WaSH-Mia/SATREPS: Manual No.4-2

Handbook for Installation, Operation, and Maintenance of Locally fitted, compact, and distributed (LCD) water treatment system

Contents

1. Introduction

1.1. What and Why LCD water treatment?

Piped water supply system is not enough to satisfied drinking water demand in some cases: very remote area, blank area of drinking water supply design. In such case, locally available water resources (i.e. groundwater, spring water, surface water) should be utilized. But, water quality of such alternative resource is not always match to drinking water standards; contaminants (i.e. heavy metal, nitrogen, etc.) make water quality deteriorate.

Being developed current drinking water technology (e.g. Reverse Osmosis membrane filtration, ultra-fine filtration, Ion exchange filtration) is not suitable choice in some countries, because it requires cutting edge equipment and frequent maintenance. By such technology is not achieved due to limitation of economical, technological and cultural background. Sustainable water distribution is absolutely imperative to people life and water security improvement.

Locally fitted, compact and decentralized (so called LCD) system is an option to overcome above bottle necks, and it make possible to sustainable drinking water distribution. Simple structure, easy construction, less management cost and sufficient treatment performance; are vital concept of drinking water treatment system, which LCD system have.

Until now, the LCD system can remove major contaminants in drinking water resources: Iron and Nitrogen. Iron is a vital element for human body. But, high concentration of iron causes; bad taste, turbidity increase and coloring water by oxidized iron, and chlorination efficiency suppression due to iron biding to free chlorine.

Major nitrogen contaminants in drinking water resources are ammonium and nitrate which was produced by geological and artificial factors. Ammonium contamination causes water smell badly, and it suppress chlorination efficiency as same as iron. Nitrate is another form of nitrogen, which is produced from ammonium oxidation by environmental process. Nitrate in the human body change the form with reacting amino acid, and it may change the form to carcinogenic compound. To provide safe drinking water, nitrogen contaminants removal should be applied.

The aim of this manuscript is to share the knowledge and

experiments about the LCD systems achieved during 5 yeas international collaboration research project between Nepal and Japan: Hydro-microbiological Approach for Water Security in Kathmandu Valley, Nepal (WASHmia) under Science and Technology Research Partnership for Sustainable Development (SATREPS) supported by the Japan Science and Technology Agency (JST) and Japan International Cooperation Agency (JICA).

1.2. How to select the LCD system for drinking water treatment

The way to select LCD system is explained in this section. Before selecting the LCD systems, water quality analysis should be conducted. Based on the inlet water quality, you know which type of LCD systems are needed for drinking water distribution followed bellow diagram (Fig.1.1).

In case of iron contamination prevalent, iron removal system should be applied. Type of the LCD systems and its number would be changed in case of form of the nitrogen contaminants. For NH_4-N contamination, nitrification system should be installed. Beside this, denitrification system is required for NO_3-N removal. Nitrification is only converting NH_4-N to NO_3-N. Therefore, denitrification system also should be installed in case of influent NH_4-N>10 mg-N/L, otherwise only nitrification system is required. After LCD system, charcoal filtration is required to remove color, smell and solid particle from LCD. It is very important that disinfection step (i.e. Chlorination, boiling, and ceramic filtration) application before distribution.

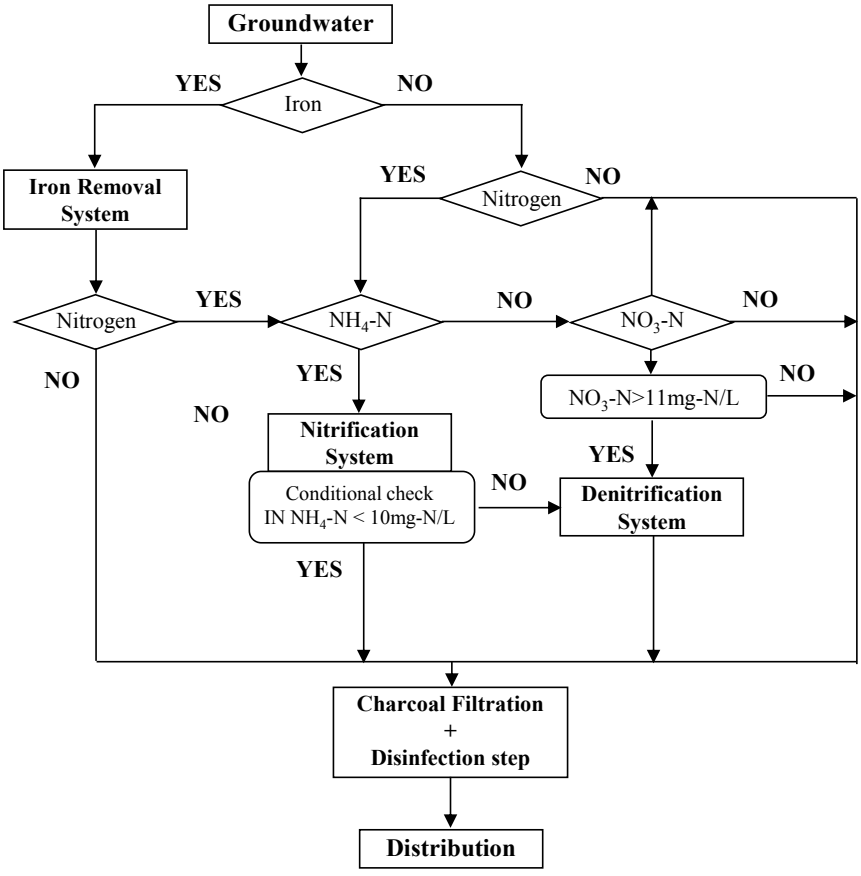


Figure 1.1. Diagram of selection of LCD system for drinking water distribution

2. Detail mechanism of the LCD systems

2. Detail mechanism of the LCD systems

This section explains the basic concept of contaminants removal mechanisms and characteristics of each LCD systems. Basic knowledge should be learned by other literature review, while this section explains small tips of each mechanism.

2.1. Iron removal unit

There are two choice for Iron removal system: sponge filtration (for house hold level water use) and Sand filter (for community scale). Iron removal is generally achieved by chemical and physical reaction in each system. Dissolved iron (as a form of Fe_2^+) is oxidized to solid form iron (generally the form as $Fe(OH)_3$) by chemical reaction (Fig.2.1). Solid iron is physically separated from water by filter material: sponge and sand, then groundwater get iron free. The iron removal efficiency is deteriorated after several days' operation when filter material get clogging. Filter material need to be washed frequently to recover the performance.

Oxidation of dissolved iron is critical factor for enhancing iron removal performance. Therefore, increase the oxidation efficiency enhance iron removal efficiency, which can be achieved by increasing contact time of water to air.

$$Fe_2^+ + H^+ + 0.25O_2 + 2OH^- + 0.5H_2O \rightarrow Fe(OH)_3$$

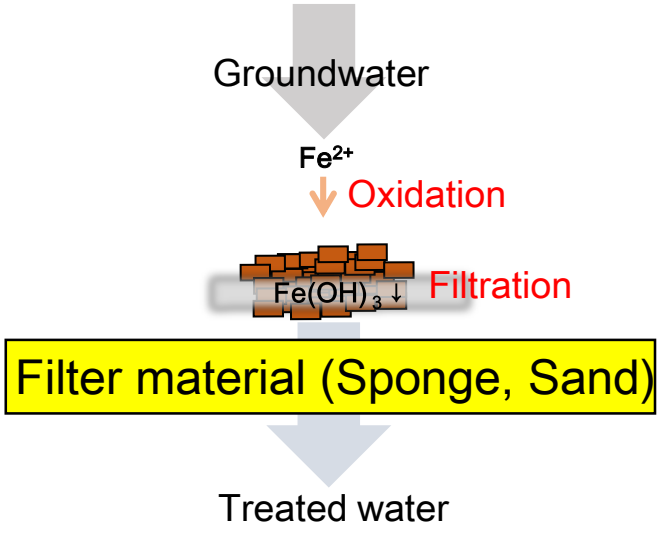


Fig. 2.1. Schematic images of iron removal mechanism

2.2. Nitrogen removal units

Microbiological processes are utilized as a main mechanism of nitrogen removal on LCD systems. The target nitrogen contaminants are ammonium and nitrate, which are major compounds in groundwater. In the LCD system, two microbial processes: nitrification and denitrification are used to remove NH_4^+ and NO_3^- (Fig.2.2). Those nitrogen contaminants are converted to nitrogen gas and released to air, resulting nitrogen free water can be obtained. This se

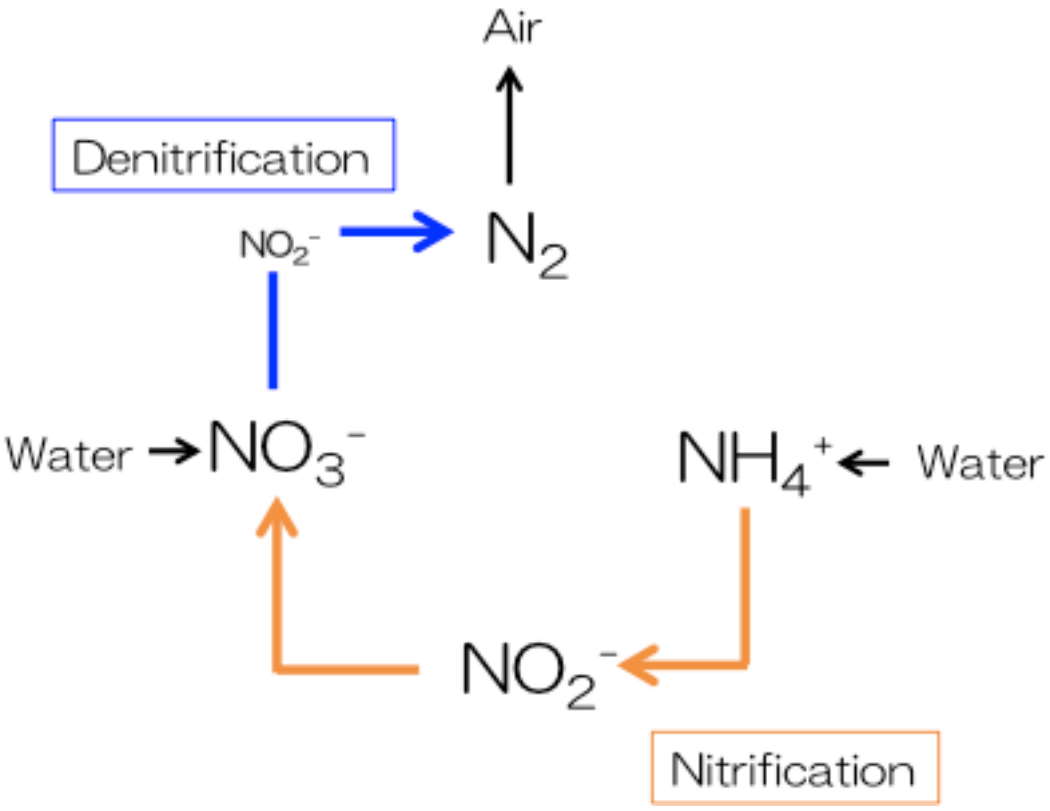


Figure 2.2. Schematic diagram of nitrogen removal flow

2.2.1. Nitrification system for NH_4^+ removal

For NH_4^+ removal, nitrification process is used. This process only changes the form of NH_4^+ to NO_3^- by aerobic microbiological activity. Thus, almost same amount of NO_3^- is remained in effluent of nitrification system. Generally, NH_4^+ is oxidized to nitrate via nitrite by respiration of NH_4^+ oxidizing bacteria and NO_2^- oxidizing bacteria (Fig.2.3). Therefore, insufficient oxygen supply induced nitrogenous compounds remains in effluent.

$$NH_4^+ + 1.5O_2 \rightarrow NO_2^- + H_2O + 2H^+ (NH_4^+ \text{ oxidation step})$$
$$NO_2^- + 0.5O_2 \rightarrow NO_3^- (NO_2^- \text{ oxidation step})$$

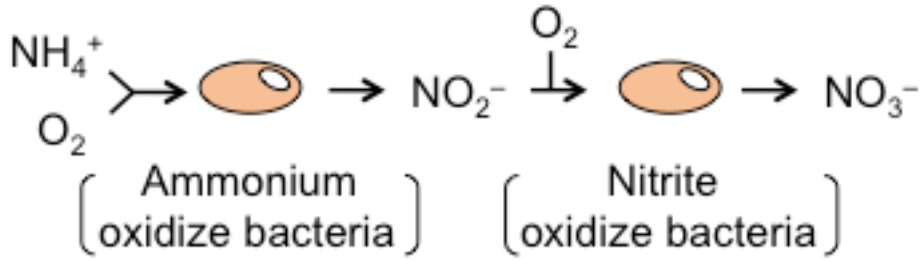


Figure 2.3. Schematic images of nitrification process

To achieve the complete oxidation of NH_4-N to NO_3-N, the nitrification unit of LCD system is used sprinkling water supply mechanisms as shown in Fig.2.4. Ground water is sprinkled on microbial carrier hanging inside of the nitrification system. NH_4^+ and NO_2^- oxidizing bacteria grow on this microbial carrier and oxidize nitrogen by using oxygen naturally penetrated from air. Sprinkling water increase water surface area and enhance oxygen penetration into the water, resulting insufficient oxygen supply usually can be avoided. Further, recirculation of sprinkled water to top of the microbial carrier can further enhance of oxygen penetration and nitrification process.

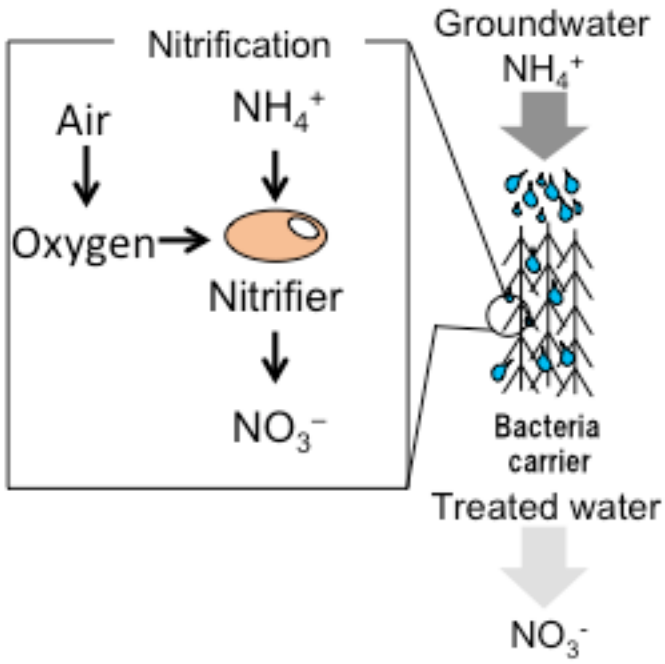


Figure 2.4. Schematic image of basic concept of nitrification unit of LCD system

2.2.2. Denitrification system for NO_3^- removal

For NO_3^- removal, denitrification process is utilized. Denitrification is microbiological process and it is a nitrogen removal process from water. The bacteria conduct denitrification is so called “denitrifier”. Denitrification takes place under the conditions: anaerobic environment, existence of NO_3^- and NO_2^- and presence of compounds utilized as ”energy” of microbial activity. In generally, organic carbon (e.g. methanol, ethanol, acetic acid, etc.) is resource of this “energy”. Thus, presence of organic carbon (or addition of organic carbon) is necessary to occur denitrification. However, organic carbon addition is not accepted in the case of drinking water purify in health risk minimization.

Hydrogen depending denitrification is also microbiological process ant it is able to remove NO_3^- to N_2 gas as previously mentioned. This denitrification uses H_2 gas as an “energy” source, denitrification take place when H_2 gas is diffused to groundwater (Fig.2.5). Since H_2 gas is harmless material and it does not cause health issue when people take it, the denitrification unit of LCD system utilized this denitrification processes. Denitrifier conducting hydrogen depending denitrification is also removed NO_3^- to N_2 gas via NO_2^-. And, H_2 gas is required in each reduction steps. Therefore, lack of H_2 gas inducted incomplete denitrification and accumulation of NO_2^-. Sufficient H_2 gas should be supplied. The LCD system equips micro bubble diffusing system to avoid incomplete denitrification, additionally (Fig.2.6.). This diffusing system can make gas bubble size smaller than usual diffuser. H_2 gas retention time and contact time to bacteria can be extended. Denitrifier can use H_2 gas as long as gas retained for reducing NO_3^- to N_2 gas. In addition, microbial carrier is fixed in the unit to trap and increase the denitrification bacteria for consuming H_2 gas and NO_3^-.

$$2\ NO_3^- + 2H_2 \rightarrow 2NO_2^- + 2H_2O$$
$$2\ NO_2^- + 3H_2 \rightarrow N_2 + 2H_2O + 2OH^-$$

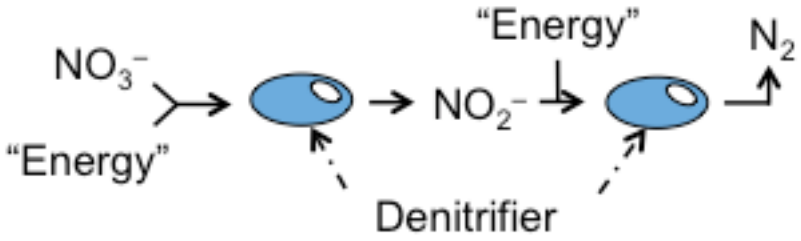


Figure 2.5. Conceptual image of nitrate removal to N_2 gas by denitrification

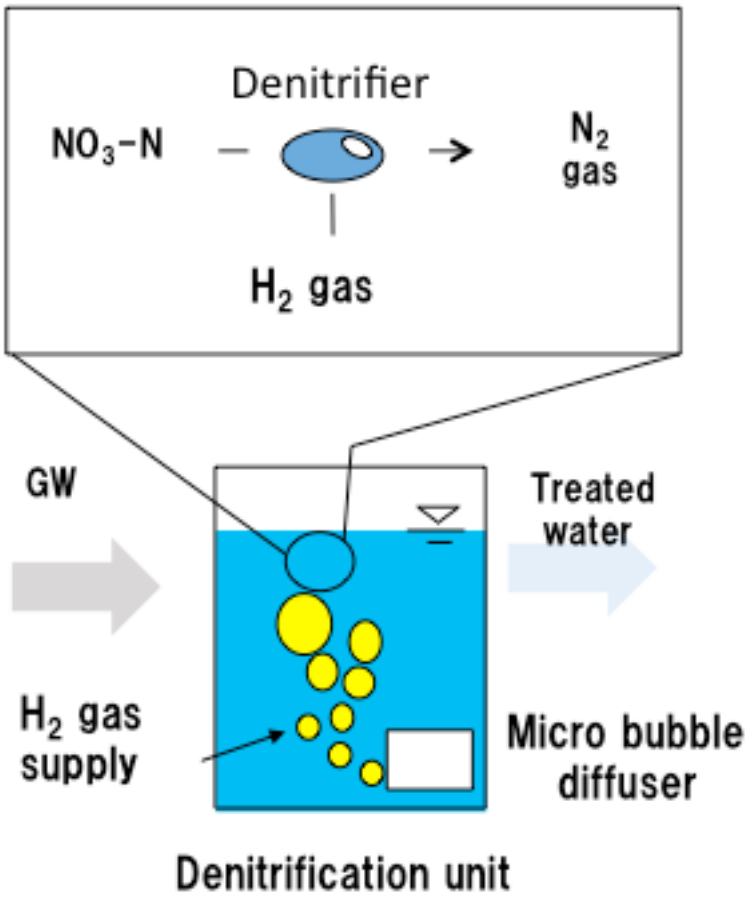


Figure 2.6. Schematic images of denitrification unit of LCD system

3. Installation of LCD systems

3.LCD systems installation

3.1. Iron filtration unit

3.1.1. Sponge Filtration unit

Sponge Filtration is used to remove the dissolved iron as well as the turbidity. Main advantage of sponge filtration is to remove high iron concentration even at the higher flow rate. Besides, it is easy to wash and high efficiency even after the backwash. In this section, it is explained that how to develop hose hold level iron filtration unit. Typical image of sponge filtration unit is described in Fig.3.1. The size and number of the units are modifiable. This system is applicable for treating 5–20 mg-N/L of Fe^{2+} removal in 500–1000 L/d of capacity, based on field experiment.

NOTE: Operational condition should be modified to get suitable treatment performance by performance evaluation after installation work.

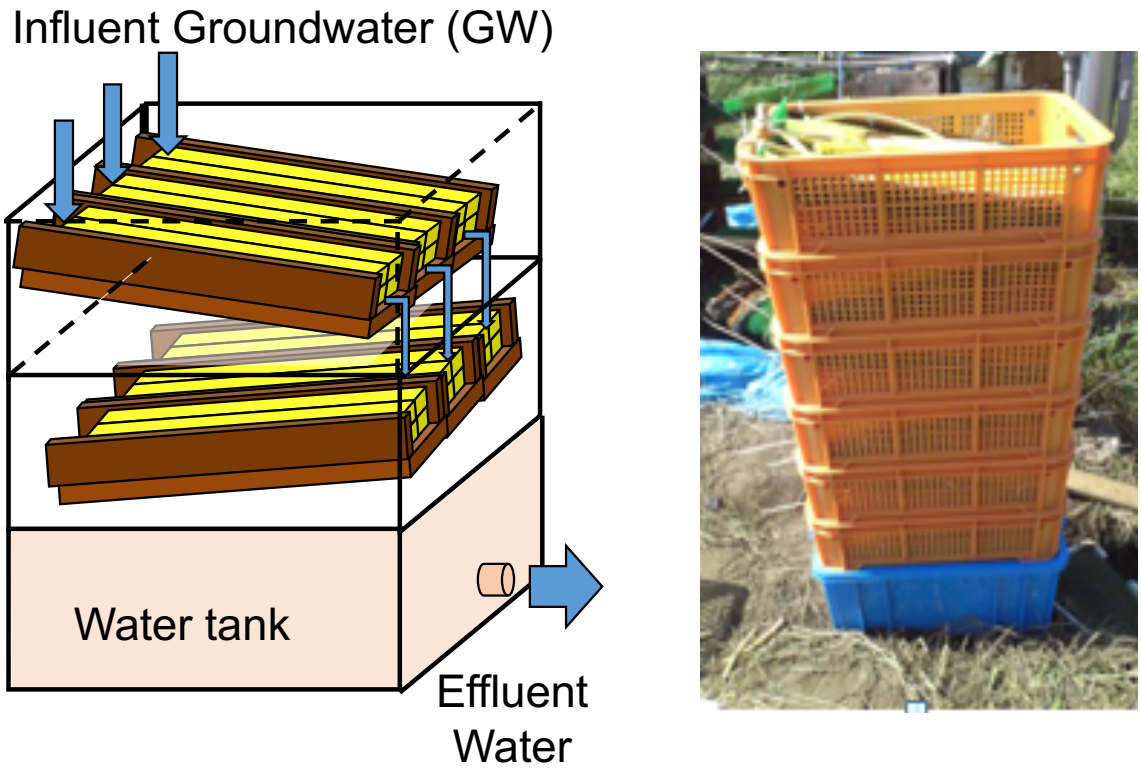


Figure 3.1. Images of the hose hold level sponge filtration unit

- **Required Material for installation**

Locally Available material

- ✧ Water Tank (1000 ltr)
- ✧ PPR Pipe
- ✧ Valves and fitting accessories
- ✧ Basket Size of size 45cm* 30cm* 15cm – 6 number
- ✧ Tray of cross section 10cm * 5cm
- ✧ Sponge
- ✧ Type: Urethane (Hardness: 10 ± 5, Density: 22 ± 2kg/m3)
- ✧ Submersible pump
- ✧ Sedimentation tank
- ✧ Collection tank

- **Materials and Equipment Preparation**

Step 1 (Basket Preparation)

Cut the basket to make hole of size 35cm x 10cm as shown in Fig.3.1. as to make the passage of water from one tray to another tray.

Step 2 (Tray Preparation)

Mark 45cm in the tray and cut 18 number of tray. Then, arrange three number of tray to make one combine tray by heating and interlock connection as shown in Fig.3.2.

Step 3 (Cutting of Supporting board)

Mark 30cm*19cm and cut 6 number of board in other to use not to flow water outside of flow.

Step 4 (Perforated pipe preparation)

Make 5mm dia. Small perforated hole in PPR pipe at the spacing of 2cm in other to make uniform flow of water in the system.

Step 5 (Sponge Preparation)

Take the stripe of sponge and make it the final size 50cm*9.5cm *3.5cm and place into the tray to fit in on it.

Step 6 (Preparation of Tank)

1000 liter PVC Water Tank is needed. Also, hole is made at the top (10 cm below from the top cover) to make pipe connection with source pipe. Also,

hole is made at the bottom of the tank to make pipe connection to inlet-perforated pipe.

Step 7 (Sedimentation Tank Preparation)

Basket of 50cm*35cm*15cm and make hole at 10cm from bottom level as to satisfy detention time before collection in collection tank.

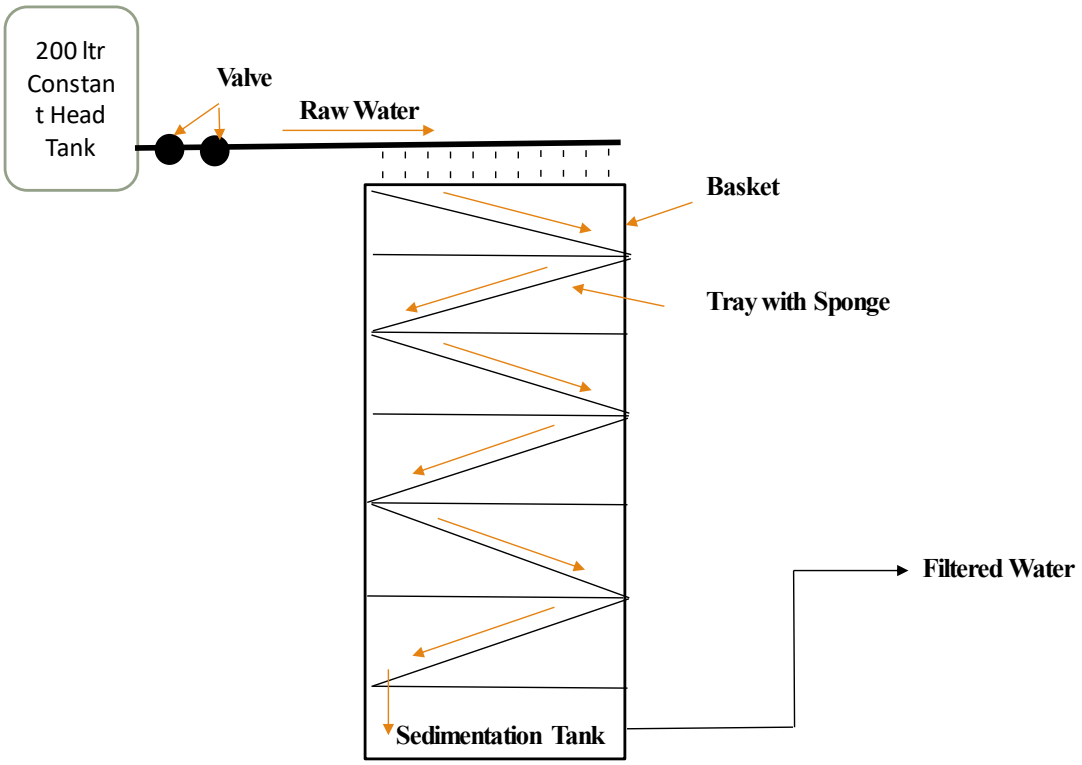


Figure 3.2. Schematic images of sponge filtration unite

- **Installation Work**

After preparation of all required materials arrangement of materials should be done to make complete model of sponge filtration model as shown in Fig.3.2 as to make the flow of water in the direction.

STEP1: Firstly, Collection Tank placed at 2m from ground level is connected through deep tube well and water is pumped through submersible pump.

STEP2: Then, pipe is connected at the bottom hole to of tank to constant head tank which is at 1.5m from ground level to maintain constant head difference.

STEP3: Then pipe with perforation is connected at about 10cm from bottom level to make uniform flow for sponge surface.

STEP4: Tray with sponge previously prepared is placed inside the basket at the slope of 10 degrees.

STEP5: Sedimentation tank is place at the ground level.

STEP6: Then basket with tray is place over the sedimentation tank. Besides, each basket is placed one over another to make complete cascade system so that water falls one after another as shown in Fig.3.2.

- **Operation and maintenance process of Sponge**

STEP1: Raw water is continuously fed in Sponge Model.

STEP2: Water flow should be fed at 300 L/D for single household.

STEp3: Filtered water is continuously collected from the bottom of the filtration tank after sedimentation.

3.1.2. Slow sand filter unit

Sand filter is used to remove iron from raw Water. Basic Design of the sand filtration is described in Fig.3.3. This system is applicable for treating 5–20 mg-N/L of Fe^{2+} removal in 500–1500 L/d of capacity, based on field experiment.

NOTE: Operational condition should be modified to get suitable treatment performance by performance evaluation after installation work.

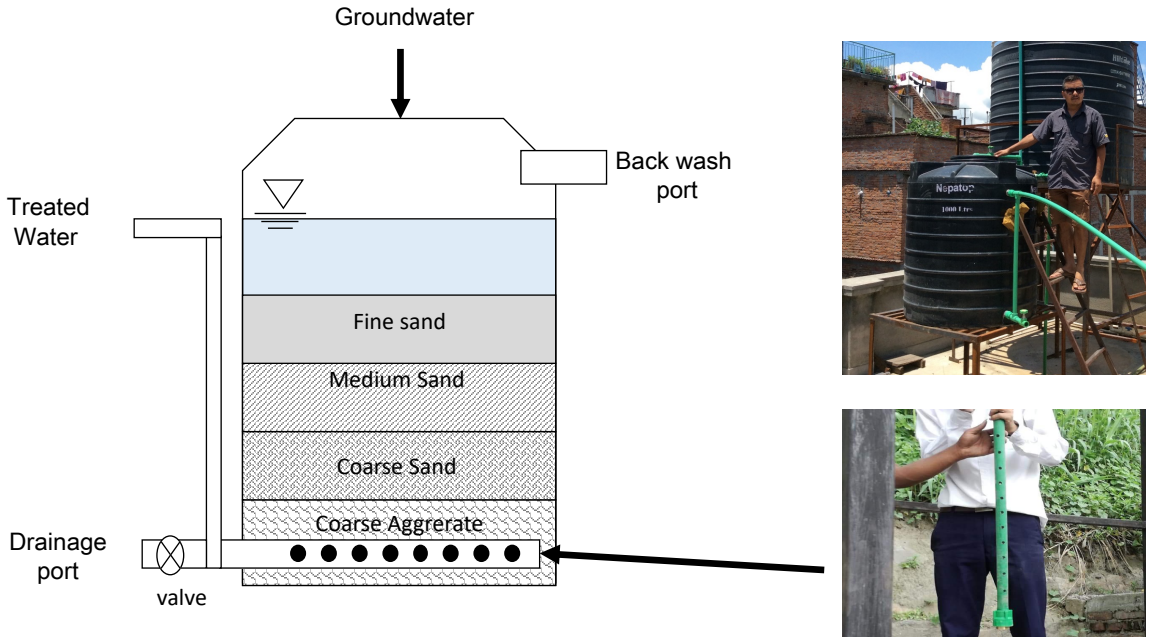


Figure. 3.3. Schematic image of sand filtration unit

- **Materials for installation**

✧ Locally Available material
✧ Water Tank (1500 liter)
✧ PPR Pipe
✧ Coarse aggregate (20 mm – 40 mm)
✧ Sand
✧ Fine Sand (<2.36 mm)
✧ Medium Sand (4.75 mm – 2.36 mm)
✧ Coarse Sand (> 4.75 mm)

- **Construction of slow sand filter**

Step 1 (Preparation of Tank)

1. 1000 liter PVC Water Tank is used as slow sand filter.
2. A hole is made at the bottom of the tank to make pipe connection to collect filtered water as shown in Fig.3.3.
3. A perforated pipe is placed at the bottom of tank to collect filtered water as shown in Fig. 3.3.
4. Also a hole is made at the top (10 cm below from the top cover) to make pipe connection for back wash.

Step 2 (preparation of filter)

1. Water Tank is filled with coarse aggregate of size 20mm – 40 mm in thickness of 10-15 cm in layer in bottom layer.
2. Coarse sand of size 10 mm - 4.75 mm is filled above coarse aggregate in thickness of 10 cm in layer.
3. Medium sand of size 4.75 mm – 2.36 mm is filled above coarse sand in thickness of 10 cm in layer.
4. Fine sand of size less than 2.36 mm is filled above medium sand in thickness of 10 cm in layer.

Step 3 (Operation process of Nitrification reactor)

1. Raw water is continuously fed in slow sand filter.
2. Water flow rate to the sand filtration unit should be at 1500 L/D.
3. Filtered water is continuously obtained from the bottom of the filtration tank.
4. Connect the filtered water to nitrification reactor.

3.2. Nitrification unit

The main function of nitrification reactor is to convert ammonia into nitrite and nitrate. Overall image of the nitrification reactor is illustrated in Fig.3.4. This system is applicable for treating 10–60 mg-N/L of NH_4-N removal in 1000–3000 L/d of capacity, based on the field system operation.
NOTE: Operational condition should be bit modified to get suitable treatment performance by performance evaluation after installation work.

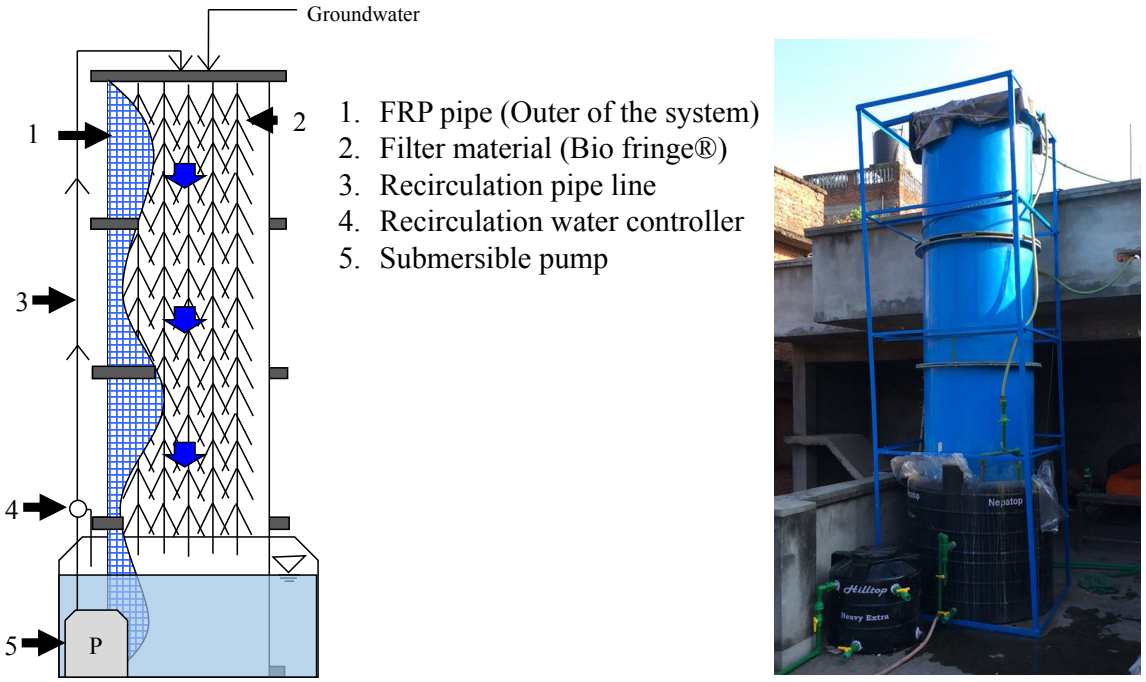


Figure 3.4. Schematic image of nitrification unit

- **Required Material for installation**

Locally Available material

Fiberglass Body for Reactor

- ✧ PPR Pipe
- ✧ Flexible PVC Pipe
- ✧ Submersible pump
- ✧ 1500 liter of water tank
- ✧ Iron Frame
- ✧ Covering Structure (Shed)
- ✧ Screw and Nuts/Bolts
- ✧ Silicon
- ✧ Fitting accessories (Gate Valve, bends etc.)
- ✧ Nitrification Bacteria seed (1-5 L of Suspended Sludge (Available in Jwagal))

Not Locally available material

- ✧ Bio fringe (Detail is available in appendix)

- **Installation procedure of nitrification unit**

Bottom part of water treatment system is made of 1500 liter water tank with open top as shown in Fig.3.5. The real treatment system is operating in Jwagal UN park (KUKL water treatment plant), Chyasal (Local community), Lokanthali (KUKL water treatment plant). Please visit the sites and learn what is the nitrification reactor before starting construction.

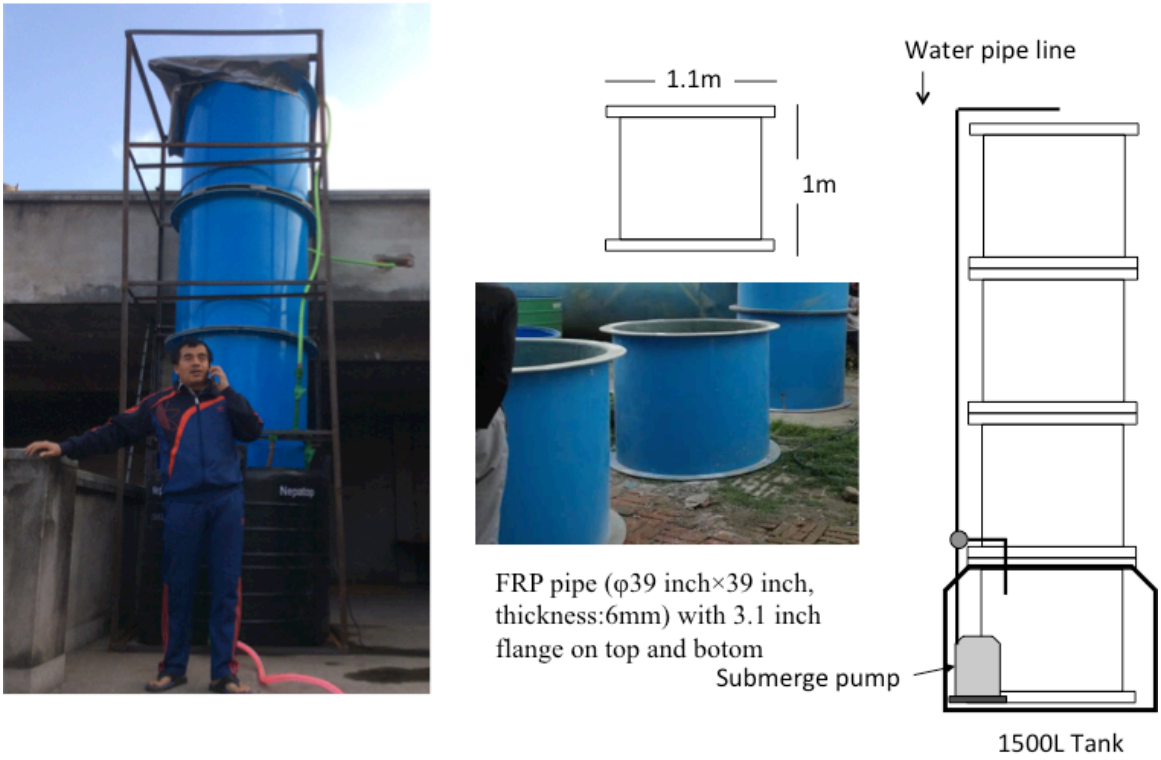


Figure 3.5. Actual image of the main body of nitrification unit

Step 1 (Reservoir Tank Preparation)

1. Cut the top part of 1500 liter PVC Water tank, to put FRP pip and to storage treated water. Note: Do not cut more than half height of the tank to avoid over flow of treated water

2. Make hole for pipe connection at the bottom for flushing as well as make another hole at the top (Approximately, 10-15 cm from the top) for collection of treated water.
   Note: Need to consider about the water level, if you want to connect this system to denitrification unit.

