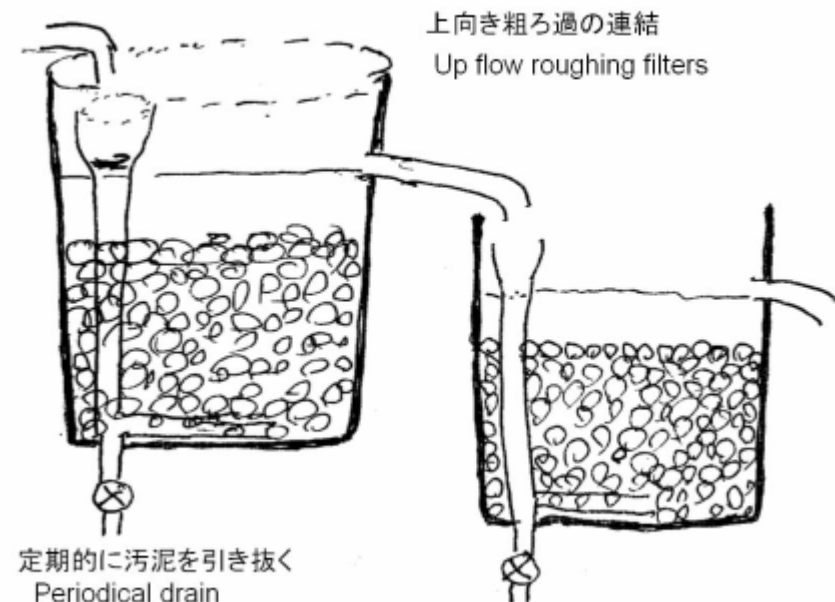
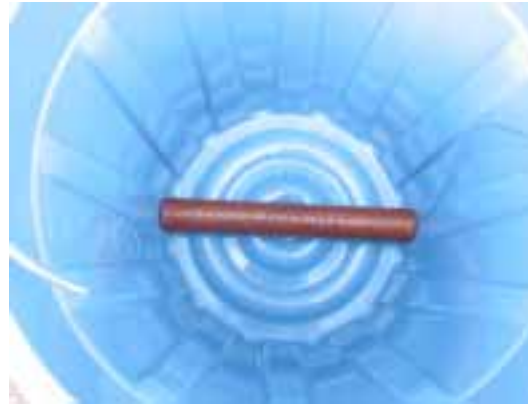


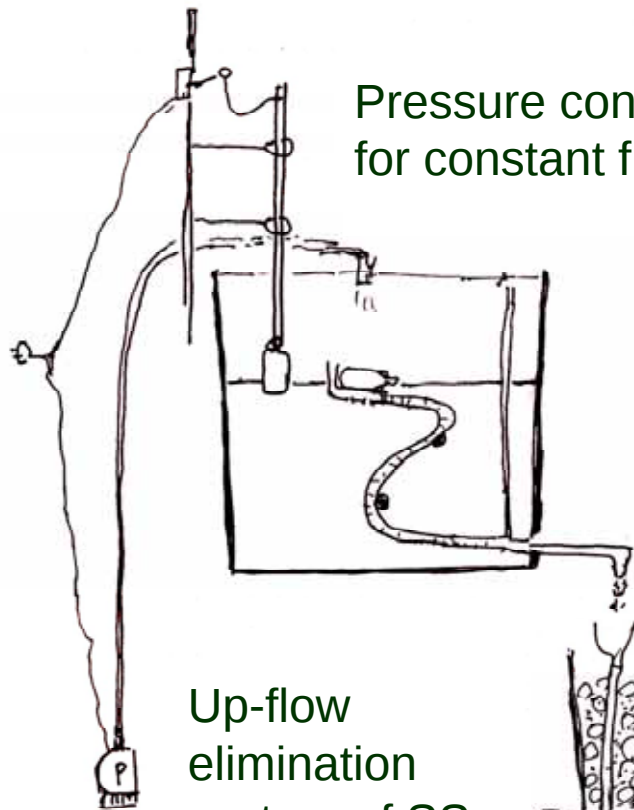
Surface water of a river + sub-surface water (low oxygen concentration)



OISCA Tokyo: polluted water (Kanda river) → gravel → gravel → small sand → safe water

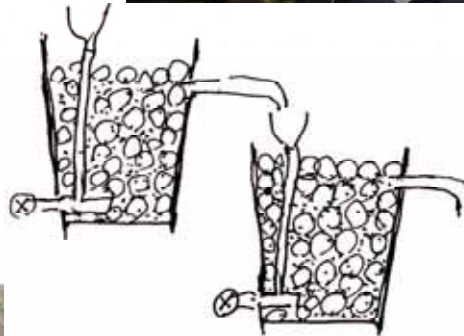
Sri Lanka: three Up flow roughing filters → sand filter → safe drinking water (300 liters / day). This water is the demand of 5-6 family.



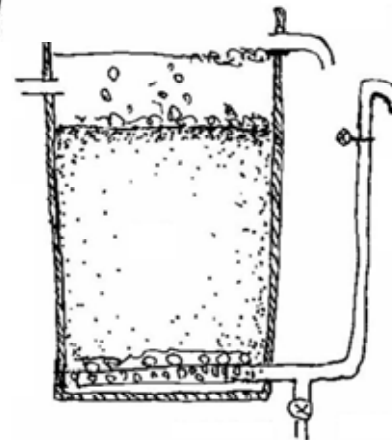


Pressure control
for constant flow

Up-flow
elimination
system of SS



Sand size
is not
important:
large size
of sand is
better.



Mr. WRIGHT Filipo(Samoa)

Mr. KAPHLE Ram Chandra(Nepal)

Mr. PHIMMASONE Vilaykhone(Laos)

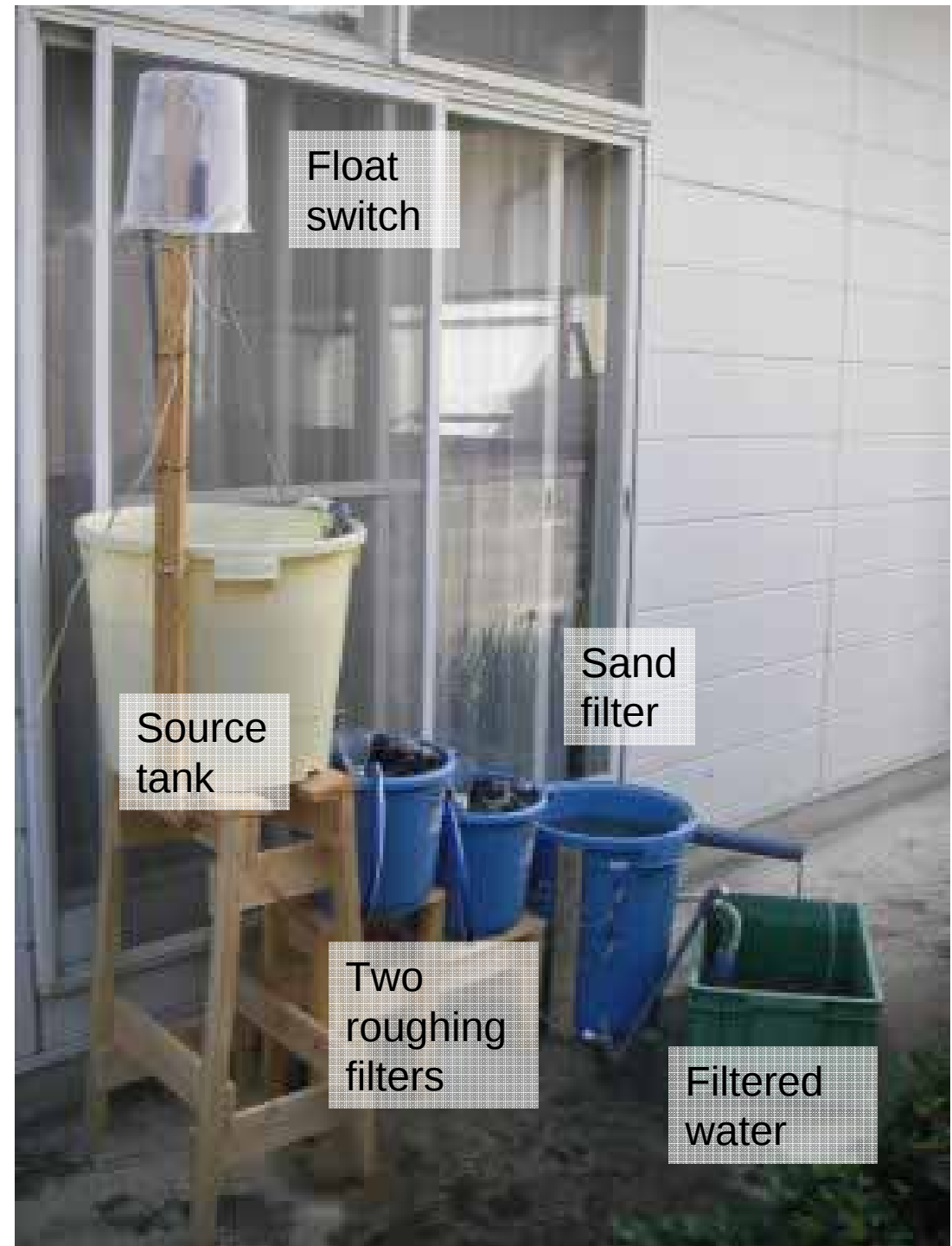
*Ecological Purification
System can be made
by yourself.*



Snap switch for a small electric pump. Using a circulate system, the filtrate and over flow water is pumped up into a source reservoir tank.



Float bottle for switch. And floating outflow to keep a constant flow rate.



