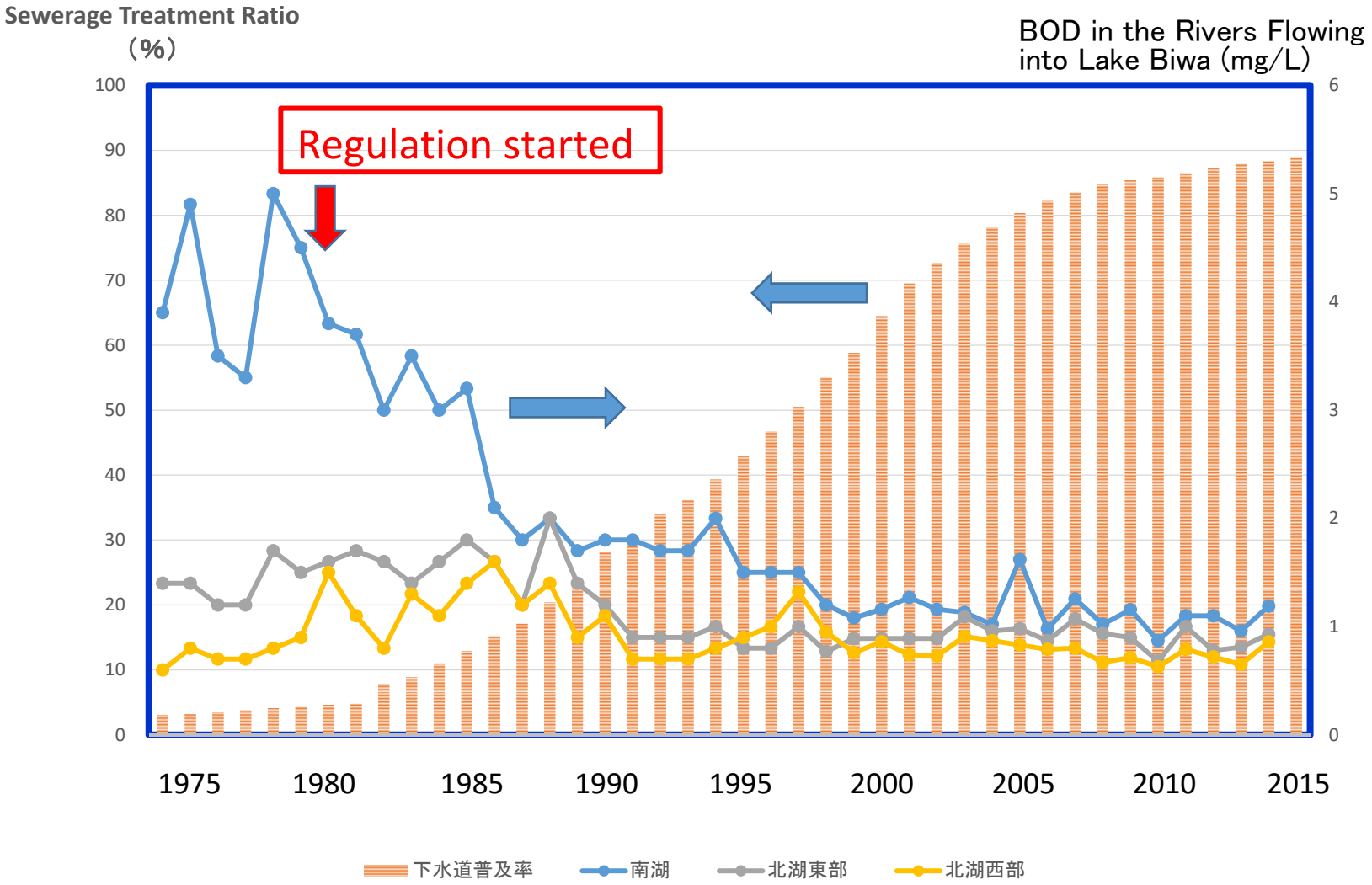


It is important to judge whether installation is possible or not according to the purpose.

In Lake Biwa they were constructed in 1990’s, but some are not in operation due to the high cost of maintenance.