Step 2 (Main Reactor Preparation)

Main body of reactor is made up of four piece of FRP pipes (1 m of height, 1.1m of diameter including 5 cm of flange, and 6 mm of thickness). The main reactor is constructed by assembling the four FRP pipes. To assemble the main body following steps should be follow of reactor body as shown in Fig.3.5.

1. Make 10 cm×10cm of hole on bottom FRP to water flow inside the pipe to outside, as shown in Fig.3.6.

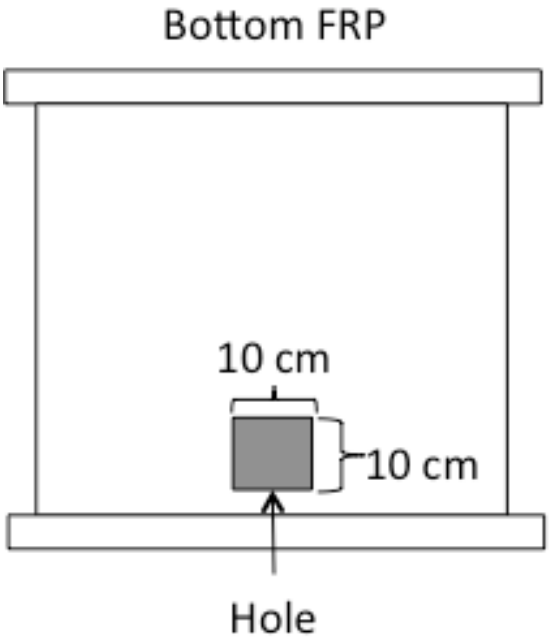


Figure 3.6. How to make the hole on the bottom main body of nitrification unit

2. Place the bottom FRP pipe reactor body inside 1500 liter water tank.
3. Mark screw hole place on outer part of FRP pipes flange. Screw hole should be placed radially.
4. Place these piece of FRP pipe on top of each other and drill 5-6 mm of screw hole (8 holes radially) f
5. following mark Fig.3.7.

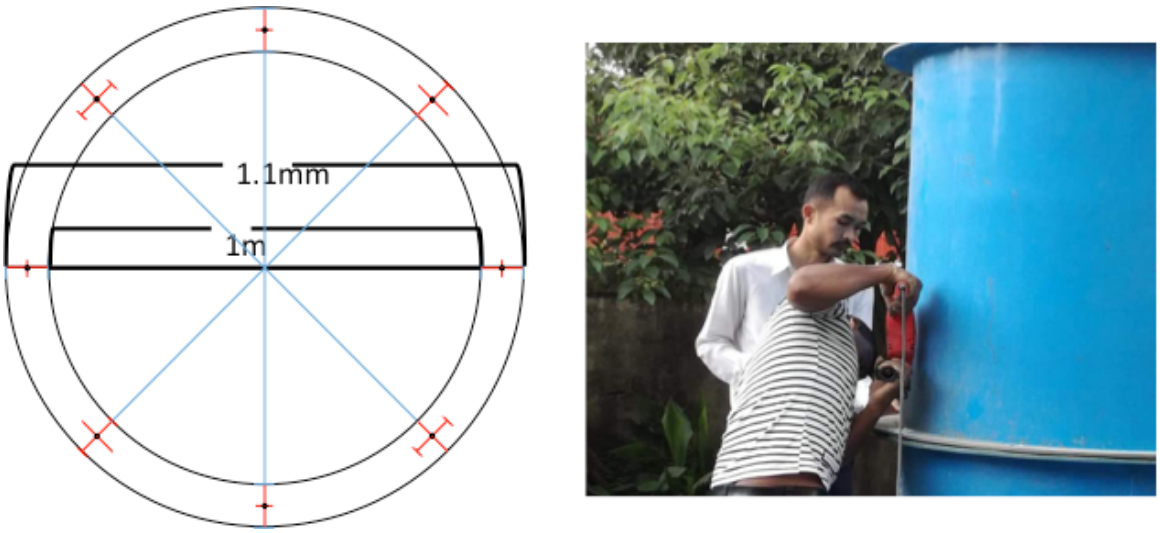


Figure 3.7. Radial drilling to connect main body of nitrification unit

6. Assemble each FRP pipe by M6 screw (recommend: 4-5 cm length). Continue this work to connect all of FRP pipe.
7. Seal the joint of reactor body with silicon to make the joint water tight.
8. Place a submersible pump inside the bottom water tank of reactor.
   Note: Do not place submersible pomp inside of the FRP pope.
9. Installed the water pump in such a way that water recirculation discharge can be regulated. To control the discharge flow control valve is fitted in the delivery part of the submersible pump as shown in Fig.3.8.

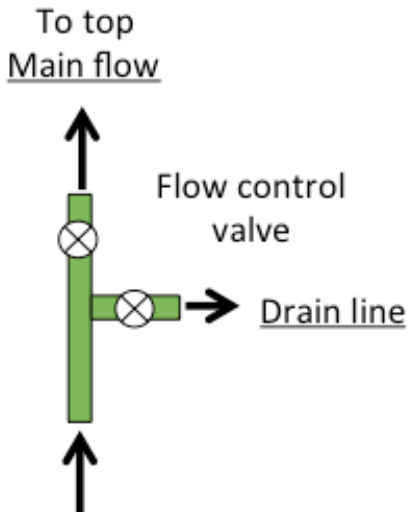


Figure 3.8. Schematic image of recycling water flow controller.

10. Top of the Nitrification reactor is covered to prevent the entry of foreign dirt and debris.

Step3 (Attachment media for bacteria)

1. Bio fringe is the attachment media for the nitrification bacteria. These attachments are long string of fabrics of length 3m which are organized in a set of width 1.5m as sown in Fig.3.9.

Figure.3.9. Actual image of the Bio fringe.

2. A nylon wire is used as string to support the bio fringe. Nylon wire is connected on both side of bio fringe. String are needed for the support the load of bio fringe soaked with water during operation (Fig.3.9).
3. Bio fringe is folded in half in width to reduce the width into 0.6-0.7m (Fig.3.10).
4. Bio fringe are arranged in a set of two with width 0.6-0.7m in a single PVC Pipe of length 1.1 m-1.2m and suspended from the top of nitrification reactor using iron flame as shown in Fig.3.10.
5. Insert iron rod into PVC pipe to hold it horizontally

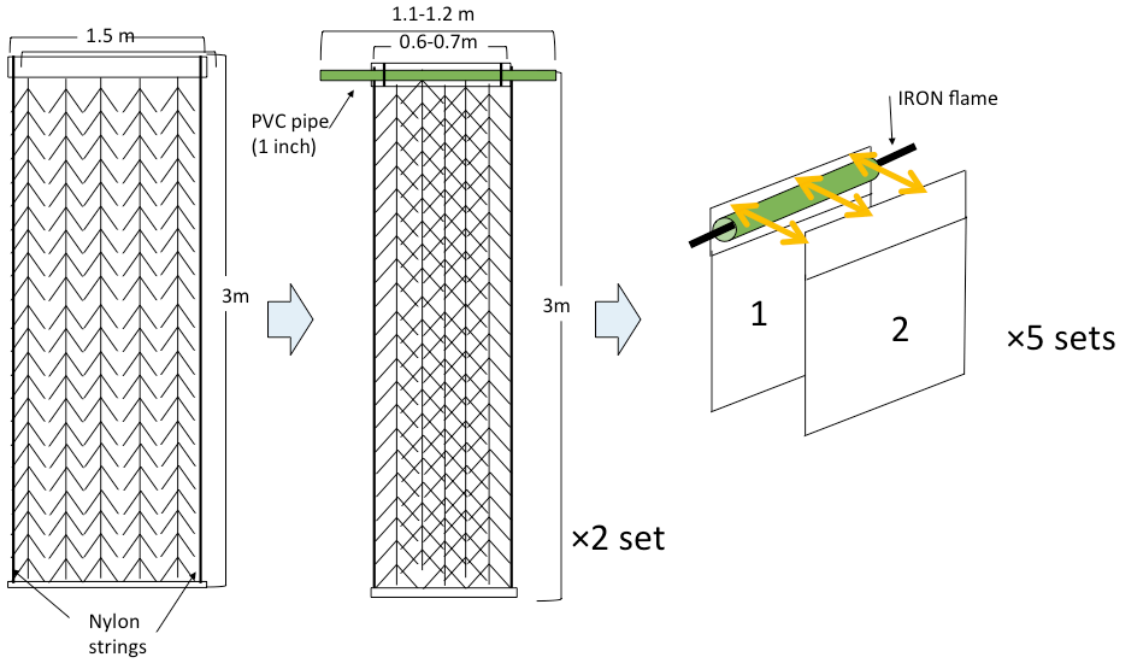


Figure 3.10. Preparation of Bio fringe.

6. Each reactor consists of 5 set of bio fringe as shown in Fig.3.11
7. Insert Bio fringe and hang on the top of the reactor
8. Connect the pipeline from submergible pomp to water pipe line. Water pipe line place on top of the reactor should be flexible pipe.
9. Make several holes on the Flexible pipe, to provide water to Bio fringe equally.
10. Flexible pipe should be placed in a spiral, as shown in Fig.3.11.

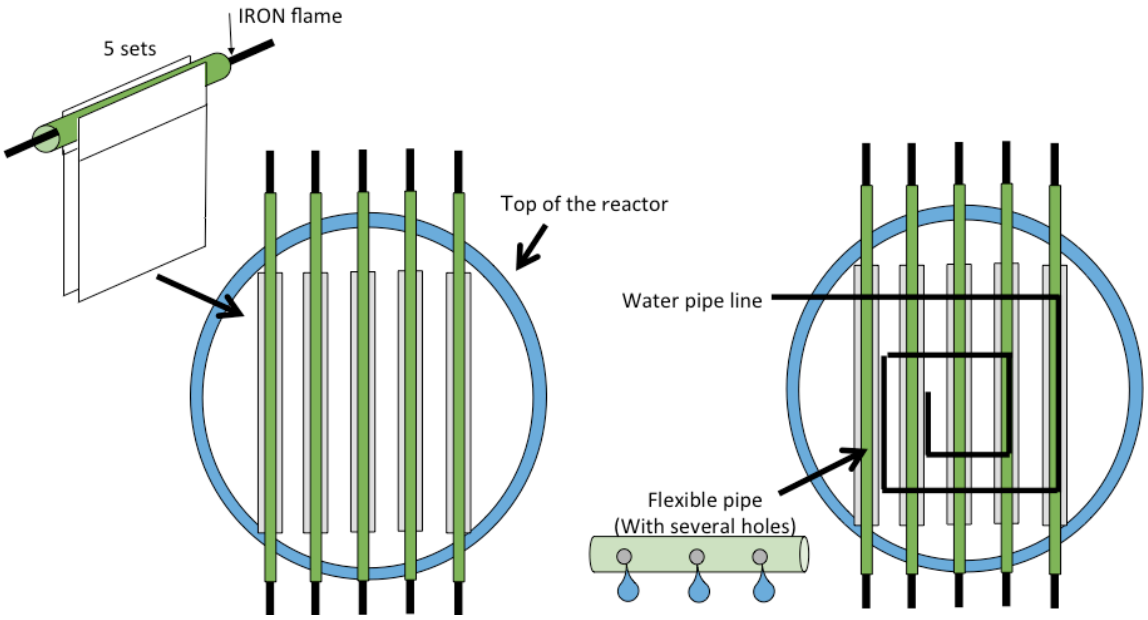


Figure 3.11. Arrangement of Bio fringe and water pipe line.

- **Operation process of Nitrification reactor**

1. Water from the sand filter unit is collected in base tank of Nitrification reactor. Water is recirculate in bio fringe using submersible pump.
   NOTE: It is better to provide water from top of the nitrification reactor, if you can construct sand filter unit or reservoir tank higher level of this unit.
2. Control the water flow rate of recirculation should be one third of the full water flow rate of submerge pump by flow control valve.
3. Add the bacteria seed to base tank of this system
4. During operation of nitrification reactor for the first time add nitrification bacteria in the water and recirculate the water for 1 mouth. This process helps in the growth of bacteria in the attachment media.

3.3. Denitrification unit

Main function of denitrification is to convert nitrogen nitrate and nitrogen nitrite into nitrogen gas. Overview of main reactor is as shown in Fig .3.12. Denitrification unit is available in Jwagal UN park (KUKL water treatment plant), Thimi (Local community), Lokanthali (KUKL water treatment plant). This system is applicable for treating 40–60 mg-N/L of NO_3-N removal with 500–1000 L/d of capacity according to field experiment.

NOTE: Operational condition should be bit modified to get suitable treatment performance by performance evaluation after installation work.

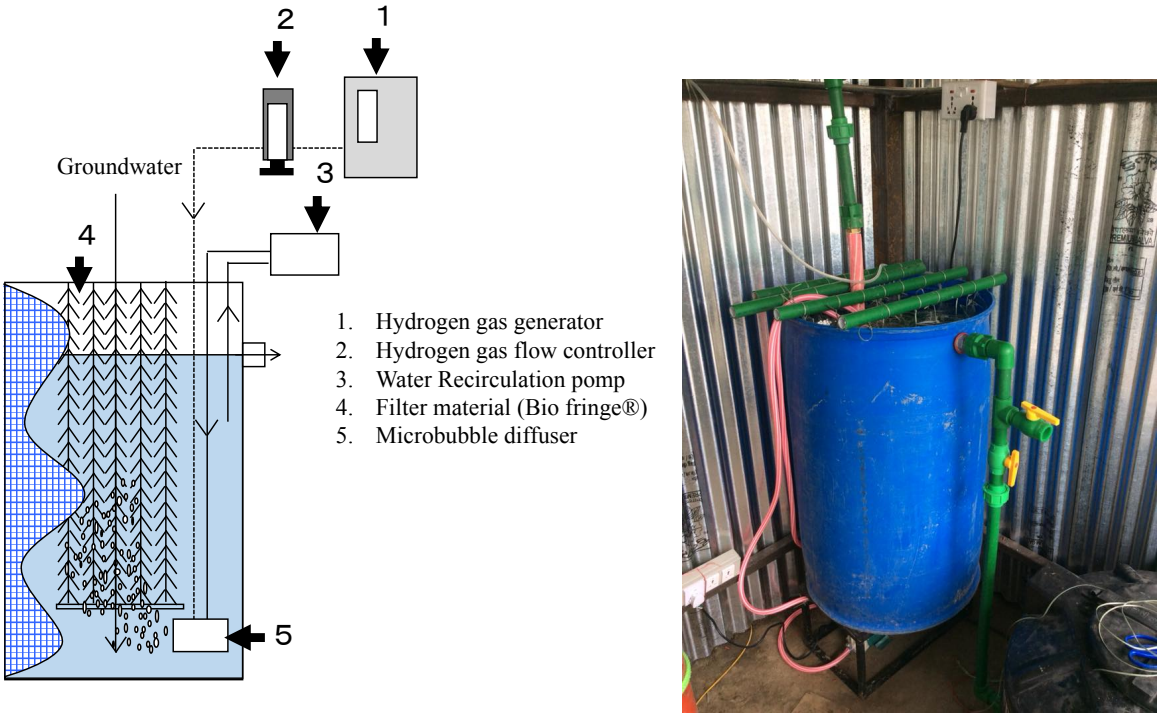


Figure. 3.12. Overall image of denitrification unit.

- **Required Material for installation**

Locally Available material

- ✧ PPR Pipe
- ✧ Flexible PVC
- ✧ Recirculation Pump (20 liter per min)
- ✧ Water Tank (300 liter better to use newly prepared oil drum)

- ✧ Fitting accessories (Gate Valve, bends etc.)
- ✧ Hydrogen Gas Cylinder (For Spare)
- ✧ Nitrification Bacteria seed (1-5 L of Suspended Sludge (Available in Thimi or Jwagal plants))

Not Locally available material

- ✧ Bio fringe (Detail is available in appendix)
- ✧ Hydrogen Generator (Detail is available in appendix)

- **Installation procedure of Denitrification Reactor**

Step 1 (Preparation of main Reactor)

1. Main reactor is made from a tank of capacity 300 liter.
2. Make necessary connection at the bottom of the tank for flushing and drainage of reactor.
3. Make connection on top of reactor (10cm below the top) for outlet of treated water and sample collection.
4. Place inlet pipe at the bottom of tank for input.

Step 2 (Preparation attachment for bacteria)

1. Bio fringe is the attachment media for the denitrification bacteria. These attachments are long string of fabrics of length 0.75 m and breath 0.5m as shown in Fig.3.13., which are hanging from PPR Pipe.

Figure 3.13. Actual image of how to set the Bio fringe in denitrification unit

2. Each PPR pipe consists of 7 string of bio fringe to complete a set of bio fringe (Total 28 pcs).

Step 3 (Operation of hydrogen gas diffusing system)

1. Microbubble diffuser and hydrogen gas flow line was connected, which was assemble to magnetic pump Fig. 3.14.

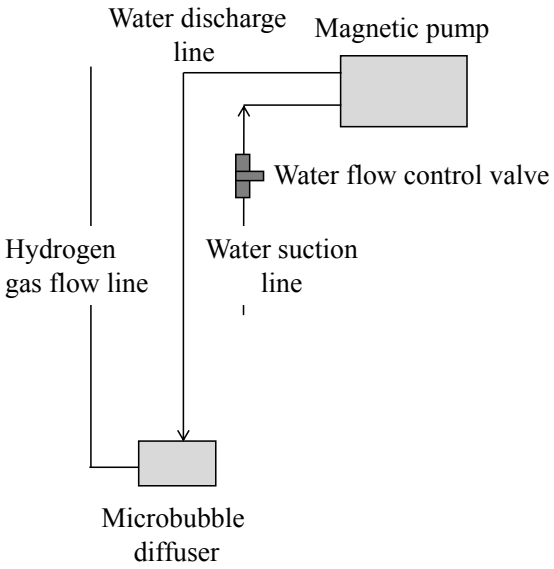


Figure 3.14. Schematic image of hydrogen gas diffusing system.

2. To control the power of water suction line, water flow control valve as like nitrification unit should be arranged.
3. Start the hydrogen gas supply with operating magnetic pump. Discharging water flow rate should be controlled by controlling the valve to make gas bubble finer.
4. Set hydrogen gas flow rate around 200–350 mL/min by controlling hydrogen gas flow controller.
   Note: This flow rate would be best for treat 40–60 mg-N/L of NO_3-N in 500–1000 L/d of capacity. If you apply denitrification unit into groundwater treatment contained more than 60 mg-N/L of NO_3-N, please modify and adjust hydrogen gas flowrate to get suitable treatment performance.
5. Adding of seed bacteria from other LCD installation site will help rapid startup of denitrification performance.

3.4. Charcoal filter unit

Nitrification and denitrification systems may produce turbidity or odor of water. Charcoal filtration should be installed every after LCD treatment, to remove sediment, volatile organic matters and odder of water. The typical lay out of charcoal filter is as shown in Fig.3.15. Standard setting of charcoal filter is explained. To full fill the demand, the size of the system (or number of the system) can be modified. Disinfection such as boiling water, chlorination, ceramic filtration, and chlorination should be applied after charcoal filtration.

NOTE: Operational condition should be bit modified to get suitable treatment performance by performance evaluation after installation work.

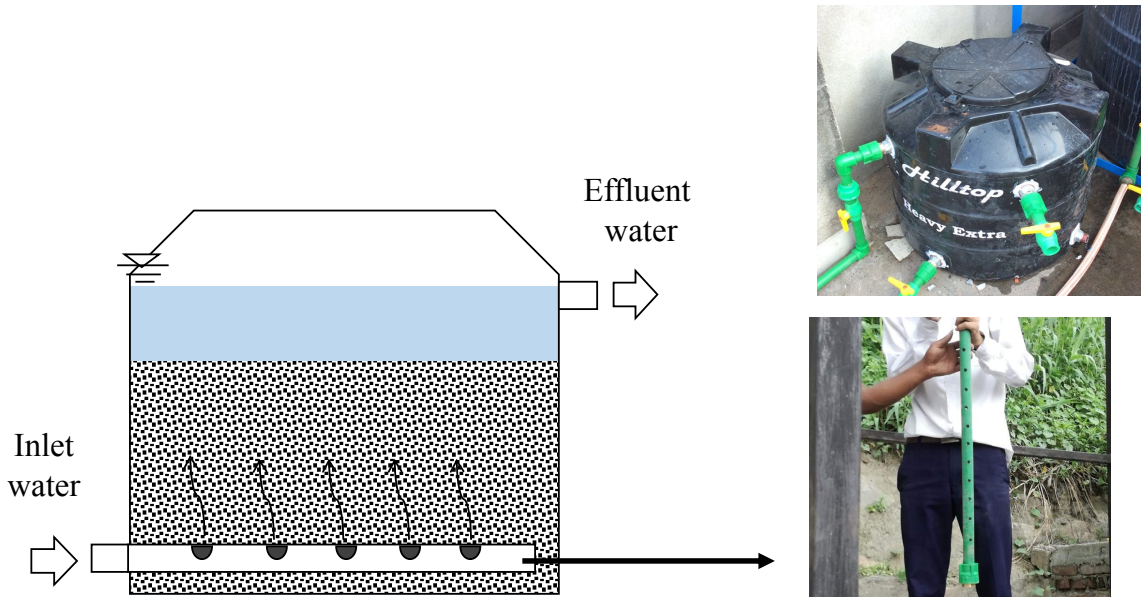


Figure 3.15. Schematic images of charcoal filtration unit

- **Required Material for installation**

Locally Available material

- ✧ PPR Pipe
- ✧ Water Tank (200 liter)
- ✧ Fitting accessories (Gate Valve, bends etc.)
- ✧ Activated charcoal (90 liter)

- **Installation procedure of activated charcoal**

Step 1 (Preparation of Water tank)

1. 200 liter PVC Water Tank is used as reactor body of this filter unit.
2. Make pipeline concoction (inlet and outlet) and drainage ports at the bottom.
3. Also a hole is made at the top (10 cm below from the top cover) to make pipe connection for backwash.

Step 2 (Preparation of charcoal)

1. Wash the charcoal until blackish water does not come out.
2. 200 liter water tank is filled with 90 liter of charcoal.
3. Cover all of the inner ports (inlet and drainage) by plastic net to prevent wash out.
4. Connect outlet from the LCD system to inlet pipeline port of charcoal filter unit.
5. Also connect outlet of the filter unit to final water collection tank.
6. Disinfection application (e.g. boiling, chlorination, ceramic filtration) should be conducted to avoid waterborne disease.

4. Maintenance of LCD systems

4. Maintenance procedure for each LCD systems

This section explains the maintenance procedure for each LCD systems. To achieve and continue the LCD system operation properly, system maintenance should be conducted following below procedures. If LCD system was installed in series, please conduct all of the maintenance independently.

4.1. Iron removal units

4.1.1.Sponge filtration unit

Daily base maintenance

- Water flow rate adjustment should be conducted every day to earn proper amount of treated water regularly.

Monthly base maintenance

- Take out the sponge from the system, and remove sediment on the surface of the sponge by washing. Better to wash sponge immediately when treated water gets color, turbidity.
- Wash and remove sediment from FRP container.
- Return back sponge to container properly.

Yearly base maintenance (Recommended)

- Replace all of the sponge when it get week and break up.
- Get rid of sponge from the reactor, and set new sponge.

4.1.2. Slow sand filter unit

Daily base maintenance (Water flow rate adjustment)

- Adjust water flow rate to the system to earn proper amount of treated water regularly. Control the valve from reservoir tank.

Weekly base maintenance (Backwash)

- Close the outlet pipeline from sand filter and fill the tank with groundwater until water comes from drainage line.

- Mix the water and sand of top layer inside of the sand filter system vigorously.
- Remove muddy water from drainage line placed on top of the system.
- Continue mixing until water inside the system get color less
- Open the outlet line and start operation.

Yearly base maintenance (Sand replacement)

- Need to replace sand if treated water get color, turbidity, and less water flow even after daily backwash.
- Remove all of the sand and wash inside of the system carefully
- Re-fill the sand following instruction manual

4.2. Nitrification unit

Daily maintenance (Water flow rate adjustment,)

- Adjust water flow rate to the system by inlet water valve, to get proper amount of treated water regularly. If LCD system is installed in series, water flow rate should be adjusted after 1st reservoir tank.
- Check the submerge pomp operation. Replace the pump if not working properly.

Weekly maintenance (Recirculation flow adjustment)

- Check the recirculation water flow and re-adjust it for suitable setting.

Monthly maintenance (Wash the submerge pump)

- Stop the system operation and take out the submerge pump
- Wash the suction port to remove sediment.
- Replace the pump if not working properly.

Yearly maintenance (Remove the sediment from the base tank)

- Stop the system operation and wash base tank to remove sediment.
- Discharge muddy water from base tank and refill water.

4.3. Denitrification unit

Daily maintenance (Hydrogen gas generator, water flow control).

Detail in summarized user's manual (See appendix)

- Add ionized water to hydrogen gas generator. NOTE: Do not supply ionized water if it has color or sediment.
- Please get detail information from the product manual, and follow proper procedures.
- Check the hydrogen gas flow rate and control again.
- Check the micro bubble diffuser. It is not produced bubble, check the water recirculation line. Usually, micro bubble diffuser is stopped due to clogging of drainage line for recirculation pump.
- Adjust water flow rate to get proper amount of treated water. NOTE: If denitrification unit was installed in series, please control water flow rate in water pipe line from 1st reservoir tank.

Weekly maintenance (Silica and molecular sieve replacement)

- Stop the hydrogen gas generator, and take out silica and molecular sieve chamber.
- Replace silica and molecular sieve to completely dried one.
- Dry silica and molecular sieve pellets in over at 60-80°C for 1 day. (or Heat it by pan until get it dry)

Monthly maintenance (Cleanup of micro bubble diffuser)

- Stop water recirculation pump.
- Take out the micro bubble diffuser and wash it carefully to remove sediment.
- Return it to the reactor and start operation.
- Replace water recirculation pump when it get broken.

4.4. Charcoal filter unit

Activated charcoal requires not daily maintenance (e.g. water flow adjustment). But, please check carefully to find out the sudden operational error.

Monthly maintenance (Back wash)

- Close the outlet pipe line and fill water until full.
- Mix the charcoal of top layer vigorously, and remove sediment though discharge line
- Regularly back wash the activated charcoal in monthly basis.

Yearly maintenance (Replace activated charcoal)

Please replace all of the activated charcoal, if treated water get odor and color even though you conduct proper maintenance.

- Take out all of the activated charcoal.
- Wash newly prepared activated charcoal and refill the unit following installation procedure.

5. Material list for LCD installation

5. Material list for LCD construction

The list of the material and equipment that used to construct LCDs during the period of the project are summarized in this section. Also, cost of each material is listed. Utilizing the same material is not mandatory. You can use cheaper material for LCD installation. The LCD system should be modifiable to reduce installation cost, operational cost, and to match the situation of Kathmandu valley.

- Sponge filtration unit

Table.1. List of material for constructing sponge filtration unit (house hold level system)

Special Order ☆: Locally available ★:Not locally available	Item	Unit	Amount	Price (NPR)
	1000 L reservoir tank with cover (φ38.5 inch×42 inch)	unit	1	12,500
	PPR pipe (φ1 inch)	m	3	700
	PPR Male Socket (φ1 inch)	unit	3	2,100
	Tank nipple (φ1 inch)	unit	3	1,200
	PPR Elbow (φ1 inch)	unit	2	200
	PPR Ball Valve (φ1inch)	unit	2	1,600
	Waterproof sealing tape	unit	2	100
	Sealing bond	unit	2	100
	Float switch	unit	1	1,700
☆	Iron frame for holding the system	unit	1	15,000
	Sponge	80L	6	1,200
	Sponge tray (Recycled material)	unit	5	0
			Total	36,400

- Sand filtration unit

Table. 2. Lists of material for constructing the sand filtration unit

Special Order ☆: Locally available ★:Not locally available	Item	Unit	Amount	Price (NPR)
	1000 L reservoir tank with cover (φ38.5 inch×42 inch)	unit	2	25,000
	PPR pipe (φ1 inch)	m	10	3,000
	PPR Male Socket (φ1 inch)	unit	10	6,000
	Tank nipple (φ1 inch)	unit	10	3,000
	PPR Elbow (φ1 inch)	unit	10	1,000
	PPR Ball Valve (φ1 inch)	unit	10	7,000
	Waterproof Sealing Tape	unit	10	1,000
	Sealing bond	unit	10	1,000
	Float switch	unit	1	2,000
☆	Iron frame for reservoir tank hold	set	1	20,000
	Sand	80L	10	2,000
	Gravel	80L	10	2,000
			Total	73,000

- Nitrification unit

Table 3. List of material for constructing nitrification unit.

Special Order ☆: Locally available ★:Not locally available	Item	Unit	Amount	Price (NPR)
☆	FRP pipe (φ39 inch×39 inch, thickness:6mm) with 3.1 inch flange on top and bottom	unit	4	138,000
★	Bio-fringe (3 m strings, 12 sets)	unit	10	326,000
	Submersible water pump with float switch controller (1 inch pipe connection)	unit	1	9,000
	1500 L reservoir tank with (φ42.5 inch×47 inch)	unit	1	20,000
	Vinyl hose (φ1 inch, 1 roll)	unit	1	2,000
	PPR pipe (φ1 inch×3m)	m	10	7,000
	PPR Male Socket (φ1 inch)	unit	10	7,000
	Tank nipple (φ1 inch)	unit	10	4,000
	PPR Elbow (φ1 inch)	unit	10	1,000
	PPR "T" shape (φ1 inch)	unit	10	1,000
	PPR Ball Valve (φ1 inch)	unit	10	8,000
	Hose Clip for 1 inch pipe	unit	10	1,000
	Waterproof sealing tape	unit	10	1,000
	Sealing Silicon set (Sealing silicon and Sealing gun)	unit	1	3,000
☆	Base and holding frame construction	set	1	202,000
			Total	730,000

Note: Details of Bio-fringe is available in appendix.

- Denitrification unit

Table 4. List of material for constructing denitrification unit.

Special Order ☆: Locally available, ★:Not locally available	Item	Unit	Amount	Price (NPR)
★	H_2 gas generator (YH500)	unit	2	818,000
★	H_2 gas flow controller	unit	2	205,000
★	Micro bubble diffuser	unit	2	45,000
★	Diffuser pomp	unit	2	41,000
	500 L Reservoir Tank (φ: 35 inch, height: 36.5 inch)	unit	1	8,000
	100 L Reservoir Tank (φ:19 inch, ,height: 24 inch)	unit	2	3,000
	PPR pipe (φ1 inch)	m	10	3,000
	PPR Male Socket (φ1 inch)	unit	10	7,000
	Tank nipple (φ1 inch)	unit	10	4,000
	PPR Elbow (φ1 inch)	unit	10	1,000
	PPR T (φ1 inch)	unit	10	1,000
	PPR Ball Valve (φ1 inch)	unit	10	8,000
	Waterproof sealing tape	unit	10	1,000
☆	Base and holding frame construction	set	1	202,000
			Total	1,347,000

Note: Detail of hydrogen gas generator is available in appendix.

- Charcoal filtration unit

Table 5. List of material for constructing activated charcoal filtration unit construction.

Special Order ☆: Locally available ★:Not locally available	Item	Unit	Amount	Price (NPR)
	200 L reservoir tank with cover (φ28 inch×24 inch)	unit	1	24,000
	PPR pipe (φ1 inch)	m	5	2,000
	PPR Male Socket (φ1 inch)	unit	5	4,000
	Tank Nipple (φ1 inch)	unit	5	2,000
	PPR Ball Valve (φ1 inch)	unit	5	4,000
	Waterproof Sealing Tape	unit	10	1,000
★	30L packages of activated charcoal	unit	3	35,000
			Total	72,000

Appendix

● LCD installed site

Detail information of the LCD installation site is summarized as an appendix in this section. During 5 yeas SATREPS project, Japanese and Nepali research team have installed LCD systems into 6 sites as summarized in Fig.A1 and Table A1. Fig. A1 shows details location of 5 LCD installed site. Since LCD system (Sponge filtration unit) has been installed in private house, detail information is excluded. Table A1 denotes series of LCD system, location information, major contaminates, major contaminants and contacting organization. The system flows in 5 LCD installed sites are summarized in Fig. A2 to A6. You can get detail information and way of operation and maintenance by visiting and seeing actual setting of LCD systems. User's manual of hydrogen gas generator and Bio fringe are available in the end of appendix.

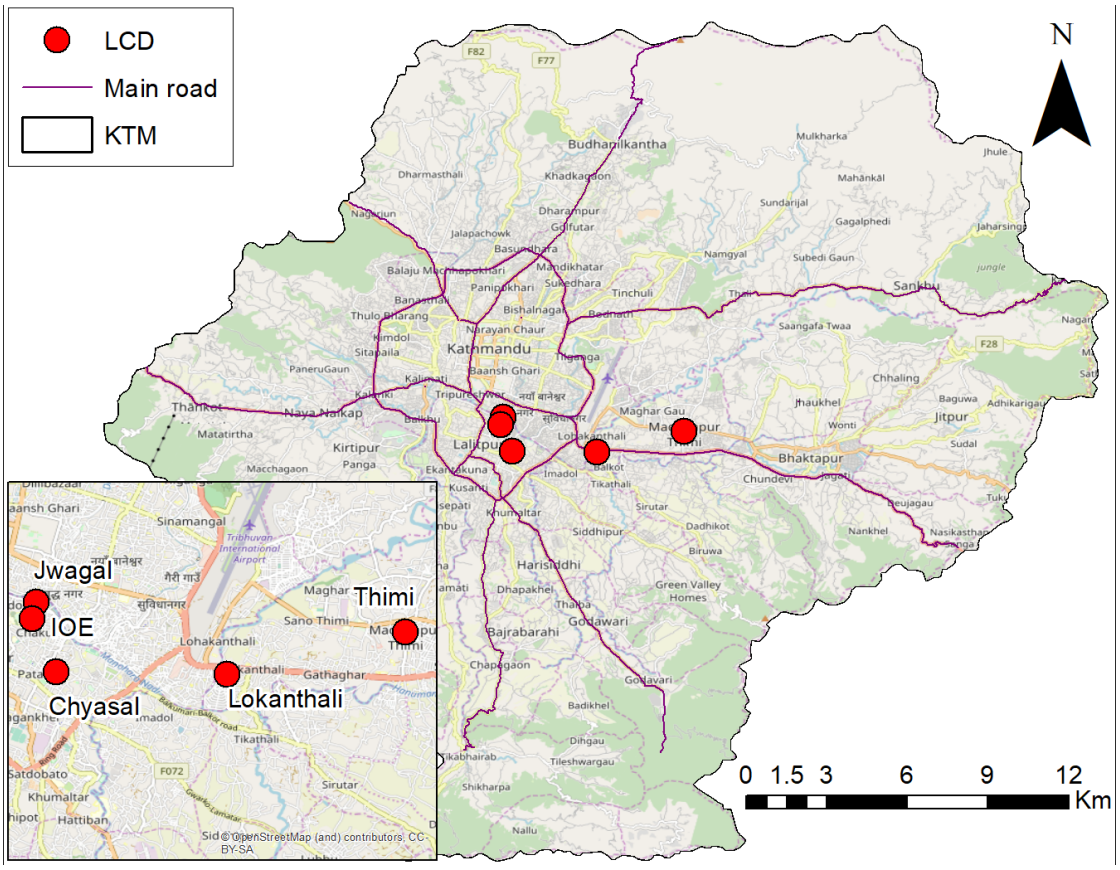


Figure A1. Location of the LCD installation site. Please contact to the contact person, to visit and see the LCD. Information of the private hose was excluded from this figure.

Table A1. Location information of 6 LCD installed sites.