Float switch

Source tank

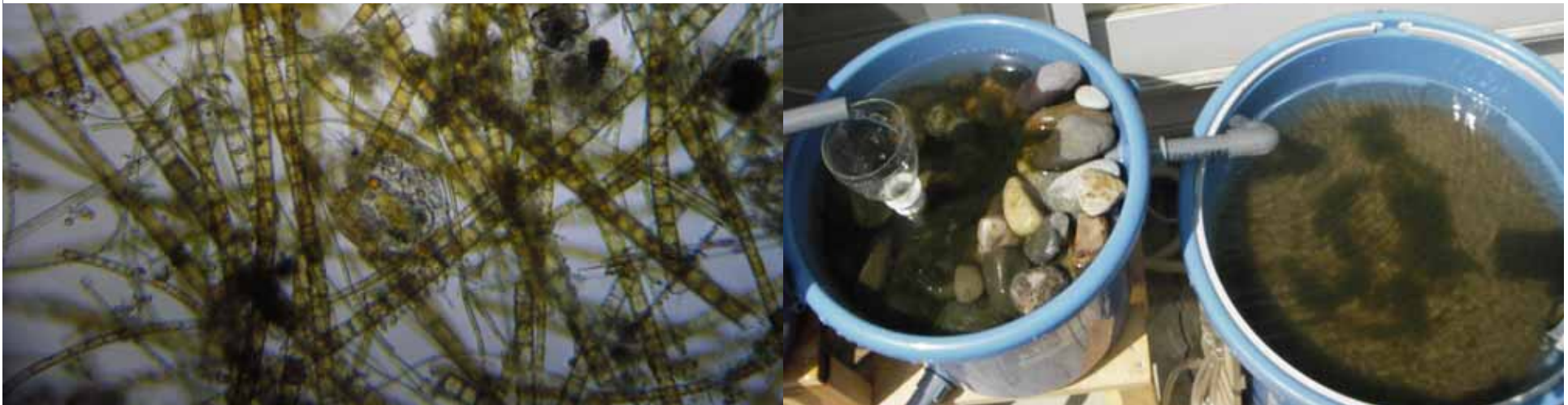
Sand filter

Two roughing filters

Filtered water



In the flood plain, there is a spring. This water is a clear subsurface water. While, surface water of the river is turbid water.

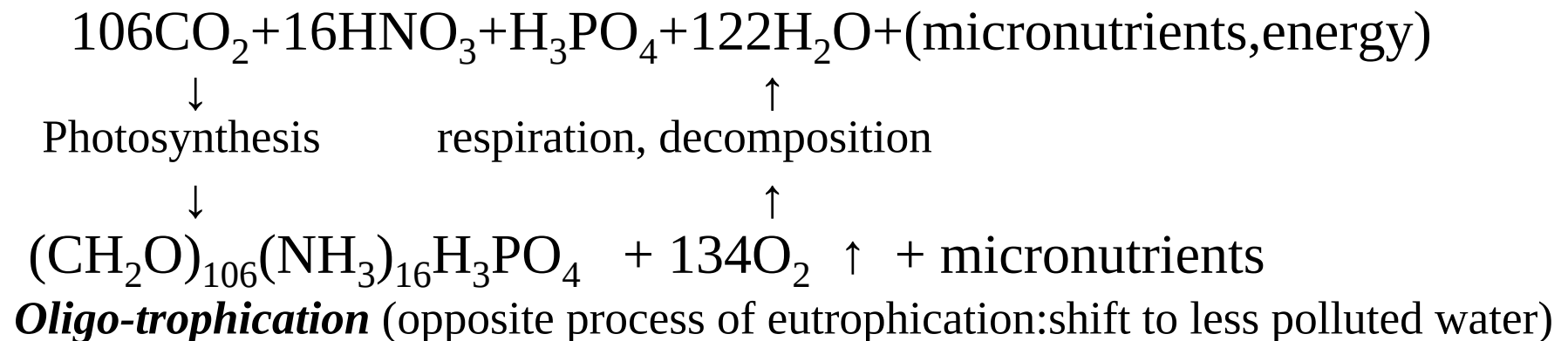


Muddy matter on the gravel was observed by a microscope. It was filamentous diatom of *Melosira*. Many small animals were also seen. Ecological Water Purification System was set on May 27. I put some amount of water sample as a seed into this model.

Biological Phenomena of Ecological Purification System(EPS)

Oxygen Production by Photosynthesis $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{CH}_2\text{O} + \text{O}_2 \uparrow$
Gives a better condition for heterotrophs. (Decomposer: bacteria, small animals)

Reduction of Nutrients in Water by Algal Growth



Production of Food and Energy Source for Heterotrophic Organisms
Algae is one of the best food for animals in EPS.

Shift to High pH and High DO Concentration by Photosynthesis
(Low CO_2 concentration shifts to high pH condition)

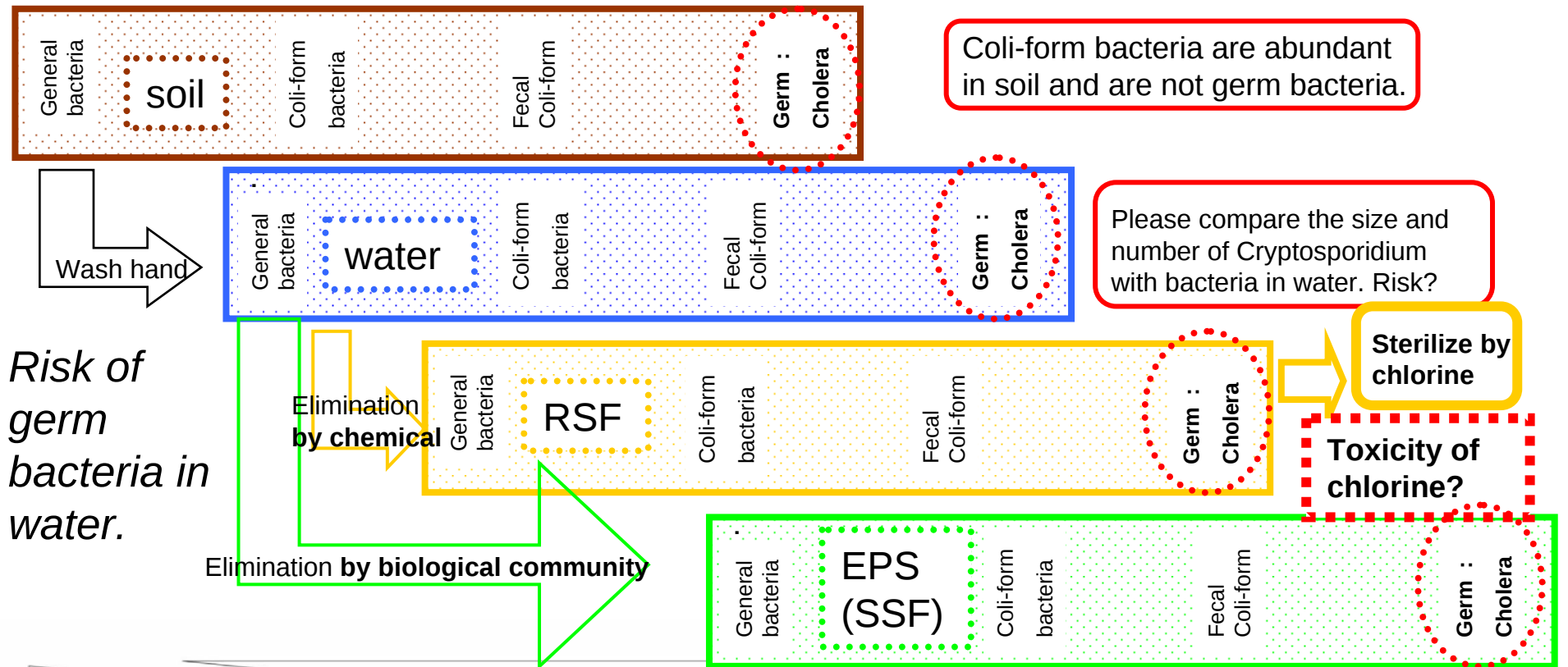
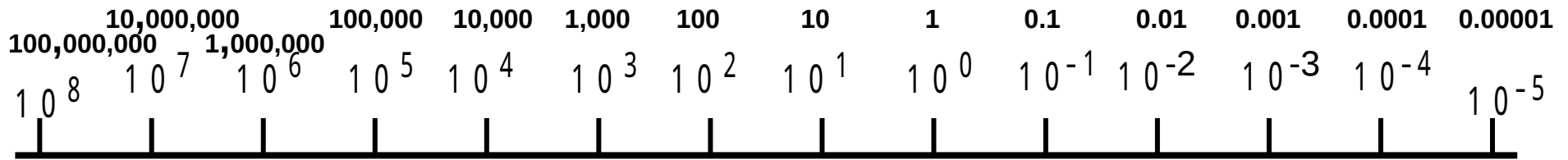
Metal ions are easily changed to hydro-oxide compounds.

Easily precipitate: **bio-mineralization**

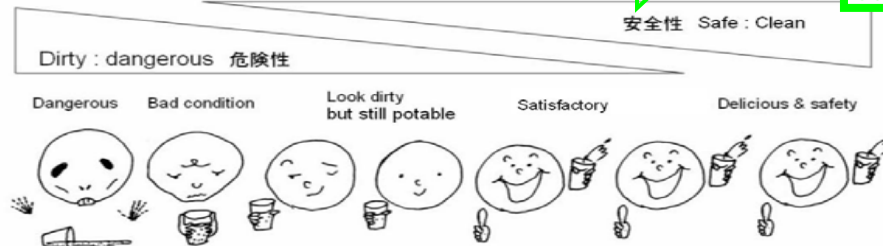
Reduction of metal ions: Reduction of toxic heavy metals

There are so many bacteria. → Medical doctor touches with patients. Doctor is safe.