Example of Analysis of Results

(Changes of Water Quality of Inflowing Rivers)



Measurement without Laboratory or Experts

- Some inorganic ions can be measured with electrode on site
- Many inorganic ions can be measured by colorimetry way with eyes or equipment

  (Slightly different from the Standard Method)
- Turbidity is easily measurable with a tube by eyes

Necessity of On-site Survey and Simplified Analysis

- Compensate the official survey by site or time
- Participation of citizen at many places in a special time
- Continuous Survey by citizen group at a special point

Colorimetry by Pack-Test

- Various kinds of “Chemicals in Tube” are prepared

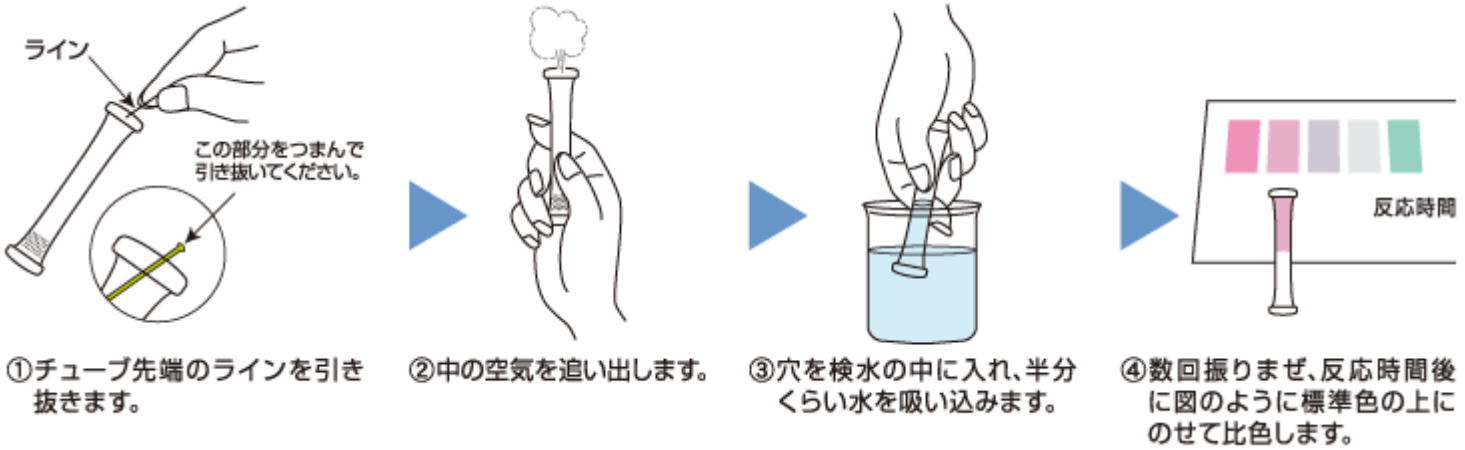
  B, Cl, CN, F, NH_4, NO_2, NO_3, PO_4, S, SiO_2

  Ag, Al, Ca, Cr, Cu, Fe, Mg, Mn, Mb, Ni, Zn

  COD, pH, Phenol, ClO
- Easily Measurable on site by eyes
- Quantity Analysis can be conducted with Portable Colorimeter

Colorimetry by Pack-Test(2)

From HP of Kyoritsu Chemical-Check Lab.,Corp.