Place	Location	Major contaminants	LCD systems	Contact
KUKL water treatment plant in UN park at Jwagal	27.685785, 85.324829	Iron, Ammonia	Sponge filtration, Nitrification, Denitrification	KVWMS/KUKL
Chyasal Community	-	Iron, Ammonia	Sand filtration, Nitrification	CREEW
Thimi Community	-	Nitrate	Denitrification	CREEW
Girls hostel in IOE	-	Iron, Ammonia	Sand filtration, Nitrification	Institution of engineering, Tribhuvan university
KUKL water treatment plant at Lokanthali	27.673998, 85.356279	Iron, Ammonia	Sand filtration, Nitrification, Denitrification	KVWMS/KUKL
Personal house at Jwagal area	-	Iron	Sponge filtration	CREEW

Jwagal Drinking Water Treatment Plant

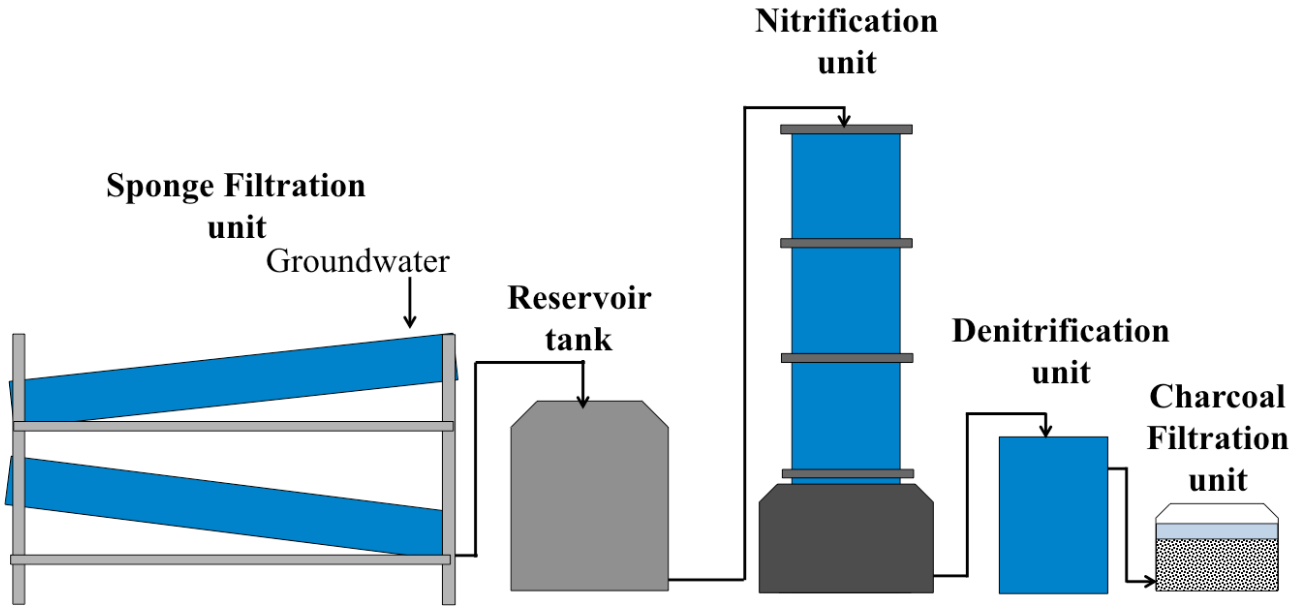


Figure A2. Outline of the LCD in Jwagal drinking water treatment plant

Chyasal Drinking Water Treatment Plant

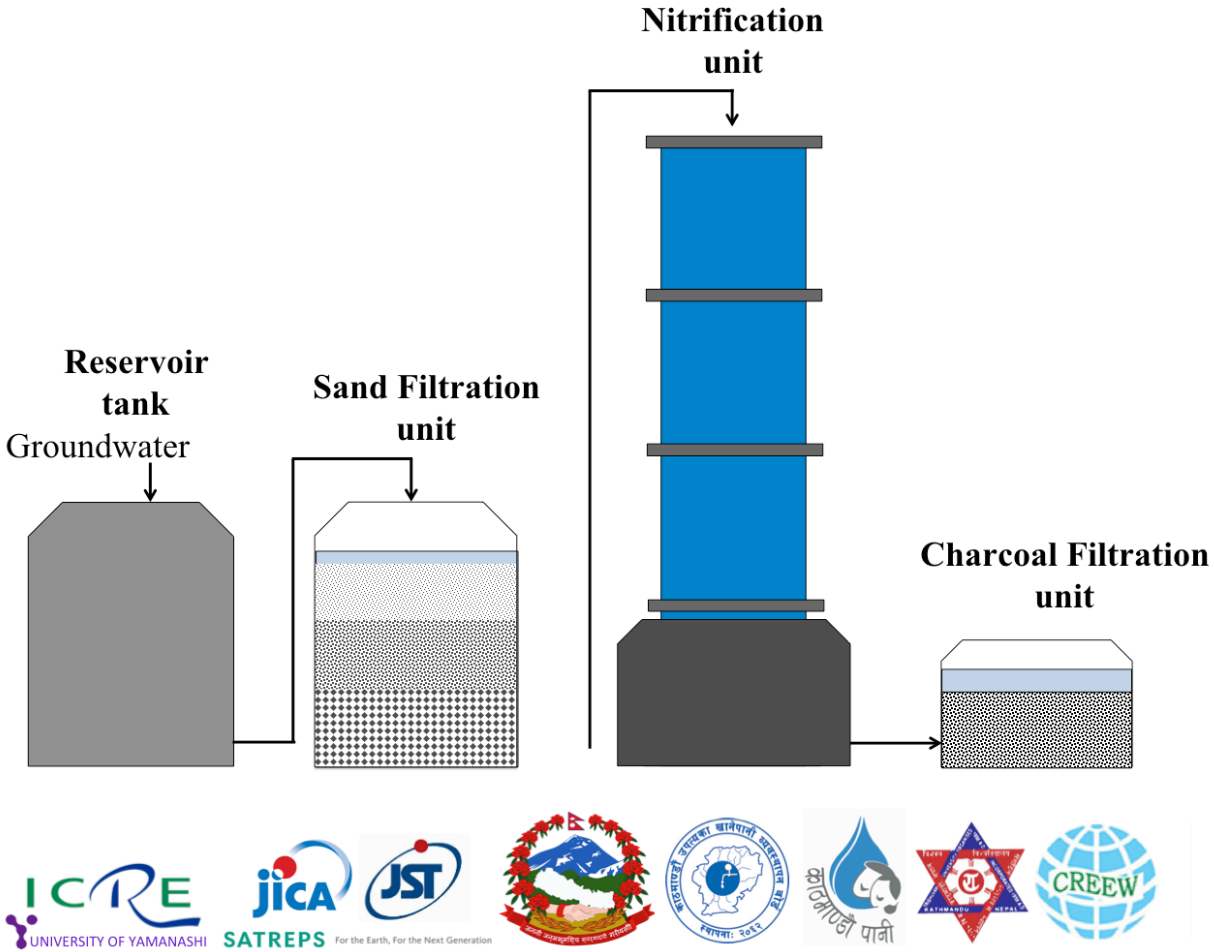


Figure A3. Outline of the LCD in Chyasal drinking water treatment plant.

Chapacho Drinking Water Treatment Plant

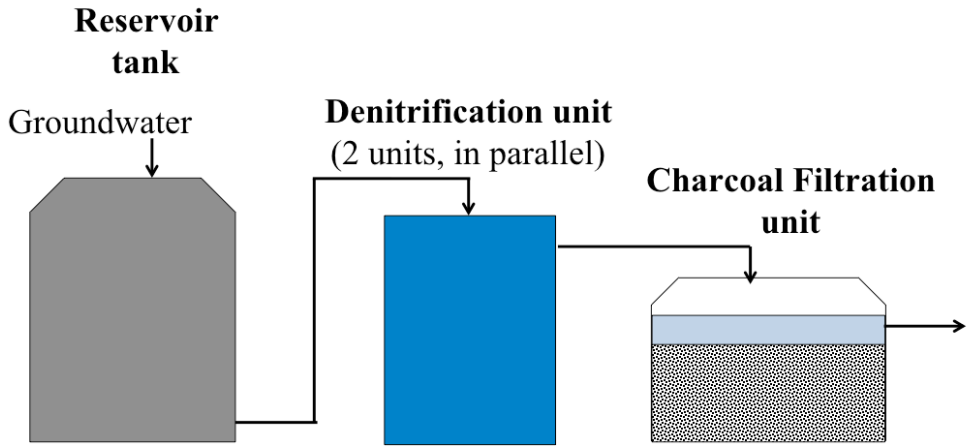


Figure A4. Outline of the LCD in Chakacha (Thimi) drinking water treatment plant.

IOE Girls' Hostel Water Treatment Plant

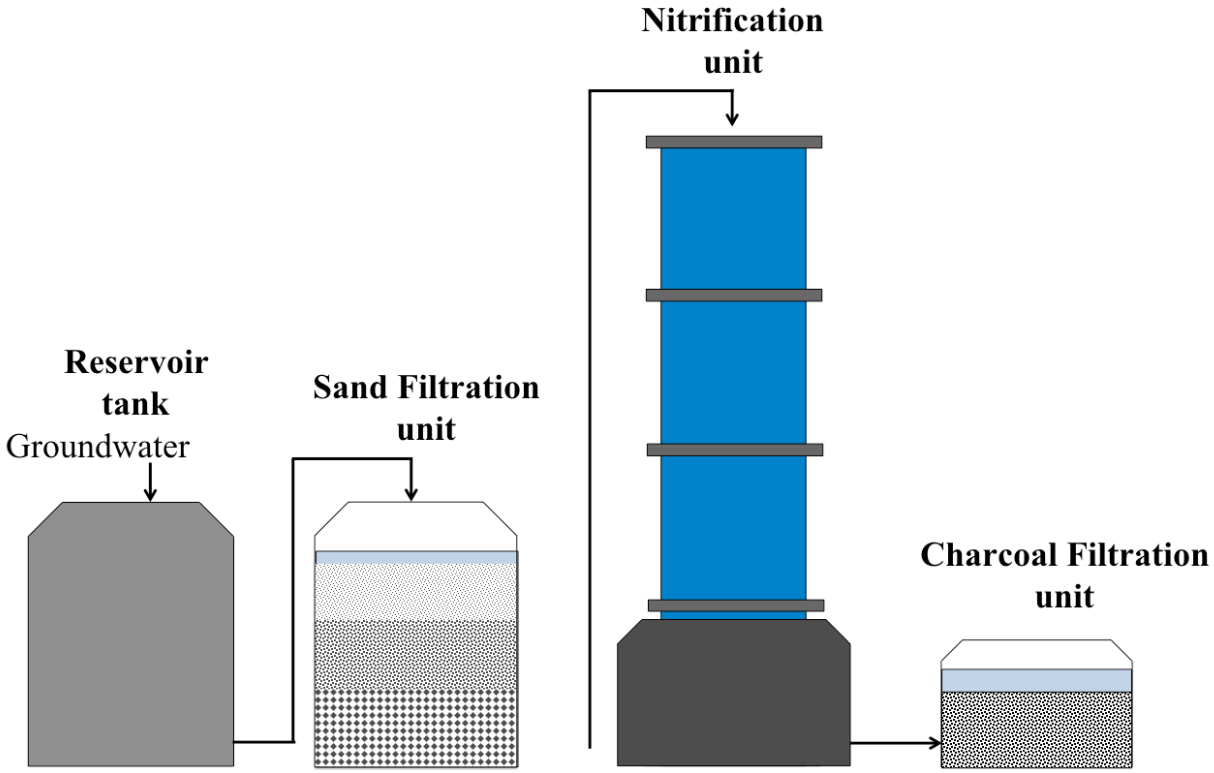


Figure A5. Outline of the LCD in Chyasal drinking water treatment plant.

Outline of Lokanthali Drinking Water Treatment Plant

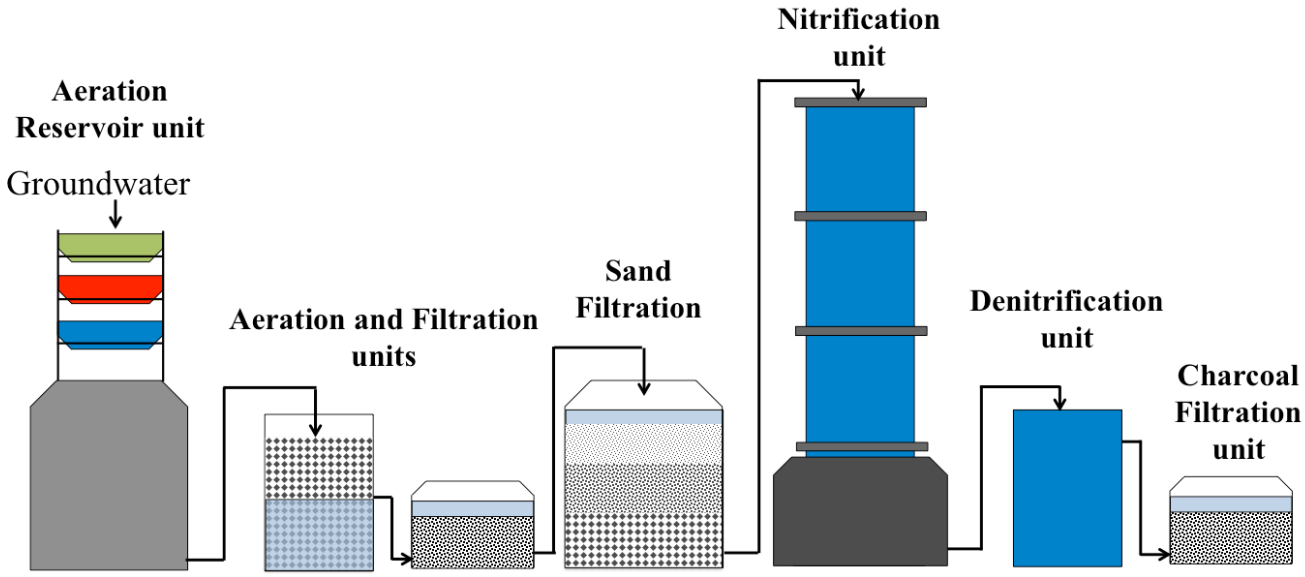


Figure A6. Outline of Lokanthali drinking water treatment plan

- **Users manuals**

User's manual for hydrogen gas generator and Bio fringe which was transported from Japan, are listed in this section. You can replace it to cheaper material as you wish.

OPERATING MANUAL

FOR

YH-500 HYDROGEN GENERATOR

Scitem Co., Ltd.

Komatsu Business Creation Plaza 013
2 Komatsu-no-mori, Komatsu-shi, Ishikawa 923-0869 Japan
TEL: +81-761-48-4058 FAX: +81-761-48-4059
info@scitem.co.jp

Warnings:

a. Please read this manual carefully before the operation!
b. The conductivity of the de-ionized water should be **LESS THAN** 1.0 μs/cm!
c. When not use the instrument for a long time, please **DO NOT** pour the water of liquid bucket completely, to maintain the electrolytic cell wet!
d. The instrument has water level automatic safety device, please add water in time!

Notes:

a. Please pour the de-ionized water (conductivity<1.0 μs/cm) into the liquid bucket slowly!
b. Please add the de-ionized water (conductivity<1.0 μs/cm) promptly when the water is nearly to low limit!
c. Please rotate the filter tightly after replacing the absorption material, to avoid leakage!
d. Please change the de-ionized water every month.

CONTENT

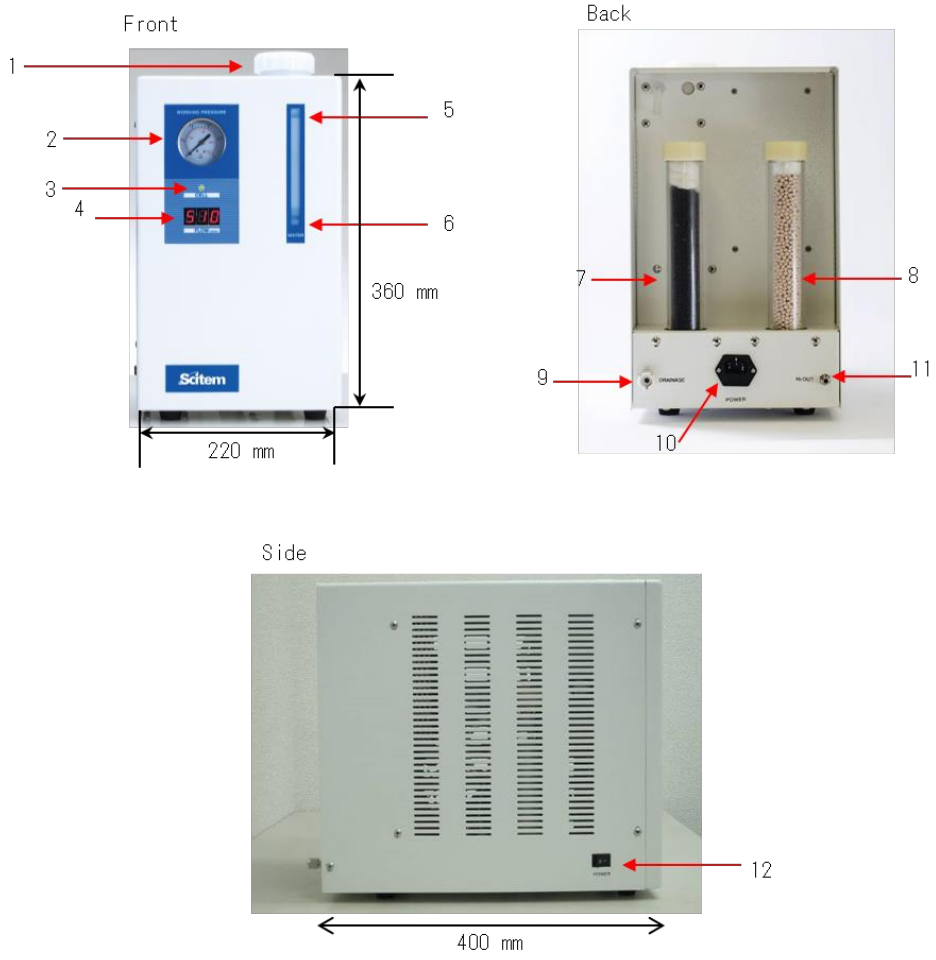
1. INTRODUCTION

YH-500 High Purity Hydrogen Generator employs the latest technology to satisfy various models of gas chromatographs, which are manufactured by domestic and aboard manufactures.

Its pressure control adopts high sensitive fuzzy control and automatic tracking system to make the precision range of the pressure stability less 0.001MPa.

Its electrolytic cell utilizes Solid Phase Electrolyte (SPE) technology and process multi-stage purification. There are two filters providing with the instrument. The hydrogen purity can be reached up to: oxygen content : less 3ppm, water content dew point temperature :-56℃.

2. DESCRIPTIONS FOR EACH PART OF INSTRUMENT



1-- Liquid bucket of de-ionized water
2-- Indicator of working pressure
3-- Indicating lamp of electrolytic solution
4-- Hydrogen digital flow
5-- Upper limit indication of de-ionized water
6-- Low limit indication of de-ionized water
7-- Color changing silica gel purified tube
8-- Molecule sieve purified tube
9-- Water outlet port
10-- Cable of power supply
11-- H_2 output
12-- Switch of power supply

3. INSTALLATION AND OPERATION

3.1 Preparation before the operation

3.1.1 Take the instrument out from the packing box. Check if there is any damage on the instrument during the transportation and verify that all of spare parts are provided with the main unit according to the packing list.

3.1.2 Adding the de-ionized water

Open the outer cover of the liquid bucket of the instrument, put the de-ionized water (Conductivity <1.0 μs/cm) into the liquid bucket, screw the outer cover tightly.

3.2 Self checking of instrument (When the instrument is the first use or problems)

3.2.1 Connect with the power supply, at the same time tightening the seal nut on H_2 output.

3.2.2 Switch on the power supply. The moment the pressure meter goes up. Verify that the electrolytic indicating lamp (green lamp) on the instrumental panel is lit, digital flow indication (Digital meter) should be more than 500 and less than 550. The pressure indication (Pressure meter) in eight minutes should reach up to 4Kg/cm^2 (about 0.4Mpa) and digital flow indication drops to “000”. That shows the instrument working in a normal case and the self-checking is qualified.

3.3 Operation of instrument

3.3.1 Take off the sealing nut located at the outlet port of the rear of the hydrogen generator. **(Please keep it well for the next usage after taking it off).** The outlet port of the hydrogen generator qualified after the self-checking is connected to the inlet port of the hydrogen of the gas chromatograph using a gas tube with the outer diameter of 3mm. Screw up the nut to be sure for good seal. Switch on the power supply, after heating and automatic gas release, the instrument enters into the working status.

3.3.2 Great attention should be taken that the flow display should be in accord with the flow display used by the gas chromatograph. When the flow displayed exceeds more than the actual flow used, promptly stop the instrument running and verify the gas leakage carefully. Please refer to the sections of troubleshooting in this manual. After so, the self-checking is made again. It can be operated until the self-checking of the instrument is qualified

3.3.3 There are two filters filled in color changing silica gel and molecule sieve provided with the instrument. Observe through the viewed window if the color of the silica gel in the filter has been changed. If it is so, please immediately make the replacement or regeneration. Its method shows as follows: In the gas pressure to "0" state, rotate off the overall filter, take out the cotton in the bottom. Replace the absorption material, then fill in the cotton again and compaction. Mount the filter to the chassis and rotate it tightly. After so, check if the gas leakage exists.

3.3.4 The de-ionized water is gradually reduced when the instrument is used for a certain period. Therefore, add the de-ionized water promptly when the water is nearly to low limit. Don’t exceed the water level line of the upper limit when the water is added. **(Caution: the conductivity of the de-ionized water should be less than 1.0 μs/cm .)**

3.3.5 Please change the de-ionized water every month.

3.3.6 Don’t detach and open the electrolytic cell by user so as to avoid the instrument running in abnormal case. It can’t be repaired by user self.

4. FEATURES OF INSTRUMENT

4.1 Program control: The specialized chip is used in the control system of the instrument. All working process of the instrument will be completed by the program control. The automatic constant voltage, constant current and hydrogen flow can be automatically adjusted according to the requirements.

4.2 High purity of hydrogen production: The film separating technique and effective de-humidity device are used in the system, with trace oxygen removal agent (does not need activate), so the original humidity is more reduced. The multi-polar absorption is adopted to make the hydrogen humidity reaching up to -56℃ of dew point temperature ,and oxygen content is less than 3ppm.

4.3 Easy operation: Only switch on the power supply if the hydrogen is required, and switch off after use, do not need release pressure. It can be used continuously or at intervals, the hydrogen production is very stable without the attenuation.

4.4 Safe and reliable: The safe device is equipped with the system, sensitive and reliable.

5. TROUBLING SHOOTING

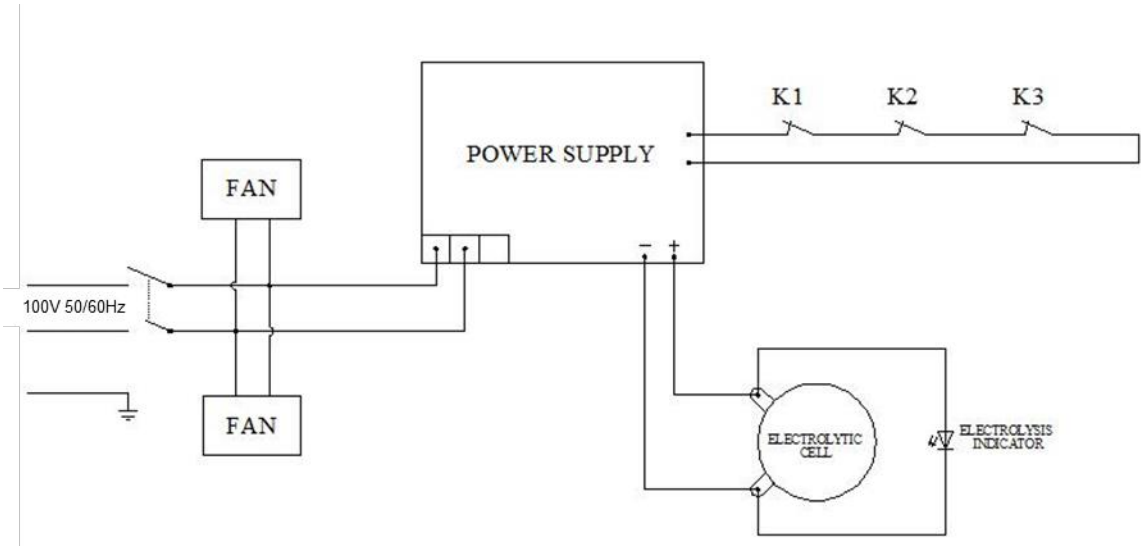
5.1	Problem	1. There is no work in the system.
	Possible causes	1. No connection to the circuit 2. Switch of power supply may be damaged.
	Checking area	1.Test the circuit 2. Measure the voltage of the electrolytic cell to confirm if it is about 2.3V using a universal meter.
	Solution	1. Repair the power supply. 2. Replace the damaged switch of power supply.
5.2	Problem	1. Hydrogen production can not reach to presetting pressure. 2. Hydrogen digital display shows over 550. 3. Amount of hydrogen displayed exceeds more of amount practice used.
	Possible causes	1. Gas leakage exists in gas piping system. 2. No screw tightly between the filter and the top cover of the filter. 3. Reverse leakage of electrolytic cell.
	Checking area	Verify gas leakage on each joint using test leakage liquid.
	Solution	1. Replace gas leakage part. 2. Screw the leakage point tightly. **3. Electrolytic cell can never be repaired by users themselves.**
5.3	Problem	1. Hydrogen production exceeds resetting pressure of 0.1Mpa.
	Possible causes	1. Dowser of automatic tracking device may be dislocation or drop off. 2. Photo thermal couple is damaged.
	Solution	1.When the pressure on the front panel reaches to 4Kg/cm^2(About0.4Mpa), promptly mount the dowser in a proper position, then repeatedly increase the pressure for several times to

		determine if it is mounted properly. Afterwards slightly knock in the dowser. 2. Replace the photo thermal couple.
	Location	1. In the instrument. 2. It is located beside of the control pressure meter.

6. MAIN TECHNICAL PARAMETERS

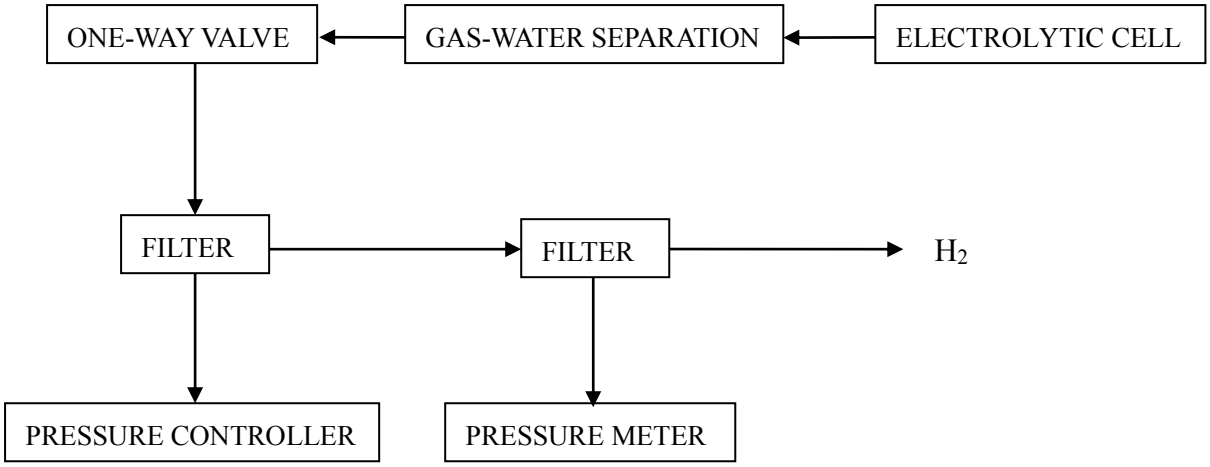
6.1 Hydrogen purity: 99.999%
6.2 Hydrogen flow: 0-500ml/min
6.3 Output pressure: 0-4Kg/cm^2 (about 0.4Mpa)
6.4 Pressure stability: < 0.001MPa
6.5 Power supply: AC100V, 50/60Hz
6.6 Consumption power: 200W
6.7 Ambient temperature: 1-40℃
6.8 Relative humidity: < 85%
6.9 Outer dimension: 400×360×220mm
6.10 Weight: About 14Kg

7. SYMBOLS AND DIAGRAMS



K1: Water lack protecting switch K2: Overflow protecting switch K3: Overpressure protecting switch

7.1 Electrical Schematic



7.2 Gas-line flow chart

Simplified design procedure of wastewater treatment system using Biofringe(BF).

Followings are design procedure for BF system.

① Calculate the loads to the wastewater treatment system.
The load(kg/day)=Discharge volume(m^3/d)× (impunity concentration in influent(mg/L) —impunity concentration of effluent(mg/L)) ÷1000

② Calculate the total BF length.
Treatment of BOD (Biochemical Oxygen Demand) requires BF length 25m per kg/day.
Treatment of n-hexane (Normal Hexane Extracts) requires BF length 250m per kg/day
Compere both BF lengths, and choose the longer BF length.

③ In case of using steel frame for BF installation, the length of one thread of BF shall be one meter shorter than water depth. Choose the nearest length from BF standard size list on the our home page : http://net-bio.jp/netpdf/jppdf/BF-S1003.pdf

④ To determine of the BF sheet, choose the nearest width (number of BF thread) from above mentioned list from 50% of width of the aeration tank minus one mater.
The largest width of sheet is 12 threads (1.2m), if the required width is longer or shorter than 1.2m, choose the proper sheets from the list to be fit the required width.
After the sheet width and thread length are determined, the required sheet number shall be calculated.

⑤ By the sheet number of BF, BF frame length shall be calculated because the BF should be installed 100mm pitch.
If the length of the frame is longer than length of the aeration tank or too short to the tank, please contact us, we will advise you how to do.

⑥ Calculate the required air volume.
Required air volume (V) is calculated by following equation:
V (m^3/minute) = BOD load (kg/day)×1.3/0.277×0.08×24×60=BOD load×0.041
1.3 = weight of air (kg/m^3), 0.277=oxygen weight in air (kg/kg)
0.08= dissolve oxygen ratio in water. 24×60= conversion to day.
You should calculate the number of aeration equipment which normally has capacity (m^3/minute) from 0.7 to 1.4.

⑦ Design the BF frame based on the number of BF sheets.
Calculate the strength to bear the BF's weight which is 1.4kg/m with sludge.
If you wash the BF by water jet while pulling up the frame for maintenance, the strength of the frame should be enough to bear during pulled up.

⑧ In case of tank type, choose the nearest BF thread length from the list and determine the number of aeration equipment
The list is on home page ; http://net-bio.jp/netpdf/jppdf/siryou3BFhyouzyunzu.pdf.

WaSH-Mia/SATREPS: Manual No.5

Manual for the Socio-Economic Survey on Household Water Use

Table of Contents

Introduction

The Kathmandu Valley being capital city is the most urbanized center of Nepal. The city has seen extensive population growth which increased from 1.6 million in 2001 to 2.5 million by 2011 and the population growth rate of 5.2% was one the highest in South Asia (CBS 2012). Rapidly grown population has water demand of 320 million liters per day (MLD) but the water supplying agency could only provide 106 MLD and 76 MLD in wet and dry seasons, respectively (KUKL 2010). In order to provide water to all connections despite of huge water deficit, the agency can supply water intermittently to the households. None of the municipal areas in the valley are receiving piped water 24 hours supply per day while most of them were receiving <4 – 7 hours per week (ADB 2010). Therefore, like in many Asian cities, alternative water sources constitute large proportion of domestic water use in the valley.

Other improved sources consist of groundwater (tube well / protected bore well/ protected dug well), protected spring and rain water while unimproved sources include unprotected dug well, vendor's tanker water, unprotected spring water, bottled water, and surface water (WHO/UNICEF 2012). According to a wide scale survey conducted by ADB 2010, 52% of households use groundwater, 10% use stone spout, 1% use river water, 27% use rainwater, 17% use bottled or jar, 8% use vendor's tanker and 4% use other sources in the valley. Private self-supply is greatly practiced by urban dwellers as 'coping-strategy' against partially or highly inadequate municipal water supply (Foster et al. 2010). But, 'private self-supply' by households is often excluded from official statistics and is usually taken as granted by government. In 2009, ADB had conducted a wide scale survey about water supply status but within the period of 5 years after that survey KUKL connections has been increased by thousands but the performance of KUKL is rather stagnant. In a short span of time, water business has flourished tremendously. So, undoubtedly the composition of water sources being used in households as well the coverage of different water sources might have experienced a huge shift. Therefore, we felt an urgency to understand as well as to document current household water use situation of the valley.

We conducted the following two kind of surveys:

(1) Household survey targeted household members and asked about present water use situation and relating issues in each household to know the average and the variation of these parameters in urban Kathmandu valley.

(2) Community survey targeted social mobilizers and community leaders and asked mainly

about water availability and use in households in the community to identify the most water scarce communities to be taken measures for preferentially.

This study is a part of "Hydro-microbial approach for water security in Kathmandu Valley" project of University of Yamanashi (UY) under the program "Science and Technology Research Partnership for Sustainable Development", jointly funded by Japan Science and Technology Agency (JST) and Japan International Cooperation Agency (JICA). One of the aims of this survey was to understand different dynamics of household water use based in the valley in dry and wet seasons.

Part I Household survey

1. Sampling

1.1 Study settings:

The longitudinal survey was conducted in municipal areas of the Kathmandu Valley as before January 2017; Kathmandu metropolitan city (KMC), Lalitpur Sub-metropolitan city (LSMC), Kritipur municipality (KrM), and Thimi municipality (TM) (Figure 1). The longitudinal survey was performed in three different phases: Phase I - January to 2015 March; Phase II - December 2015 to February 2016; Phase III - July to September 2016. KMC and KrM lie Kathmandu district and LSMC in Lalitpur district and TM in Bhaktapur district. KUKL supplied piped water to these municipal areas of the valley.

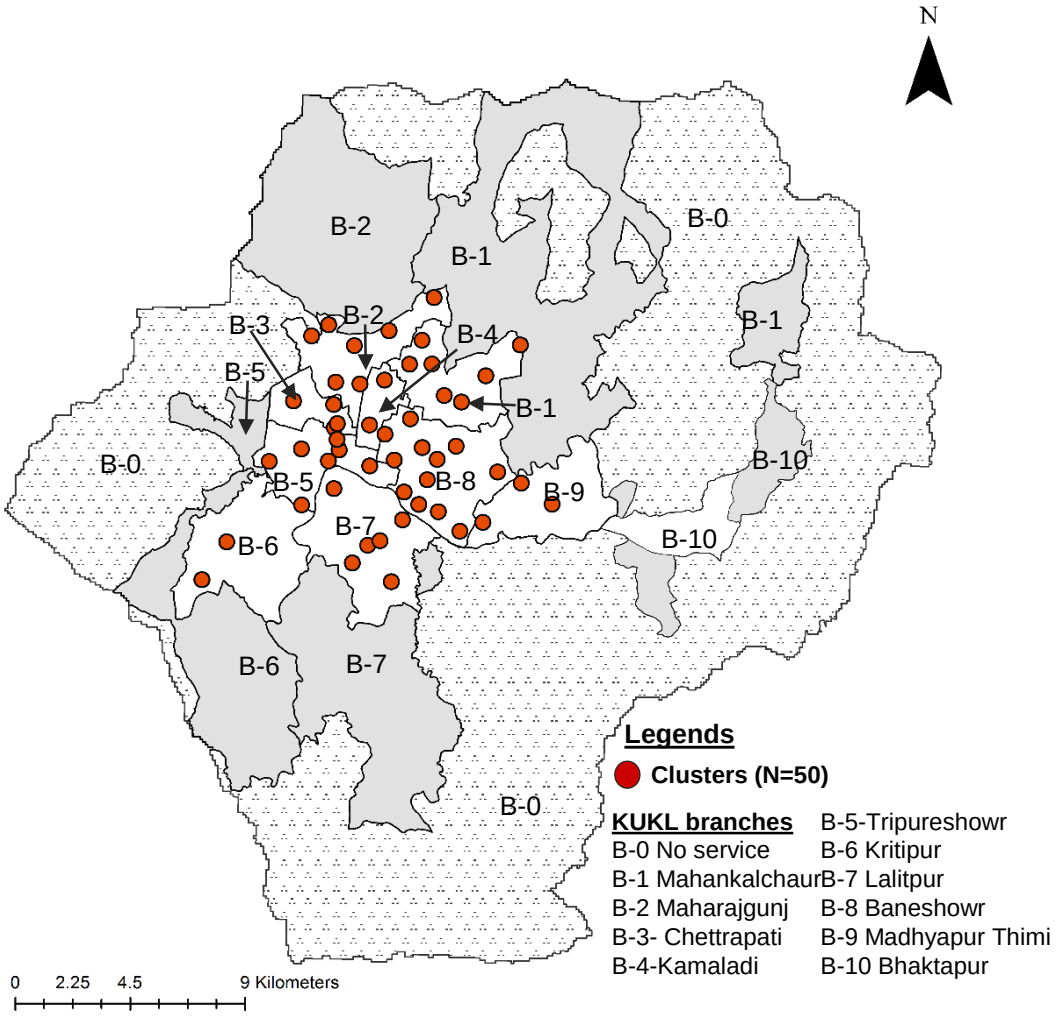


Figure 1. Distribution of sampling clusters (N=50) in the study area. Kathmandu Upatyaka Khanepani Limited (KUKL) branches are designated water service areas. White areas refer to municipal boundaries, and gray areas to village development committee boundaries of respective KUKL branches. Our study focused within municipal boundaries, except for B-10. B-0 area had no KUKL services.

1.2 Sampling technique:

Our sampling unit is one household, and our target area consisted of more than 40,000 households. We have chosen a multi-stage cluster survey design which eliminated the need for a complete list of all units in the population. A multi-stage cluster survey includes two steps to select samples. The sampling technique we have used is probability proportional to HH size (PPS). Here, wards in KMC, LSMC, KrM and TM were considered as clusters and the wards greatly vary in their household sizes. PPS is a sampling technique under which the probability of a cluster (wards) being selected is proportional to the size of the ultimate unit (HH), giving larger clusters a greater

probability of selection and smaller clusters a lower probability. PPS is most useful when the sampling units vary considerably in size because it assures that those in larger sites have the same probability of getting into the sample as those in smaller sites and vice versa. In the second step, exactly same number of the ultimate units are selected per cluster so that the ultimate units in the large clusters have small probability of being sampled. Hence, each ultimate unit (HH) in the study area has the same probability of being sampled. The basic probability weights were calculated. At first, 50 clusters were selected in the study area. Each cluster had different HH sizes. Secondly, 30 HHs closest to each clusters were selected. So the total sample size was 1500 HHs in each phase of survey.

1.3 Selecting survey locations and households

For deciding actual location, 50 geographical landmarks were chosen for one for each cluster in GIS map and 30 HHs closest to each chosen landmark were selected and surveyed. The red closed circles in the figure 1 were the landmark chosen for the clusters.

For HH selection, 30 HHs for each clusters were chosen randomly. It was identified whether it is possible to interview an appropriate household informant. In the context of the Kathmandu Valley, one house building consists of more than one household. Hence, only one household per house was surveyed. Interviewers were trained to use judgement in selecting the households and respondents.

1.4 Selecting an appropriate respondent

The inclusion criteria of the informants were being above 15 years of age, should be in the state to give interview physically and mentally, and were willing to provide written informed consent to participate in the study voluntarily. The respondent should be knowledgeable about the necessary aspects of water use.

2. Guidelines for completing household survey forms or questionnaires

A structured questionnaire was used and data was collected by trained interviewers. The questionnaire included socio-demographic characteristics, domestic water use behavior, water quality management, hygiene behavior and physical symptoms.

2.1 General guideline

- ✓ The interviewer explained the reason for the survey in simple, clear terms.
- ✓ Participation in the survey was voluntary, and the respondent could refuse to be interviewed.
- ✓ Consent was documented according to locally applicable standards for protection of human

subjects.

- ✓ When individual consent is required, each respondent was asked to sign an Informed Consent Form before starting the interview. A model form is provided in Annex II (a&b). If the participants decide to discontinue the survey in the middle, he/she filled up Annex III (a&b).
- ✓ The interviewer checked that the respondent had understood the form before signing it. If the respondent is illiterate or unable to read the consent form (e.g. due to visual impairment), the form was read by the interviewer and explained to the respondent.
- ✓ Interviews with respondents was face-to-face, in local language(s), using paper and pen.
- ✓ Interviewers read questions (and possible responses, if indicated) and mark the respondent's answers on the questionnaire. Interviewers explained the meaning if the respondents could not understand the questions.
- ✓ Responses was verified by repeating the answers.
- ✓ The officers of the counterpart should check the completed household questionnaires.

2.2 Guidelines for completing questionnaire

Phase I

Q1 Personal Information

Q1.1 to Q1.6 are basic information of respondents their contact, age, ethnicity and ownership of the house.

Q1.6 to Q 1.9 are regarding information number, occupation, and education of household members. Household members share resources together. A member of the household can be someone who usually stays in the household, sleeps and shares meals there, who has that address as primary place of residence.

Q2. Current health status of household member.

This section collects the information on common health problems experienced by household members in the last two weeks, problem of diarrhoea as well as treatment facilities accessed during health problem including the cost of treatment.

Q3. Household water system

Q3.1 Does your house connect piped water?

Piped water connection at house is the water supplied by KUKL or the municipal water source.

The options 'Yes' was for condition when the household building has its own piped water connection, 'No' if there was no connection.

Q3.2 How many hours does the piped water supply in a day or week now?
Enter the number of hours water is supplied to through the piped supply in a day or in worst conditions in a week. The condition of intermittent water supply is prevailing in the Kathmandu Valley. The water is not supplied 24 hours and every day.

Q3.3 Do you store piped water in your house?
This information is for piped water storage behavior of household. The appropriate piped water storage was selected from the options. Other option is for the water storage container that has been used by the household but not listed in the options.