Logarithmic bacteria number in 1 ml



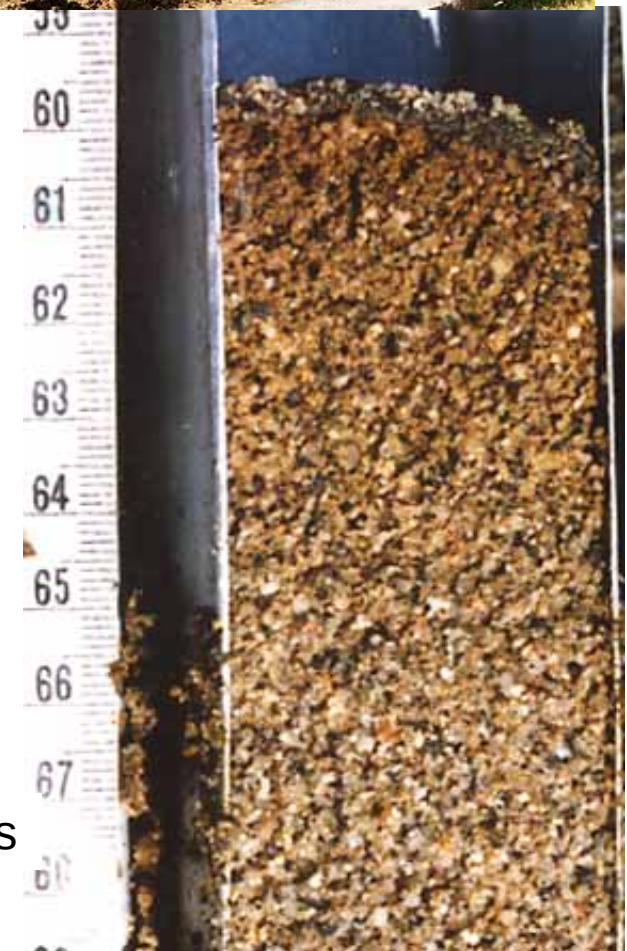
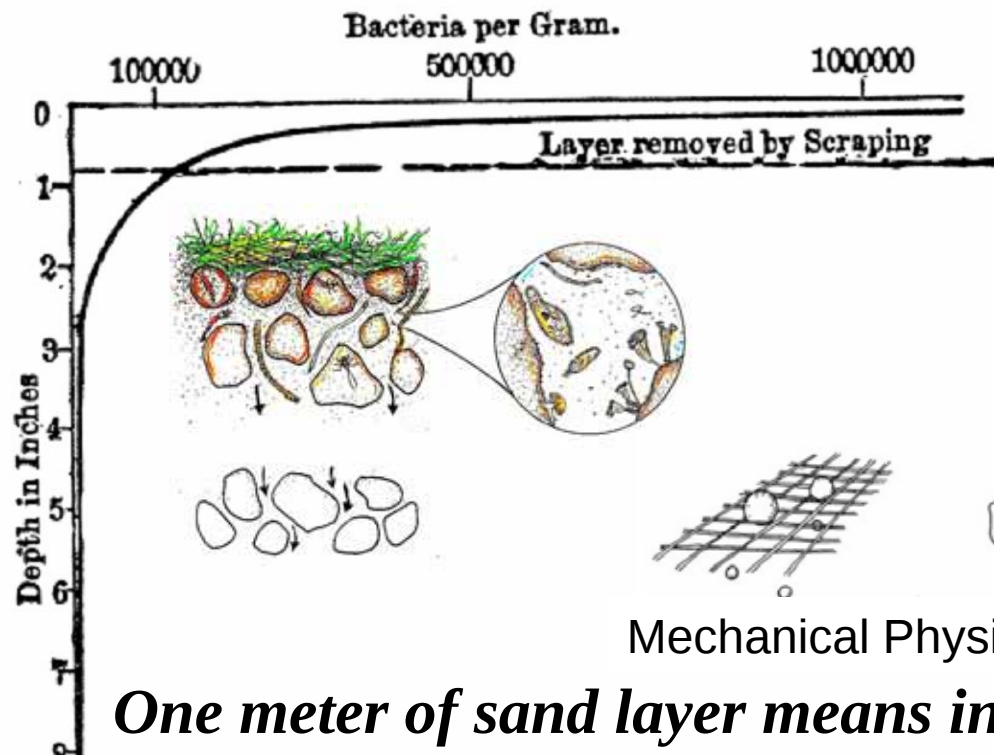
Risk of germ bacteria in water.

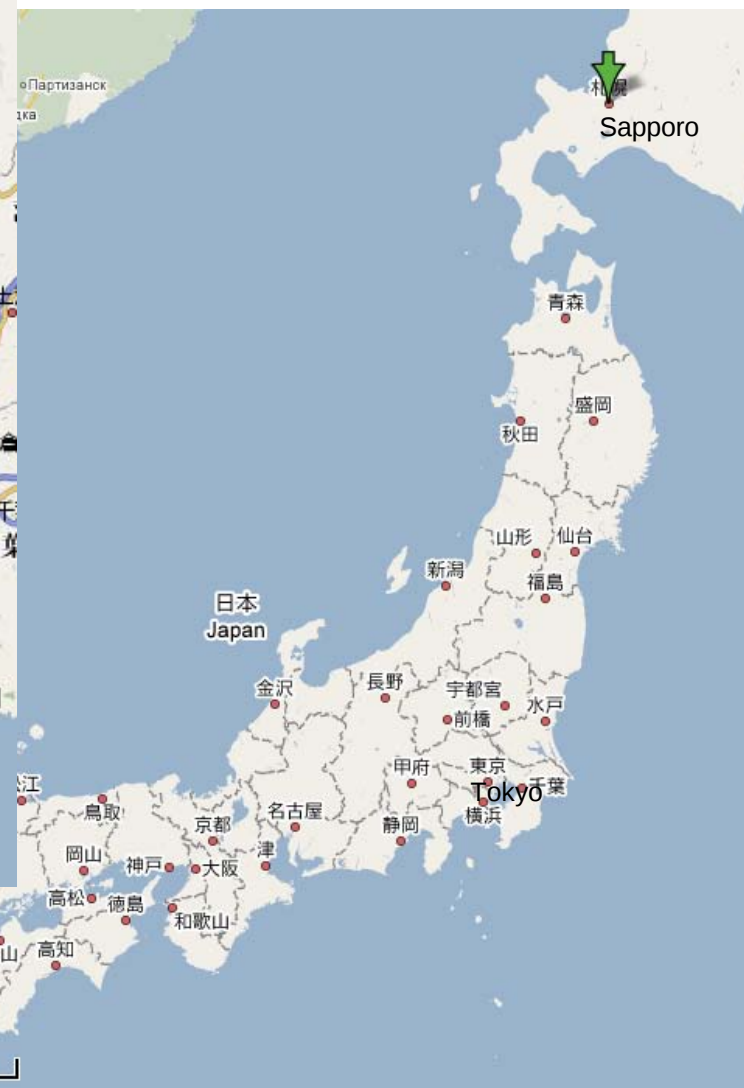


We have to think about acceptable risk.



Passing through the active layer where microbe live in the upper sand layer of 1 to 2 cm. It takes only several minutes. It means really instant process.





Ojouchi water works(Nagano city)

Water source: Togakushi Reservoir

Accumulation of Dead Plankton on the bed (Effect of Algaecide of CuSO_4)

Nishihara water works(Suzaka city)

Water source: subsurface stream water

Bloom of filamentous algae

Ishifune water works (Ueda city)

Sugadaira High Land (Agricultural field)

Sewerage treatment and Reservoir

Someya water works (Ueda city)

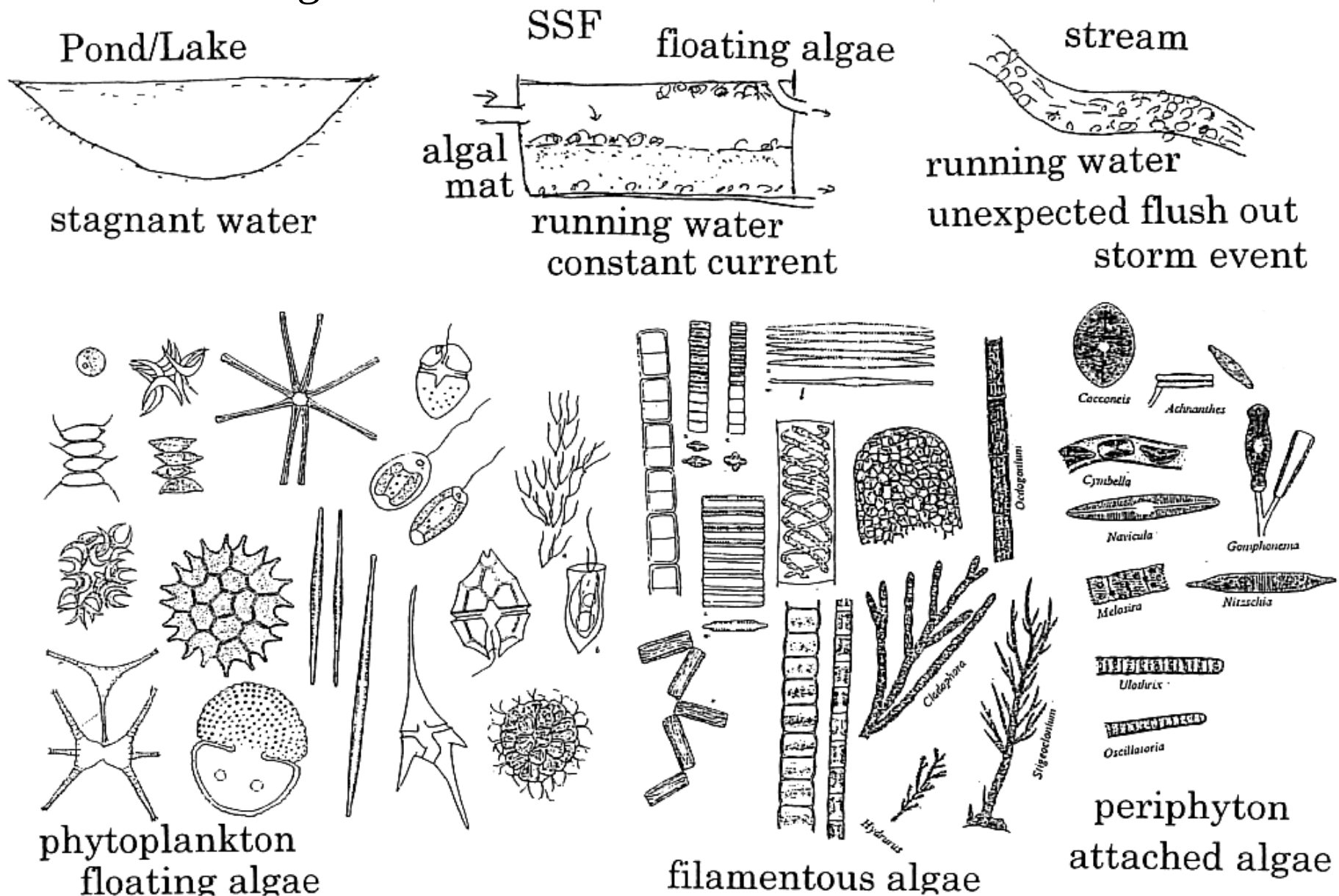
Surface stream water: sometimes add coagulant

Koshigoe water works (Maruko, Ueda city)

