

# Water Supplies

Rain Water Harvesting has been practiced throughout the world for thousands of years. Rain Water Harvesting (RWH) is a sustainable, ecologically friendly, and cost efficient resource that provides clean potable water for human use and consumption. Using RWH techniques benefit those especially in third world or developing countries and regions where municipalities, sewer lines, and potable water is not readily available. Rain water is a natural resource and it is available for everyone to utilize for their own benefits. By utilizing simple technologies and available resources, clean water supplies can be available to everyone.

\*RWH requires 300mm of annual rainfall per year to be operable. Water basins need to be sized according to personal needs.

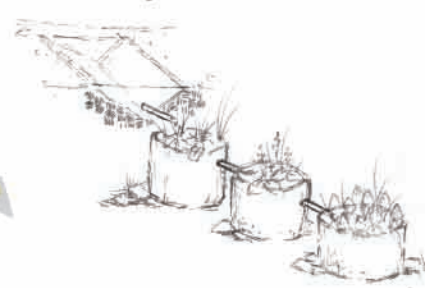
## Rain Water Harvesting as Renewable Technology

RWH can be recycled after use in a home and used for agriculture.

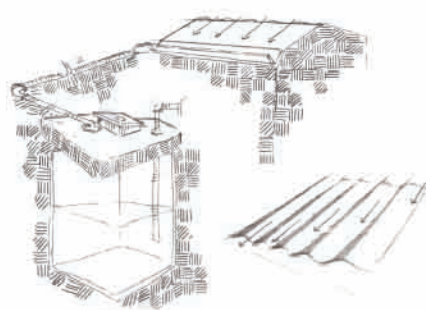


individual level

After water is collected from the fields, RWH can be filtered through a living machine and used once again.



"Living Machine"



agricultural level

Runoff from agricultural fields can be filtered and reused once again.

## Sumatra's Average Annual Rainfall Statistics

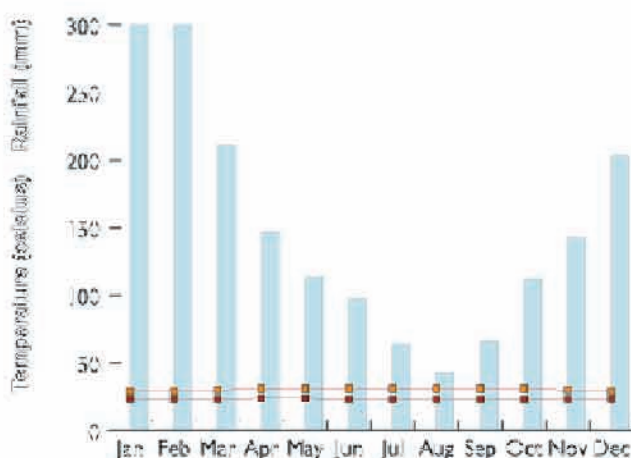
Indonesia Data (Average monthly totals) 2004

| Month     | J   | F   | M   | A   | M   | J   | J   | A   | S   | O   | N   | D   |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Rain (mm) | 610 | 510 | 330 | 280 | 260 | 180 | 200 | 230 | 220 | 270 | 360 | 460 |
| Temp (°C) | 26  | 26  | 27  | 27  | 27  | 28  | 27  | 28  | 27  | 27  | 26  | 26  |

\*Information obtained from <http://www.burford.oxon.sch.uk>

Indonesia lies within zone AEZ 3 according to (WMO) the World Meteorological organization, this is characterized as warm humid tropics. Most of Indonesia has a moist tropical climate, with abundant rains and high temperatures. Annual rainfall ranges from 1000 to more than 5000 mm/yr, with more than 90% of the country receiving average rainfall of more than 1500 mm. December, January, and February are the months with highest rainfall.