Q3.4. How much amount of piped water do you consume in a day/ week/ month?
The tentative amount of piped water used either per day or week or month was used.

Q3.5. What is the purpose of using piped water?
The appropriate purposes for which piped water has been used in the household were selected. 'Other' option is for purpose of piped water being used in the household but not listed in the options.

Q3.6. How much do you pay for piped water supply in a day/ week/ month?
The cost that the household has been paying to the KUKL per month or week or day was entered.

Q3.7 –Q 3.10. These questions are asked to collect the information on private groundwater well, the amount of groundwater being used, the purposes for which groundwater was used by the household, groundwater storage behavior of the household.

Q 3.11- 3.14. These questions are asked to collect the information on use of rainwater, the amount being used, the purposes of use, storage behavior of the household.

Q3.15. This question collected information on water buying behavior of household. The major water sources for buying that were considered were tanker water and jar water.

Q3.16. These questions are asked to collect the information on use of public water sources or water source from neighbors, the amount being used, and the purposes of use.

Q3.17. How long does it take to go there, get water, and come back per time?
The average amount of time required for a member of the household to fetch (to go, collect, and come back) water from public water sources or from neighbors was entered in terms of minutes per event.

Q3.18. Mainly, who collects and manage domestic water in your house?
The question collected information on the workforce involved in managing water in household.

Q 3.19. Do you treat water?
This question probed data on water treatment systems commonly being used for treating water that is used for several purposes.

Q 3.20. How much water did your family consumed for following purposes in past 5 days?
This information is basically the water diary stratified by purpose of use. The tentative amount of water, irrespective of the source, from 1 day to 5 days before the survey day.

Q 3.21. What kind of toilet facility do members of your household usually use?
The type of toilet facility the household was selected. This portion is related with the status of sanitation of the household.

Q 3.22. How much are you willing to pay for clean water in a day/ week/ month?
This question probed the information on household's willingness to pay (WTP). The amount of arbitrary amount of cost that the household would like to pay for received good water quality was entered.

Q 3.23. How frequently do you clean water stored containers?
The question probed the information about the hygiene behavior of the household. The number of times the water storage vessels were cleaned were entered.

Q 3.24 & Q 3.25 were questions collecting information about amount of water used for drinking

from different water sources and the treatment systems being used for treating water from sources. 'Other' is the treatment system that is being used in the household but not listed in the option. Such information was entered.

Q 3.26. Water insecurity scale

This scale is a 15-item scale, that probed information on the perception of household members on different difficulties and inconvenience that they have to experience due to poor availability and poor quality of water. Each item has six different choices; never, rarely, sometimes, often, mostly, and always. 'Never' means never experienced such difficulty and 'always' means experienced always.

Q4. Hygiene behavior

Q4.1 to Q4.3 are the questions that probe the hygiene behavior of the household members such as washing hands before preparing meal, after toilet, showering frequency.

Q5. Economic status of household.

Q5.1 In your household, what do you have?

The presence of total 16 different assets were asked. The assets varied from necessity to luxurious items. Based on the possession of these assets, weights are calculated and wealth index is calculate to categorize the wealth status of the households. These are presented in terms of wealth quintile. For further details procedure of calculating wealth index, please consult 'Methodological Note: Measuring Relative Wealth using Household Asset Indicators' in https://www.vanderbilt.edu/lapop/insights/I0806en_v2.pdf.

Q5.2 How much do you expense in the last month?

The amount of expenditure by the household in the last month was entered. This is considered as equivalence of income in this study.

Second section

This section is World Health Organization Quality of Life BREF (WHOQOL-BREF). It has few questions (Q1-7) for collecting general information of the respondents. The WHOQOL-BREF is a 26-item scale. This section is for assessing the quality of life.

Phase II

Phase II survey was conducted after Gorkha Earthquake 2015. Hence, there are some additional questions in the questionnaire.

Q8. During one-month after earthquake, what was the piped water availability?

This question collected information on piped water supply status one-month after earthquake. The suitable option was selected and if necessary, number of days was entered. 'Others' option was for the piped water availability that has been experienced by the household but not listed in the options. Entry was made upon selecting that option.

Q29 & Q30. These questions were used to collect information on any damage in underground tank due to earthquake.

Section 5 Impact of earthquake on water system

This section was added to gather information on water quality, quantity, availability after earthquake. Information on management of water for daily activities, for different purposes were gathered. The connection of household with some community and any kind of support obtained for managing water were also assessed. The information on support from different organizations and volunteers was also obtained from this section.

Phase III

Q27 For how many days do you store water before using it, on an average?

The number of days water is stored in before it is used has been entered.

Q 28 What are the capacities of your storage tanks and vessels?

This question collects information on the capacities of the storage tanks and vessels being used for storing water for drinking and other purposes, separately. The capacities of the storage vessels have been entered.

Section 4 collects the information on water diary.

Q31 How much do you pay for water treatment in a week/ month?

The cost the household was paying for treatment of water in a week or a month was entered.

Q32 How much are your willing to pay for water treatment in a month?

The cost the household was willing to pay for water treatment in a month was entered.

3 Data entry and analysis

The entry of Phase I data was done using Microsoft Excel and that of Phase II and Phase III data was done using EpiData (Version 3.1) Software. For further details procedure, please consult EpiData Help Manual produced by the EpiData Association, Odense Denmark, 2004 in http://www.epidata.dk/downloads/epidata_pdf.pdf. Data analysis has been done in IBM SPSS Statistics Version 20.0 (IBM Corporation, Armonk, NY, USA).

4 Calculation of indicators

4.1 Water insecurity scale (WIS)

WIS is a 15-item scale, rated on a 6-point Likert-type scale. A score is given to each option: never: 0; rarely: 1; sometimes: 2; often: 3; mostly: 4; always: 5. Total scores for a household range from 0 to 75, with higher scores indicating higher water-insecurity perception.

4.2 WHOQoL-BREF scale

We used WHOQOL-BREF, a 26-item abbreviated version of WHOQOL-100 to measure Quality of life (QoL). Each item rating varies from 1 to 5 on a Likert-type scale. There are two items that are examined separately: question 1 asks about an individual's overall perception of quality of life and question 2 asks about an individual's overall perception of their health. This scale has four domains: physical health, psychological health, social relationships, and environmental. The four domain scores denote an individual's perception of quality of life in each particular domain. Domain scores are scaled in a positive direction (i.e. higher scores denote higher quality of life). Physical health domain includes question - 3, 4, 10, 15, 16, 17, 18; psychological health domain includes questions – 5, 6, 7, 11,19, 26; social relationships domain includes questions – 20, 21, 22; environmental health domain includes questions – 8, 9, 12, 13, 14, 23, 24, 25. For details of the calculation procedure, please consult WHOQOL-BREF Introduction, Administration, Scoring and Generic Version of The Assessment Field Trial Version December 1996 in http://www.who.int/mental_health/media/en/76.pdf.

Part II Community Survey

1. Selection of communities

The coverage of the survey is all wards in five municipalities (Kathmandu, Kirtipur, Lalitpur, Bhaktapur and Madhyapur Thimi municipalities) in central Kathmandu valley. The social mobilizer in each ward was asked to select two communities: the most water scarce community and the typical community in terms of water scarcity in within the word. Contact address of the selected communities were provided by social mobilizer. Interview was conducted to each community leaders. Table II-1 to II 5 show the names of communities surveyed.

Table II-1 Typical and most water scarce communities in Wards in Kathmandu municipality

Ward No.	Most water scarce community	Typical community
1	JYAPU TOL	GAURIDHARA
2	GAURIDHARA	MATHILLO KHUSANTAR
3	BANSBARI	JANA MARGA
4	LAMTANGAIN	DHUMBARAHI HEIGHT
5	BHATBHATENI	HADIGAUN
6	SIMALTAR	TINCHULI
7	CHABAHIL CHOWK	MAIJU BAHAL
8	TILGANGA	GUHESHOWRI
9	SINAMANGAL	BIJAYA CHOK
10	SAHABHAGI MARGA	LAKHECHAUR
11	THAPATHALI	TRIPURESHOR
12	MUSUM BAHAL	HYUMAT
13	GANYODAYA MARGA	NILBARAHI
14	GODAR GAUN	LAMPATI
15	BIJESHORI	KHUTE SALLA
16	GORATAR	NERAHITY
17	KHUSIBU	DHOBICHAUR
18	NARADEVI	MARU
19	YATKHA	MARU DHOKA
20	RAMGHAT AREA	SIGHANANI
21	BHOTEBAHAL	LAGAN
22	RANJANA GALLI	TEBAHAL
23	BALAMBU CHOWK	OM BAHAL
24	KILAGAL	NARADEVI
25	SUCHIKAR GALLI	TANGAL
26	TAHARA MARG	MAITI
27	ASON	JYATHA
28	ICHHUMATI GALLI	SAHID SUKRA MARGA
29	GHATTEKULO	KALIKASTHAN
30	BHAIRAB THAN	MAITIDEVI
31	JAGRITI NAGAR	DEURALI CLUB
32	JADIBUTI	KOTESHOR

Table II-2 Typical and most water scarce communities in Wards in Kirtipur municipality

Ward No.	Most water scarce community	Typical community
1	WHAKANCHA	KHAMBAHAL
2	GACHI	DEUDHOKA
3	LUMANTI	KHASIBAZAR
4	GMACHA	DUDHPOKHARI
5	BHUSAL TOL	DIUKHEL
6	CHOBHAR DANDA	JALBINAYAK
7	BHAJANGAL	ITAGOL
8	DHOKASI	NANGKHWA
9	SAMEG TOLE	NAGAUN
10	ITACHHEIN	JIFAGAL

Table II-3 Typical and most water scarce communities in Wards in Lalitpur municipality

Ward No.	Most water scarce community	Typical community
1	GUSINGAL	KUMARI TOLE
2	SANEPA HEIGHT	RAJTIRTHA
3	SHANTI BASTI	PULCHOWK
4	BAGDOLE	JAWALAKHEL
5	THASIKHEL	DAKSHIN THASIKHEL
6	OKUBAHAL	KANIBAHAL
7	PILACHHEIN	MAIN SADAK
8	LOLA	GUITOL
9	BHOL DHOKA	KHAPINSE
10	JWAGAL	KUPANDOLE
11	TANANI	MALIDO
12	CHABAHAL	CHOCHHE
13	KUSUNTI HEIGHT	DIBYANAGAR
14	SHIVA CHOWK	THASIKHEL
15	KHUMALTAR	DEEPAWALI MARGA
16	DAUBAHAL	NAGBAHAL
17	SUNDHARA	HAKTOL
T18	BAHUN GAUN	KHADGA GAUN
19	TECHHU GALI	KUMARIPATI
20	PURNA CHANDI	KHWABAHIL
21	DHOKASHI	KHOKANA
22	CHUNIKHEL	BUNGMATI
23	DHAPAKHEL	JHOCHEIN
24	BHIMSEN PIPALBOT	DHAPAKHEL
25	NAKHUTOLE	SAINBU
26	CHIBAHAL	DOLAHITI
27	CHOKIBA TOLE	SUNAKOTHI
28	SAPHAL TOLE	HARISIDDHI KANIKHEL
29	LAKHAPUKHU	HARISIDDHI

Table II-4 Typical and most water scarce communities in Wards in Bhaktapur municipality

Ward No.	Most water scarce community	Typical community
1	DUDHPATI	SALLAGHARI
2	ITTACHEIN	KHAWMW
3	BANSAGOPAL	BARAHISTHAN
4	LAABUCHHE	THUCHO
5	SUKUDHOKA	TAUMADI
6	BALACHHEIN	LALACHHEIN
7	CHORCHA	GOLMADI
8	LIWALI	JENLA
9	BRAMHAYANI	SURYAMADI
10	NASCHA	MULDHOKA

Table II-5 Typical and most water scarce communities in Wards in Madhyapur Thimi municipality

Ward No.	Most water scarce community	Typical community
1	SHIVANAGAR	SARASWOTINAGAR
2	JATIGAL	MAGARGAUN
3	GANESH AREA	ACHARYA TOLE
4	DUIPOKHARI	DATHUTOLE
5	KAMEROTAR	POBU
6	KUNDAL TOLE	PACHO
7	MAHAKHELTOLE	PUKUSHITOLE
8	BISHNUGHAT	KHAPALA
9	TIGANANI	TARANTOLE

2. Survey period

The survey was conducted from August to October 2017 by SEN researchers or enumerators hired by SEN.

3. Questionnaire

Basic procedure and guidelines are same as the household survey shown PART I. However, signed consent forms were not collected and questionnaire was not translated to Nepali. Questionnaire was shown in Appendix VII. Questionnaire consists of the questions on

(1) Residents: population and economic status
(2) Current household water system in the tole or community: Major drinking water sources, Use of various water sources, purpose, perceived quality, in-house treatment
(3) Community involvement in water management
(4) Health information of community

4. Data entry and analysis

Data was entered by using EpiData (Version 3.1) Software, converted to SPSS data file and then

exported to EXCEL file. Data were compiled to the GIS data set and maps were created. Figure II-1 shows the maps on main drinking water source (primary and secondary) and the maps indicated in Table II-6 are available at present.

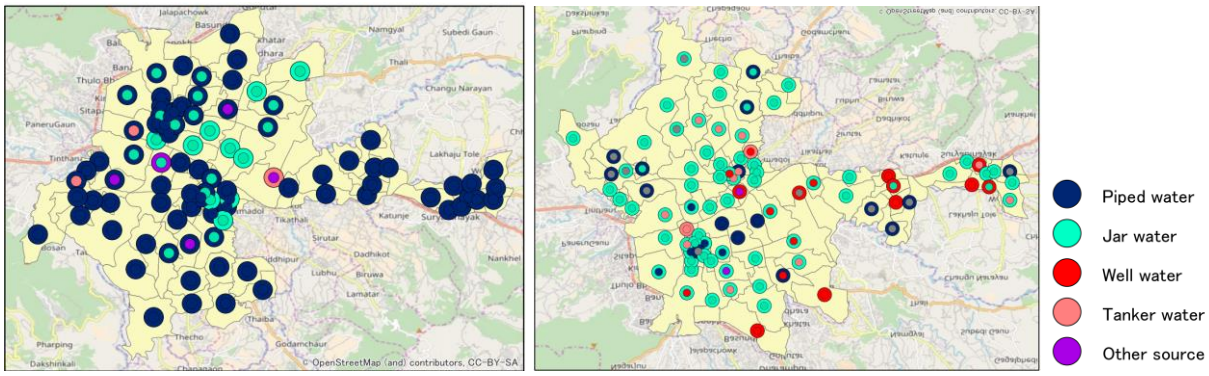


Figure II-1 Drinking water sources (Left: main, right: secondary source). Larger circle indicates the typical community, smaller circle indicates the most water scarce community in each ward.

Table II-6 Available maps

Drinking water source	Primary Secondary
KUKL connection	
KUKL supply hours per week	
Well water use	All purpose For drinking and cooking
Well water quality	Taste Smell Color Turbidity
Tanker water use	All purpose For drinking and cooking
Tanker water quality	Taste Smell Color Turbidity
Priority of LCD introduction	

Appendix I

Table 1. Geographical landmark, ward no. and location for clusters

SN	Municipality	Ward no.	Geographical landmark	Location
1	Kathmandu	2	Nil Saraswoti Mandir, Lajimpat	Lazimpat
2	Kathmandu	3	Shahid Gangalal National Heart Center, Bansbari	Bansbari
3	Kathmandu	3	Hotel Seto Gurans Resturant & Bar, Thirbam Sadak	Maharajgunj
4	Kathmandu	4	Dhumbarahi Temple, Baraha Marga	Dhumbarahi
5	Kathmandu	4	Alpine Valley School, Rajpath Marg, Near Chappal Karkhana	Chappalkarkhana
6	Kathmandu	4	Gunraj Pathak Memorial Nursing Campus, Bishal Nagar	Baluwataar
7	Kathmandu	6	Boudhanath Stupa	Boudha
8	Kathmandu	6	Bal Srijana Boarding School, Jorpati	Tinchuli
9	Kathmandu	7	Sagarmatha Vidya Mandir, Gaurighat Marg	Gaurighat
10	Kathmandu	8	Kathmandu International School, Pashupati Nath Road	Kharibot
11	Kathmandu	9	Praphutan International Academy, Sinamangal	Sinamangal, Battisputali
12	Kathmandu	10	KMC School, Shankamool Marg	Shankamul
13	Kathmandu	10	New Summit College, Basuki marga, Devkota Sadak	New Baneshwor
14	Kathmandu	11	St. Xavier College, Thapathali	Thapathali
15	Kathmandu	12	Sukra Raj Tropical and Infectious disease Hospital, Teku	Teku
16	Kathmandu	13	Kathmandu Engineering College, Ganeshman Singh Path, Kalimati	Kalimati
17	Kathmandu	14	Amarjyoti English Boarding School, Kalanki	Kalanki
18	Kathmandu	14	Green Lawns Academy, Balkhu	Balkhu
19	Kathmandu	15	Arunodaya Academy Higher Secondary School, Soyambhu	Shoyambhu
20	Kathmandu	18	Chettrapati	Chettrapati
21	Kathmandu	16	Balaju Park	Balalu Park
22	Kathmandu	16	Bajeko Sekuwa Corner, Sorahkhutte	Sorakhutte
23	Kathmandu	17	Saraswoti Boarding School, Paknajol	Paknajol
24	Kathmandu	19	Suraj Arcade, Sidhidas Marg, Indra Chowk	Yatkha
25	Kathmandu	21	Dewy dawn high school, near China Town, Bhote Bahal	Bhotebahal
26	Kathmandu	22	Nirmal Vidyapeath, Secondary School, Pukhuddha Marg, Pako road - near RB complex	Newroadh

SN	Municipality	Ward no.	Geographical landmark	Location
27	Kathmandu	26	Lumbini Bank, Indrachowk	Killagal/Bhedasingh
28	Kathmandu	29	Greenland School, Tokha	Samakhusi town planning
29	Kathmandu	29	Ambassador Hotel, Lainchaur	Launchar
30	Kathmandu	31	Opposite to Padma Kanya Campur and Behind Shrestha tailoring, Baagbajar	Bagbazzar
31	Kathmandu	32	Kalikasthan Mandir or Planitum Management College, Putali Sadak	Putalisadak
32	Kathmandu	32	Madan Bhandari Memorial College, Shanti Binayak Marga Dhobikhola	Anamnagar
33	Kathmandu	33	Welcare Hospital and Research Center, Pashupati Road, Gyaneshowr	Ratopul
34	Kathmandu	34	Katyani Mandir, Milan Chowk marga	Katyani
35	Kathmandu	34	NK Singh Memorial English Preparatory High School, NK Singh Marga	NK singh
36	Kathmandu	34	IFCD, Shrinkhala Galli	Minbhawan
37	Kathmandu	35	Oriental Academy School, Gandnayak Marga	Koteshowr
38	Kathmandu	35	AIMS International Academy	Jadibuti
39	Kathmandu	35	Nexus Academy	Pepsicola
40	Kirtipur	7	Shitalbasti/Chhugaon	Shitalbasti/Chhugaon
41	Kirtipur	16	Rarahil Memorial School, Kirtipur	Chugawn
42	Lalitpur	2	Shining Star Boarding School, Sanepal, Lalitpur	Sanepa
43	Lalitpur	5	Patan Hospital, Lagankhel	Lagankhel
44	Lalitpur	9	Himalayan College of Engineering, Lalitpur	Chyasal
45	Lalitpur	13	Machhapurchre International School, Damodar Marg	Ekantakuna
46	Lalitpur	15	Backside of NAST Research Center, Khumaltaar	Khumaltaar
47	Lalitpur	14	Kumaripati, Lalitpur	Kumaripati
48	Madhyapur	2	Pragati Secondary School	Sano Thimi
49	Madhyapur	10	Municipal office, Chapacho	Chapacho
50	Madhyapur	16	Tristar English Secondary School, Near Santosh drug house	Lokanthali

Appendix II (a)

INFORMED CONSENT

Evaluating impact of new water supply and water treatment system on health and socio-economic status in Kathmandu Valley: A population-based study

Water scarcity and polluted water are two major water problems in the Kathmandu Valley. Insufficient water quantity has forced the residents to use alternative water sources such as groundwater, rainwater, bottled or jar water, vendors' water, stone spout water, rainwater etc. Most of these water sources are polluted with fecal contamination and household storage of water elevated the contamination. Diarrhoea and other waterborne diseases are very prevalent in the Kathmandu Valley. And, there were few researches which showed that poor availability and poor quality of water is affecting health of the valley residents. The government of Nepal is soon implementing Melamchi Water Supply Project (MWSP), which will increase amount of water supplied in the valley, with an objective to improve health and well-being of people in the valley. In addition, International Research Centre for River Basin Environment (ICRE) of University of Yamanashi (UY) will soon initiate "Hydro-microbiological approach for water security in Kathmandu Valley" project which will integrate newly developed water treatment system in Kathmandu Upatyaka Khanepani Limited's (KUKL) water treatment systems. We want to evaluate the impact of the MWSP and UY projects on health and socio-economic in the valley.

The research group is composed of members of University of Yamanashi, Japan. We are asking you to answer some questionnaires. In order to protect your privacy, we will not keep your name with the information you have told us, while we analyze it. You will help us to analyze the impact of such big projects on health and socio-economic condition of households in the valley. You are free to take part in this study. No penalty or benefit loss will occur if you refuse to take part. You may freely withdraw from the study at any time.

Consents and Signature

I agree that I will join in this international research project regarding the health and socio-economic conditions of people living in the Kathmandu Valley, "Evaluating impact of new water supply and water treatment system on health and socio-economic status in Kathmandu Valley: A population-based study". I have been fully explained about the research purpose, methods, freedom for cancellation of this agreement, and privacy protection by Prof. Futaba Kazama of University of Yamanashi, Japan and her colleagues. I know that giving information for this study is my own choice.

Name:…….

Date:……..

Signature:……..

Appendix II (b)

मञ्जुरीनामा पत्र

नयाँ पानी वितरण तथा प्रशोधन प्रणालीको काठमाण्डौं उपत्यकामा बसोबास गर्ने व्यक्तिहरुको स्वास्थ्य तथा आर्थिक स्थितिमा पर्ने असर सम्बन्धी अध्ययन

पानीको अभाव र संक्रमण काठमाण्डौं उपत्यकामा देखिएका दुइ गंभिर पानी संग सम्बन्धीत समस्याहरु हुन । पानीको अभावका कारण यहाँका मानिसहरु अन्य विभिन्न संक्रमणयुक्त पानीका अतिरिक्त श्रोतहरुमा निर्भर हुन बाध्य छन र पछिल्ला सोधहरुका अनुसार केयुकेलबाट वितरीत पानी तथा ती अतिरिक्त श्रोतहरुमा ढल मिसिएको हुन सक्ने प्रबल संभावना रहेको छ । काठमाण्डौं उपत्यकामा झाडा पखाला तथा अन्य पानीका माध्यमबाट सर्ने रोगहरुको संक्रमण धेरै तादातमा र निरन्तर देखिँदै आएको छ । विशेषत काठमाण्डौं उपत्यकामा पानीको अभाव र संक्रमणको झाडा पखालासंगको सम्बंन्ध पुष्टि गर्ने सोध पत्रहरुमा खासै जोड दिइएको पाइएको छैन । काठमाण्डौं उपत्यका बासीहरुको स्वास्थ्यमा सुधार गर्न पानी वितरणलाइ सहज गर्ने हेतुले नेपाल सरकारले मेलम्ची खानेपानी परियोजनाको थालनी गरेकोछ । यसै गरी जापानको यामानाशी विश्वविद्यालयद्धारा शुद्ध पानी वितरण गर्ने मनसायले पानी प्रशोधन परियोजनाको थालनी गरीएकोछ । यसैकारण यी दुबै परियोजनाहरु लागूभए पछि यी परियोजनाहरुले काठमाण्डौं उपत्यकामा बसोबास गर्ने व्यक्तिहरुको स्वास्थ्य तथा आर्थिक स्थितिमा पर्ने असर सम्बन्धी अध्ययन गर्ने उदेश्य यो अध्ययनले लिएकोछ ।

यो अनुसन्धान टोलीमा जापानको यामानाशी बिश्वबिद्यालयका सदस्यहरु रहेका छन् । हामी तपाईसँग केहि प्रश्न सोध्नेछौ । हामी तपाईको गोप्यता सुरक्षित राख्नेछौ । अध्ययनको क्रममा तपाईको नाम सार्वजनिक गरिने छैन । तर तपाईको इच्छा भएमा हामीलाई यस अध्ययनमा मद्धत गर्न सक्नुहुनेछ । तपाई यस अध्ययनमा भाग लिन वा नलिन स्वतन्त्र हुनुहुन्छ । तपाईले भाग लिन अस्विकार गर्नुभएमा पनि कुनै दण्ड वा नोक्सानी हुनेछैन । यो अध्ययनबाट आफ्नो सहभागिता जुनसुकै समयमा पनि स्वतन्त्र रुपमा छोड्न सक्नुहुनेछ ।

स्वीकृति र दस्तखत

नयाँ पानी वितरण तथा प्रशोधन प्रणालीको काठमाण्डौं उपत्यकामा बसोबास गर्ने व्यक्तिहरुको स्वास्थ्य तथा आर्थिक स्थितिमा पर्ने असर सम्बन्धी अध्ययनमा म सहभागी हुन मन्जूर गर्दछु । जापानको यामानाशी बिश्वबिद्यालयका प्राध्यापक फुतावा काजामा र उहाका साथीहरुले यस अनुसन्धानको ऊद्देश्य, तरिका, सम्झौता खारेज गर्नसक्ने स्वतन्त्रता र गोप्यताको बारेमा मलाई पूर्ण जानकारी गराउनुभएको छ । यो अध्ययनको लागि जानकारी दिने मेरो आफ्नो छनौट हो भन्ने कुरासँग म राम्रोसँग अवगत छु ।

नाम:-.....

मिति:-.....

दस्तखत :-.....

Appendix III (a)

Retraction of the Agreement

Although I agreed that I participate in the international research project regarding the health and socio-economic conditions of people living in the Kathmandu Valley, "Evaluating impact of new water supply and water treatment system on health and socio-economic status in Kathmandu Valley: A population-based study", I here-in retract the agreement.

Name_____

Date_____

Signature_____

Appendix III (b)

सम्झौताको खारेजी

नयाँ पानी वितरण तथा प्रशोधन प्रणालीको काठमाण्डौं उपत्यकामा बसोबास गर्ने व्यक्तिहरुको स्वास्थ्य तथा आर्थिक स्थितिमा पर्ने असर सम्बन्धी अध्ययनमा सहभागी हुन मैले सम्झौता गरे पनि म यो सम्झौता खारेज गर्दछु ।

नाम.....

मिति.....

दस्तखत.....

ID:

Appendix IV (a)

Water supply, sanitation and health status of households in Kathmandu Valley (Phase I)

1. Personal Information

(1) Name: ☐ Female ☐Male

(2)Address: ……..District …….Village ……. Ward ……..Tole

(3) Phone number: ……

(4)Age: ……Year

(5) Ethnicity: ☐ Bramhan ☐Chettri ☐ Janajati ☐ Dalit ☐ Other ( ) ☐ Don't want to disclose

(6) Are you Ownership of the house? ☐ Owner ☐ Tenant

(7) How many households in the house? _____ households

(8) How many persons in your family? _____ persons

(9) Please tell us your Household member

S.N.	A. Member's position	B. Last educational attainment	C. Occupation
1.	Household head	Illiterate	Agriculture
2.	Household's wife/husband	No formal school	Business
3.	Father/Mother of household head or wife	Primary school (1-5 classes)	Skilled manual labour
4.	Child of household head	Lower secondary (6-8 classes)	Unskilled manual labour
5.	Brother/Sister of household head or wife	Secondary (9-10 classes)	Service
6.	Others……	Upper secondary (10-12 classes)	Remittance
7.		College/ University	Student
8.		Do not want to disclose	Other

☑for interviewee	Member position[A)]	Age	Sex (M/F)	Last educational attainment[B)]	Occupation[C]
1 ☐					
2 ☐					
3 ☐					
4 ☐					
5 ☐					
6 ☐					

7 ☐					
8 ☐					
9 ☐					
10 ☐					

2. Current health status of your household member

1. In the last two weeks, have you or your household members had any physical symptoms?

☐ No ☐ Yes, if, yes which members of household have?

Member in position	Health symptoms	Health symptoms number*
		1. Headache
		2. Fever
		3. Cold
		4. Nausea/ Vomiting
		5. Stomach Pain
		6. Back Pain
		7. Skin disease (scabies)
		8. Eye disease (Trachoma)
		9. Typhoid
		10. Other (…….)

2. Did you or your family get diarrhoea (three or more loose or liquid stools per day) in the last two weeks?

☐ NO → Go to Q6

☐ YES → Which member and how many times?

Member	Times

3. Did you and your household member seek advice or treatment for the diarrhoeal diseases, typhoid, trachoma, or scabies of member under/over 10 years old from any source?

Under 10 yrs.: ☐ YES ☐ NO Over 10 yrs.: ☐ YES ☐ NO

4. If YES, where and how often did you and your household member seek advice or treatment?

	Times・Persons	
	Under 10 years old	Over 10 years old
☐ Hospital/Clinic		
☐ Government health center		
☐ Private doctor		
☐ Pharmacy		
☐ Others (Specify)		

5. How much did you and your household member pay for the advice or treatment in the last two weeks?

   NRs……..per month

6. Have you or your household member were given any drug for intestinal worms in the last six months (including any deworming)

☐ YES ☐ NO

3. Your household water system

1. Does your house connect piped water?

☐ YES ☐ NO → Go to Q13

2. How many hours does the piped water supply in a day or week now?

( ) Hours ☐ per Day , ☐ per Week

3. Do you store piped water in your house?

☐ No, I do not

☐ Yes, I stored in: ☐ Tank on the roof ☐ Tank underground

☐ Vessels ☐ Other ( )

4. How much amount of piped water do you consume in a day/ week/ month?

( ) Liter ☐ per Day ☐ per Week ☐ per Month

5. What is the purpose of using piped water? Please tick all that apply.

☐ Drinking ☐ Cooking ☐ Bathing ☐ Laundry ☐ Cleaning

☐ Gardening ☐ Other (Specify)

6. How much do you pay for piped water supply in a day/ week/ month?

( ) NPR ☐ per Day, ☐ per Week, ☐ per Month

7. Do you have a well in your yard/compound?

☐ YES ☐ YES, but dried → Go to Q17 ☐ NO→ Go to Q11Q

8. How much amount of well water do you consume in a day/ week/ month?

( ) Liter ☐ per Day ☐ per Week ☐ per Month

9. Do you store well water in your house?

☐ No, I do not

☐ Yes, I stored in: ☐ Tank on the roof ☐ Tank under the floor

☐ Vessels ☐ Other ( )

10. What is the purpose of using water from well? Please tick all that apply.

☐ Drinking ☐ Cooking ☐ Bathing ☐ Laundry ☐ Cleaning

☐ Gardening ☐ Other (Specify)

11. Do you collect rain water for domestic use?

☐ YES ☐ NO → Go to Q21

12. How much amount of rain water do you consume in a day/ week/ month?

( ) Liter ☐ per Day ☐ per Week ☐ per Month

13. Do you store rain water in your house?

☐ No, I do not

☐ Yes, I stored in: ☐ Tank on the roof ☐ Tank under the floor

☐ Vessels ☐ Other ( )

14. What is the purpose of using rain water? Please tick all that apply.

☐ Drinking ☐ Cooking ☐ Bathing ☐ Laundry ☐ Cleaning

☐ Gardening ☐ Other (Specify)

15. Does your family buy water for domestic use? If yes, how frequently and how much do you pay for per time?

☐ YES ☐ No → Go to Q16

Source	Frequency	Payment	Purpose
Bottled or Jar water	☐Everyday ☐ ( )times per week ☐ ( )times per month	( ) NPR/per time	☐Drinking ☐Cooking ☐Bathing ☐Laundry ☐Cleaning ☐Gardening ☐Other (Specify)
Tanker-truck	☐Everyday ☐ ( )times per week ☐ ( )times per month	( ) NPR/per time	☐Drinking ☐Cooking ☐Bathing ☐Laundry ☐Cleaning ☐Gardening ☐Other (Specify)

16. Do you collect the water? How much water and how many times do you collect water in a day/week/ month? And what is the purpose of using collecting water? Please tick all that apply.

Source	Litre	Times	Per	Purpose
☐Neighbour's piped water			☐ Day ☐ Week ☐ Month	☐Drinking ☐Cooking ☐Bathing ☐Laundry ☐Cleaning ☐ Gardening ☐Other (Specify)
☐ Neighbour's well			☐ Day ☐ Week ☐ Month	☐Drinking ☐Cooking ☐Bathing ☐Laundry ☐Cleaning ☐ Gardening ☐Other (Specify)
☐Tanker-truck			☐ Day ☐ Week ☐ Month	☐Drinking ☐Cooking ☐Bathing ☐Laundry ☐Cleaning ☐ Gardening ☐Other (Specify)
☐River/Lake/ Ponds			☐ Day ☐ Week ☐ Month	☐Drinking ☐Cooking ☐Bathing ☐Laundry ☐Cleaning ☐ Gardening ☐Other (Specify)
☐Bottled or Jar water			☐ Day ☐ Week	☐Drinking ☐Cooking ☐Bathing ☐Laundry ☐Cleaning ☐

			☐ Month	Gardening ☐Other (Specify)
☐Public well			☐ Day ☐ Week ☐ Month	☐Drinking ☐Cooking ☐Bathing ☐Laundry ☐Cleaning ☐ Gardening ☐Other (Specify)
☐ Spring			☐ Day ☐ Week ☐ Month	☐Drinking ☐Cooking ☐Bathing ☐Laundry ☐Cleaning ☐ Gardening ☐Other (Specify)
☐ Stone spout			☐ Day ☐ Week ☐ Month	☐Drinking ☐Cooking ☐Bathing ☐Laundry ☐Cleaning ☐ Gardening ☐Other (Specify)
☐ Other ( )			☐ Day ☐ Week ☐ Month	☐Drinking ☐Cooking ☐Bathing ☐Laundry ☐Cleaning ☐ Gardening ☐Other (Specify)

17. How long does it take to go there, get water, and come back per time?

☐ ( ) Minutes per time

☐ I do not know

18. Mainly, who collect and manage domestic water in your house?

☐ Adult women ☐ Adult men ☐ Female child (under 15 years)

☐ Male child (under 15 years) ☐ Other (specify)

19. Do you treat water? Please tick all that apply.

For	With
☐ Drinking	☐ Filtering ☐ Boiling ☐ Euro-guard ☐ Chlorine/Alum/Potash ☐ Domestic treatment plant ☐ Other ( ) ☐ No treatment
☐ Cooking	☐ Filtering ☐ Boiling ☐ Euro-guard ☐ Chlorine/Alum/Potash ☐ Domestic treatment plant ☐ Other ( ) ☐ No treatment
☐ Washing vegetable and fruits	☐ Filtering ☐ Boiling ☐ Euro-guard ☐ Chlorine/Alum/Potash ☐ Domestic treatment plant ☐ Other ( ) ☐ No treatment
☐Brushing teeth / washing mouth	☐ Filtering ☐ Boiling ☐ Euro-guard ☐ Chlorine/Alum/Potash ☐ Domestic treatment plant ☐ Other ( ) ☐ No treatment
☐Bathing	☐ Filtering ☐ Boiling ☐ Euro-guard ☐ Chlorine/Alum/Potash ☐ Domestic treatment plant ☐ Other ( ) ☐ No treatment

20. How much water did your family consumed for following purposes in past 5 days?

Day/Purpose	Drinking (L)	Cooking (L)	Laundry (L)	Bathing (L)	Dish cleaning (L)	Toilet (L)	Gardening (L)	Cleaning (L)
1 day before								
2 day before								
3 day before								
4 day before								
5 day before								

21. What kind of toilet facility do members of your household usually use?

☐ Flush to piped sewer ☐ Flush to septic tank/ pit

☐ Flush to somewhere ☐ Pit latrine ☐ Public toilet

☐ No facility/ Bush/ Open space ☐ Other (Specify)

22. How much are you willing to pay for clean water in a day/ week/ month?

( ) NRs ☐ per day ☐ per week ☐ per Month

23. How frequently do you clean water stored containers?

☐ Every day ☐ ( ) time per week ☐ ( ) time per month ☐ Never

24. How many liters of water do you drink from following sources per day?

(1) Piped water …… L (2) Jar water …… L

(3) Tanker water …… L (4) Stone spout …… L

(5) Groundwater …… L

25. Do you treat following water sources for drinking purposes?

Sources	With
Piped water	☐ Filtering ☐ Boiling ☐ Euro-guard ☐ Chlorine/Alum/Potash ☐ Domestic treatment plant ☐ Other ( ) ☐ No treatment
Jar water	☐ Filtering ☐ Boiling ☐ Euro-guard ☐ Chlorine/Alum/Potash ☐ Domestic treatment plant ☐ Other ( ) ☐ No treatment
Tanker water	☐ Filtering ☐ Boiling ☐ Euro-guard ☐ Chlorine/Alum/Potash ☐ Domestic treatment plant ☐ Other ( ) ☐ No treatment
Stone spout	☐ Filtering ☐ Boiling ☐ Euro-guard ☐ Chlorine/Alum/Potash ☐ Domestic treatment plant ☐ Other ( ) ☐ No treatment
Groundwater	☐ Filtering ☐ Boiling ☐ Euro-guard ☐ Chlorine/Alum/Potash ☐ Domestic treatment plant ☐ Other ( ) ☐ No treatment

26. How have you experienced the water related issues in the past 30 days? Please tell us the closest feeling, not just how you feel today.

(1) I worry about my household would not collect less amount of water than needed

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(2) My household could not use safe drinking water

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(3) My household use poor quality of water (e.g. colored water/ smelled water)

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(4) My house could not clean enough

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(5) My household collected water from an undesirable / dirty source

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(6) I took long time for water collection

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(7) I dispute with neighbour/tenant/owner due to water

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(8) I dispute with family members due to water

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(9) I and my family reduced time for daily work/ income generating activities due to water collection

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(10) My children reduced time for studies or missed school due to water collection

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(11) My household paid much money to buy safe water

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(12) I and my family members could not participate in any social activities such as wedding/occasions/festivals due to water collection

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(13) I and my family members slept very few hours because of water collection

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(14) I and my family members cook undesirable food because there was not enough water

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(15) I and my family members have health problems/weakeness/tiredness because of water collection

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

4. Your hygiene behaviour

1. Do you wash your hands before preparing meal?

☐ Yes, always with running water with soap ☐ Yes, always with running water

☐ Yes, always with stored water ☐ Yes, Sometimes ☐ Never

2. Do you wash your hands after toilet?

☐ Yes, always with running water with soap ☐ Yes, always with running water

☐ Yes, always with stored water ☐ Yes, Sometimes ☐ Never

3. How often do you take a bath/a shower in a week?

( ) times per Week

5. Economic status of household

1. In your household, what do you have?

Electricity	☐ YES ☐ NO	Radio	☐ YES ☐ NO
Television	☐ YES ☐ NO	Mobile phone	☐ YES ☐ NO
Land phone	☐ YES ☐ NO	Refrigerator	☐ YES ☐ NO
Bicycle	☐ YES ☐ NO	Motor bike	☐ YES ☐ NO
Car	☐ YES ☐ NO	Computer	☐ YES ☐ NO
Fan	☐ YES ☐ NO	Kerosene stove	☐ YES ☐ NO
Electric stove	☐ YES ☐ NO	Gas stove	☐ YES ☐ NO
Domestic servant	☐ YES ☐ NO	Invertor	☐ YES ☐ NO

2. How much do you expense in the last month? ( ) NRP/month.

Thank you very much for your cooperation!!