Surface stream water: sometimes add coagulant



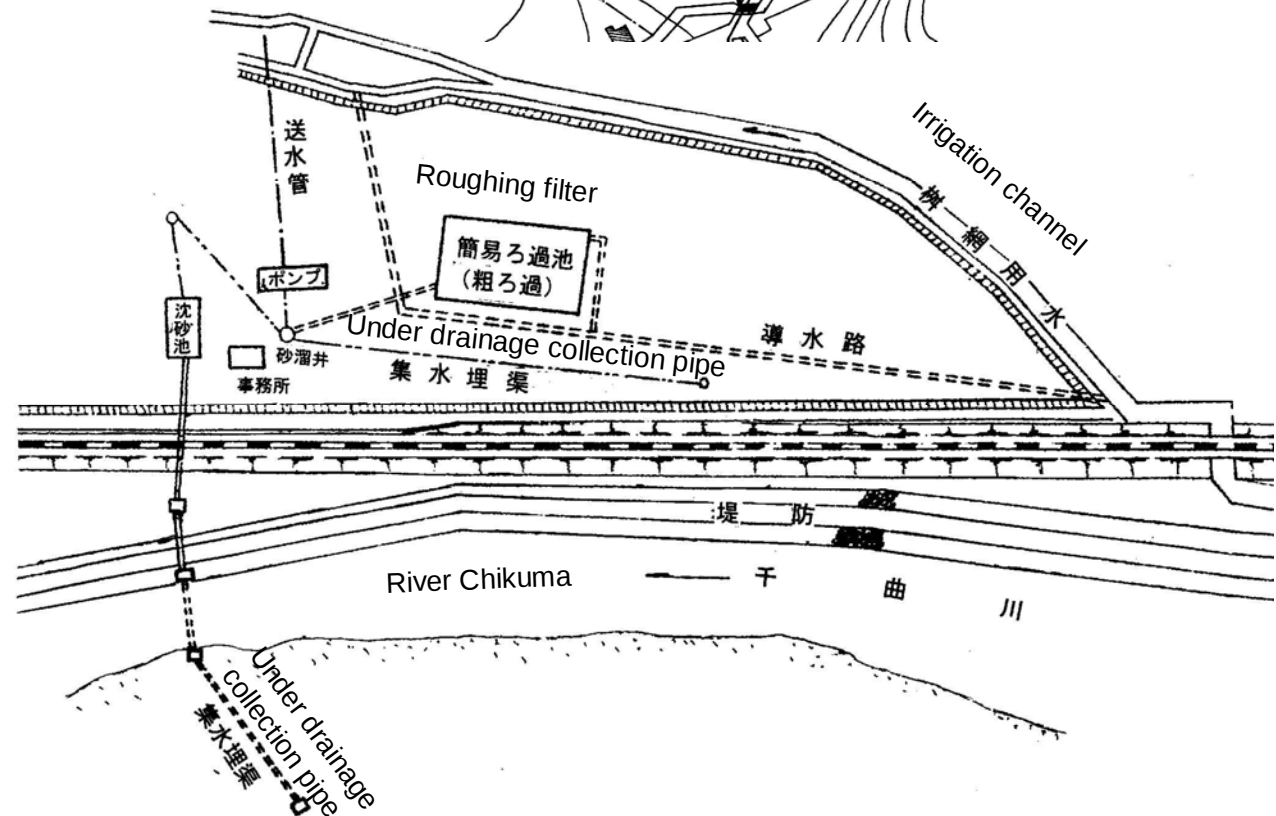
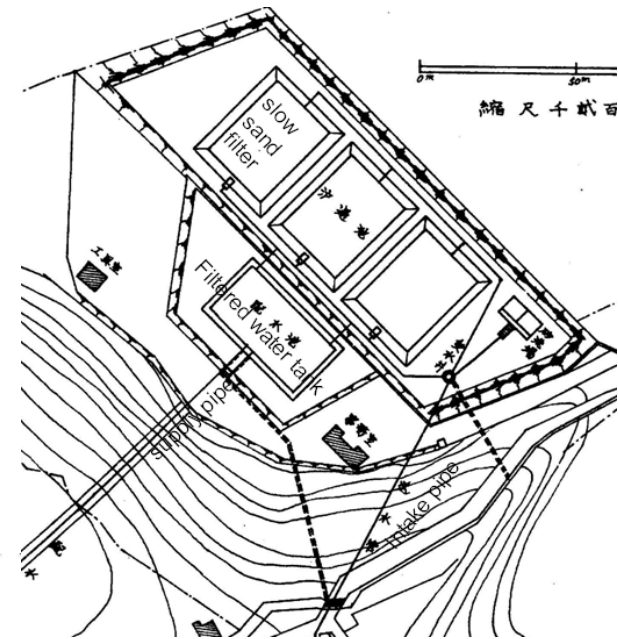
SSF(Ecological Purification System) is the suitable environment for filamentous algae.



Someya waterworks, Ueda city, Nagano was completed in 1923.

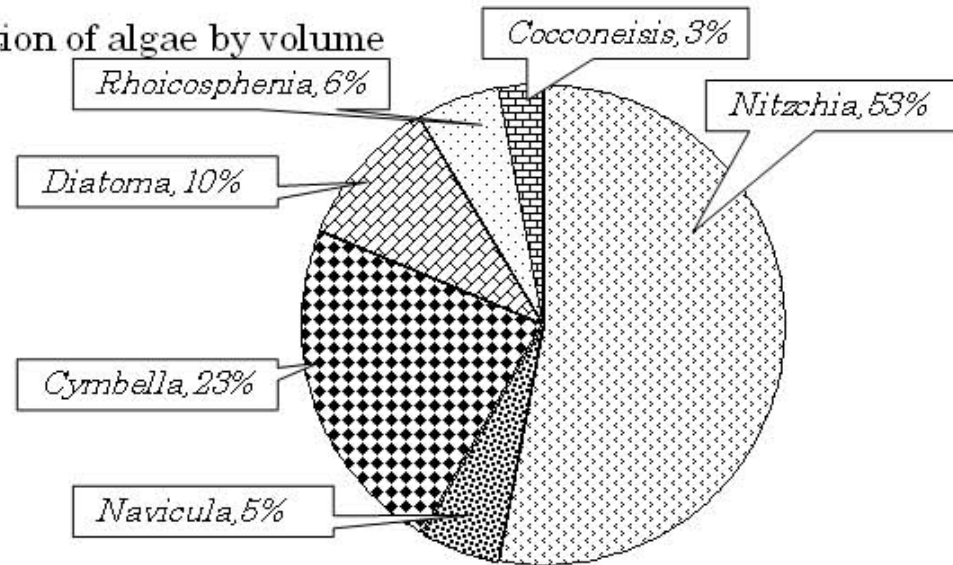
Subsurface underground water of River Chikuma was taken and was pumped up to the filter plant.

Original waterworks has 3 filters and storage tank.

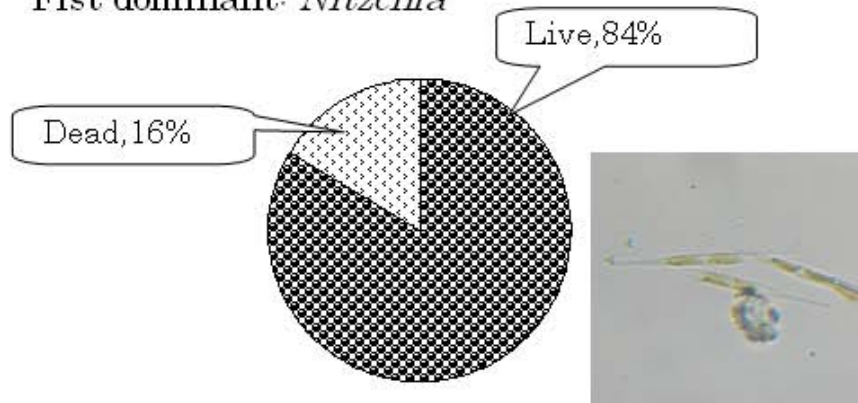


River bed (Chikuma River, Periphyton)