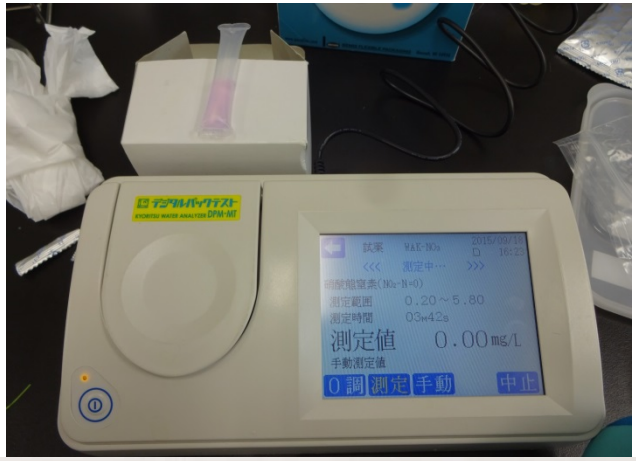
①チューブ先端のラインを引き抜きます。

②中の空気を追い出します。

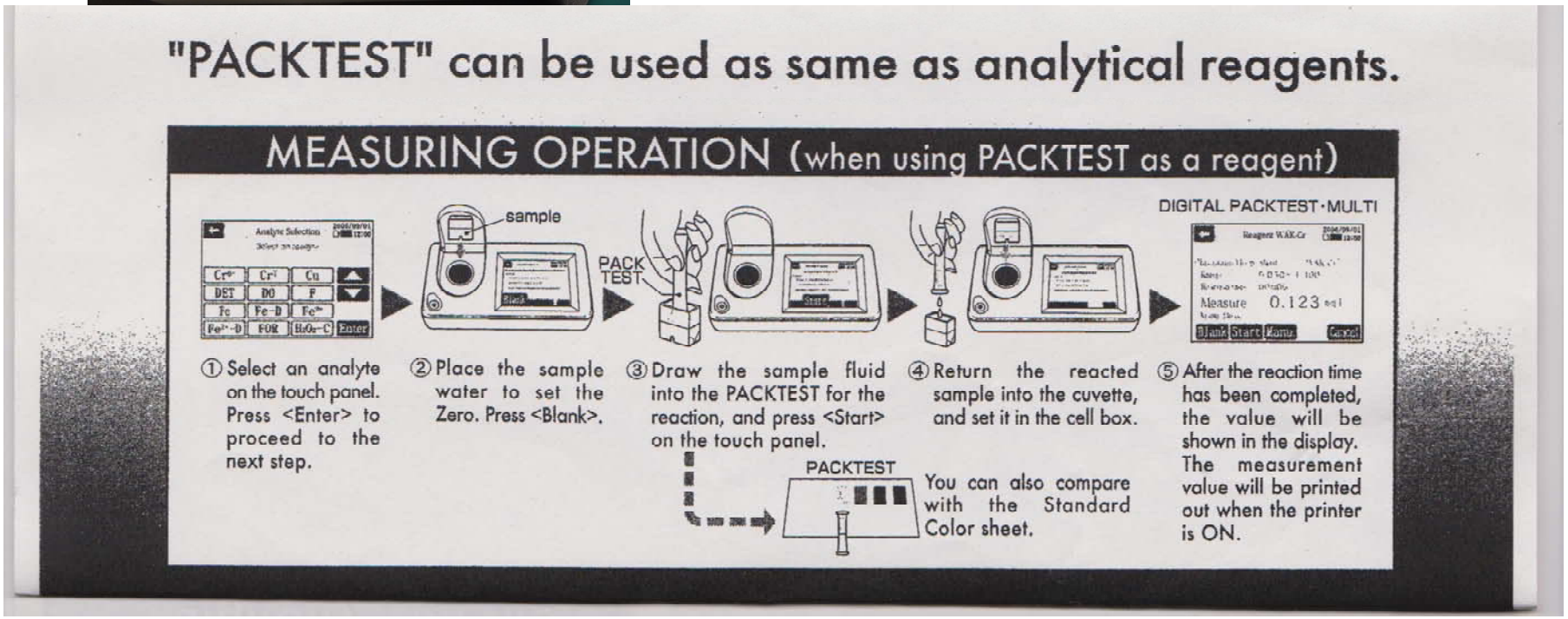
③穴を検水の中に入れ、半分くらい水を吸い込みます。

④数回振りまぜ、反応時間後に図のように標準色の上にのせて比色します。

Colorimetry by Pack-Test(3)