## Indonesia's Monsoon Season Statistics



Monsoon Seasons bring great torrential rains through Indonesia. These seasons are typically found between the months of November through to March. With large amounts of rain water obtained from monsoons cisterns provide opportunity to capture potable water. The archipelago is alternately dominated by the north monsoon, blowing from China and the north Pacific between November and March, and the south monsoon, blowing from the Indian Ocean and the Australian continent between May and September. Rainfall is heavy and well distributed around the year almost everywhere in Indonesia. Many places have two wetter periods during the passage of the Doldrum belt; but south-facing coasts and islands south of the equator tend to be wetter during the period of the south monsoon, and north-facing coasts and the northern islands are wetter during the period of the north monsoon.

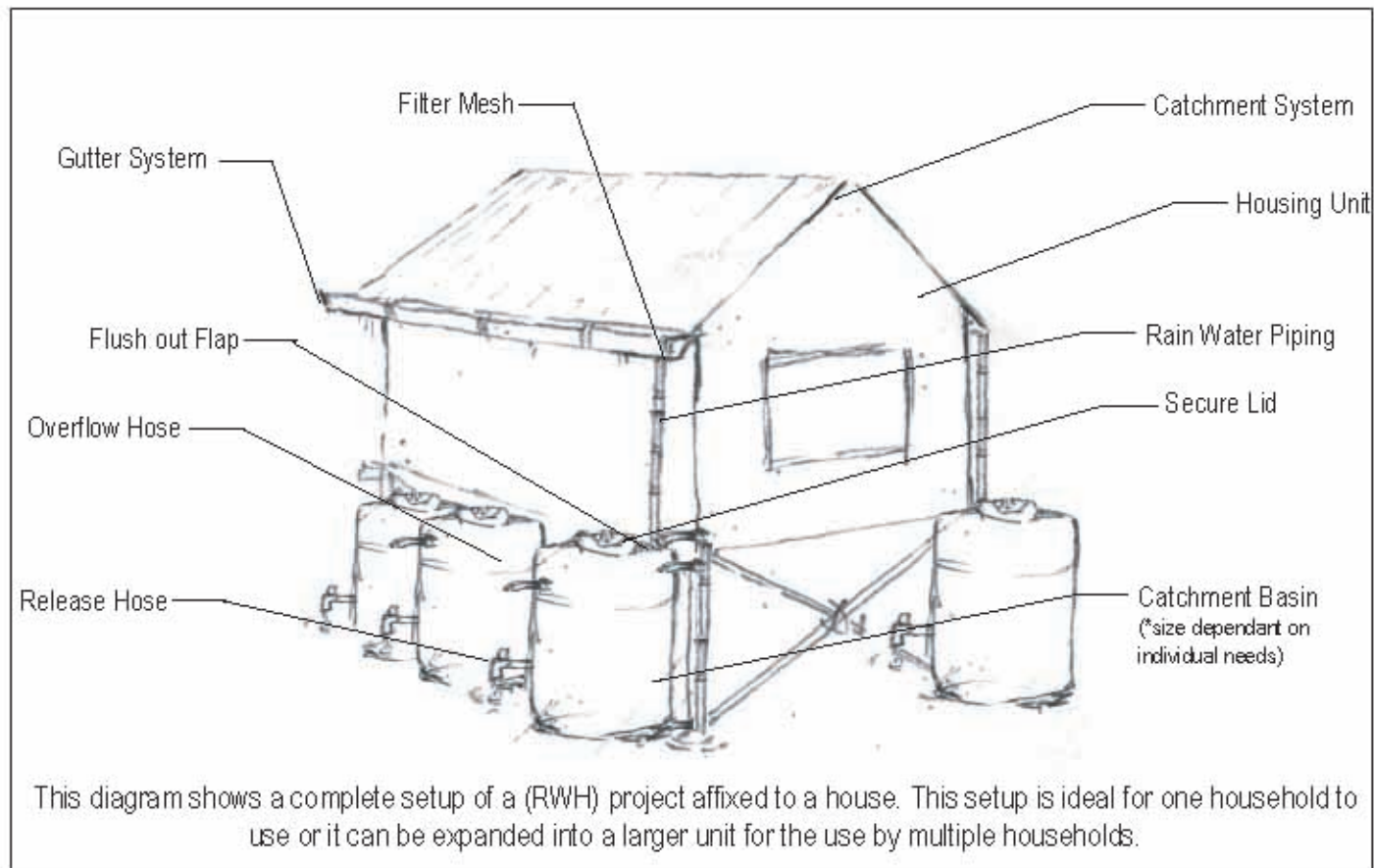


# Water Supplies

## SYSTEMS FOR INDIVIDUAL HOUSES

Rainwater harvesting (RWH), through diverted roof water is a technique which has been adopted in many areas of the world especially where conventional water supply systems have failed to meet the needs of the people. It is a technique which has been used since early civilization and examples of RWH systems can be found throughout history. The complexity of this technique is directly related with available materials within a particular region. Depending on toxicity levels in collected water, rainwater can be a resource for potable drinking water, agriculture and household needs.