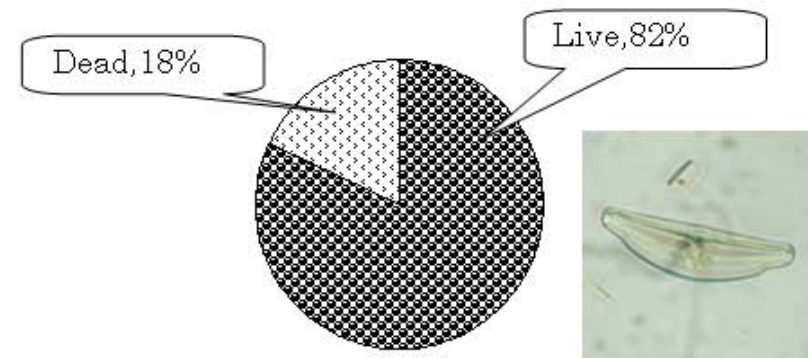
Contribution of algae by volume

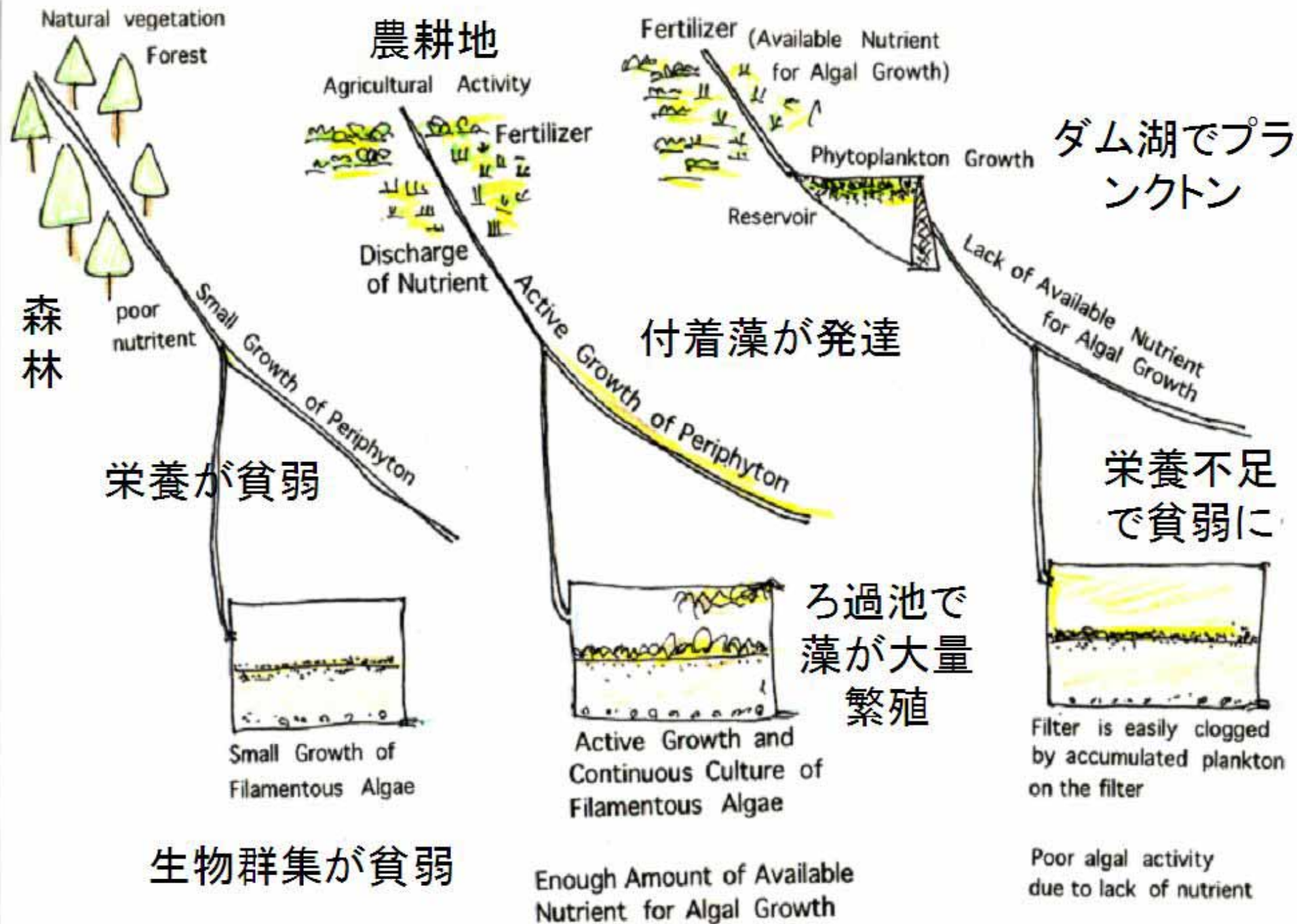


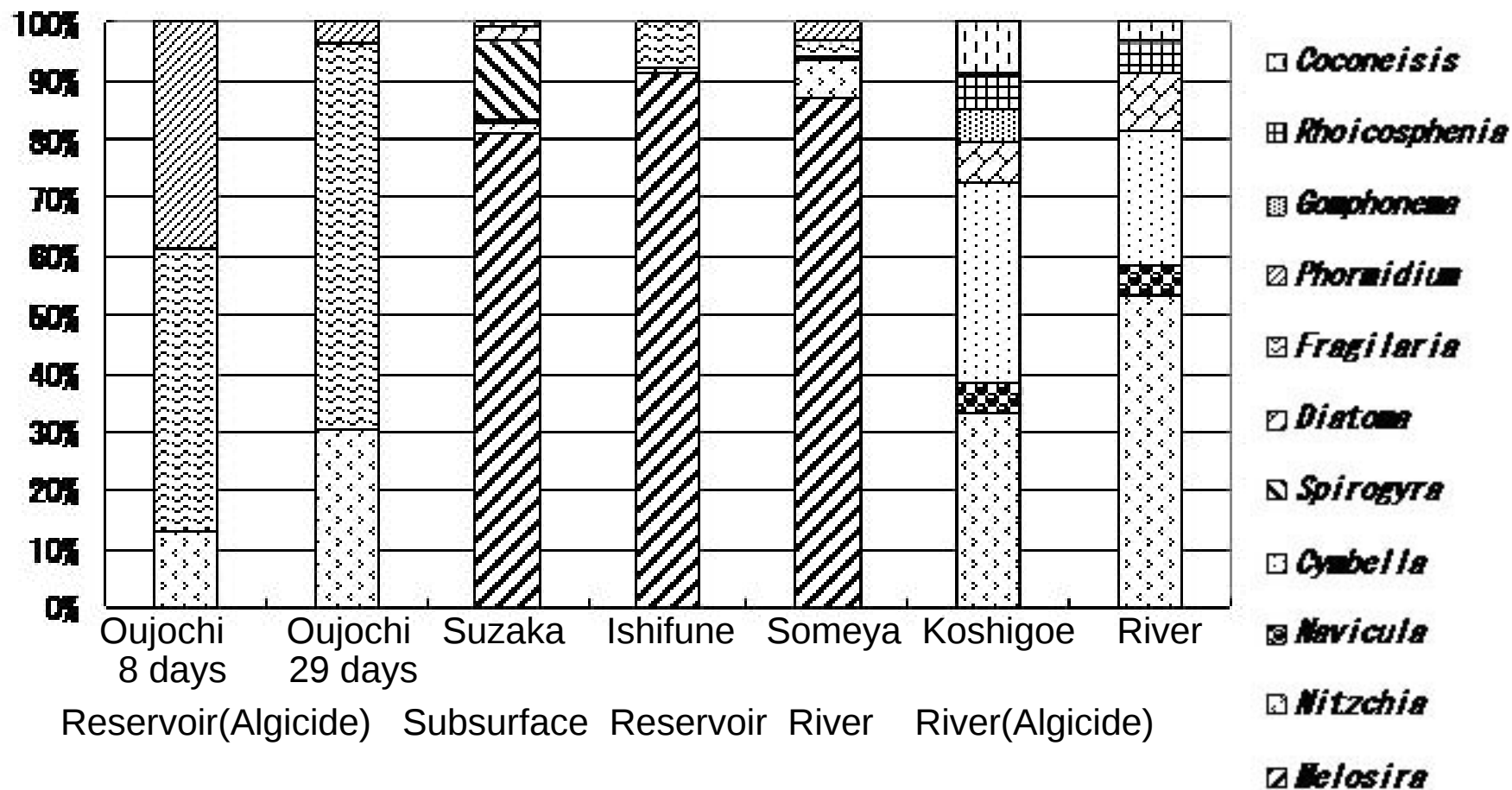
1st dominant: *Nitzschia*



2nd dominant: *Cymbella*







Coconeisis *Rhoicosphenia* *Gomphonema* *Phormidium* *Fragilaria* *Diatoma*



Spirogyra *Cymbella* *Navicula* *Nitzschia* *Melosira*



Sometimes, copper sulfate is added to regulate the algal bloom in a reservoir. This treatment is for the chemical treatment of RSF. In case of SSF, this treatment is sometimes caused the short filter run.

Togakushi reservoir 戸隠貯水池

Oh-joh-chi waterworks 往生地浄水場, Nagano since 1915.

One filter area is 860m² (x 3 ponds = total 2,580 m²).
storage tank : 8,760 m³

Original plan for 60,000 persons demand in 1915.

If filter rate of 5m/d is adopted, 12,900 m³/d of filtered water can be made. This capacity is equal to the demand of 43,000 persons (0.3m³/d/person).



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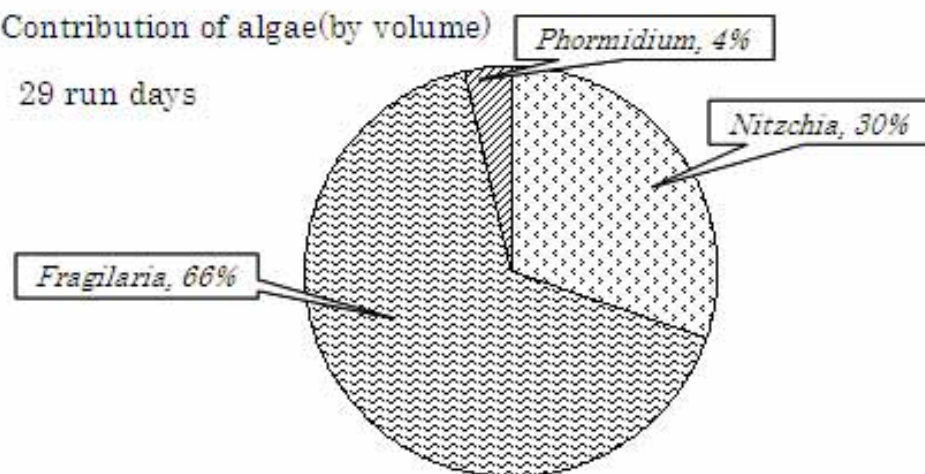
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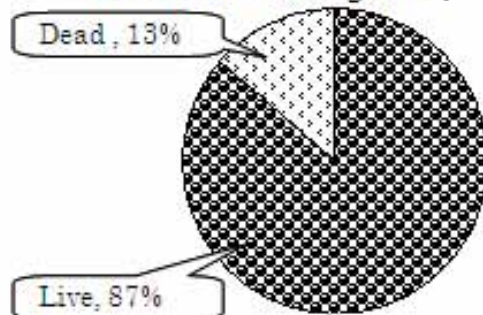
Oujouji (Nagano)

Contribution of algae (by volume)

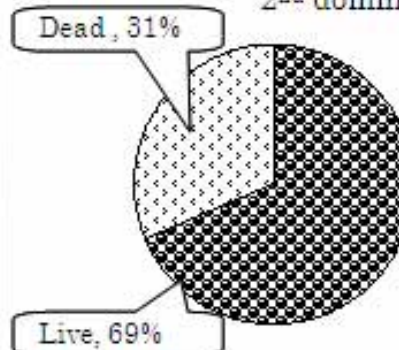
29 run days



1st dominant: *Fragilaria*,



2nd dominant: *Nitzschia*





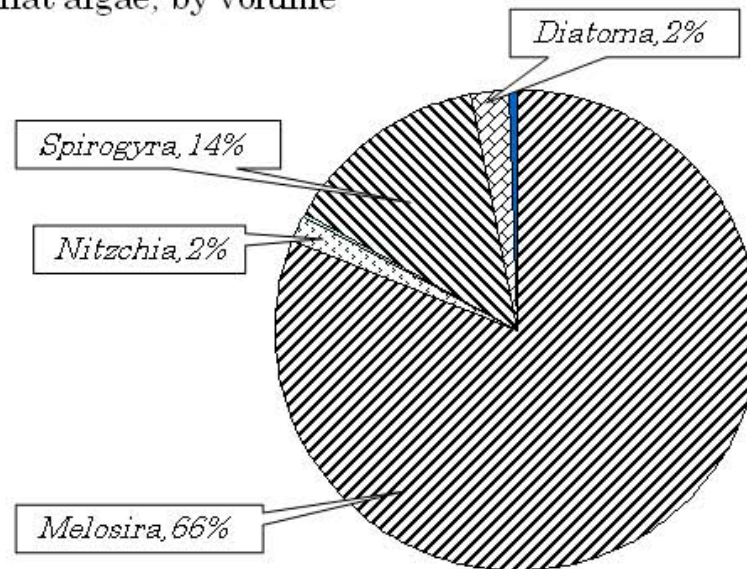
Nishihara waterworks, Suzaka city, Nagano. Raw water: SS free of subsurface water. Over one year, there is no scrapping. This is almost no work to maintenance. One filter area: $6.8\text{m} \times 13.5\text{m} = 91.8\text{m}^2$ One filter capacity : $459\text{m}^3/\text{d}$. One filter can supply for 1500 persons demand ($0.3\text{m}^3/\text{d}$).