With Simplified Colorimeter

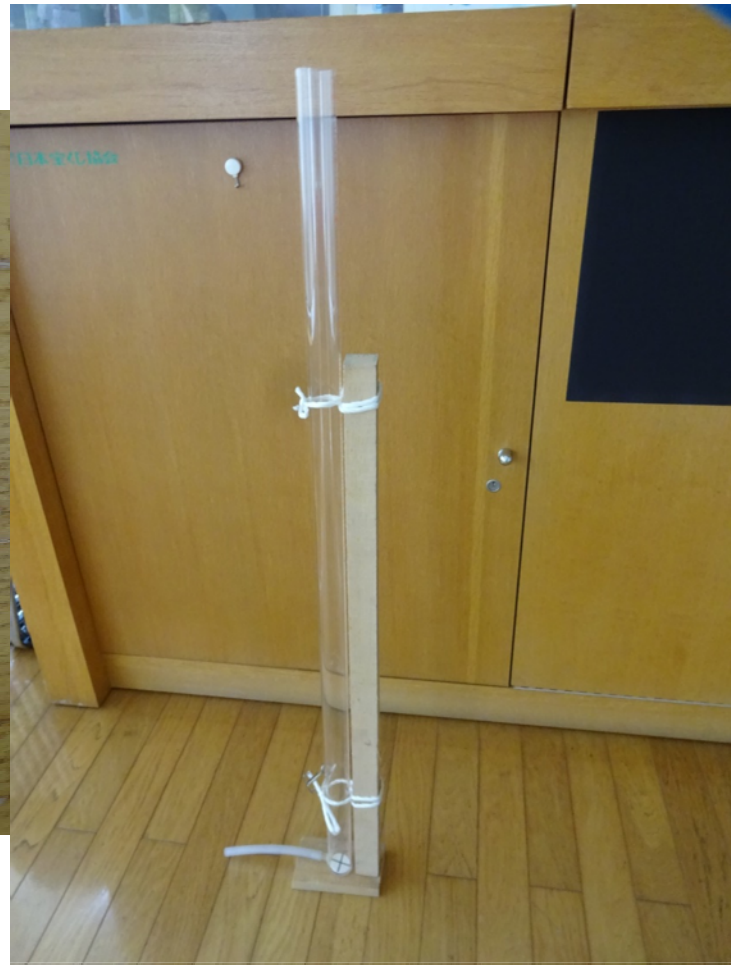


On-site Transparency Survey

- To know the extent of erosion is very important
- But it depends on the time and place
- Self monitoring by citizen or farmer is favorable

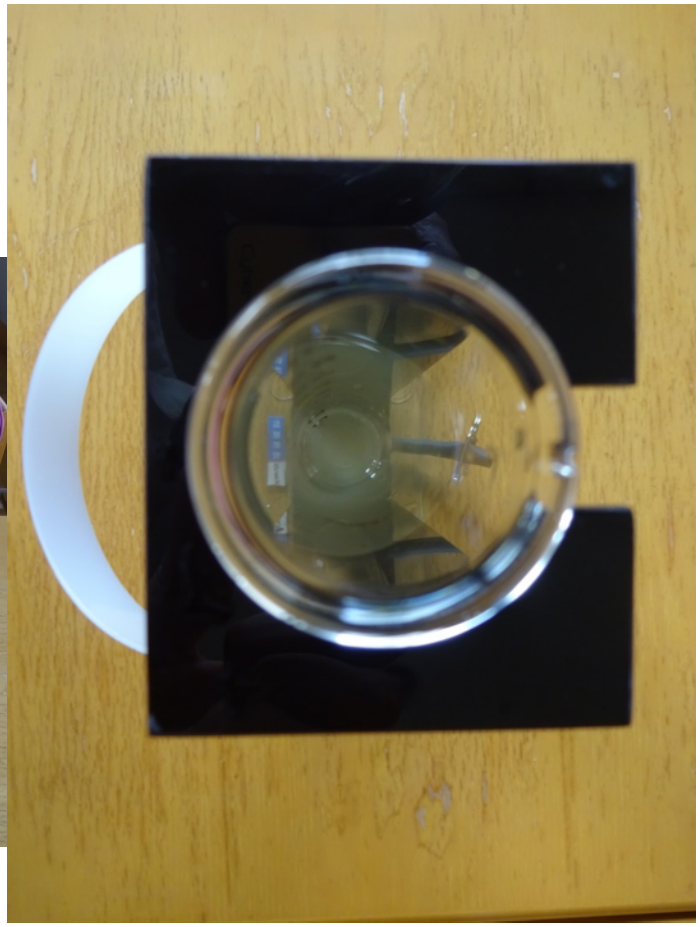
On-site Transparency Survey (2)