materials and components +  
maintenance +  
installation +



### 1. Materials and Components

Materials needed to create this technology include:

- impervious roofing material
- catch basin to hold water
- piping to channel rain water
- secure lid for basin
- water release hose
- impervious piping to channel rain water
- diversion / gutter system to collect rainwater
- catch basin of impervious material to hold water
- overflow nozzle
- optional-filter meshes and flush-lid

Materials can be supplemented with optional materials that are readily available for a given specific region. Factors that determine material includes cost, availability, and durability.

### 2. Maintenance

Annual maintenance is required for durability and care. Keeping this system operable and sanitary is essential if one is to consume from collected water. Maintenance includes a required cleaning of fallen debris and accumulated debris inside basin. Basins can be cleaned with ordinary water or disinfected with a teaspoon of bleach per 50 gallon containment. Roofs need to be swept regularly and gutters clean of dirt, fallen debris, bird droppings and any accumulated foreign objects. (Continued)

# Water Supplies

## SYSTEMS FOR INDIVIDUAL HOUSES (continued)

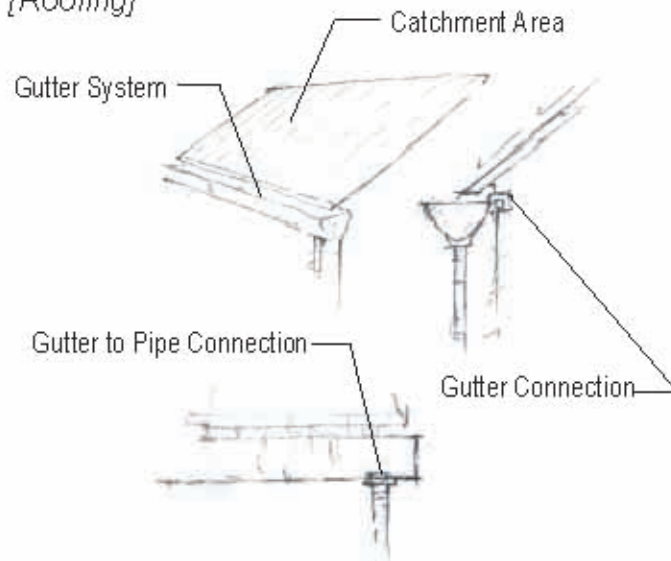
### 3. Installation

-Roofing material needs to be impervious free and clean of debris and preferably paint free or contaminated free. Any undesirable substances needs to be removed.