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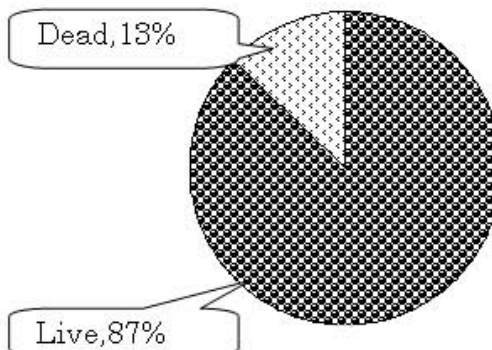
At the foot of mountain, there is a reed plant where underground water leaks out. Porous pipes were set to take the subsurface water which is suspension free water.



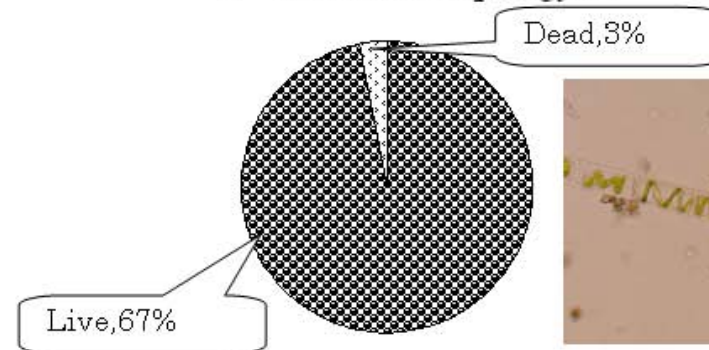
Dominant algae, by volume

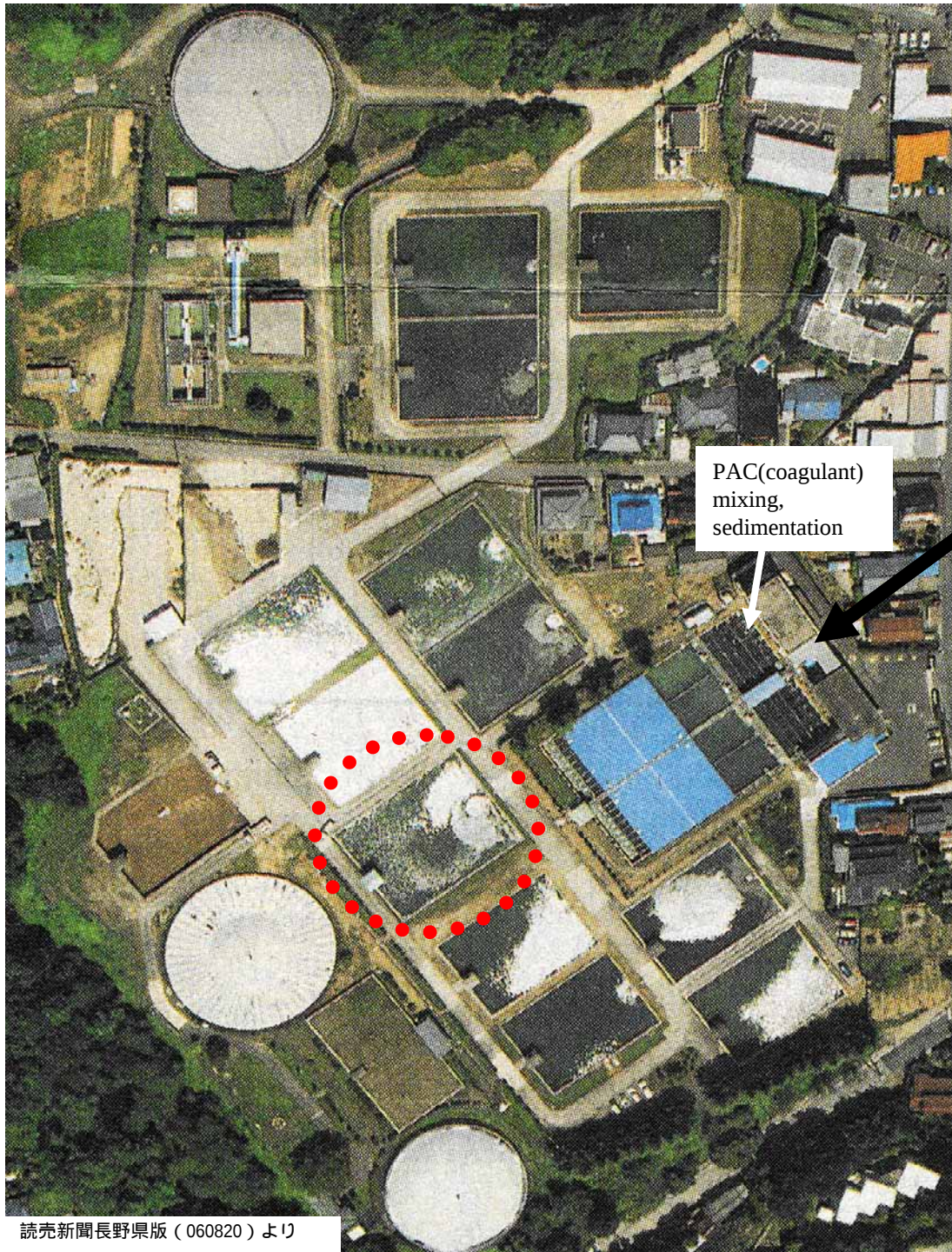


First dominant: *Melosira*



2nd dominant: *Spirogyra*





読売新聞長野県版 (060820) より



In 1964, Sugadaira reservoir was completed at about 15 km up from the waterworks. This water flows to Kangawa river and flows to the waterworks.

Present waterworks has 13 filters. Only one original slow sand filter pond is remained. The side wall of the original filter pond is slant wall like a natural pond. In case of other new filter pond, the wall are all vertical wall.

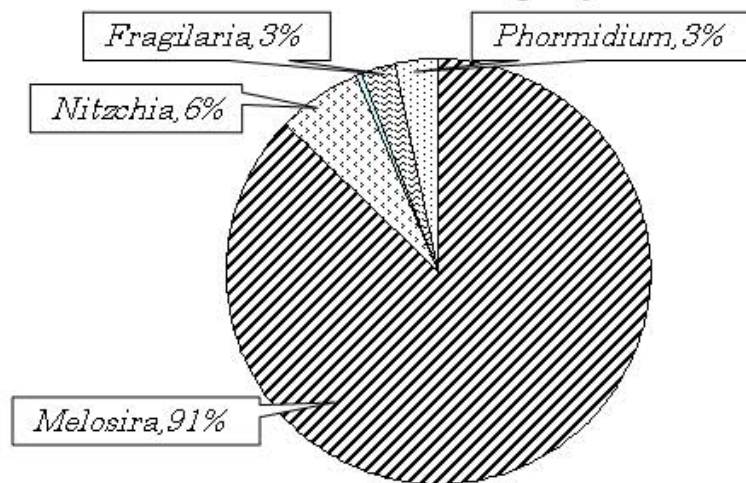
In case of the old filter, algae grows well and easily grow at the shallow place on a slant wall of the old filter. Seed of algae easily stop and hang on the slant wall.

Area of each one filter bed is 780m². Total area of filtering space is 10,140m² (= 780m² × 13). If 13 filters are operated under normal Japanese standard filtering rate (4.8m/d), total capacity of filtered water is 48,672m³ (= 10,140m² × 4.8m).

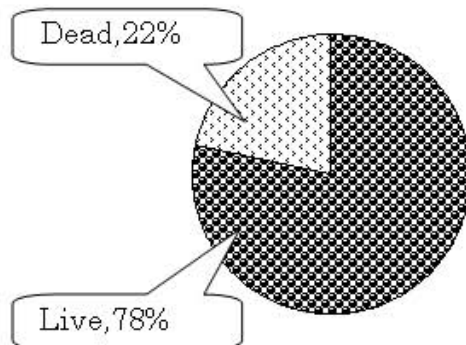
The capacity of water demand is 162,240 persons (0.3m³/d/person).