30cm tube



100cm tube

On-site Transparency Survey(3)



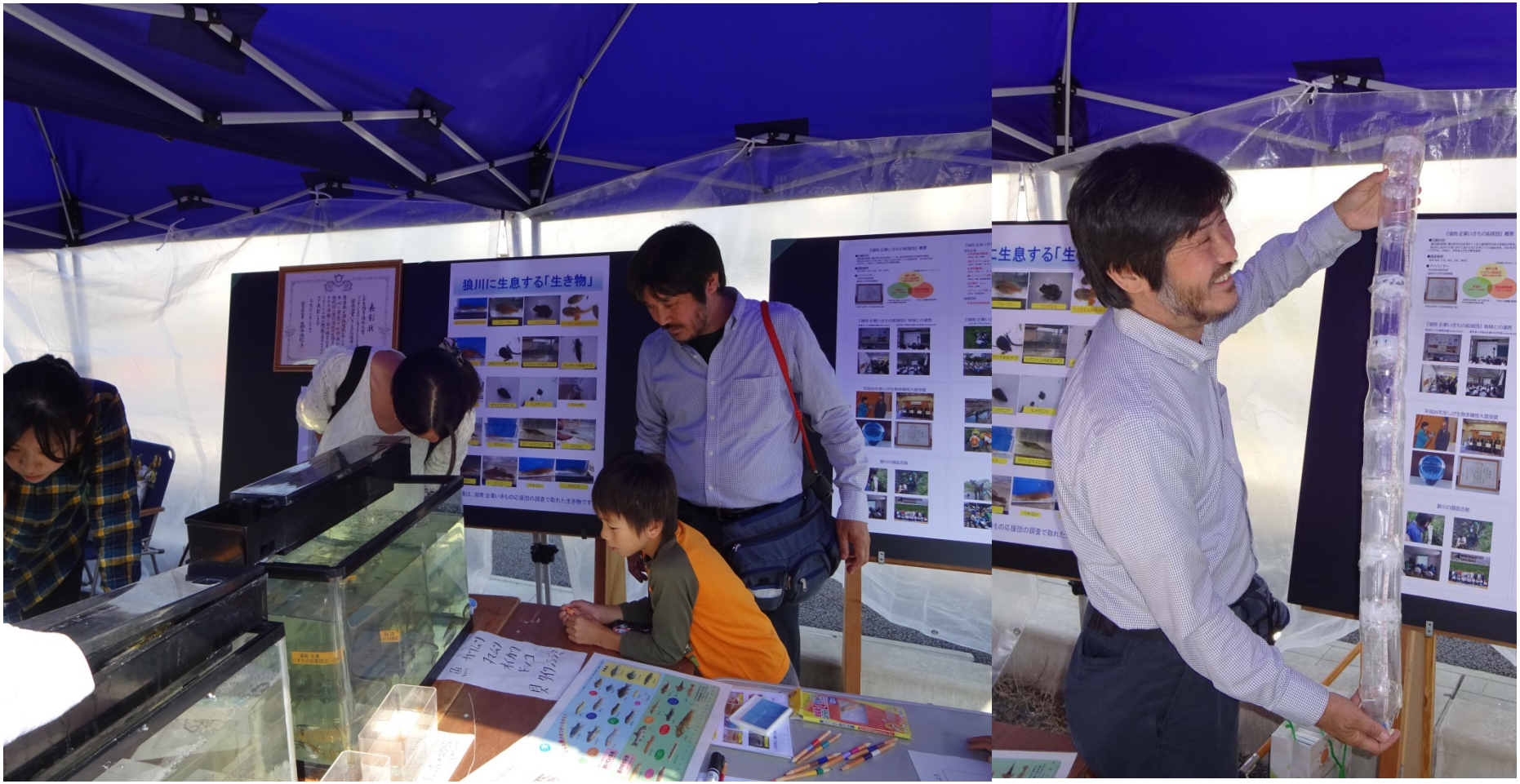
Tap Water

Lake Water

On-site Transparency Survey(4)