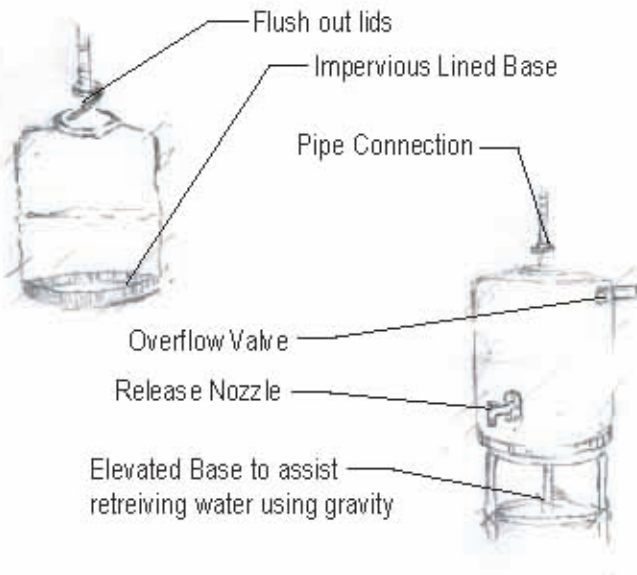
-Gutters need to be fastened and secured to roofs with available material.

-Pipe connection needs to be secured to roof structure and pipes need to be graded for proper drainage towards one direction. Connection pipes need to follow same protocol as roofing materials drainage.

[Roofing]



[Catchment Basin]



-Flush-out lids are optional for (RWH). This option functions as a extra safety mechanisms that diverts initial rainwater and accumulated debris away from the basins.

-Impervious material needs to be a part of the drainage basins base. Having an impervious material lining catchment basins prevent water loss through absorption and infiltration.

-Overflow valves connected near the top of the basin ejects any water that exceeds the basins maximum capacity.

-Place release nozzle a few inches above base of catchment basin. This prevents debris that has settled to be transferred to water source.

[How to connect components]

-Connect roofing material to gutter system

-Connect gutter system to piping

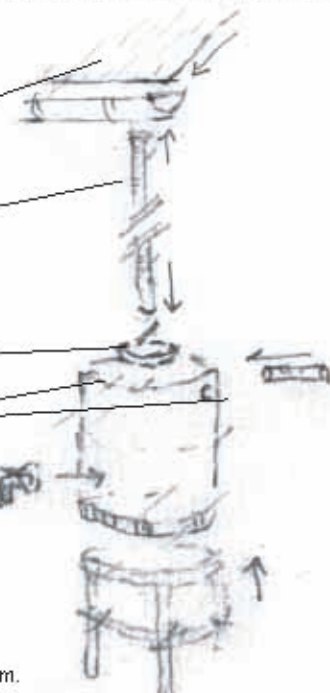
-Connect piping to flush-out flap

-Connect overflow nozzle into

-Secure lid

-Connect release nozzle

These images show the connectivity diagram of all components and parts required to build a standard (RWH) system. Optional alternative materials can be used to supplement suggested materials in diagram.