Someya(Ueda)

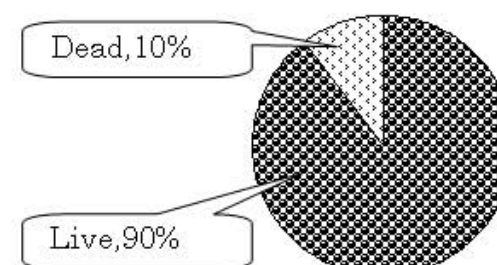
Contribution of Dominant alga by volume



First dominant: *Melosira*

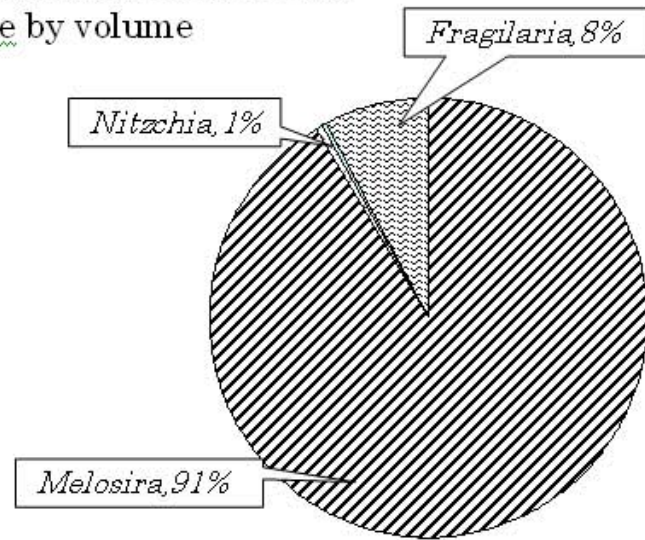


2nd dominant: *Nitzschia*

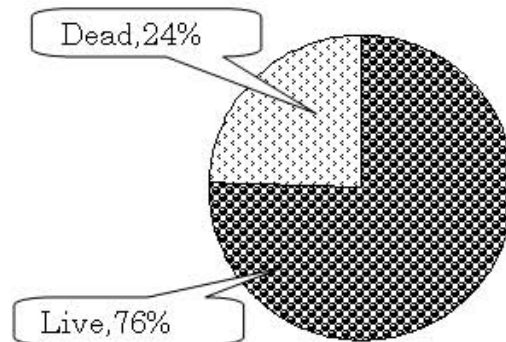


Ishifune (Ueda)

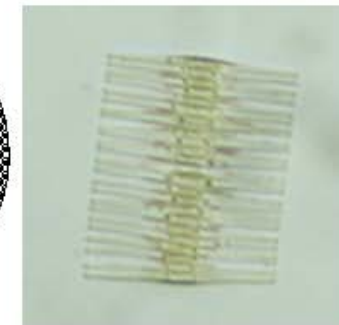
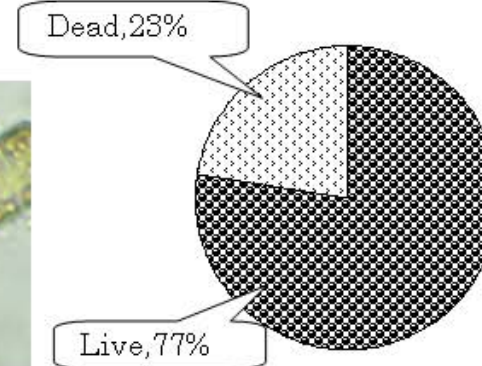
Contribution of Dominant
algae by volume



First Dominant: *Melosira*



2nd Dominant: *Fragilaria*



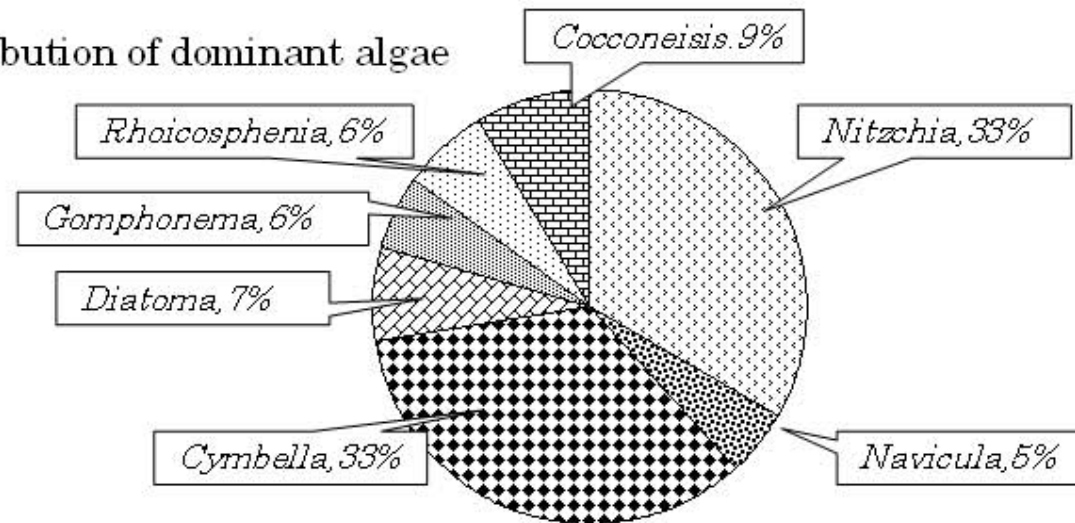


Koshi-go-e water works, Ueda-Maruko, Nagano: Surface water of a river → algaecide +coagulant → mixing → sedimentation → slow sand filter. Filter rate : about 3 m/d. Filter head loss became about 60 cm within one month. There is no active biological community in sand filters.

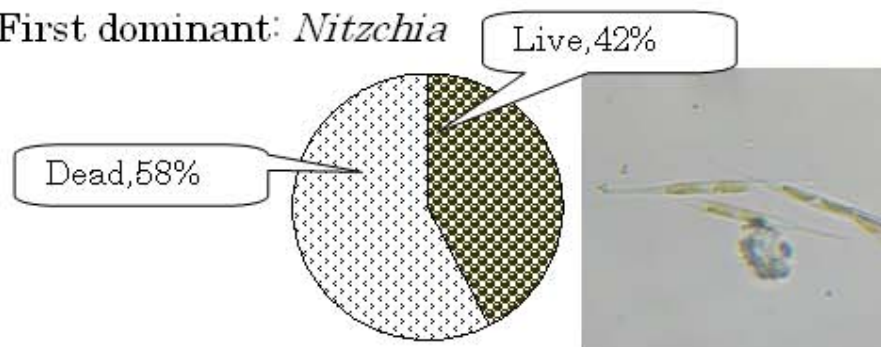


Koshigoe (Maruko, Ueda)