ID no. ……..

Name of interviewer: …….. Date of interview: ……

Second section

1. Gender: ☐ Male ☐ Female
2. Age: ……Years
3. Caste:
4. Religion: ☐ Hindu ☐ Muslim ☐ Buddhist ☐ Others
5. Marital status: ☐ Single ☐ Separated / Married / Divorced ☐ Widowed
6. Education status: ☐ None at all ☐ Primary school ☐ Secondary school ☐ Tertiary
7. Are you currently ill? ☐ Yes ☐ No

   If something is wrong with your health what do you think it is?

   _____illness/ problem

Please read each question, assess your feelings of last weeks, and circle the number on the scale for each question that gives the best answer for you.						
QN	**Statement**	**Please circle in any one of the following options**				
1	How would you rate your quality of life?	Very poor	Poor	Neither poor nor good	Good	Very good
2	How satisfied are you with your health?	Very poor	Poor	Neither poor nor good	Good	Very good
3	To what extent do you feel that physical pain prevents you from doing what you need to do?	Not at all	A little	A moderate Amount	Very much	An extreme Amount
4	How much do you need any medical treatment to function in your daily life?	Not at all	A little	A moderate Amount	Very much	An extreme Amount
5	How much do you enjoy life?	Not at all	A little	A moderate Amount	Very much	An extreme Amount
6	To what extent do you feel your life to be meaningful?	Not at all	A little	A moderate Amount	Very much	An extreme Amount
7	How well are you able to concentrate?	Not at all	A little	A moderate Amount	Very much	An extreme Amount
8	How safe do you feel in your daily life?	Not at all	A little	A moderate Amount	Very much	An extreme Amount
9	How healthy is your physical environment?	Not at all	A little	A moderate Amount	Very much	An extreme Amount
10	Do you have enough energy for everyday life?	Not at all	A little	Moderately	Mostly	Completely
11	Are you able to accept your bodily appearance?	Not at all	A little	Moderately	Mostly	Completely
12	Have you enough money to meet your needs?	Not at all	A little	Moderately	Mostly	Completely
13	How available to you is the information that you need in your day-to-day life?	Not at all	A little	Moderately	Mostly	Completely
14	To what extent do you have the opportunity for leisure activities?	Not at all	A little	Moderately	Mostly	Completely
15	How well are you able to get around?	Very poor	Poor	Neither	Good	Very good
16	How satisfied are you with your sleep?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
17	How satisfied are you with your ability to perform your daily living activities?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
18	How satisfied are you with your capacity for work?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied

19	How satisfied are you with yourself?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
20	How satisfied are you with your personal relationships?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
21	How satisfied are you with your sex life?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
22	How satisfied are you with the support you get from your friends?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
23	How satisfied are you with the conditions of your living place?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
24	How satisfied are you with your access to health services?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
25	How satisfied are you with your transport?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
26	How often do you have negative feelings such as blue mood, despair, anxiety, depression?	Never	Seldom	Quite often	Very often	Always

ID:

Appendix V

Water supply, sanitation and health status of households in Kathmandu Valley-Phase II

1. Personal Information

Name:…….. □ Male □ Female

Age:…….years

Address: ……District……..Village……Ward……Tole

Phone no……

2. Current health status of your household member

1. Did you or your household members had any physical symptoms?

If, yes which members of household have? (Please check all that apply).

□ No, nobody has

□ Yes,

Member in position	Symptoms number*

***Symptoms and diseases:** 1. Headache 2. Fever 3. Cold 4. Nausea/ Vomiting 5. Stomach Pain 6. Back Pain 7. Skin disease (scabies) 8. Eye disease (Trachoma) 9. Typhoid (high fever and rose spots on the chest) 10. Other ( )

2. Did you or your family get diarrhoea (three or more loose or liquid stools per day) in the last two weeks?

□ NO → Go to Q6

□ YES → Which member and how many times?

Member	Times

3. Did you and your household member seek advice or treatment for the diarrhoeal diseases, typhoid, trachoma, or scabies of member under/over 10 years old from any source?

Under 10 yrs.: □ NO □ YES Over 10 yrs.: □ NO □ YES

4. If YES, where and how often did you and your household member seek advice or treatment?

	Times・Persons	
	Under 10 years old	Over 10 years old
□ Hospital/Clinic		
□ Government health center		
□ Private doctor		
□ Pharmacy		
□ Others (Specify)		

5. How much did you and your household member pay for the advice or treatment in the last two weeks? NRs. ( ) per month

6. Have you or your household member were given any drug for intestinal worms in the last six months (including any deworming)?

☐ NO ☐ YES

3. Your household water system during and after earthquake

Piped water

7. Does your house have piped water connection?

☐ NO → Go to Q14 ☐ YES

8. **During one-month after earthquake**, what was the piped water availability?

☐ No water (For……days) ☐ Less water but same quality

☐ Less water and poor quality ☐ Same quantity and poor quality

☐ Same as before earthquake ☐ Others (Specify…….)

9. How many hours does the piped water supply in a day or week **now**?

( ) Hours ☐ per Day , ☐ per Week

10. Do you store piped water in your house **now**?

☐ No, I do not

☐ Yes, I stored in: ☐ Tank on the roof ☐ Tank under ground

☐ Vessels ☐ Other (Specify)

11. How much amount of piped water do you consume in a day/ week/ month**, now**?

( ) Liter ☐ per Day ☐ per Week ☐ per Month

12. What is the purpose of using piped water? Please tick all that apply.

☐ Drinking ☐ Cooking ☐ Bathing ☐ Laundry ☐ Cleaning

☐ Gardening ☐ Other (Specify)

13. How much do you pay for piped water supply in a day/ week/ month?

NRs. ( ) ☐ per Day, ☐ per Week, ☐ per Month

Well water

14. Do you have a well in your yard/compound?

☐ NO→ Go to Q19 ☐ YES, but dried → Go to Q19 ☐ YES

15. **During one-month after earthquake** how was the water availability in well (dug/tube)?

☐ No water (For……days) ☐ Less water but same quality

☐ Less water and poor quality ☐ Same quantity and poor quality

☐ Same as before earthquake ☐ Others (Specify…….)

16. How much amount of well water do you consume in a day/ week/ month now?

( ) Liter ☐ per Day ☐ per Week ☐ per Month

17. Do you store well water in your house?

☐ No, I do not

☐ Yes, I stored in: ☐ Tank on the roof ☐ Tank under ground

☐ Vessels ☐ Other ( )

18. What is the purpose of using water from well, **now**? Please tick all that apply.

☐ Drinking ☐ Cooking ☐ Bathing ☐ Laundry ☐ Cleaning

☐ Gardening ☐ Other (Specify)

Rainwater

19. Do you collect rain water for domestic use **after the earthquake**?

☐ NO → Go to Q23 ☐ YES

20. Do you store rain water in your house?

☐ No, I do not

☐ Yes, I stored in: ☐ Tank on the roof ☐ Tank under ground

☐ Vessels ☐ Other (Specify)

21. How much amount of rain water do you consume in a day/ week/ month?

( ) Liter ☐ per Day ☐ per Week ☐ per Month

22. What is the purpose of using rain water? Please tick all that apply.

☐ Drinking ☐ Cooking ☐ Bathing ☐ Laundry ☐ Cleaning

☐ Gardening ☐ Other (Specify)

Water storage

23. Did you have stored water **during one-month after earthquake**?

☐ NO → Go to Q28 ☐ YES

24. Where you had stored that water?

☐Overhead tank ☐ Underground (☐ cement tank ☐ plastic tank)

☐ Separate vessels ☐ Other (Specify)

26. What was the source of the stored water?

☐Piped water ☐ Dug /tube well ☐ Rain water ☐Stone spout

☐ Deep tube well/boring ☐ Mixed (specify:)

27. For which purpose did you use stored water? (Check more than one option if necessary)

☐Drinking ☐Cooking ☐ Bathing ☐Washing ☐Toilet ☐ Gardening

28. Did you have water storage at your home before earthquake happened?

☐ NO → Go to Q31

☐ YES ☐ Overhead tank ☐Underground tank (☐plastic tank ☐Cemented tank)

☐ Separate vessels ☐other (Specify……..)

29. Was there any damage in underground tank due to earthquake?

☐ NO → Go to Q31 ☐ YES (☐plastic tank ☐Cemented tank)

30. What kind of damage was occurred on underground tank due to earthquake?

……..

Water collection and buying

31. Currently, do you collect the water? How much water and how many times do you collect water in a day/week/ month? And what is the purpose of using collecting water? Please tick all that apply.

Source	Liter	Times	Per	Purpose
Neighbour's piped water			☐ Day ☐ Week ☐ Month	☐Drinking ☐Cooking ☐Bathing ☐Laundry ☐Cleaning ☐Gardening ☐Other (Specify)
Neighbour's well			☐ Day ☐ Week ☐ Month	☐Drinking ☐Cooking ☐Bathing ☐Laundry ☐Cleaning ☐Gardening ☐Other (Specify)
River/Lake/ Ponds			☐ Day ☐ Week ☐ Month	☐Drinking ☐Cooking ☐Bathing ☐Laundry ☐Cleaning ☐Gardening ☐Other (Specify)
Public well			☐ Day ☐ Week ☐ Month	☐Drinking ☐Cooking ☐Bathing ☐Laundry ☐Cleaning ☐Gardening ☐Other (Specify)
Spring			☐ Day ☐ Week ☐ Month	☐Drinking ☐Cooking ☐Bathing ☐Laundry ☐Cleaning ☐Gardening ☐Other (Specify)
Stone spout			☐ Day ☐ Week ☐ Month	☐Drinking ☐Cooking ☐Bathing ☐Laundry ☐Cleaning ☐Gardening ☐Other (Specify)
Other ( )			☐ Day ☐ Week ☐ Month	☐Drinking ☐Cooking ☐Bathing ☐Laundry ☐Cleaning ☐Gardening ☐Other (Specify)

32. How long does it take to go there, get water, and come back per time?

☐ ( ) Minutes per time

☐ I do not know

33. Currently, does your family buy water for domestic use? If yes, how frequently and how much do you pay for per time?

☐ No → Go to Q34 ☐ Yes

Source	Water volume (L)	Frequency	Payment (NPR)	Purpose
□Bottled or Jar water	……... each time	□Everyday □ ( )times per week □ ( )times per month	( ) per time	□Drinking □Cooking □Bathing □Laundry □Cleaning □Gardening □Other (Specify)
□Tanker-truck		□Everyday □ ( )times per week □ ( )times per month	( ) per time	□Drinking □Cooking □Bathing □Laundry □Cleaning □Gardening □Other (Specify)

34. How much are you willing to pay for clean water in a day/ week/ month?

NRs. ( ) ☐ per day ☐ per week ☐ per Month

Water quality management

35. Do you treat water? Please tick all that apply.

For	With
☐ Drinking	☐ Filtering ☐ Boiling ☐ Euro-guard ☐ Chlorine/Alum/Potash ☐ Domestic treatment plant ☐ Other ( ) ☐ No treatment
☐ Cooking	☐ Filtering ☐ Boiling ☐ Euro-guard ☐ Chlorine/Alum/Potash ☐ Domestic treatment plant ☐ Other ( ) ☐ No treatment
☐ Washing vegetable and fruits	☐ Filtering ☐ Boiling ☐ Euro-guard ☐ Chlorine/Alum/Potash ☐ Domestic treatment plant ☐ Other ( ) ☐ No treatment
☐Brushing teeth / washing mouth	☐ Filtering ☐ Boiling ☐ Euro-guard ☐ Chlorine/Alum/Potash ☐ Domestic treatment plant ☐ Other ( ) ☐ No treatment
☐Bathing	☐ Filtering ☐ Boiling ☐ Euro-guard ☐ Chlorine/Alum/Potash ☐ Domestic treatment plant ☐ Other ( ) ☐ No treatment

36. How have you experienced the water related issues in the past 30 days? Please tell us the closest feeling, not just how you feel today.

(1) I worry about my household would not collect less amount of water than needed

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(2) My household could not use safe drinking water

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(3) My household use poor quality of water (e.g. colored water/ smelled water)

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(4) My house could not clean enough

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(5) My household collected water from an undesirable / dirty source

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(6) I took long time for water collection

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(7) I dispute with neighbour/tenant/owner due to water

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(8) I dispute with family members due to water

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(9) I and my family reduced time for daily work/ income generating activities due to water collection

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(10) My children reduced time for studies or missed school due to water collection

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(11) My household paid much money to buy safe water

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(12) I and my family members could not participate in any social activities such as wedding/occasions/festivals due to water collection

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(13) I and my family members slept very few hours because of water collection

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(14) I and my family members cook undesirable food because there was not enough water

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

(15) I and my family members have health problems/weakeness/tiredness because of water collection

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Mostly ☐ Always

4. Your hygiene behaviour

1. Where did you go to toilet <u>during one-month after earthquake</u>?

☐ own home ☐ outside open field ☐ Neighbour's home ☐ Temporary toilet

☐ Toilet in evacuation centre ☐ Others (specify:)

2. Do you wash your hands before preparing meal?

□ Yes, always with running water and soap □ Yes, always with stored water □ Yes, Sometimes □ Never

3. Do you wash your hands after toilet?

□ Yes, always with running water with soap □ Yes, always with stored water □ Yes, Sometimes □ Never

4. How often do you take a bath/a shower in a week?

( ) times per Week

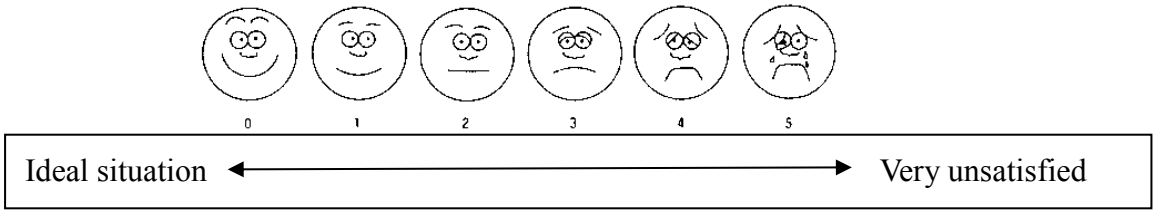
5. How frequently do you clean water stored containers?

☐ Every day ☐ ( ) time per week ☐ ( ) time per month

☐ Never

5. Impact of earthquake on water system

1. Please see the following picture. If the ideal quantity and quality of water supply system is valued as "0", how do you rate the community water system before the earthquake, during emergency period (1 month after earthquake), and current situation?



Before the earthquake …….

One month after the quake …….

Current situation ……....

Please recall the <u>one-month period right after the earthquake</u> and answer the following questions.

Water availability:

2. How was the availability of overall quantity of water?

□ No water □ Less than half available □ More than half available

□ Same as before earthquake □ More than before earthquake

3. Could you manage water for carrying out daily activities?

□ No □ Yes, without any problem □ Yes, but difficult to manage

4. How about water availability for the following purposes?

Drinking	□ Less water	□ No water	□ Same as before earthquake
Cooking	□ Less water	□ No water	□ Same as before earthquake
Bathing	□ Less water	□ No water	□ Same as before earthquake
Laundry	□ Less water	□ No water	□ Same as before earthquake
Dishes	□ Less water	□ No water	□ Same as before earthquake
Toilet	□ Less water	□ No water	□ Same as before earthquake
Gardening	□ Less water	□ No water	□ Same as before earthquake

5. How was the water availability in stone spout?

☐ No water (For…....days) ☐ Less water but same quality

☐ Less water and poor quality ☐ Same quantity and poor quality

☐ Same as before earthquake ☐ Others (Specify…….)

6. How did you manage water in case of less water availability? (Check more than one option if necessary)

□Used stored water □ Fetched from other places

□Used water source that we had not used before □ Bought water

□Water distributed from volunteers □ Rainwater harvesting

□Treated dirty water and used

7. Do you have any community group or Guthi?

□ No □ Yes

8. Were you provided with water stored and managed by your community?

□ No community □ No water management □ Yes

9. Did you and your community act together for managing water?

□ No □ Yes

10. Please check activities among following that you and your community work for water management. (Check all that applies)

□ collecting water □Sharing water □Maintenance of broken pipelines

□Maintenance of other damaged water sources □Installing new water sources

□Working for water availability in the community.

11. Did you receive any support from volunteers or organization to solve water problem?

□ No □ Yes

12. Please check kind of support that you received from volunteers and organizations

□ Jar water distribution (……times per week)

□ Bottled water distribution (……..times per week)

□ Tanker water distribution (…… times per week)

□ Consultation in water managing during disaster

□ Consultation in treating water

6. Economic status of household

Q1 In your household, what do you have?

Electricity	□ YES □ NO	Radio	□ YES □ NO
Television	□ YES □ NO	Mobile phone	□ YES □ NO
Land phone	□ YES □ NO	Refrigerator	□ YES □ NO
Bicycle	□ YES □ NO	Motor bike	□ YES □ NO
Car	□ YES □ NO	Computer	□ YES □ NO
Fan	□ YES □ NO	Kerosene stove	□ YES □ NO
Electric stove	□ YES □ NO	Gas stove	□ YES □ NO
Domestic servant	□ YES □ NO	Invertor	□ YES □ NO

Q2 How much do you expense in the last month? ( ) NRP/month.

Thank you very much for your cooperation!!

Name of interviewer: …….. Date of interview:……

Second section

8. Gender: ☐ Male ☐ Female
9. Age: ……Years
10. Caste:
11. Religion: ☐ Hindu ☐ Muslim ☐ Buddhist ☐ Others
12. Marital status: ☐ Single ☐ Separated / Married / Divorced ☐ Widowed
13. Education status: ☐ None at all ☐ Primary school ☐ Secondary school ☐ Tertiary
14. Are you currently ill? ☐ Yes ☐ No

If something is wrong with your health what do you think it is?

_____illness/ problem

Please read each question, assess your feelings of last weeks, and circle the number on the scale for each question that gives the best answer for you.						
QN	**Statement**	**Please circle in any one of the following options**				
1	How would you rate your quality of life?	Very poor	Poor	Neither poor nor good	Good	Very good
2	How satisfied are you with your health?	Very poor	Poor	Neither poor nor good	Good	Very good
3	To what extent do you feel that physical pain prevents you from doing what you need to do?	Not at all	A little	A moderate Amount	Very much	An extreme Amount
4	How much do you need any medical treatment to function in your daily life?	Not at all	A little	A moderate Amount	Very much	An extreme Amount
5	How much do you enjoy life?	Not at all	A little	A moderate Amount	Very much	An extreme Amount
6	To what extent do you feel your life to be meaningful?	Not at all	A little	A moderate Amount	Very much	An extreme Amount
7	How well are you able to concentrate?	Not at all	A little	A moderate Amount	Very much	An extreme Amount
8	How safe do you feel in your daily life?	Not at all	A little	A moderate Amount	Very much	An extreme Amount
9	How healthy is your physical environment?	Not at all	A little	A moderate Amount	Very much	An extreme Amount
10	Do you have enough energy for everyday life?	Not at all	A little	Moderately	Mostly	Completely
11	Are you able to accept your bodily appearance?	Not at all	A little	Moderately	Mostly	Completely
12	Have you enough money to meet your needs?	Not at all	A little	Moderately	Mostly	Completely
13	How available to you is the information that you need in your day-to-day life?	Not at all	A little	Moderately	Mostly	Completely
14	To what extent do you have the opportunity for leisure activities?	Not at all	A little	Moderately	Mostly	Completely
15	How well are you able to get around?	Very poor	Poor	Neither	Good	Very good
16	How satisfied are you with your sleep?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
17	How satisfied are you with your ability to perform your daily living activities?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
18	How satisfied are you with your capacity for work?	Very dissatisfied	Dissatisfied	Neither dissatisfied	Satisfied	Very satisfied

				nor satisfied		
19	How satisfied are you with yourself?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
20	How satisfied are you with your personal relationships?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
21	How satisfied are you with your sex life?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
22	How satisfied are you with the support you get from your friends?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
23	How satisfied are you with the conditions of your living place?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
24	How satisfied are you with your access to health services?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
25	How satisfied are you with your transport?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
26	How often do you have negative feelings such as blue mood, despair, anxiety, depression?	Never	Seldom	Quite often	Very often	Always

Appendix VI

Water supply, sanitation and health status of households in Kathmandu Valley-Phase III , 2016

ID:

7. Personal Information

Name:……. Sex: □ Male □ Female Age:…….

Address: District…….. Municipality/VDC……..…Ward…….. Tole……..……

Phone no…… Education:…… Occupation: ……

Household head: Name:……..……. Sex: □ Male □ Female Age:……..…….

Education:……. Occupation: ……

Are you owner of this house? □ Owner □ Tenant

How many households in the house ? _____ households

How many persons in the household of interviewee? _____ Persons (Above 10 years old)

_____ Persons (Under 10 years old)

8. Current health status of your household member

Q1. Did you or your household members had any physical symptoms?

□ No, nobody has □ Yes,

Q2. If, yes which members of household have? (Please check all that apply).

SN	Age	Symptoms number*
1		
2		
3		

***Symptoms and diseases:** 1. Headache 2. Fever 3. Cold 4. Nausea/ Vomiting 5. Stomach Pain 6. Skin disease (scabies) 7. Eye disease (Trachoma) 8. Typhoid (high fever and rose spots on the chest) 9. Musculoskeletal problems (Back pain, leg pain, bone and joint problem) 10. Jaundice 11. Other (Specify……)

Q3. Did you or your family get diarrhoea (three or more loose or liquid stools per day) in the last two weeks?

□ NO → Go to Q7

□ YES → Which member and how many times?

SN	Age	Times
1		
2		
3		

Q4. Did you and your household member seek advice or treatment for the diarrhoeal diseases, typhoid, trachoma, or scabies of member?

Under 10 yrs.: □ YES □NO ***Over 10 yrs***.: □ YES □ NO

Q5. If YES, where and how often did you and your household member seek advice or treatment?

	Times	
	Under 10 years old	Over 10 years old
□ Government Hospital		
□ Private Hospital		
□ PHCC/ Health Post/ Health Centre		
□ Private Clinic/ Poly clinics		
□ Pharmacy Shop		
□ Others (Specify)		

Q6. How much did you and your household member pay for the advice or treatment in the last two weeks?

NRs (…….....)

Q7. Have you or your household member were given any drug for intestinal worms in the last six months (including any deworming)?

□ YES □ NO

9. Current your household water system

Piped water

Q8. Does your house have piped water connection?

□ NO → Go to Q14 □Yes but no supply at all → Go to Q14 □ YES

Q9. How many hours does the piped water supply in **a week now**?

(……) Hours

Q10. Do you store piped water in your house **now**?

□ No, I do not

□ Yes, I store in: □ Tank on the roof □ Tank under the floor

□ Vessels □ Other (Specify……)

Q11. How much amount of piped water do you consume in **a day, now**?

(……) Litre

Q12. What is the purpose of using piped water? Please tick all that apply.

□ Drinking □ Cooking □ Bathing □ Laundry □ Cleaning

□ Gardening □ Other (Specify…….)

Q13. How much do you pay for piped water supply in **a month**?

(……) NPR

Well water

Q14. Do you have a well in your yard/compound?

□ No→ Go to Q20 □ Yes, but dried → Go to Q20 □ Yes

Q15. How much amount of well water do you consume by your family in **a day,** now?

(……) Litre

Q16. What is the purpose of using water from well, **now**? Please tick all that apply.

□ Drinking □ Cooking □ Bathing □ Laundry □ Cleaning

□ Gardening □ Other (Specify ……..)

Q17. Do you store well water in your house?

□ No, I do not (Go to Q20)

□ Yes, I store in: □ Tank on the roof □ Tank under the floor

□ Vessels □ Other (Specify ……..)

Q18. Do you share well-water stored in the tanks with others in your house?

□ No→ Go to Q20 □ Yes

Q19. How many people or households (families) do you share well-water in your house?

……..people, …….. HHs (Family)

Rainwater

Q20. Do you collect rain water for domestic use?

□ YES □ NO → Go to Q24

Q21. Do you store rain water in your house?

□ No, I do not

□ Yes, I store in: □ Tank on the roof □ Tank under the floor

□ Vessels □ Other (Specify……..)

Q22. How much amount of rain water do you consume in **a day**?

(……) Litre

Q23. What is the purpose of using rain water? Please tick all that apply.

□ Drinking □ Cooking □ Bathing □ Laundry □ Cleaning

□ Gardening □ Other (Specify……..)

Water collection and buying

Q24. Currently, does your family buy water for domestic use?

□ No → Go to Q26 □ Yes

Q25. If yes, how frequently and how much do you pay for per time? Answer following questions in table:

Source	Water volume (Litre)	Frequency	Payment (NRS)	Purpose (Please tick all that apply)	Time for collection
Jar water □ No □ Yes →	……...each time	…..times per **week** …..times per **day**	(……) per time	1. Drinking 2. Cooking 3.Bathing 4. Laundry 5. Cleaning 6. Gardening 7. Other (Specify……)	……minute □ I don`t know
Water from vendor □ No □ Yes →	……...each time	….times per week …..times per day	(……) per time	1. Drinking 2. Cooking 3.Bathing 4. Laundry 5. Cleaning 6. Gardening 7. Other (Specify……)	…..……minute □ I don`t know
Tanker water □ No □ Yes →	Do you share tanker water with others in your house? □ No □ Yes			How many people or households (families) share tanker water in your house? ……..people, …….. HHs	
	……...each time	….times per **month** ….times per **year**	( ) per time	1. Drinking 2. Cooking 3.Bathing 4. Laundry 5. Cleaning 6. Gardening 7. Other (Specify……)	…..……minute □ I don`t know

Q26. Currently, do you collect the water? (Please mention the Volume, Frequency, Purpose and Time taken in below, and tick all that apply).

Source	Water volume (Litre)	Frequency	Purpose Please tick all that apply	Time for collection
Neighbour's piped water □ No □ Yes →	……...each time	…. times per day	1. Drinking 2. Cooking 3. Bathing 4. Laundry 5. Cleaning 6. Gardening 7. Other (Specify……)	……..min □ I don`t know
Neighbour's well □ No □ Yes →	……...each time	.... times per day	1. Drinking 2. Cooking 3. Bathing 4. Laundry 5. Cleaning 6. Gardening 7. Other (Specify……)	…….min □ I don`t know
Public well □ No □ Yes →	……...each time	……. times per day	1. Drinking 2. Cooking 3. Bathing 4. Laundry 5. Cleaning 6. Gardening 7. Other (Specify……)	……..min □ I don`t know
Stone spout □ No □ Yes →	……...each time	…….. times per day	1. Drinking 2. Cooking 3. Bathing 4. Laundry 5. Cleaning 6. Gardening 7. Other (Specify……)	……min □ I don`t know

Water storage

Q27. For how many days do you store water before using it, on an average?

□ For drinking …….days □ For rest purposes ……days

Q28. What are the capacities of your storage tanks and vessels?

□ For drinking

Tank on the roof ……L, Tank underground ……L, Vessels (altogether) ……..L

□ For rest purposes

Tank on the roof ……L, Tank underground ……L, Vessels (altogether) ……..L

10. Household water consumption diary

Q29. How much **water (in litres, L)** did your family consumed for following purposes in the days?

Drink	Cook	Laundry	Bath	Dish-wash	Toilet	Garden	Clean

Q.29.1 How many times per week do you wash cloth at home?

……times

Q29.2 How many times per week do you clean your house (eg. mopping)?

…….times

11. Treatment and Perception of Water Scarcity:

Water Treatment:

Q30. Do you treat water for following purposes? Please tick all that apply.

For	With
□ Drinking	1. No treatment 2. Filtering 3. Boiling 4. Euro-guard 5. Chlorine/Alum/Potash 6. Domestic treatment plant 7. Other (……..……..)
□ Cooking	1. No treatment 2. Filtering 3. Boiling 4. Euro-guard 5. Chlorine/Alum/Potash 6. Domestic treatment plant 7. Other (……..……..)
□ Washing vegetable and fruits	1. No treatment 2. Filtering 3. Boiling 4. Euro-guard 5. Chlorine/Alum/Potash 6. Domestic treatment plant 7. Other (……..……..)
□ Brushing teeth / washing mouth	1. No treatment 2. Filtering 3. Boiling 4. Euro-guard 5. Chlorine/Alum/Potash 6. Domestic treatment plant 7. Other (……..……..)
□ Bathing	1. No treatment 2. Filtering 3. Boiling 4. Euro-guard 5. Chlorine/Alum/Potash 6. Domestic treatment plant 7. Other (……..……..)

Q31. How much do you pay for water treatment in a week/ month?

(……..) NPR □ per Week, □ per Month

Q32. How much are your willing to pay for water treatment in a month?

(……..) NPR per Month

Water insecurity scale

Q33. How have you experienced the water related issues in the past 30 days? Please tell us the closest feeling, not just how you feel today.

No.	Statements	Never	Rarely	Sometimes	Often	Mostly	Always
33.1	I worry about my household would collect less amount of water than needed.						
33.2	My household could not use safe drinking water						
33.3	My household use poor quality of water (e.g. colored water/ smelled water)						
33.4	My house could not clean enough						
33.5	My household collected water from an undesirable/ dirty source						
33.6	I took long time for water collection						
33.7	I dispute with neighbour/ tenant/owner due to water						
33.8	I dispute with family members due to water						
33.9	I and my family reduced time for daily work/ income generating activities due to water collection						

No.	Statements	Never	Rarely	Sometimes	Often	Mostly	Always
33.10	My children reduced time for studies or missed school due to water collection						
33.11	My household paid much money to buy safe water						
33.12	I and my family members could not participate in any social activities such as wedding/occasions/festivals due to water collection						
33.13	I and my family members slept very few hours because of water collection						
33.14	I and my family members cook undesirable food because there was not enough water						
33.15	I and my family members have health problems/weakness/tiredness because of water collection						

12. Hygiene behaviour

Q34. How often do you take a bath/a shower in a week?

(……..) times per week

Q35. With which water do you take bath?

□ Piped water (fresh) □ Vessels water □ Tank water

□ Others (Specify……..……..)

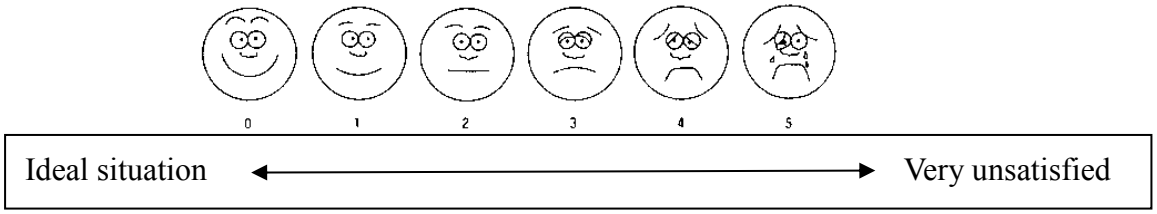
Q36. How frequently do you clean water stored containers?

□ Every day □ (……..) time per week

□ (……..) time per month □ Never

7. Impact of Earthquake on Water System

Q37. Please see the following picture. If the ideal quantity and quality of water supply system is valued as "0", how do you rate the current community water system?



Current situation ……....

Please describe the current situation comparing to the situation <u>in wet season</u> before earthquake

Q38. How is the availability of overall quantity of water?

□ No water □ Less than half available before earthquake

□ More than half available before earthquake □ Same as before earthquake

□ More than before earthquake

Q39. Can you manage water for carrying out daily activities?

□ No □ Yes, without any problem □ Yes, but difficult to manage

Q40. How about water availability for the following purposes?

Drinking □ Less water □ Same as before earthquake □ More water

Cooking □ Less water □ Same as before earthquake □ More water

Bathing □ Less water □ Same as before earthquake □ More water

Laundry □ Less water □ Same as before earthquake □ More water

Dishes □ Less water □ Same as before earthquake □ More water

Toilet □ Less water □ Same as before earthquake □ More water

Gardening □ Less water □ Same as before earthquake □ More water

Q41. How about changes in water quality after earthquake for the following purposes?

Drinking □ Better □ Same as before earthquake □ Worse

Cooking □ Better □ Same as before earthquake □ Worse

Bathing □ Better □ Same as before earthquake □ Worse

Laundry □ Better □ Same as before earthquake □ Worse

Dishes □ Better □ Same as before earthquake □ Worse

Community involvement in water management

Q42. Do you have any Community Group or *Guthi*?

□ No □ Yes

Q43. Are you provided with water stored and managed by your community?

□ No water management □ Yes

Q44. Do you and your community act together for managing water?

□ No □ Yes

8. WHOQOL BREF Questions:

Please read each question, assess your feelings of last weeks, and circle the number on the scale for each question that gives the best answer for you.						
QN	**Statement**	**Please circle in any one of the following options**				
		Very poor	Poor	Neither poor nor good	Good	Very good
1	How would you rate your quality of life?	1	2	3	4	5
2	How satisfied are you with your health?	1	2	3	4	5
		Not at all	A little	A moderate Amount	Very much	An extreme Amount
3	To what extent do you feel that physical pain prevents you from doing what you need to do?	1	2	3	4	5
4	How much do you need any medical treatment to function in your daily life?	1	2	3	4	5
5	How much do you enjoy life?	1	2	3	4	5
6	To what extent do you feel your life to be meaningful?	1	2	3	4	5
7	How well are you able to concentrate?	1	2	3	4	5
8	How safe do you feel in your daily life?	1	2	3	4	5
9	How healthy is your physical environment?	1	2	3	4	5
		Not at all	A little	Moderately	Mostly	Completely

10	Do you have enough energy for everyday life?	1	2	3	4	5
11	Are you able to accept your bodily appearance?	1	2	3	4	5
12	Have you enough money to meet your needs?	1	2	3	4	5
13	How available to you is the information that you need in your day-to-day life?	1	2	3	4	5
14	To what extent do you have the opportunity for leisure activities?	1	2	3	4	5
15	How well are you able to get around?	Very poor	Poor	Neither	Good	Very good
16	How satisfied are you with your sleep?	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
17	How satisfied are you with your ability to perform your daily living activities?	1	2	3	4	5
18	How satisfied are you with your capacity for work?	1	2	3	4	5
19	How satisfied are you with yourself?	1	2	3	4	5
20	How satisfied are you with your personal relationships?	1	2	3	4	5
21	How satisfied are you with your sex life?	1	2	3	4	5
22	How satisfied are you with the support you get from your friends?	1	2	3	4	5
23	How satisfied are you with the conditions of your living place?	1	2	3	4	5
24	How satisfied are you with your access to health services?	1	2	3	4	5
25	How satisfied are you with your transport?	1	2	3	4	5
26	How often do you have negative feelings such as blue mood, despair, anxiety, depression?	Never	Seldom	Quite often	Very often	Always

9. Economic status

Q45. How much do you expense in the last month? (……..) NRP/month.

Q46. In which average monthly income group do your family belongs to? (If you don't mind).

1) NRs <2500 2) NRs 2501 - 7500 3) NRs 7501 – 13,000 4) NRs 13,001– 19,000

6) NRs 19001 – 25,000 7) NRs 25,001 – 51,000 8) NRs >51,000 9) Do not want to answer

Thank you very much for your cooperation!!

Name of interviewer: …….. Date of interview:……/……/……

Some Codes:

Code of Education status

1. Illiterate,
2. No Formal education,
3. Primary school (1-5 class),
4. Lower secondary (6-8),
5. Secondary school (9-10),
6. Upper secondary (11-12),
7. College/University,
8. Don't want to disclose,
98. Not applicable

Code of Occupation:

1. Agriculture,
2. Professional/manager,
3. Business,
4. Skilled manual labour,
5. Unskilled manual labour,
6. Service,
7. Remittance,
8. Domestic work,
9. Student,
10. Housewife,
11. Retired,
12.No job

Appendix VII

Water supply and use in communities
In the Kathmandu Valley, Supplementary Survey 2017

ID:

Name: …….
Office address
District: …….. Municipality/VDC: ……..…Ward no.: ……..
Tole: ……..…….……..…… Phone: ……
Number of toles or communities responsible: ……..……
Name of toles or communities: Please classify them into the following 3 groups.
With severe water scarcity:

With medium water scarcity:

With less water scarcity:

Please select 2 toles or communities: the most water scarce and the typical of them.

The most water scarce tole or community
Community Name
Name of community leader
Contact address Phone number

The typical tole or community
Community Name
Name of community leader
Contact address Phone number

I) Water Scarce Tole or Community Name

(5) Residents
Q1-1 Population: ..... Q1-2 Number of Households:
Q1-3 Economic status of most of the HHs □ Rich □ Medium □ Poor □ Mix

(6) Current household water system in the tole or community
(7) Major drinking water sources
Q2-1-1 Water source for drinking used most frequently: Please select one.
□ Piped water □ Bottle/Jar water □ Well water □ Tanker water □ Other (.....)
Q2-1-1 Water source for drinking used in the next place: Please select one.
□ Piped water □ Bottle/Jar water □ Well water □ Tanker water □ Other (.....)

(8) KUKL supplied Piped water
Q2-2-1 How many HHs connected to KUKL pipeline ?
□ Almost all □ Most □ Around half □ Some □ Few of the HHs □ No KUKL supply
Q2-2-2 Average piped water supply hours per week: ..... hours/week
Q2-2-3 Main purpose of using piped water: Please tick all that apply.
□ Drinking □ Cooking □ Bathing □ Laundry □ Cleaning □ Gardening
Q2-2-4 Water quality: □ Good □ Medium □ Bad
Major problem: Please tick all that apply:
□ Taste □ Smell □ Colour □ Turbidity □ Other (……)
Q2-2-5 How much do people pay for piped water supply in a month? (……) NPR

(9) Community supplied water

Q2-3-1 Main purpose of using community supplied water: Please tick all that apply.

☐ Drinking ☐ Cooking ☐ Bathing ☐ Laundry ☐ Cleaning ☐ Gardening

Q2-3-2 Water quality: ☐ Good ☐ Medium ☐ Bad

Major problem: Please tick all that apply:

☐ Taste ☐ Smell ☐ Colour ☐ Turbidity ☐ Other (…….)

Q2-3-3 How much do people pay for community water in a month? (……) NPR

Answer following question if community water is supplied by pipe:

Q2-3-4 How many HHs connecting community supplied pipeline?

☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ No community supply

Q2-3-5 Average piped water supply hours per week: …….hours/week

(10) Well water

Q2-4-1 How many HHs using well in yard/compound?

☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None

Q2-4-2 How many HHs using public well?

☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None

Q2-4-3 Percentage of households using following types of well:

Shallow dugwell: .....%, Shallow tubewell: .....%, Deep well: .....%

Q2-4-4 Main purpose of using well water: Please tick all that apply.

☐ Drinking ☐ Cooking ☐ Bathing ☐ Laundry ☐ Cleaning ☐ Gardening

Q2-4-5 Water quality: ☐ Good ☐ Medium ☐ Bad

Major problem: Please tick all that apply.

☐ Taste ☐ Smell ☐ Colour ☐ Turbidity ☐ Other (…….)

(11) Stone spout, Spring water

Q2-5-1 How many HHs using stone spout or spring water?

☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None

Q2-5-2 Main purpose of using stone spout and spring water: Please tick all that apply.