financial

human

social

physical

natural

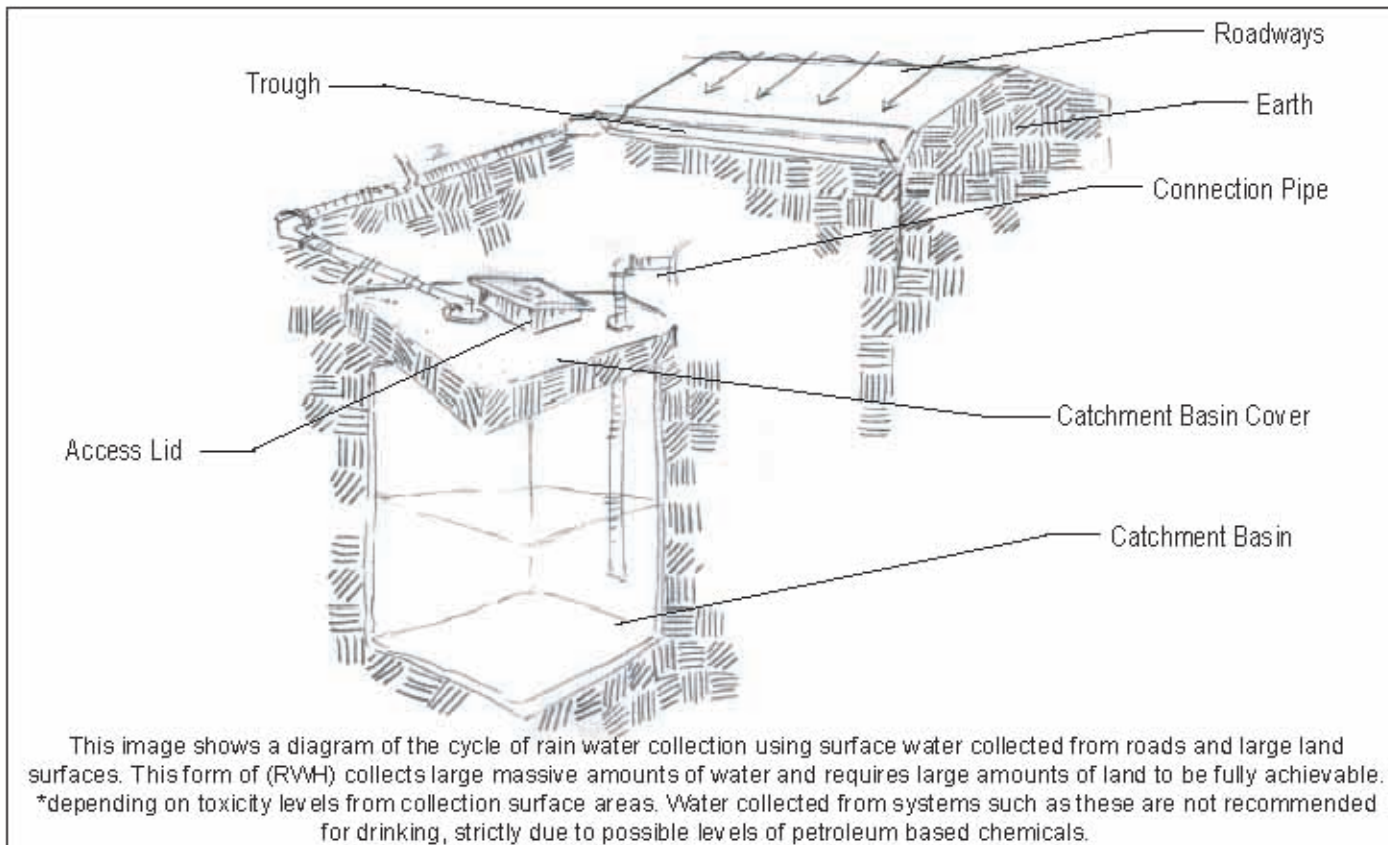


# Water Supplies

## AGRICULTURE AND FARMING

Rain Water Harvesting (RWH) can be applied to many different levels of usage. Agriculture and farming practices depend heavily on the use of water. Water often times can be scarce, especially when structural conveyances of water are damaged, specifically conveyances from municipalities. Shortly after disasters or during times of drought, self sustainable harvesting can be crucial for the life support of a community. (RWH) provides farmers and agriculturalist to use alternative techniques in obtaining water.

materials and components +  
installation programs +  
maintenance +



### 1. Materials and Components

Materials needed to create this technology include:

- impervious surfacing material
- trough system to collect water
- piping to channel rain water
- catch basin to hold water
- lids for accessibility and maintenance
- water release valve
- optional-filter meshes to filter and pumps to obtain water from basins.

Materials can be supplemented with optional materials that are readily available for any specific region. Factors that determine material includes cost, availability, and quality of given material.