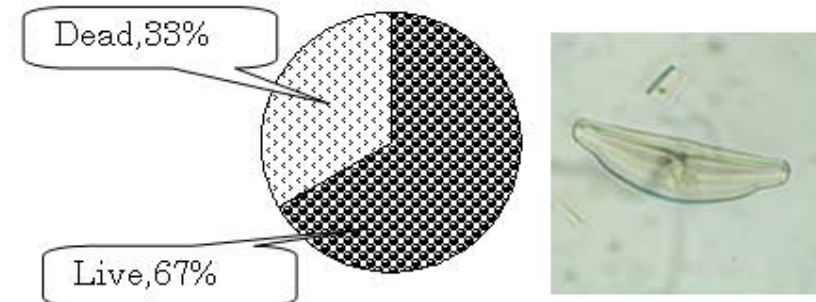
Contribution of dominant algae



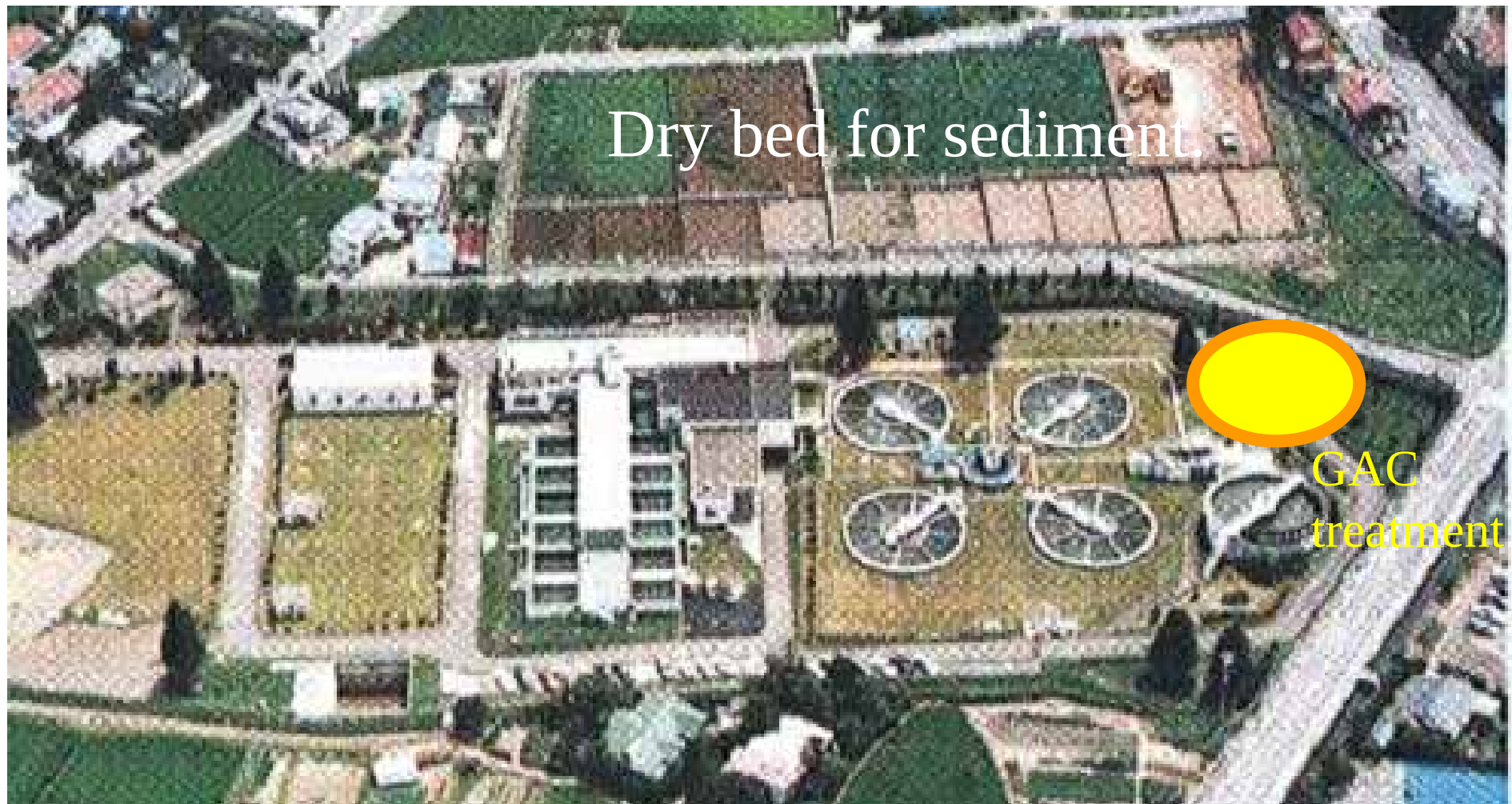
First dominant: *Nitzschia*



2nd dominant: *Cymbella*



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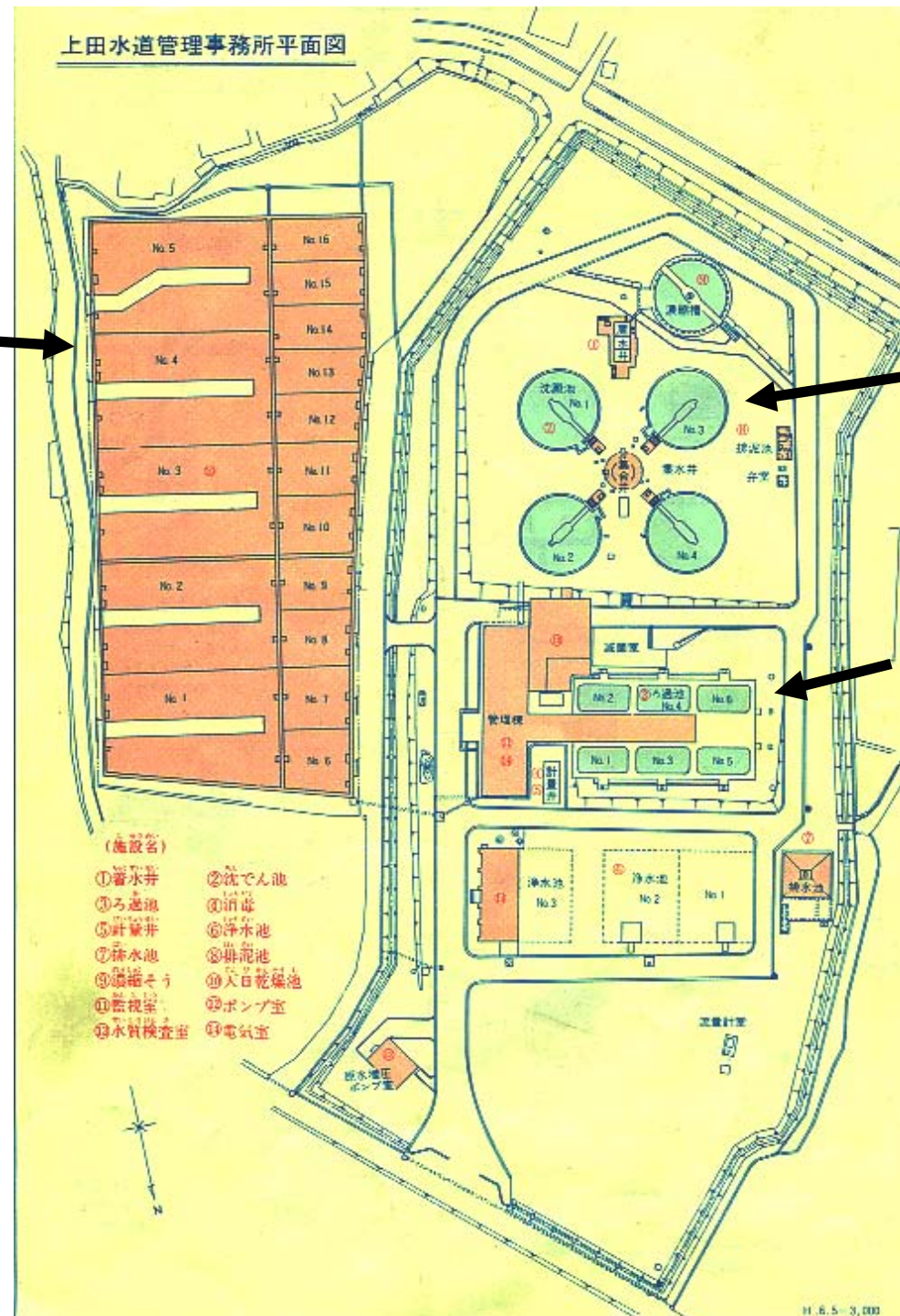


High efficiency of Rapid sand filter system is only for rapid sand filter. True efficiency is not so effective for total system. Chemical treatment produces cancer risk material, and other risks of an odor problem, cryptosporidium and etc. It produces so much waster material by chemical treatment. This system is not so easy maintenance for local people. This system is required special professional person. Modern system of rapid sand filter is uncompleted and faulty system.

Rapid sand filter system: Ueda

Drying bed for
waste sediments.

Other space
except rapid
sand filter is
large.



Mixing
and
sedimentation
basin

Rapid
sand
filter

People prefer to drink natural spring water.

People does not like chlorinated tap water.



Is this water is safe? Harris 1974

This water is not guarantied by the authority. However people trusts this natural water.

Water Purification plant for 100 persons in a village in Japan.

Storage tank

Slow sand filter

Pre-filter: roughing filter

This plant does not use any chemicals (coagulant, and chlorinated reagent)

Intake pipe under river bed



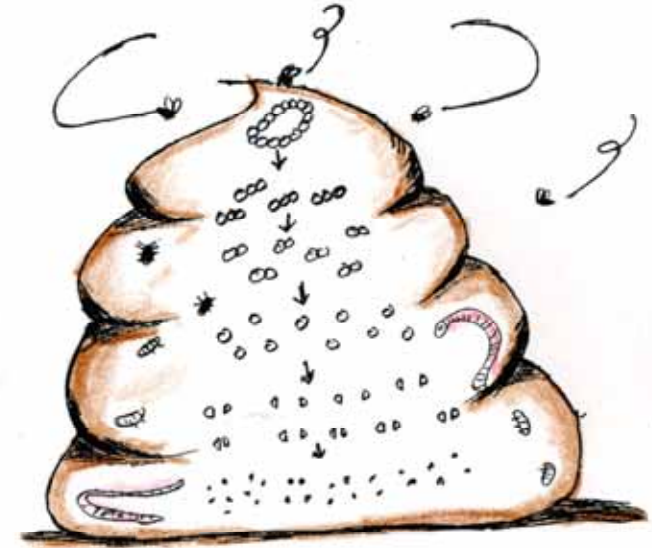


food chain

Short term work

animal

collection, crush, grazing, fecal pellet
producer, carrying up particles

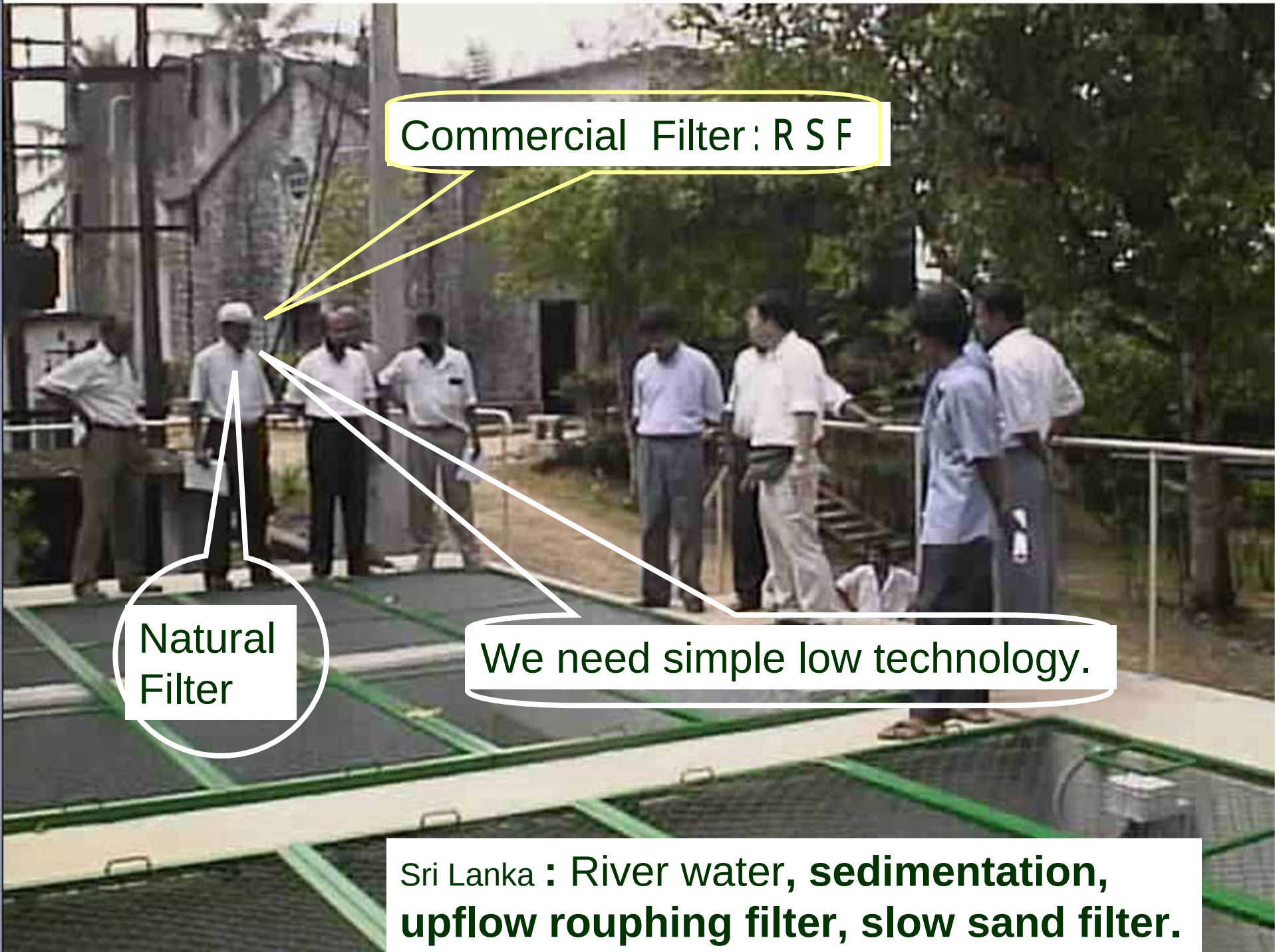


fecal pellet

microbial activity, anaerobic condition,
fermentation, decomposition of hardly
decomposable matter

Long term action

Ecological Water Purification System



Commercial Filter : R S F

Natural
Filter

We need simple low technology.

Sri Lanka : River water, **sedimentation,**
upflow roughing filter, slow sand filter.