☐ Drinking ☐ Cooking ☐ Bathing ☐ Laundry ☐ Cleaning ☐ Gardening

Q2-5-3 Water quality: ☐ Good ☐ Medium ☐ Bad

Major problem: Please tick all that apply.

☐ Taste ☐ Smell ☐ Colour ☐ Turbidity ☐ Other (…….)

(12) Rainwater

Q2-6-1 How many HHs using rainwater?

☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None

Q2-6-2 Main purpose of using rainwater: Please tick all that apply.

☐ Drinking ☐ Cooking ☐ Bathing ☐ Laundry ☐ Cleaning ☐ Gardening

Q2-6-3 How many HHs have rainwater-harvesting system installed ?

☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None

(13) Bottle/Jar water

Q2-7-1 How many HHs buying bottle/Jar water:

☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None

Q2-7-2 How much do people pay for bottle/Jar water in a month? (……) NPR

(14) Tanker/Vender water

Q2-8-1 How many HHs using Tanker/Vender water:

☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None

Q2-8-2 Main purpose of using tanker water: Please tick all that apply.

☐ Drinking ☐ Cooking ☐ Bathing ☐ Laundry ☐ Cleaning ☐ Gardening

Q2-8-3 Water quality:

☐ Good ☐ Medium ☐ Bad

Major problem: Please tick all that apply.

☐ Taste ☐ Smell ☐ Colour ☐ Turbidity ☐ Other (…….)

Q2-8-4 How much do people pay for tanker water in a month? (……) NPR

(15) **Water Treatment of drinking water:**

Q2-9-1 How many HHs treating drinking water?
☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None

Q2-9-2 How many HHs treating with Filter?
☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None

Q2-9-3 How many HHs treating by Boiling?
☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None

Q2-9-4 How many HHs treating with Euro-guard?
☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None

Q2-9-5 How many HHs treating with Chlorine/Alum/Potash?
☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None

Q2-9-6 How much do people pay for water treatment in a month? (……) NPR

(16) Community involvement in water management

Q3-1 Are there any Community Groups or *Guthi*?
□ Yes □ No

Q3-2 Do the people in the tole or community usually co-operate each other?
□ Always □ Often □ Sometimes □ Rarely □ Never

Q3-3 Do the community store and provide water to residents?
□ Yes □ No

Q3-4 Do the community member act together for managing water?
□ Yes □ No

(17) Health information of community

Q-4-1 What are the common physical symptoms in the community?

SN	Symptoms number*
1	
2	
3	
4	
5	
6	

***Symptoms and diseases:** 1. Headache 2. Fever 3. Cold 4. Nausea/Vomiting 5. Stomach Pain 6. Skin disease (scabies) 7. Eye disease (Trachoma) 8. Typhoid (high fever and rose spots on the chest) 9. Musculoskeletal problems (Back pain, leg pain, bone and joint problem) 10. Jaundice 11. Other (Specify……)

Q-4-2 Are there any diarrhoea (three or more loose or liquid stools per day) cases in community in last two weeks?
□ No □ Yes

If yes, which age group is most affected? □ Under 5 years □ Over 5 years □ Over 10 years

II) Typical Tole or Community Name

1. Residents

Q1-1 Population: ..... Q1-2 Number of Households:

Q1-3 Economic status of most of the HHs □ Rich □ Medium □ Poor □ Mix

2. Current household water system in the tole or community

(1) Major drinking water sources

Q2-1-1 Water source for drinking used most frequently: Please select one.
□ Piped water □ Bottle/Jar water □ Well water □ Tanker water □ Other (.....)

Q2-1-1 Water source for drinking used in the next place: Please select one.
□ Piped water □ Bottle/Jar water □ Well water □ Tanker water □ Other (.....)

(2) KUKL supplied Piped water

Q2-2-1 How many HHs connected to KUKL pipeline ?
□ Almost all □ Most □ Around half □ Some □ Few of the HHs □ No KUKL supply

Q2-2-2 Average piped water supply hours per week: ..... hours/week

Q2-2-3 Main purpose of using piped water: Please tick all that apply.
□ Drinking □ Cooking □ Bathing □ Laundry □ Cleaning □ Gardening

Q2-2-4 Water quality: □ Good □ Medium □ Bad

Major problem: Please tick all that apply:

□ Taste □ Smell □ Colour □ Turbidity □ Other (…….)
Q2-2-5 How much do people pay for piped water supply in a month? (……) NPR

(3) Community supplied water

Q2-3-1 Main purpose of using community supplied water: Please tick all that apply.
☐ Drinking ☐ Cooking ☐ Bathing ☐ Laundry ☐ Cleaning ☐ Gardening
Q2-3-2 Water quality: ☐ Good ☐ Medium ☐ Bad
Major problem: Please tick all that apply:
☐ Taste ☐ Smell ☐ Colour ☐ Turbidity ☐ Other (…….)
Q2-3-3 How much do people pay for community water in a month? (……) NPR

Answer following question if community water is supplied by pipe:

Q2-3-4 How many HHs connecting community supplied pipeline?
☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs □ No community supply
Q2-3-5 Average piped water supply hours per week: …….hours/week

(4) Well water

Q2-4-1 How many HHs using well in yard/compound?
☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None
Q2-4-2 How many HHs using public well?
☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None
Q2-4-3 Percentage of households using following types of well:
Shallow dugwell: ……%, Shallow tubewell: ……%, Deep well: ……%
Q2-4-4 Main purpose of using well water: Please tick all that apply.
□ Drinking □ Cooking □ Bathing □ Laundry □ Cleaning □ Gardening
Q2-4-5 Water quality: □ Good □ Medium □ Bad
Major problem: Please tick all that apply.
□ Taste □ Smell □ Colour □ Turbidity □ Other (…….)

(5) Stone spout, Spring water

Q2-5-1 How many HHs using stone spout or spring water?
☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None
Q2-5-2 Main purpose of using stone spout and spring water: Please tick all that apply.
□ Drinking □ Cooking □ Bathing □ Laundry □ Cleaning □ Gardening
Q2-5-3 Water quality: □ Good □ Medium □ Bad
Major problem: Please tick all that apply.
□ Taste □ Smell □ Colour □ Turbidity □ Other (…….)

(6) Rainwater

Q2-6-1 How many HHs using rainwater?
☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None
Q2-6-2 Main purpose of using rainwater: Please tick all that apply.
□ Drinking □ Cooking □ Bathing □ Laundry □ Cleaning □ Gardening

(7) Bottle/Jar water

Q2-7-1 How many HHs buying bottle/Jar water:
☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None
Q2-7-2 How much do people pay for bottle/Jar water in a month? (……) NPR

(8) Tanker/Vender water

Q2-8-1 How many HHs using Tanker/Vender water:
☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None
Q2-8-2 Main purpose of using tanker water: Please tick all that apply.
□ Drinking □ Cooking □ Bathing □ Laundry □ Cleaning □ Gardening
Q2-8-3 Water quality:
□ Good □ Medium □ Bad
Major problem: Please tick all that apply.
□ Taste □ Smell □ Colour □ Turbidity □ Other (…….)
Q2-8-4 How much do people pay for tanker water in a month? (……) NPR

(9) Water Treatment of drinking water:

Q2-9-1 How many HHs treating drinking water?

☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None

Q2-9-2 How many HHs treating with Filter?

☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None

Q2-9-3 How many HHs treating by Boiling?

☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None

Q2-9-4 How many HHs treating with Euro-guard?

☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None

Q2-9-5 How many HHs treating with Chlorine/Alum/Potash?

☐ Almost ☐ Most ☐ Around half ☐ Some ☐ Few of the HHs ☐ None

Q2-9-6 How much do people pay for water treatment in a month? (……) NPR

3. Community involvement in water management

Q3-1 Are there any Community Groups or *Guthi*?

□ Yes □ No

Q3-2 Do the people in the tole or community usually co-operate each other?

□ Always □ Often □ Sometimes □ Rarely □ Never

Q3-3 Do the community store and provide water to residents?

□ Yes □ No

Q3-4 Do the community member act together for managing water?

□ Yes □ No

4. Health information of community

Q-4-1 What are the common physical symptoms in the community?

SN	Symptoms number*
1	
2	
3	
4	
5	
6	

***Symptoms and diseases:** 1. Headache 2. Fever 3. Cold 4. Nausea/Vomiting 5. Stomach Pain 6. Skin disease (scabies) 7. Eye disease (Trachoma) 8. Typhoid (high fever and rose spots on the chest) 9. Musculoskeletal problems (Back pain, leg pain, bone and joint problem) 10. Jaundice 11. Other (Specify……)

Q-4-2 Are there any diarrhoea (three or more loose or liquid stools per day) cases in community in last two weeks?

□ No □ Yes

If yes, which age group is most affected? □ Under 5 years □ Over 5 years □ Over 10 years

Interviewer

Name: …….Phone number: …….

Date of interview:……/……/……

WaSH-Mia/SATREPS: Manual No.6

Manual for Web Mapping of Water Security Information

1. Preparation

1.1 Installation of GIS software

1) Download GIS software “QGIS” from https://qgis.org/en/site/forusers/download.html
* The QGIS ver. 2.18.10 is used for this manual (tutorial).

2) Install QGIS
(more in details, see https://cran.r-project.org/web/packages/RQGIS/vignettes/install_guide.html)

3) Install QGIS plug-in “qgis2web”
(more in details, see https://qgis2web-docs.readthedocs.io/en/latest/Installation/)

1.2 Copy sample data (for this tutorial)

1) create folder for sample data”c:\map_test”

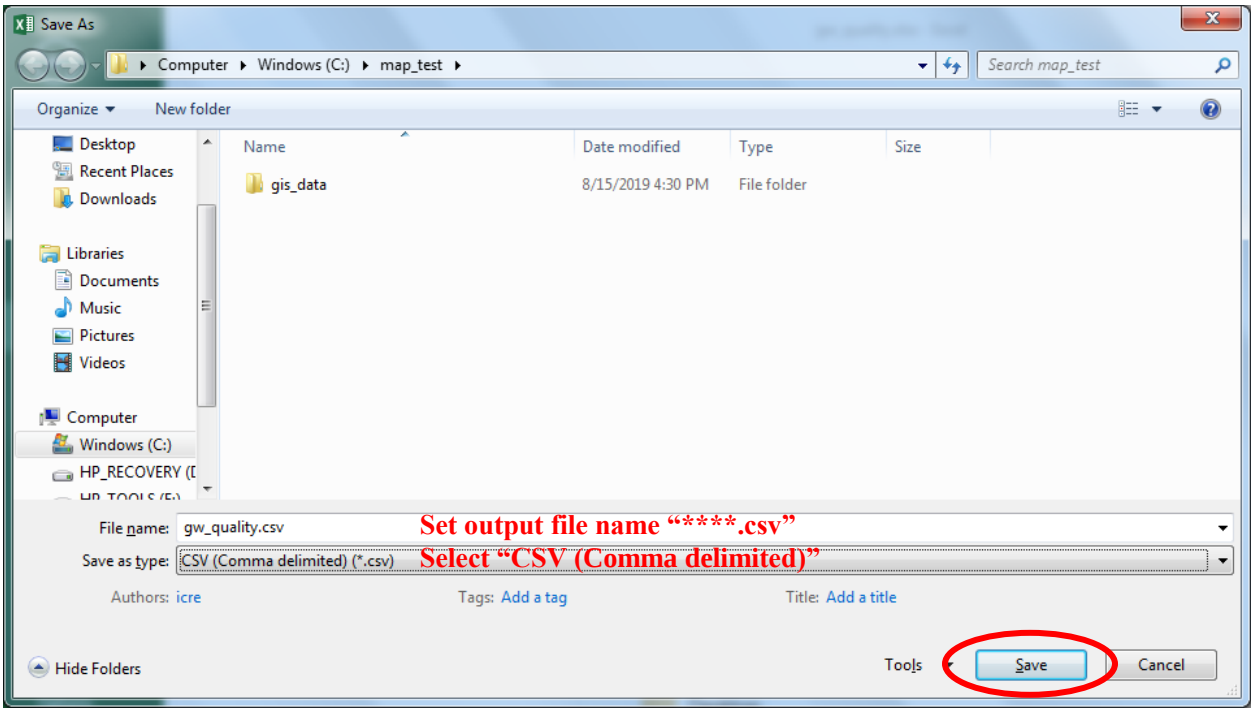
2) copy sample data (in usb/DVD or web_mappin_tutorial.zip) into ”c:\map_test”

2. Mapping of water related information (Point Data)

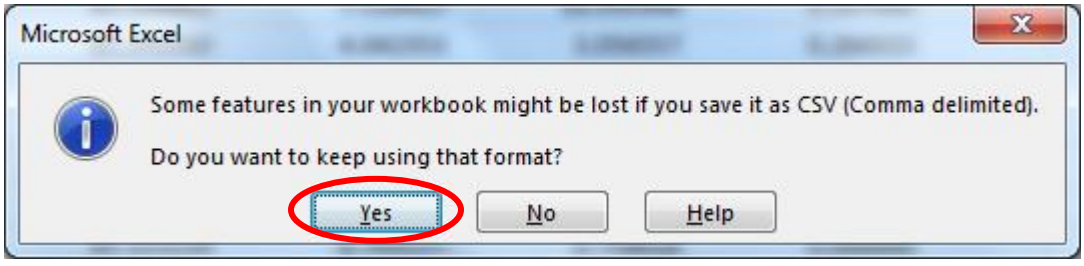
2.1 Create Point data (Shape file format) from Excel file

1) Create data in Excel file (You can use "c;\map_test\gw_quality.xlsx" for this tutorial)
* The x-y coordinates (Latitude, Longitude) should be included in the file, in addition to attributes (e.g. water quality parameters).
* The 1st line should be "label (field name)" of each column.

2) Save data as "csv" format
Open the file on MS-Excel → "File" menu on the top-left / select "Save As"
→ select folder as "map_test" (for this tutorial)
→ set "Save as Type": CSV (Comma Delimited) & put "Fine name" → "Save"

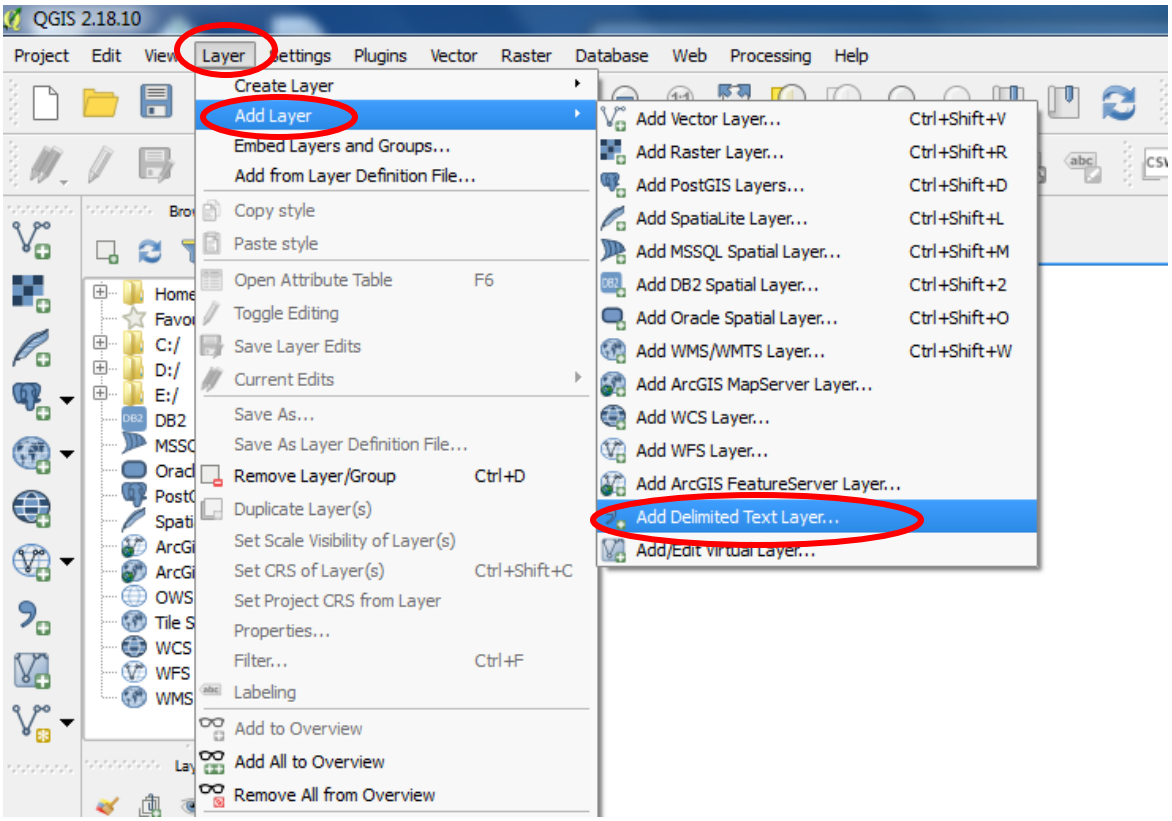


→

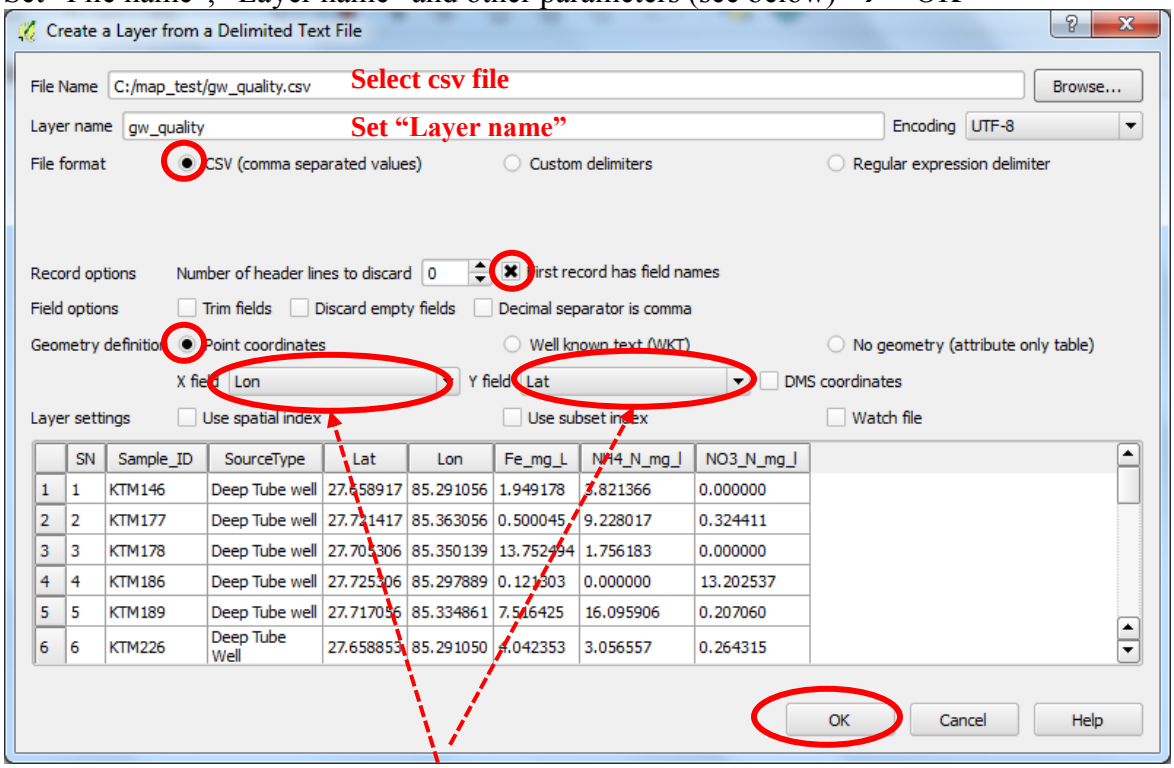


3) Start QGIS Desktop

4) "Layer" menu on the top/ "Add Layer" / "Add Delimited Text Layer…"

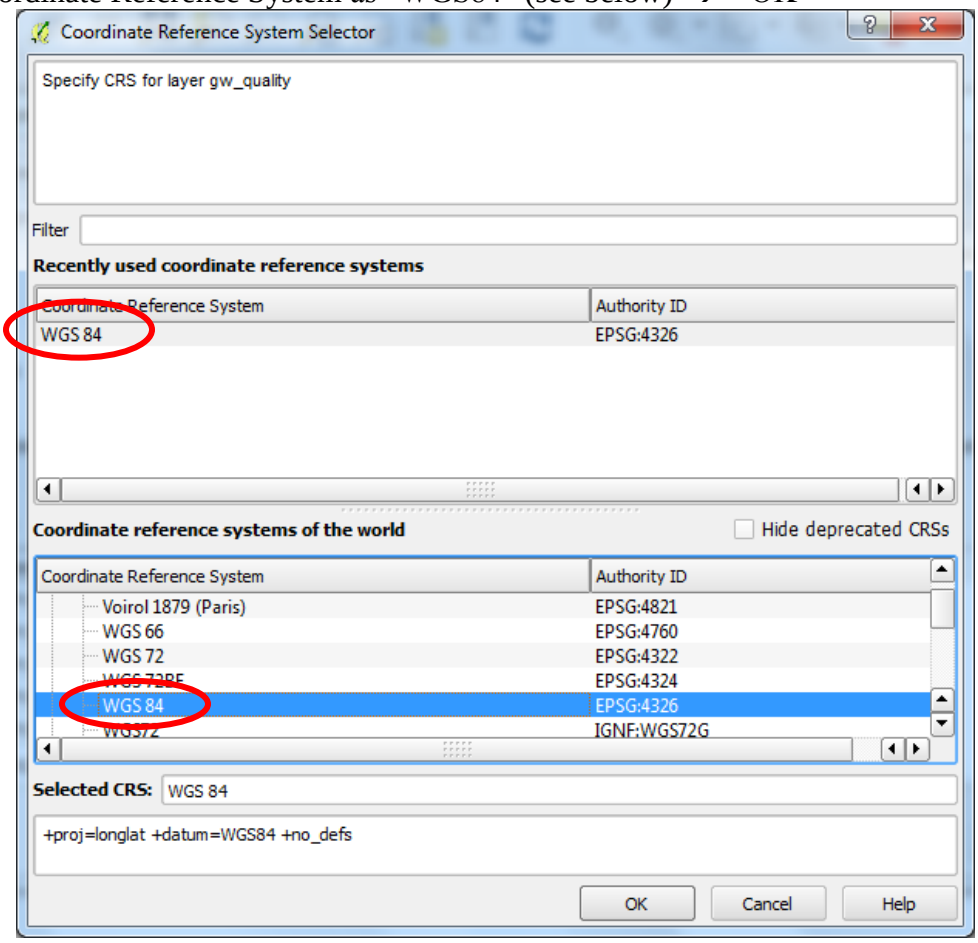


→ Set “File name”, “Layer name” and other parameters (see below) → “OK”

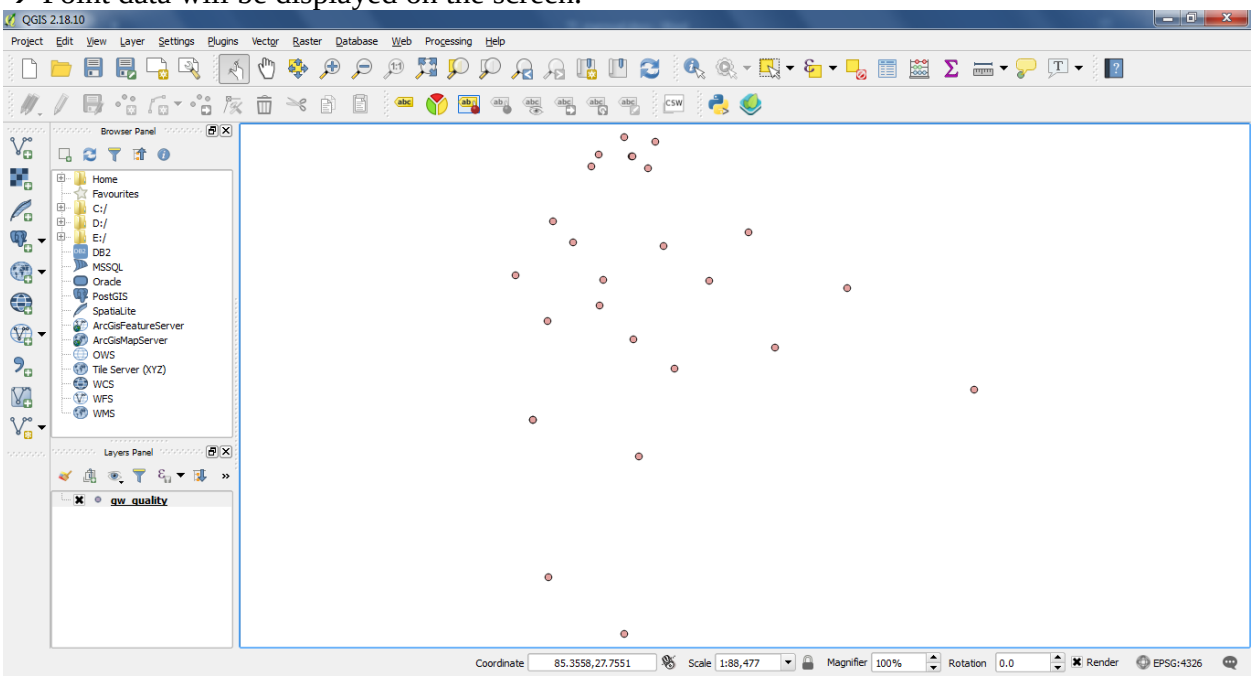


Select X field (column of x-coordinates)
Select Y field (column of y-coordinates)
*** In this tutorial, X field = “Lon”, Y field = “Lat”**

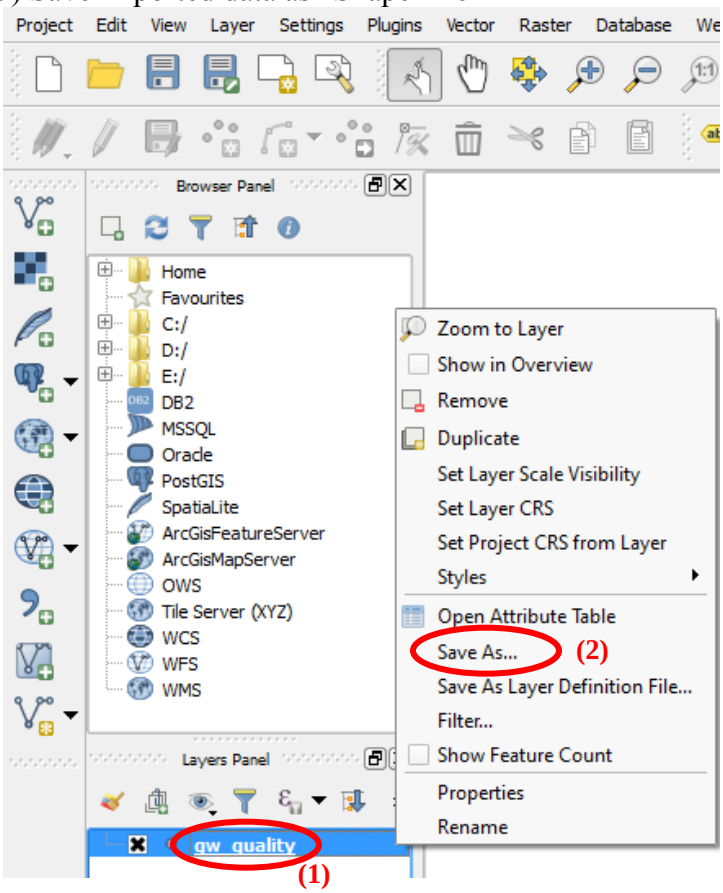
→ Set Coordinate Reference System as “WGS84” (see below) → “OK”



→ Point data will be displayed on the screen.



5) Save imported data as “Shape File”

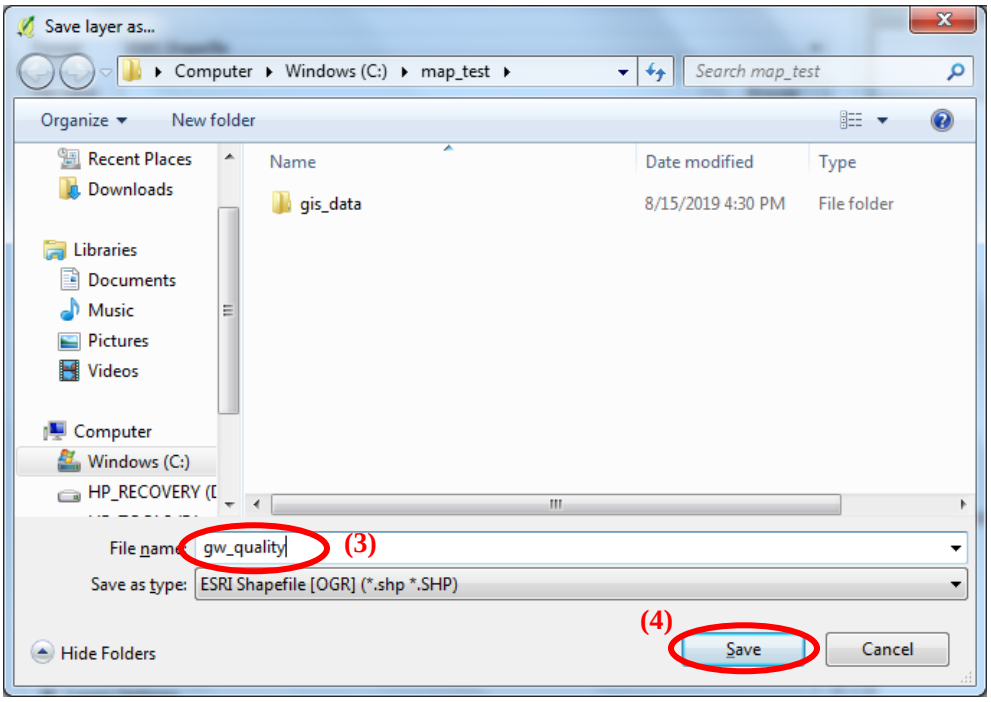


(1) Click right button of mouse on the layer name

(2) Select “Save AS”

(3) Set location (folder) and file name.
(“c:\map_test\gw_quality” for this tutorial)

(4) Clilck “Save”

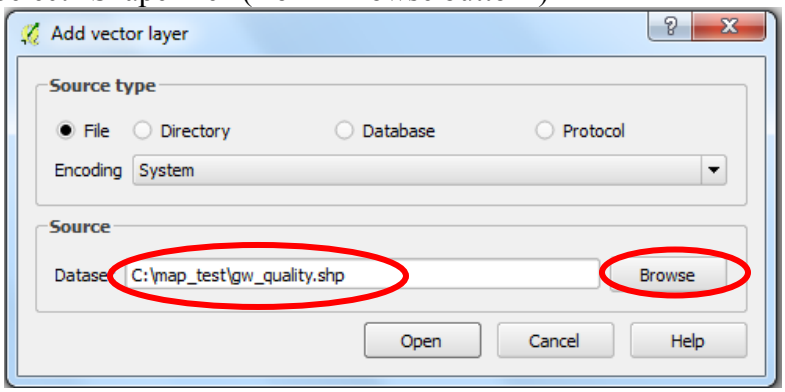


2.2 Create Map from point data

1) Start QGIS Desktop

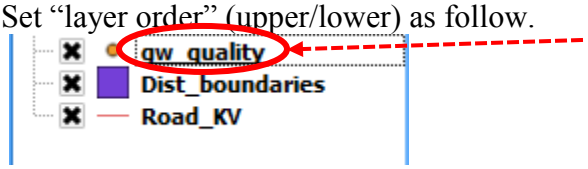
2) Click “Add vector layer”  from Tool Bar on the left side of screen

3) Select “Shape file” (from “Browse button”)



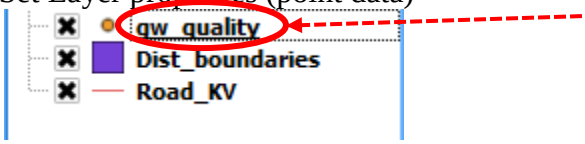
*for this tutorial, select (open) following files
- C:\map_test\gw_quality.shp (created on Section 2.1)
- C:\map_test\gis_data\dist_boundaries.shp
- C:\map_test\gis_data\road_kv.shp

* Set “layer order” (upper/lower) as follow.



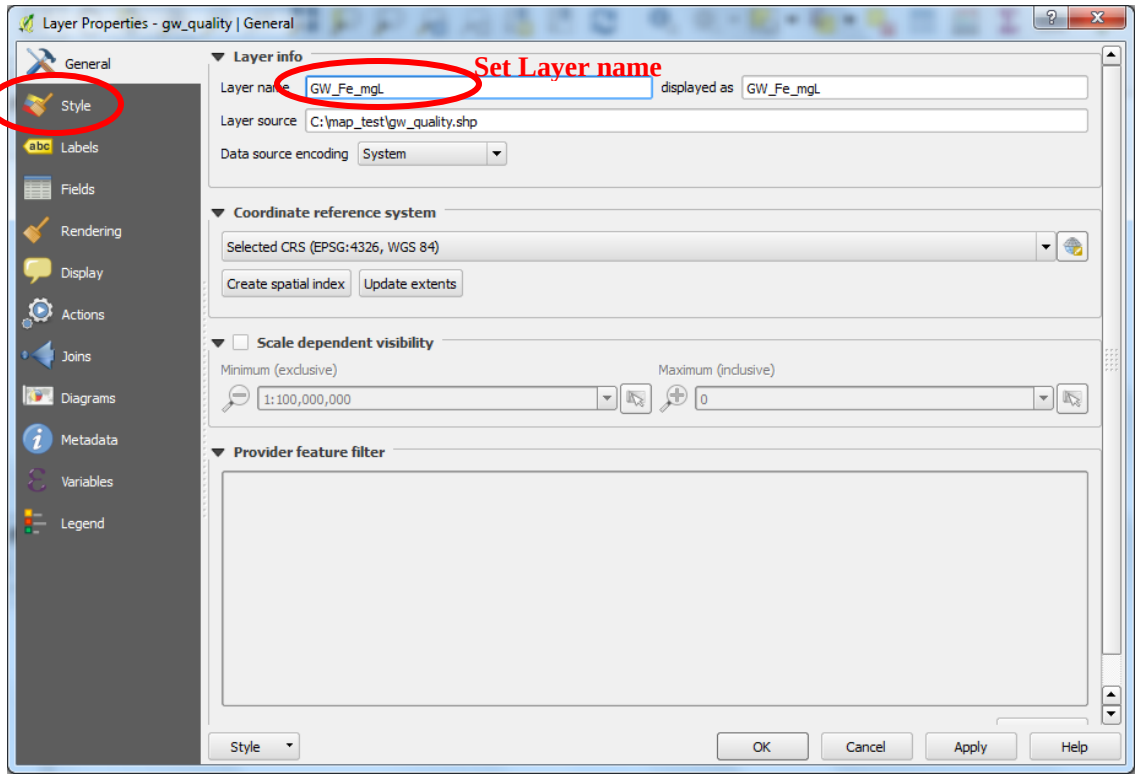
Drag “Layer name” and move up (down) to display this layer on upper (lower)

4) Set Layer properties (point data)