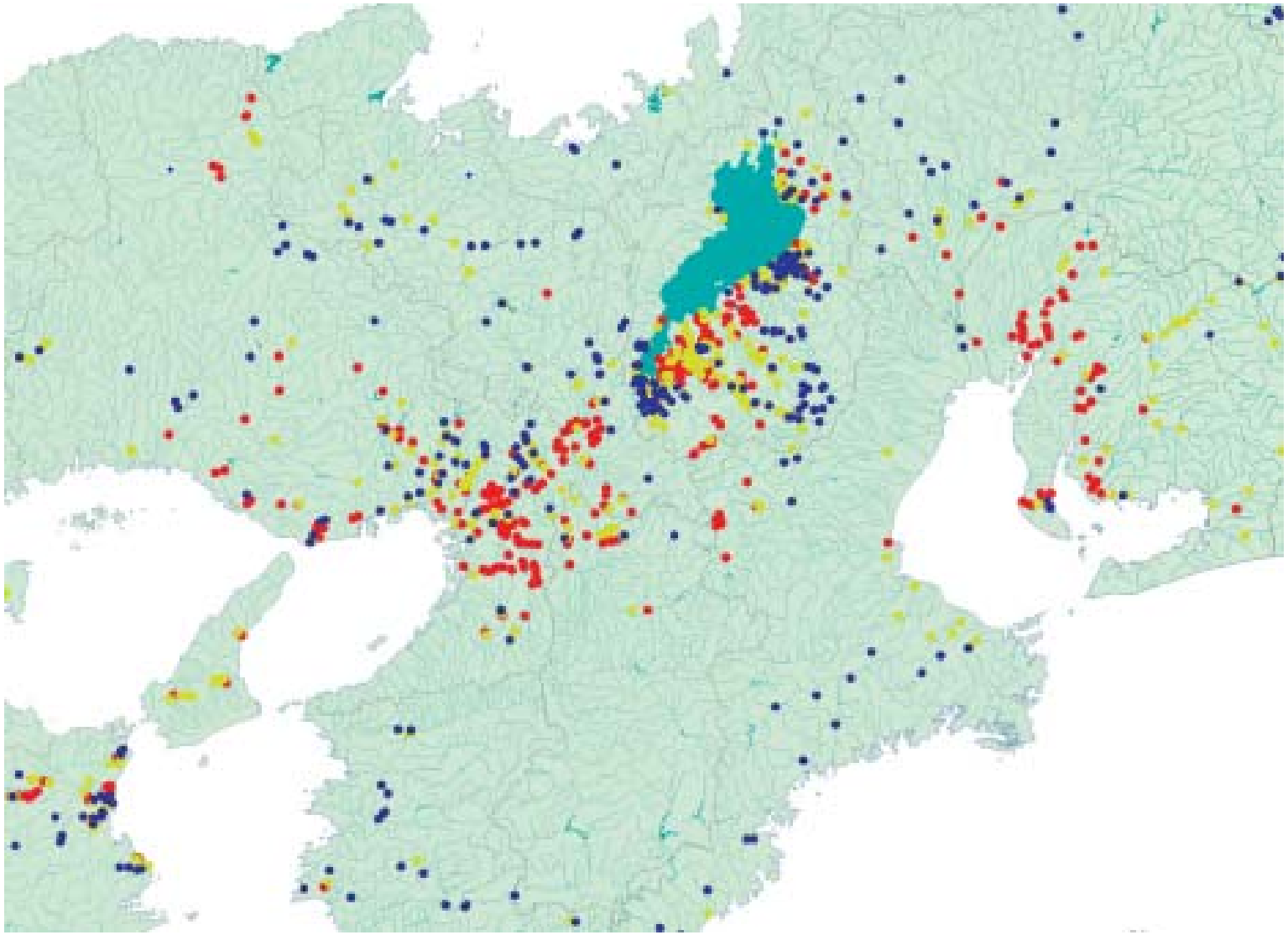
Most critical season in the paddy field is rice planting period
Farmers check it by themselves

Citizen’s Survey of Water and Fauna



With Handmade Transparency Tube

Results of Citizen's Survey in 2017



From Japan-mizumap HP