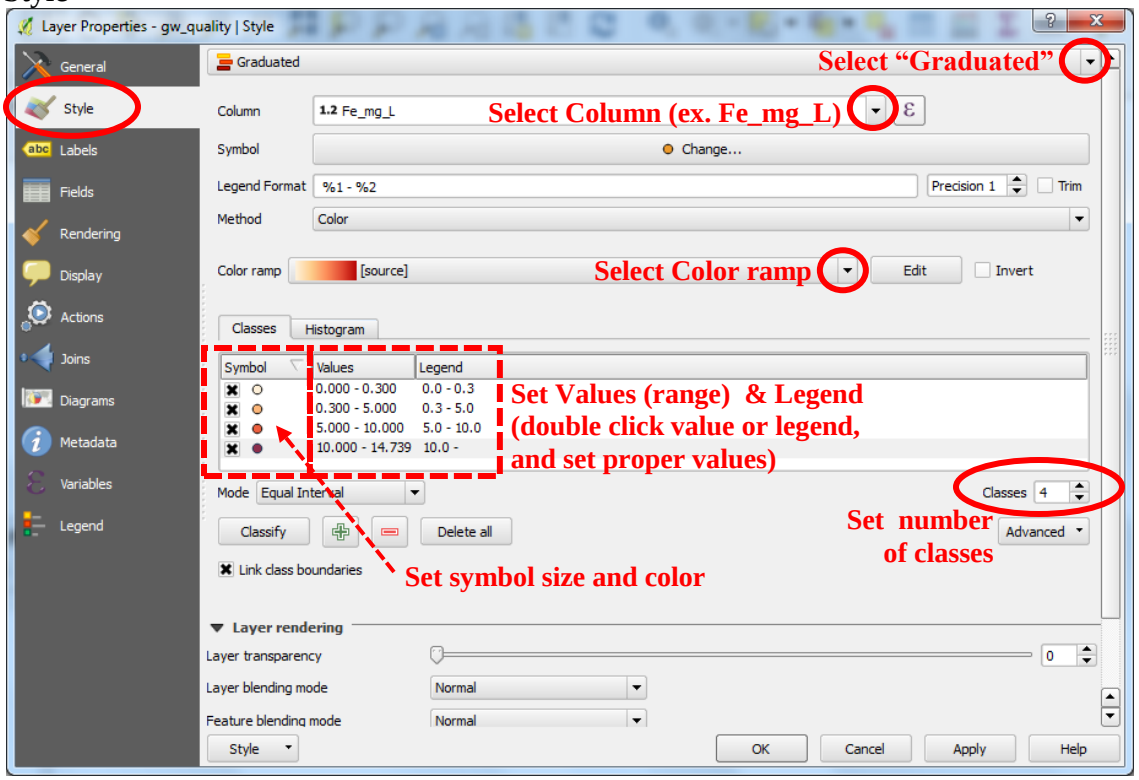


Double click on the layer name → Layer properties window will come up

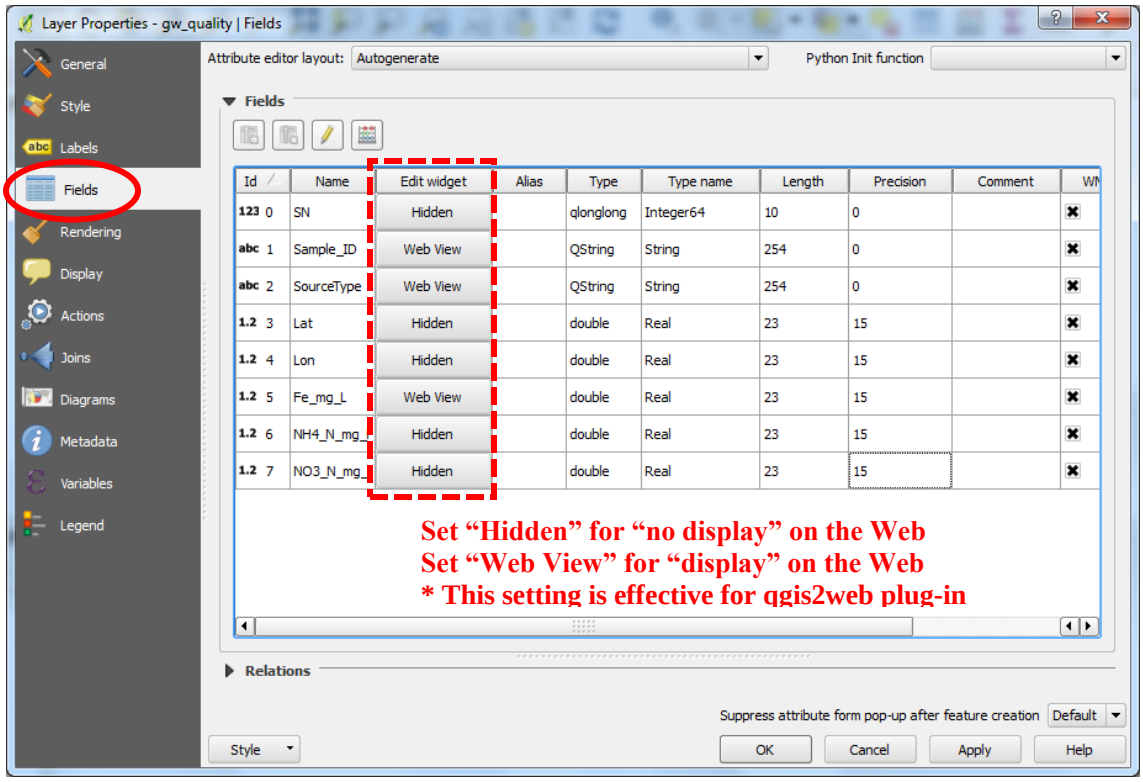
(1) General



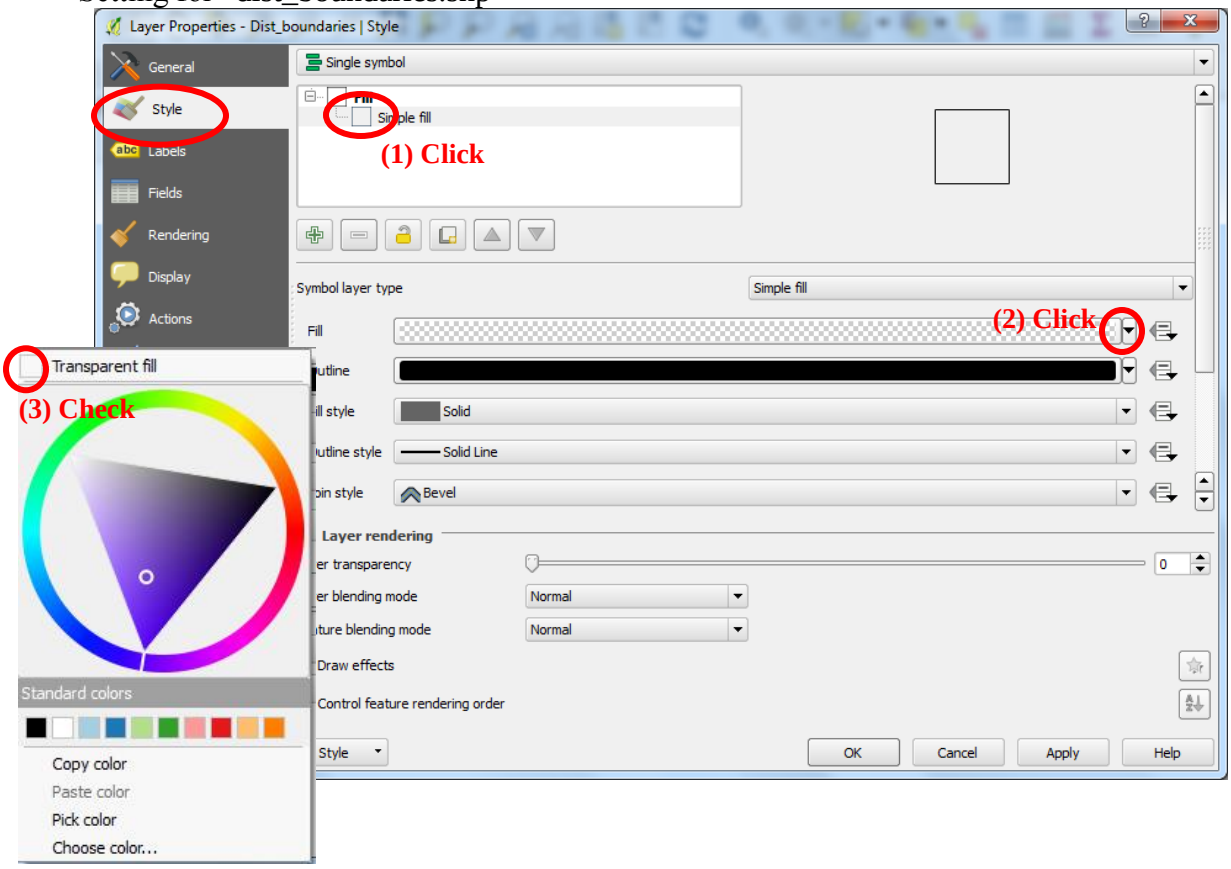
(2) Style



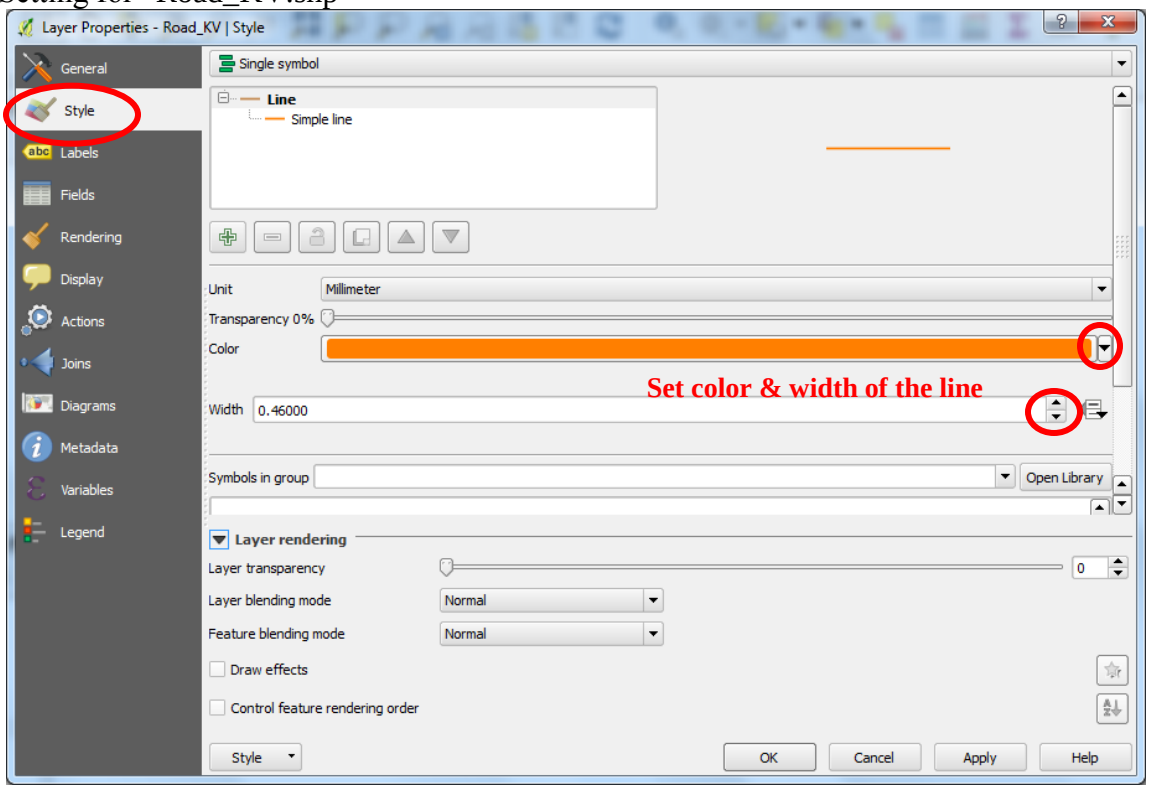
(3) Fields



* Setting for ”dist_boundaries.shp”



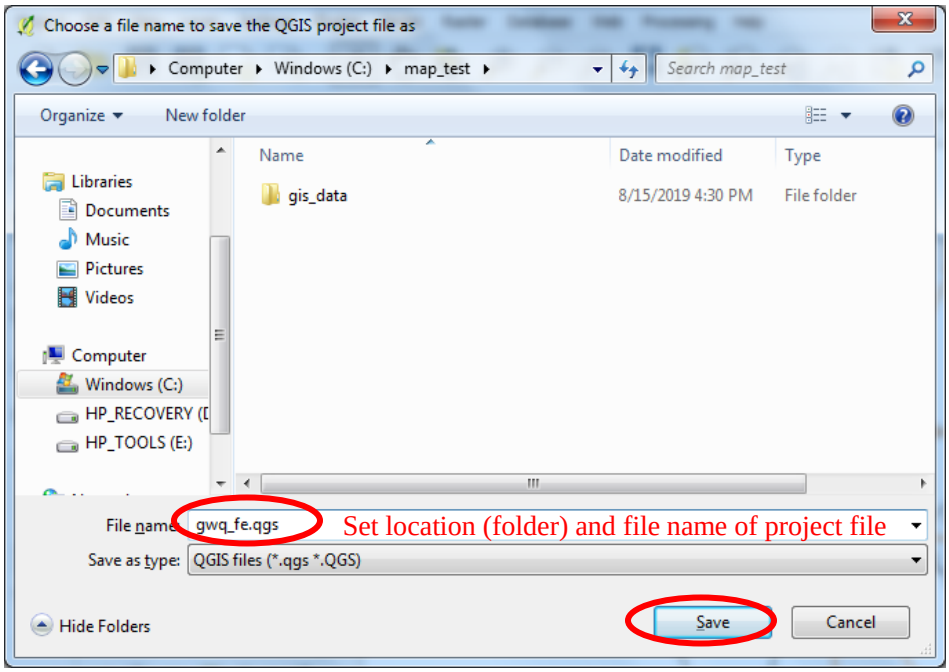
* Setting for ”Road_KV.shp”



5) Save map as “Project”

“Project” menu on the top/ “Save As”

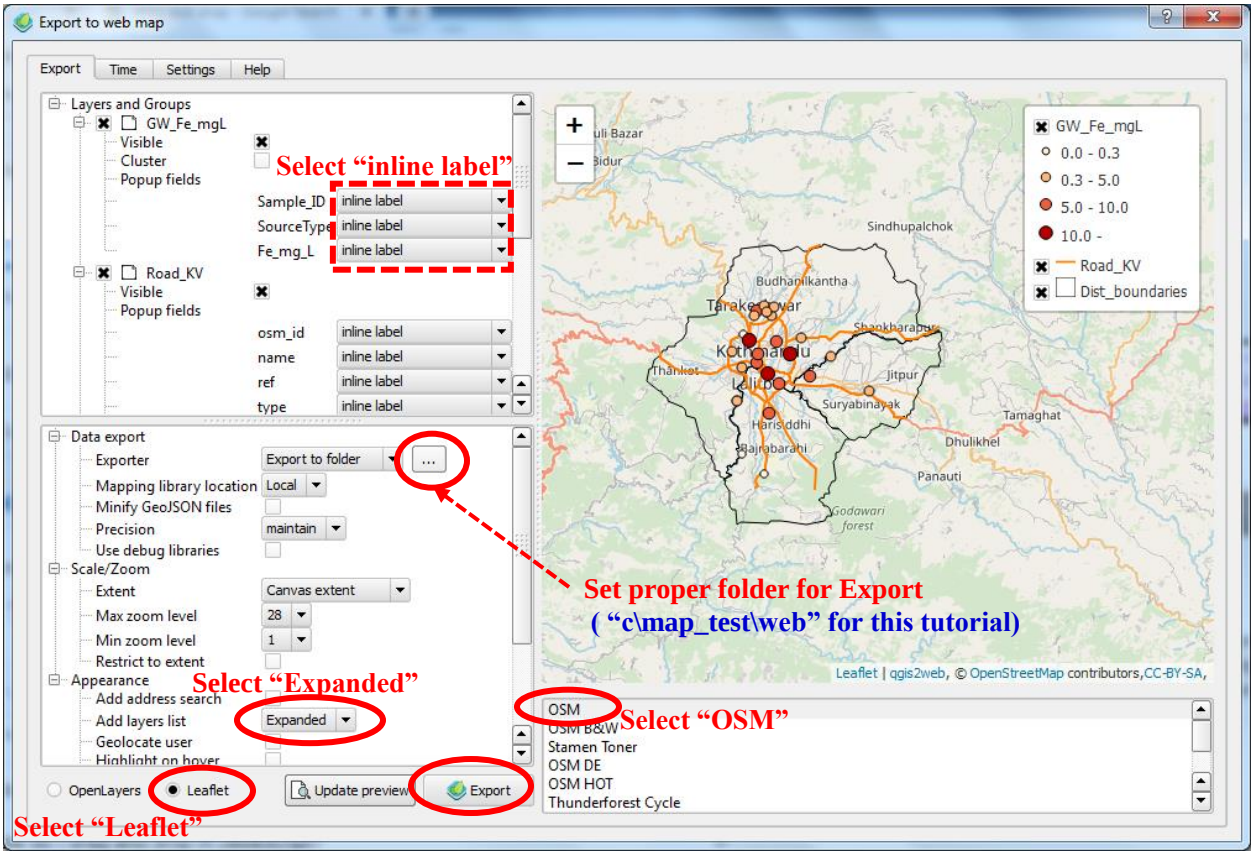
→



2.3 Web mapping with QGIS2Web (Point data)

1) Create folder for export (“c\map_test\web” for this tutorial)

2) “Web” menu on the top / “qgis2web” / “create web map”
→



3) Click “Export”

4) Rename the folder “qgis2web_2019_...” in Export folder (**“c\map_test\web” for this tutorial**)
(ex. “gw_Fe”)

3. Mapping of water related information (Polygon data)

3.1 Create Polygon data (Shape file format)

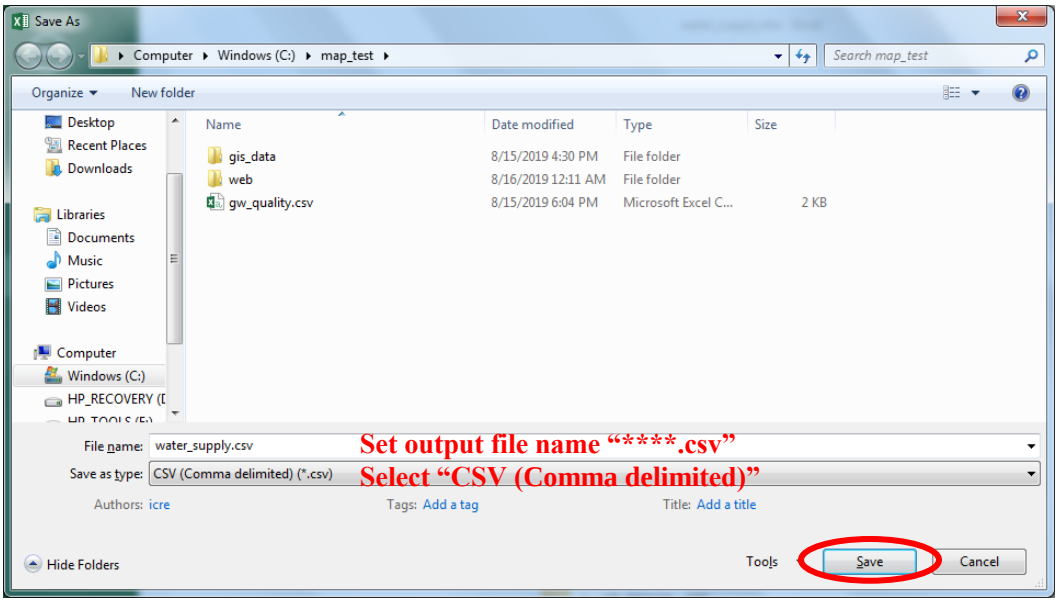
If you would like to creating a new vector dataset (Line, polygon), see below:
https://docs.qgis.org/2.8/en/docs/training_manual/create_vector_data/create_new_vector.html

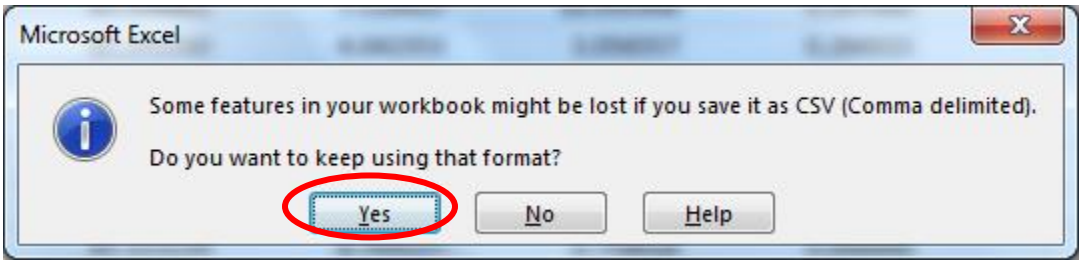
Sample data "c;\map_test\gis_data\service_area.shp" is available for this tutorial.

3.2 Create attribute data from Excel file

1) Create data in Excel file (You can use "c;\map_test\water_supply.xlsx" for tutorial)
* The 1st line should be "label" of each item (column).

2) Save data as "csv" format
Open the file on MS-Excel → "File" menu on the top-left / select "Save As"
→ select folder as "map_test" (for tutorial)
→ set "Save as Type": CSV (Comma Delimited) & put "Fine name" → "Save"



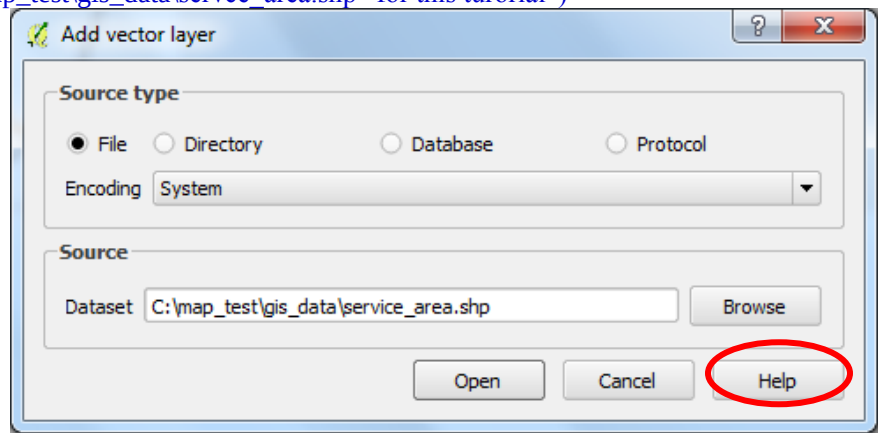


3.3 Join attribute file with shape file

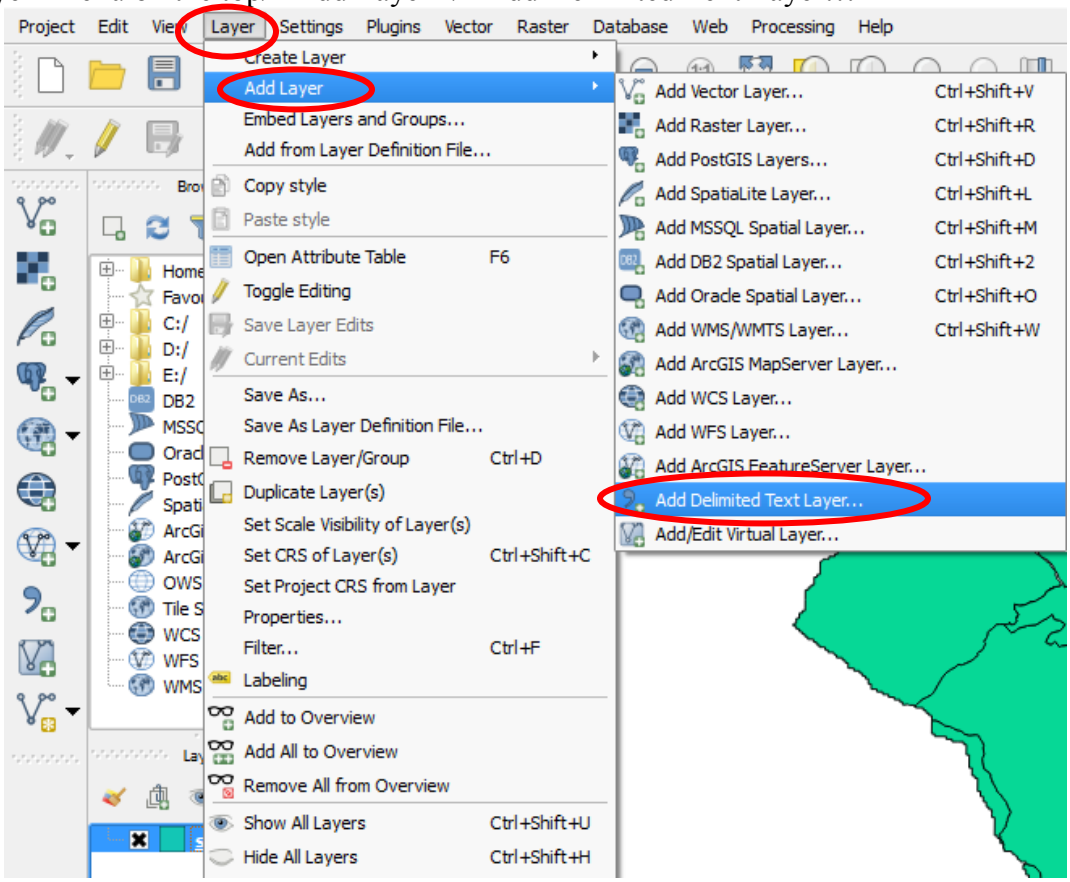
1) Start QGIS Desktop

2) Click “Add vector layer” from Tool Bar on the left side of screen

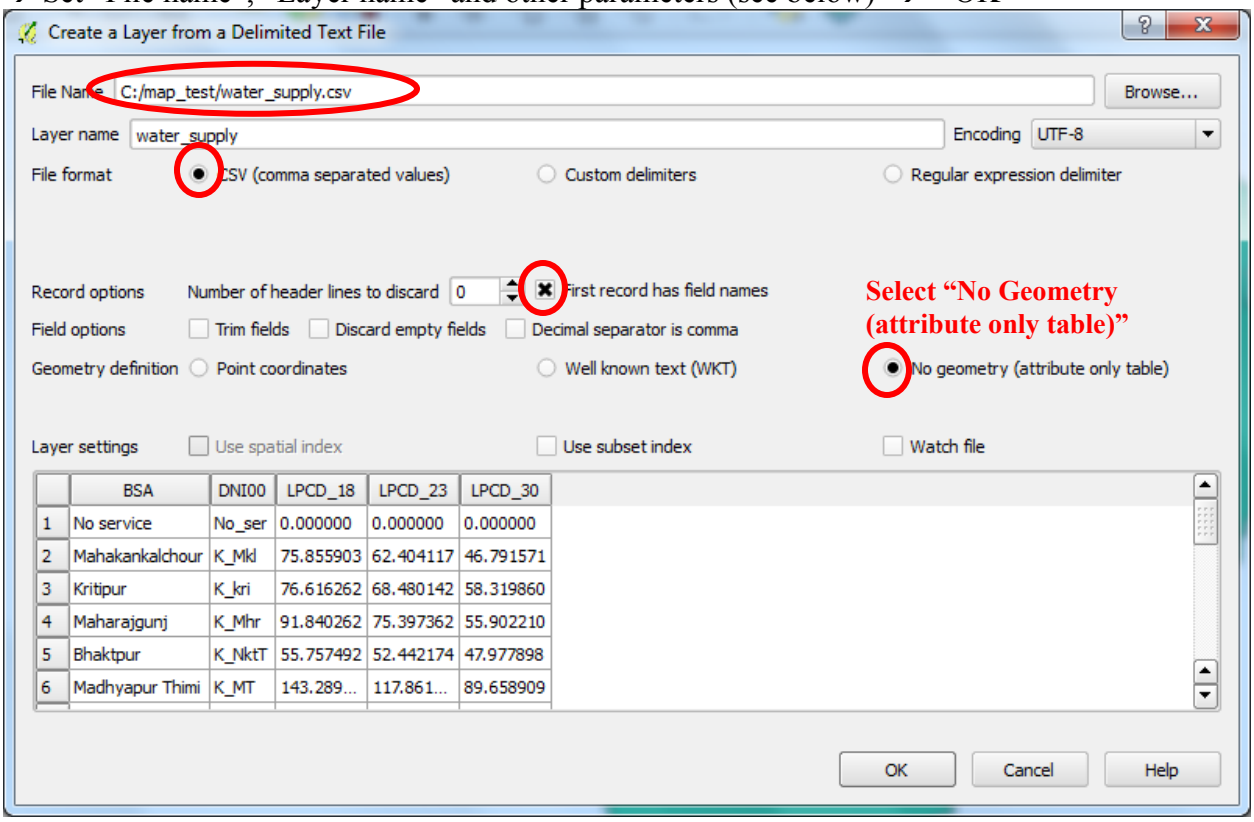
3) Select “Shape file” (from “Browse button”)
(select “c:\map_test\gis_data\servce_area.shp” for this turorial”)



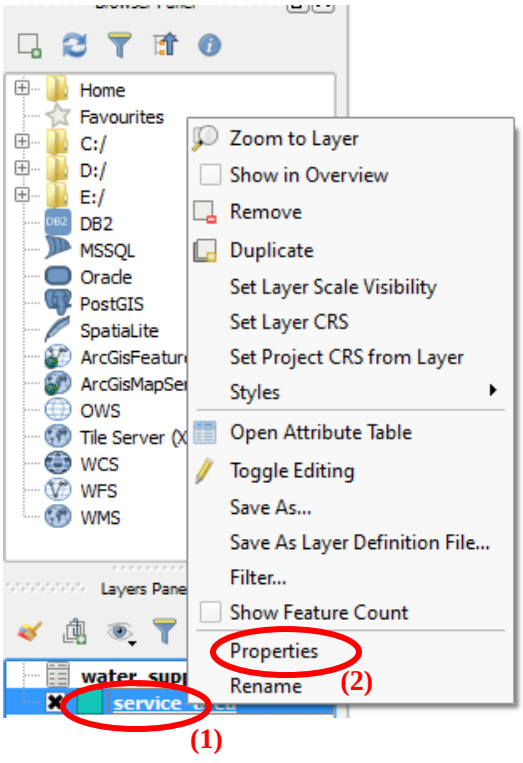
4) Open attribute file (see section 3.2)
“Layer” menu on the top/ “Add Layer” / “Add Delimited Text Layer…”



→ Set “File name”, “Layer name” and other parameters (see below) → “OK”



5) Add attributes with Shape file



(1) Click right button of mouse on the layer name

(2) Select “Properties”

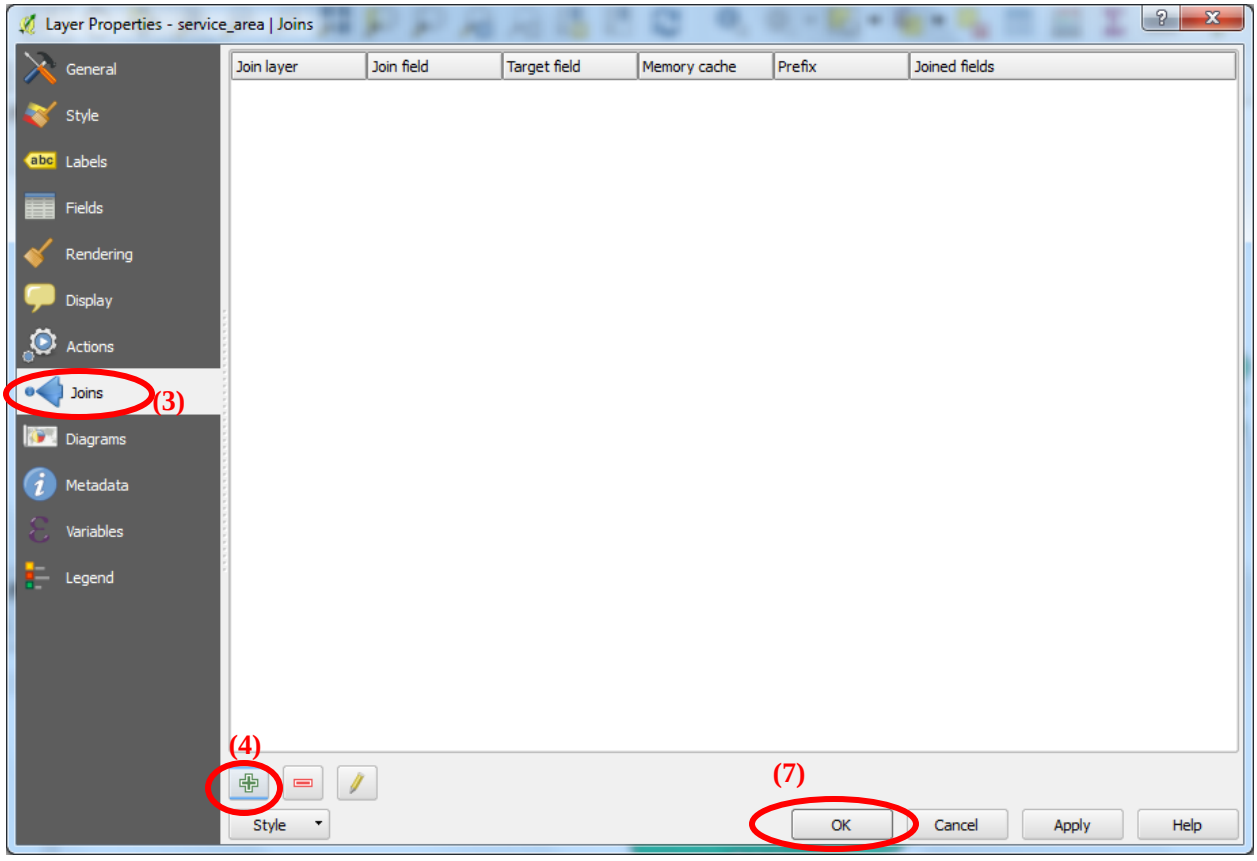
(3) Select “Join”

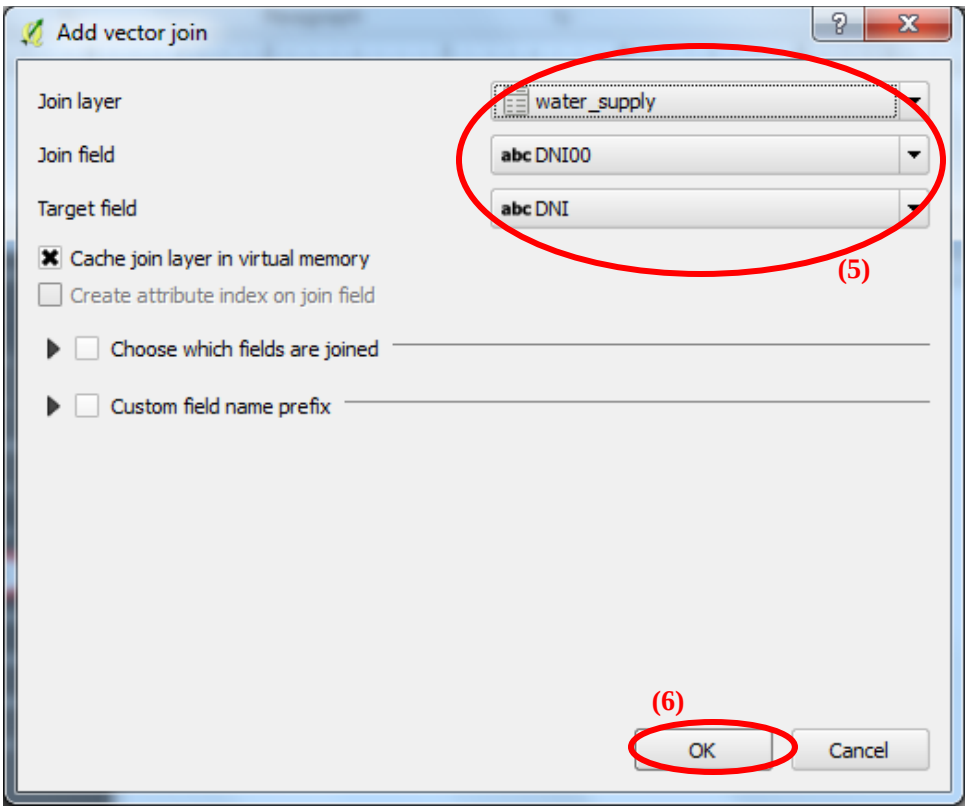
(4) Click 

(5) Set “Join Layer” (attribute file) (“c:\map_test\water_supply.csv” for tutorial) and select “Key”, where key is the common data (column) in Shape file and attribute file. (“DNI00” in attribute file and “DNI” in shape file are the key for tutorial)

(6) Click “OK”

(7) Click “OK”


Layer Properties - service_area | Joins
General
Style
Labels
Fields
Rendering
Display
Actions
Joins
(3)
Diagrams
Metadata
Variables
Legend
Join layer
Join field
Target field
Memory cache
Prefix
Joined fields
(4)
(7)
Style
OK
Cancel
Apply
Help


Add vector join
Join layer
water_supply
Join field
abc DNI00
Target field
abc DNI
(5)
Cache join layer in virtual memory
Create attribute index on join field
Choose which fields are joined
Custom field name prefix
(6)
OK
Cancel

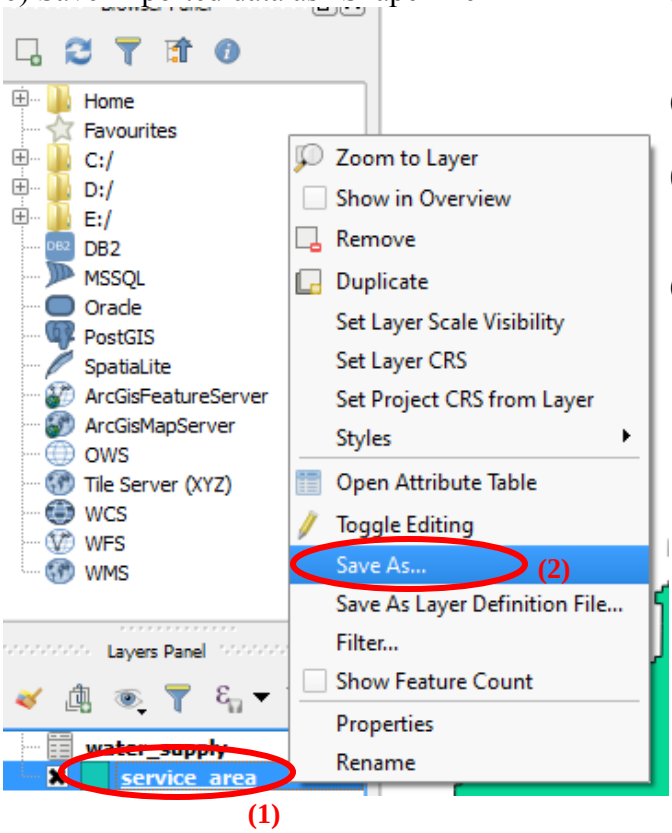
6) Save imported data as “Shape File”

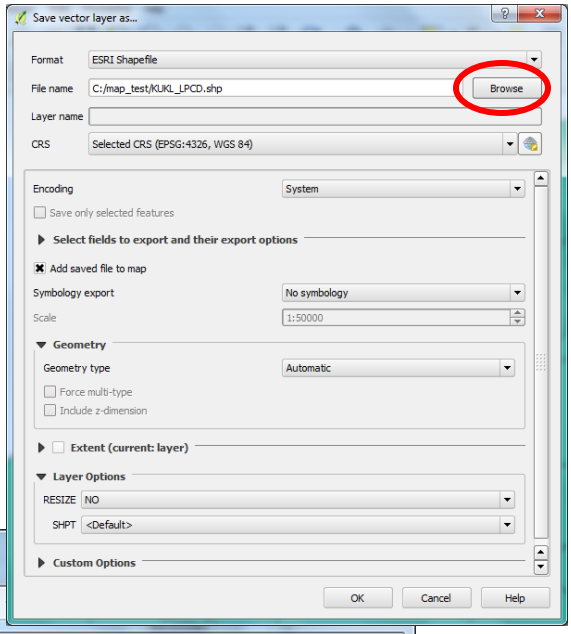
(1) Click right button of mouse on the layer name

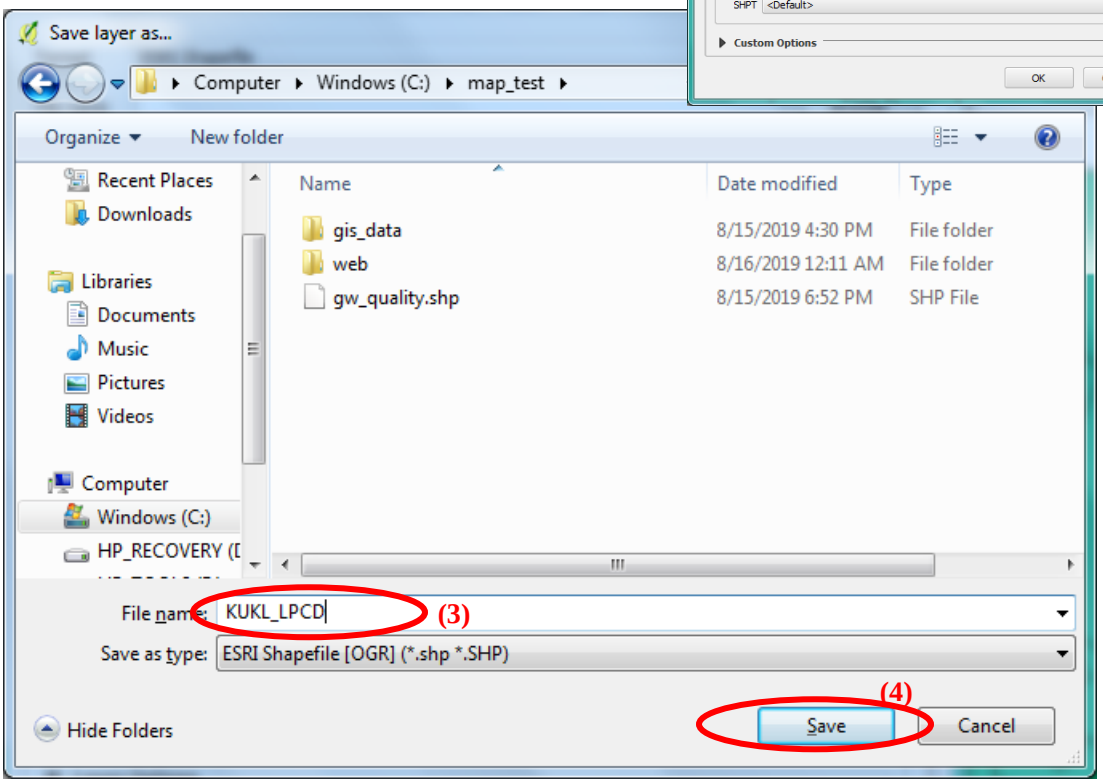
(2) Select “Save AS”

(3) Set location (folder) and file name. (“c:\map_test\KUKL_LPCD” for tutorial)

(4) Clilck “Save”





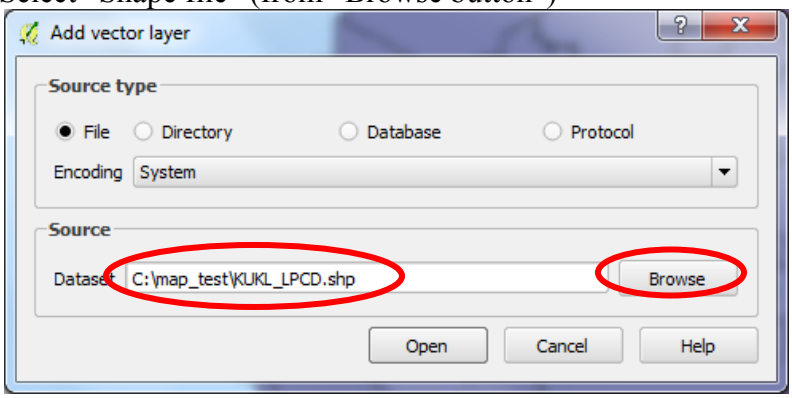


3.4 Create Map from polygon data

1) Start QGIS Desktop

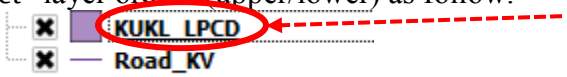
2) Click “Add vector layer”  from Tool Bar on the left side of screen

3) Select “Shape file” (from “Browse button”)



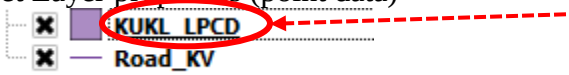
*for this tutorial, select (open) following files
- C:\map_test\KUKL_LPCD.shp (created on Section 3.3)
- C:\map_test\gis_data\road_kv.shp

* Set “layer order” (upper/lower) as follow.



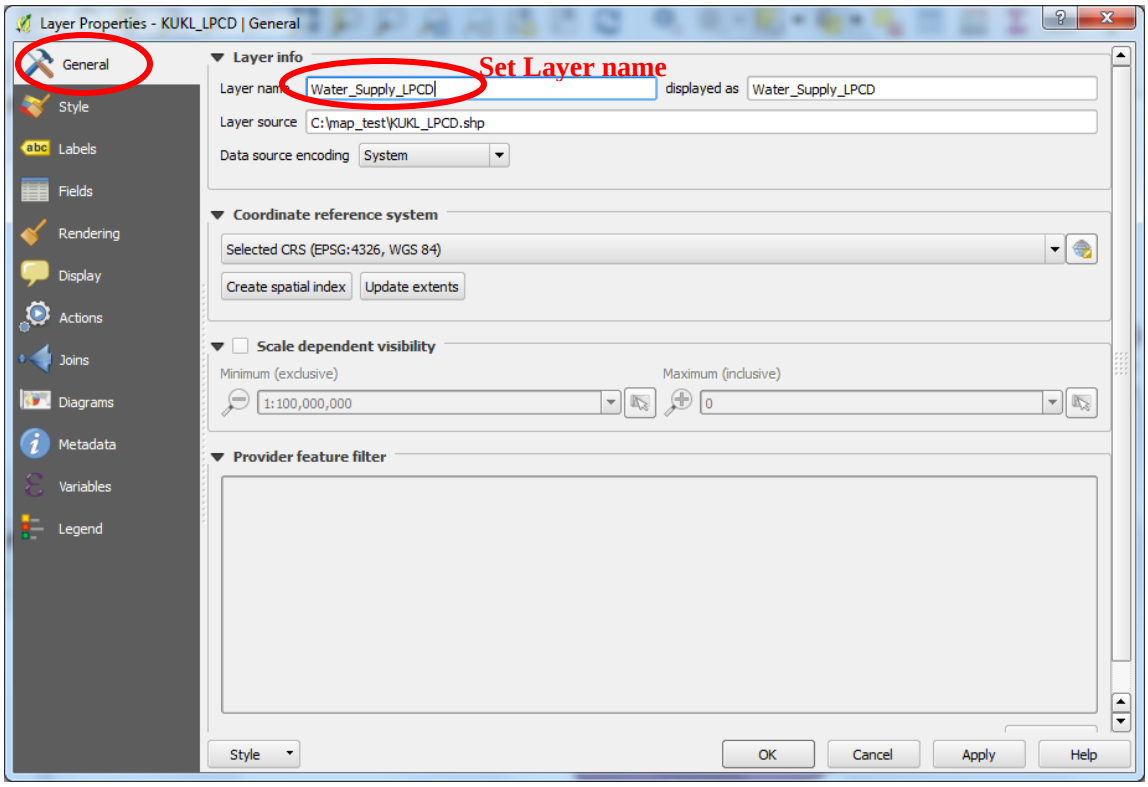
Drag “Layer name” and move up (down) to display this layer on upper (lower)

4) Set Layer properties (point data)

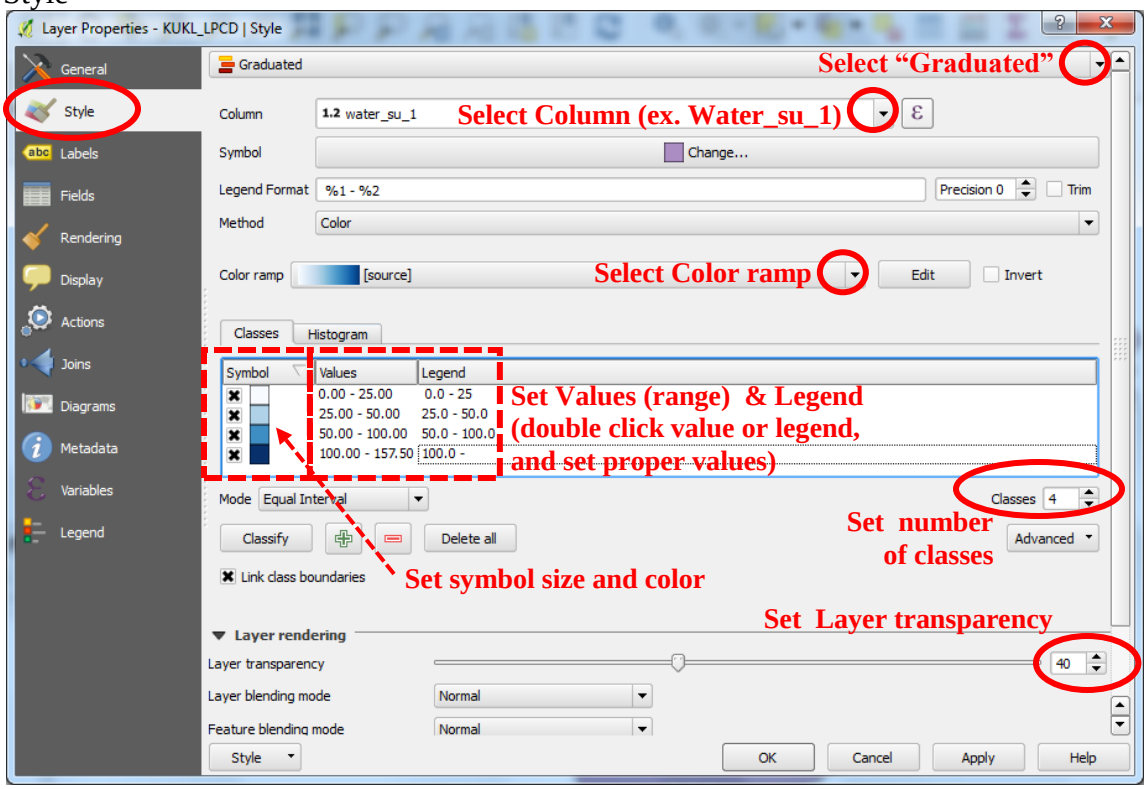


Double click on the layer name → Layer properties window will come up

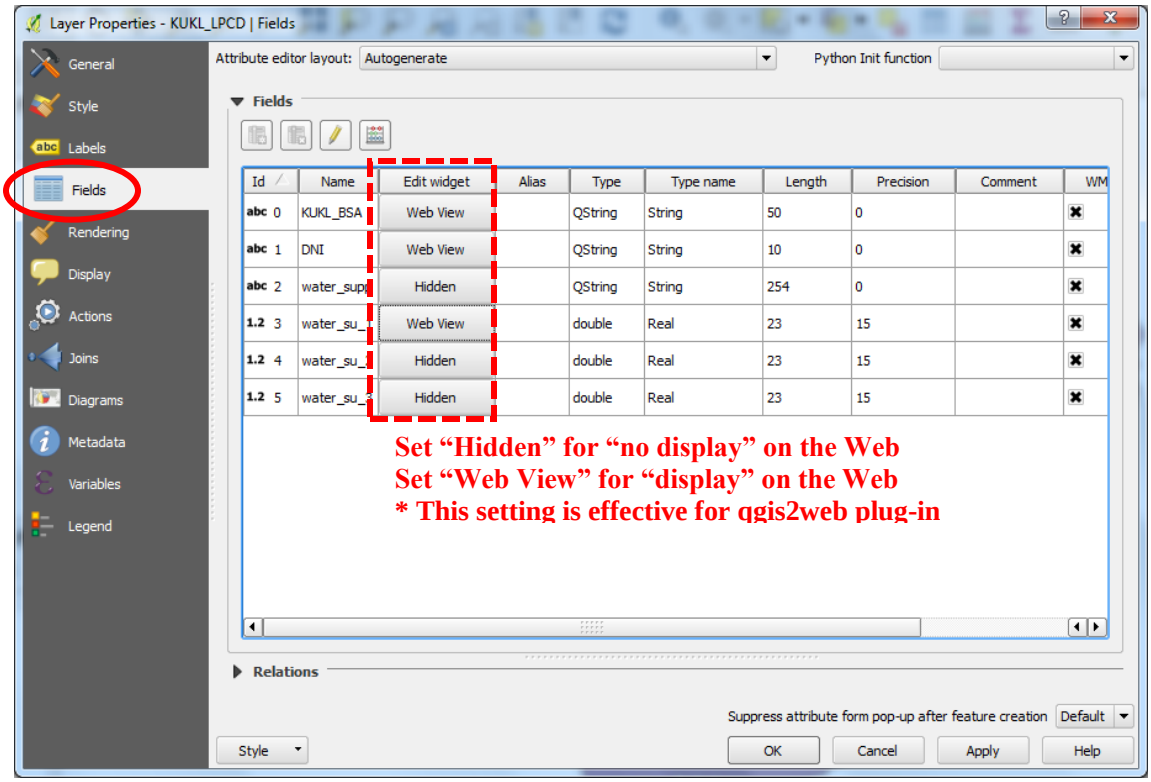
(1) General



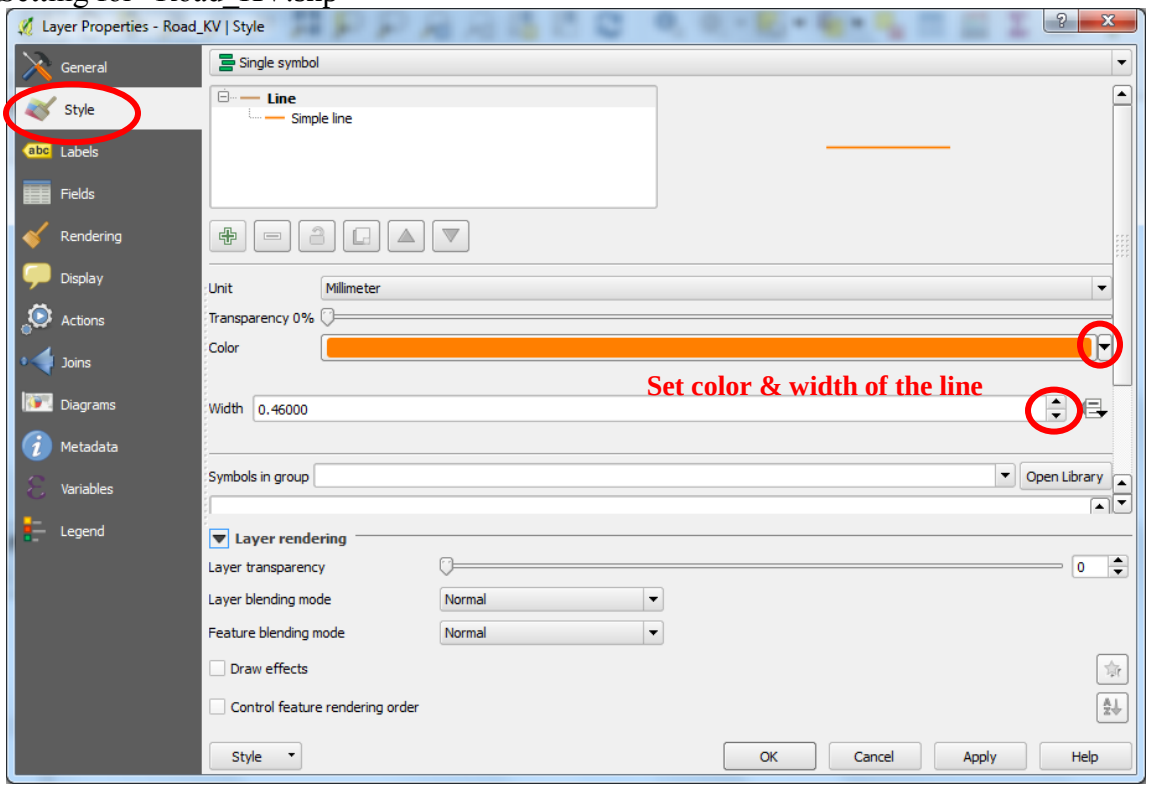
(2) Style



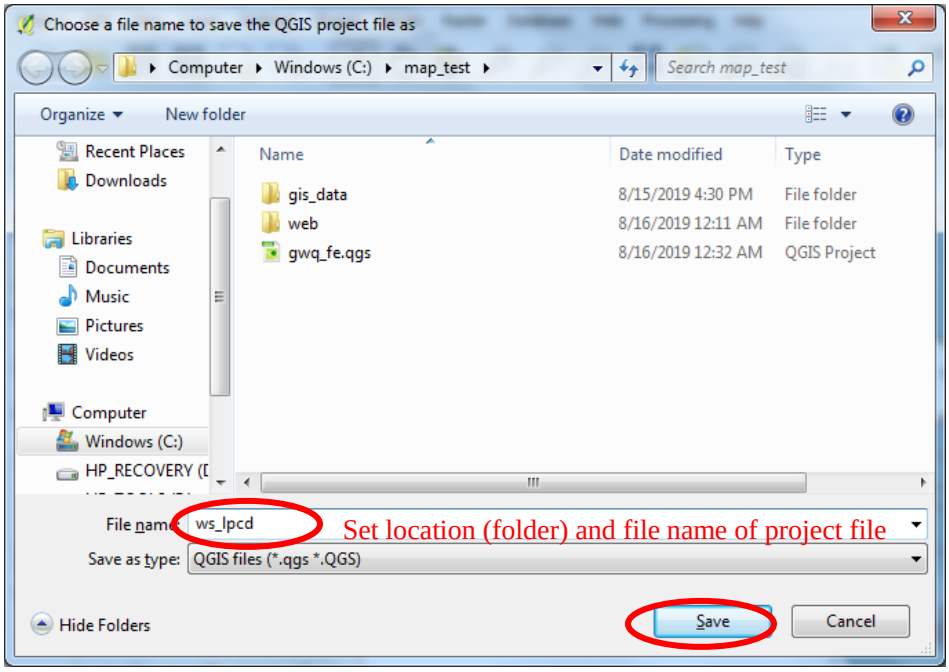
(3) Fields



* Setting for ”Road_KV.shp”



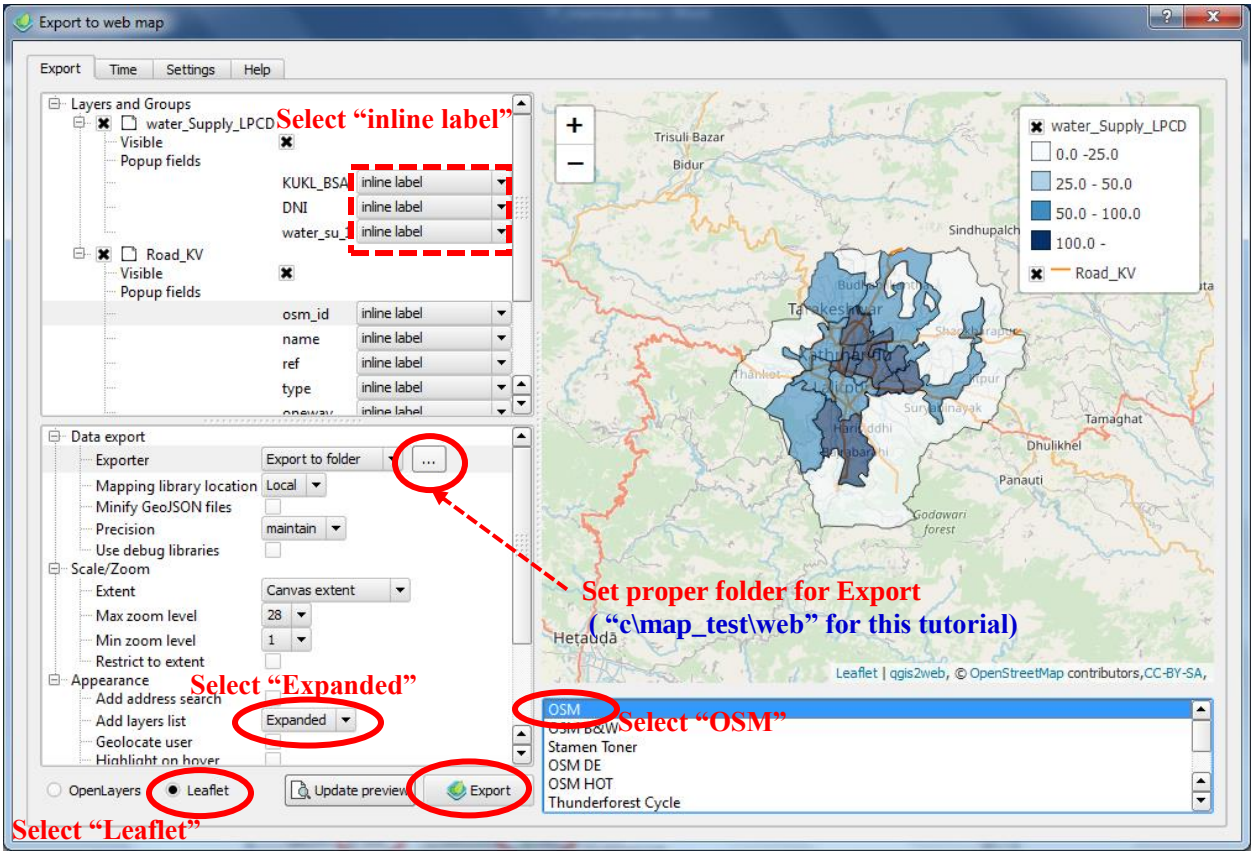
5) Save map as “Project”
“Project” menu on the top/ “Save As”
→



3.5 Web mapping with QGIS2Web (Polygon Data)

1) Create folder for export ("c\map_test\web" for this tutorial)

2) "Web" menu on the top / "qgis2web" / "create web map"
→

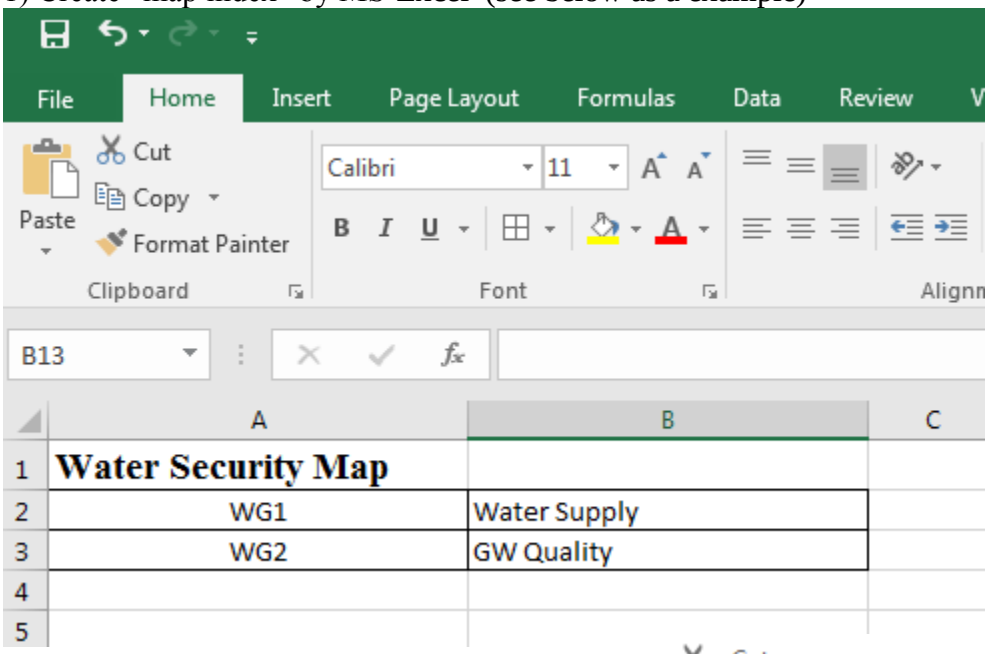


3) Click "Export"

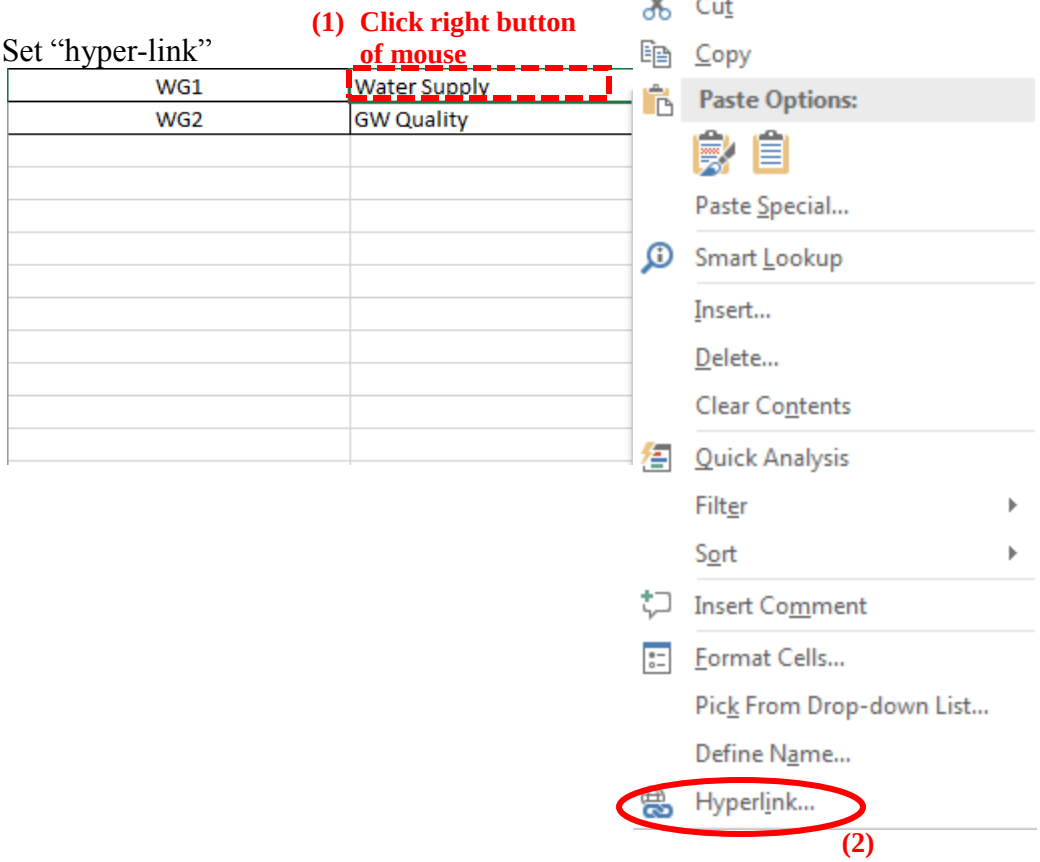
4) Rename the folder "qgis2web_2019_..." in Export folder (**"c\map_test\web" for this tutorial**)
(ex. "WS_LPCD")

4. Create map index

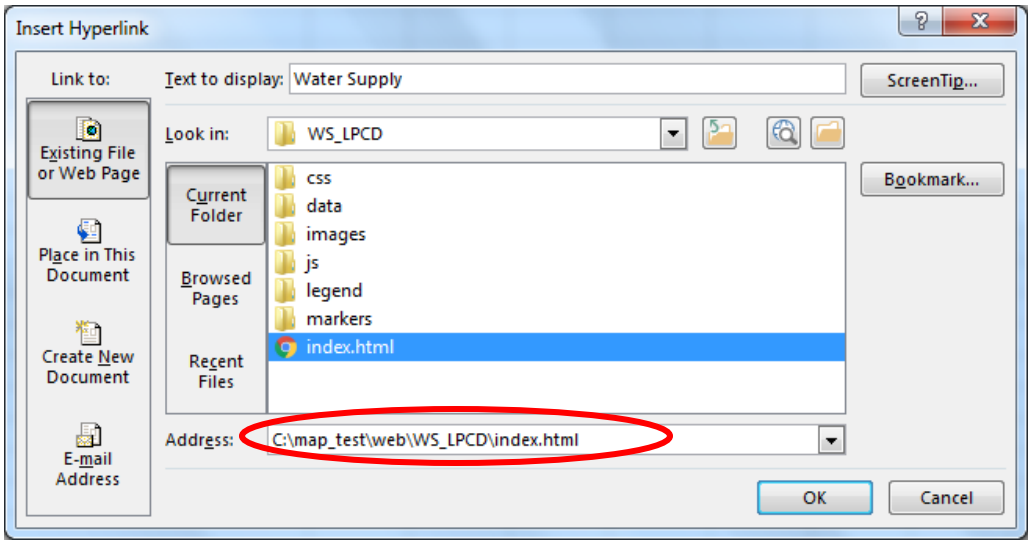
1) Create “map index” by MS-Excel (see below as a example)



2) Set “hyper-link”



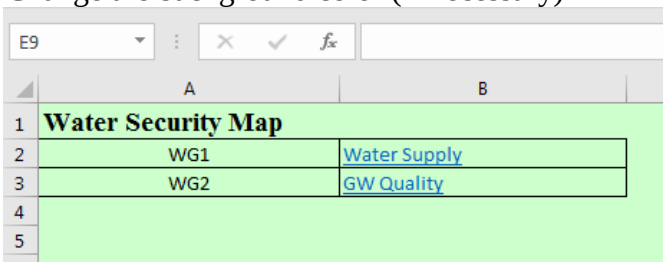
3) Set address



* Link the cell "Water Supply" with "c:\map_test\web\WS_LPCD\index.html" for this tutorial.

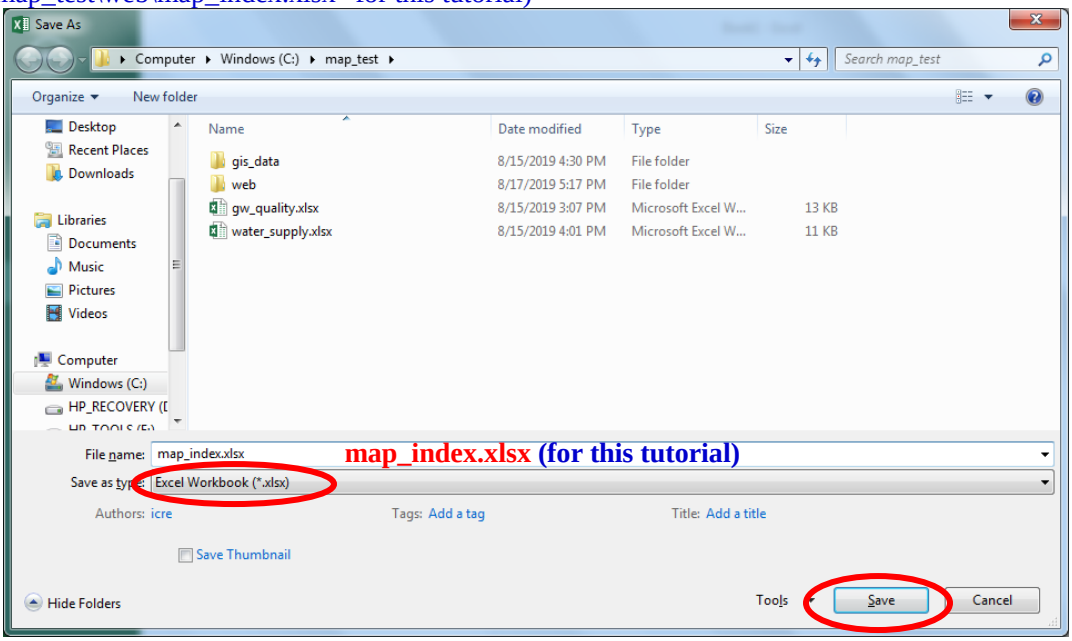
* Same for the cell "GW Quality" with "c:\map_test\web\gw_Fe\index.html"

4) Change the background color (if necessary)



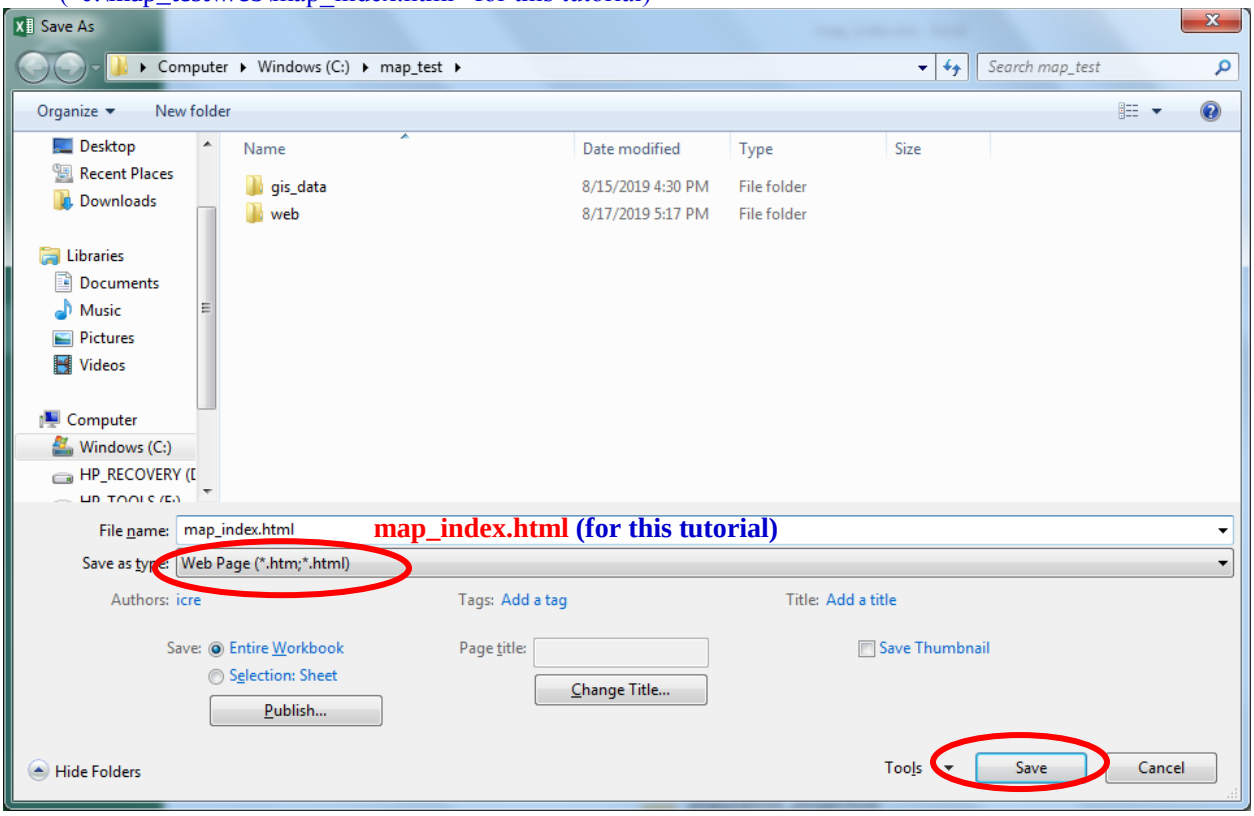
5) Save the file as MS-Excel format

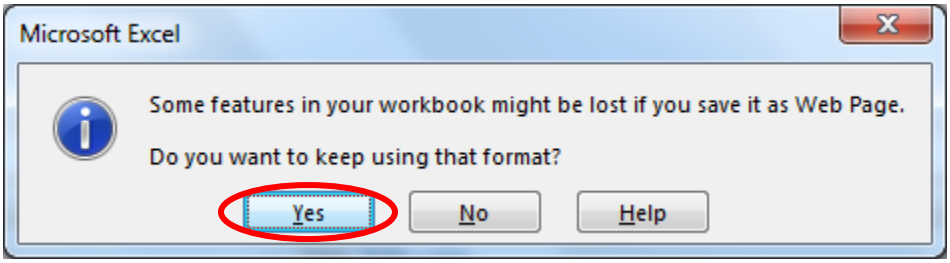
("c:\map_test\web\map_index.xlsx" for this tutorial)



6) Save the file as html (Web page) format

("c:\map_test\web\map_index.html" for this tutorial)





5. Upload files to web server

5.1 Installation of ftp (scp) client software

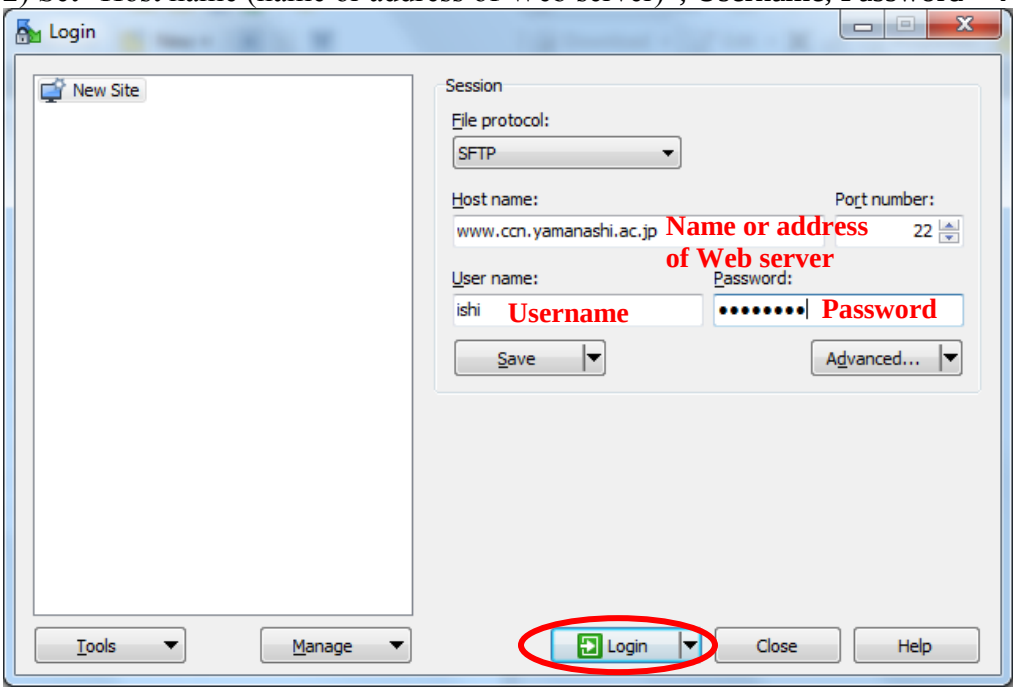
1) Download “WinSCP” installation file from https://winscp.net/eng/download.php

2) Install WinScp (Double click on the downloaded file (ex. WinSCP-5.15.3-Setup.exe))

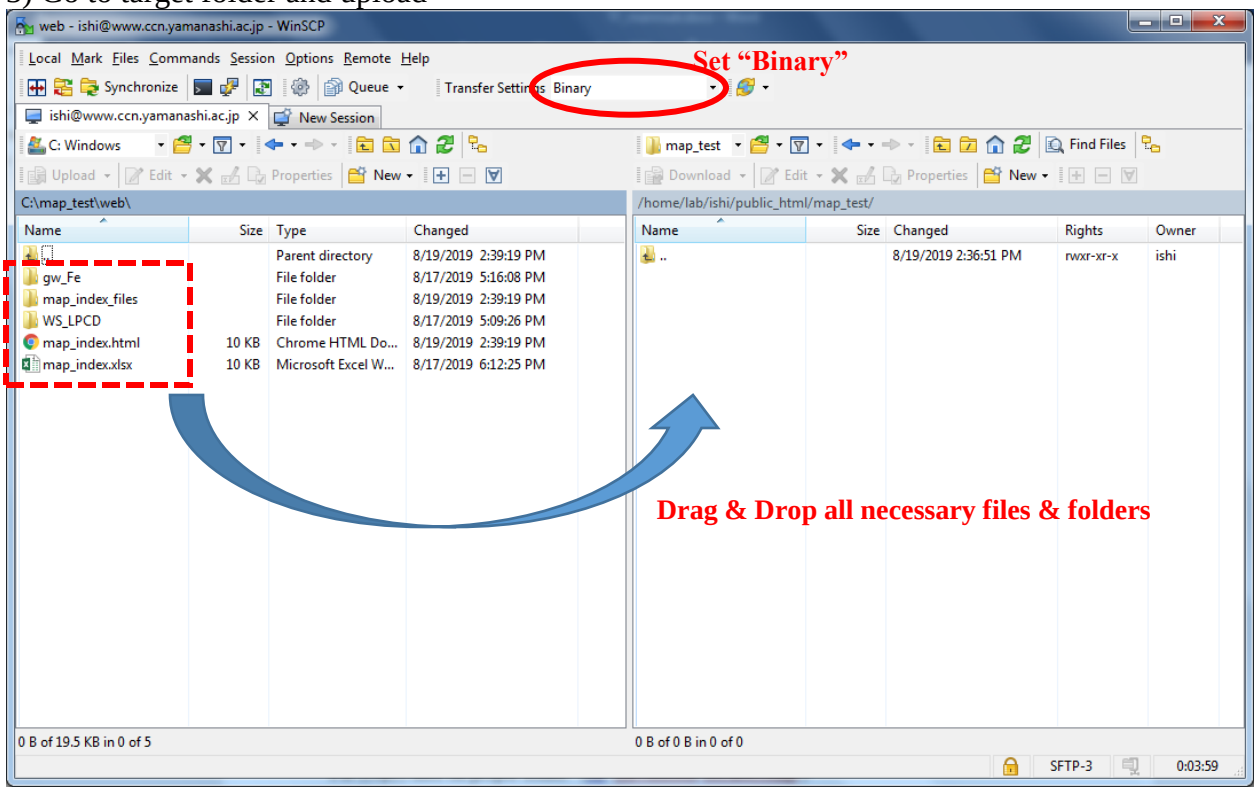
5.2 Upload

1) Start WinScp

2) Set “Host name (name or address of Web server)”, Username, Password → Login



3) Go to target folder and upload



*If Web-server is running on Windows system, you can directly put (copy) all necessary files & folders into proper folder. (ex. ServerRoot/map_test/)