### 2. Maintenance

Issues of maintenance have been described throughout the pamphlet. The most important maintenance issue is keeping basins clean. Steps to keeping basins clean include:

- Removal of debris in basins
- avoidance of contamination of water in basin by obtaining secure lids
- removal of dirt and debris
- annual cleaning of retention basin
- removal of debris from catchment areas

These maintenance issues are relatively quick and low in cost. Basins can be cleaned with one teaspoon of bleach to every 50 gallons of water.

financial

human

social

physical

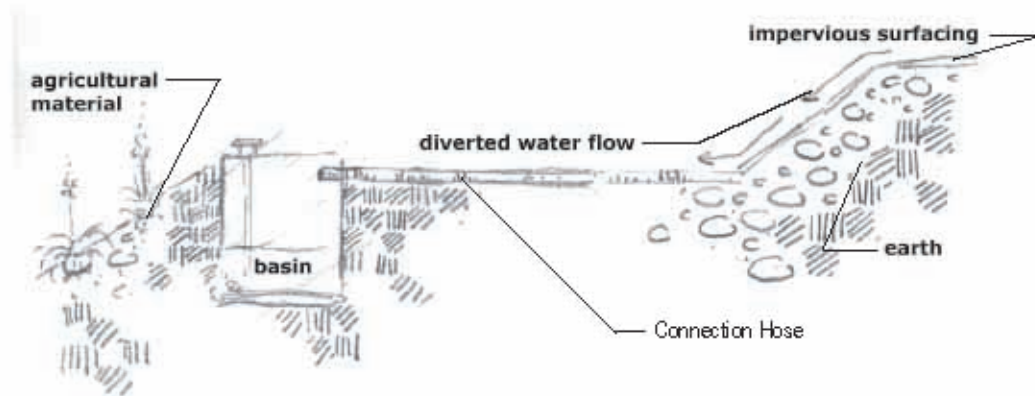
natural

# Water Supplies

## AGRICULTURE AND FARMING (continued)

### 4. Process

Applying the concept of a continuing recycle of water increases the amount of sustainability practiced and increases the renewability of rain water collection.



\*image shows prototypical design layout of rainwater diversion. Please adjust techniques according to regional landscape, available material, and specific circumstances.

1. Collecting water from the impervious surfaces.

2. Divert water flow in trough systems and guide water to appropriate areas.

3. Water is diverted from trough system into piping system and then into basin system

4. Obtain water from basin-retention area and utilize water to agricultural needs.

financial

human

social

physical

natural



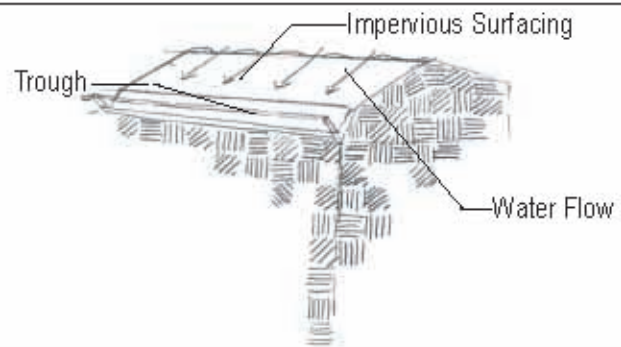
## AGRICULTURE AND FARMING (continued)

**3. Installation**

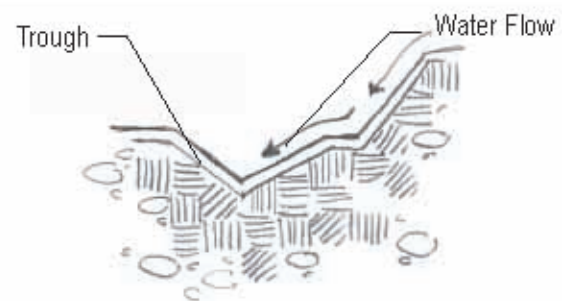
Installation programs start with education. Educating those who will utilize this knowledge and apply it to actual construction is the most important aspect of installation. Educating people with the knowledge of how to build an organic purification and rainwater catchment machine builds a sense of community and ownership. This also trains people in understanding how green technologies work. This also instills the community a sense of ownership which helps promote maintenance. Having community members construct these structures saves money on labor and maintenance cost.

*[Rain Water Catchment areas]*

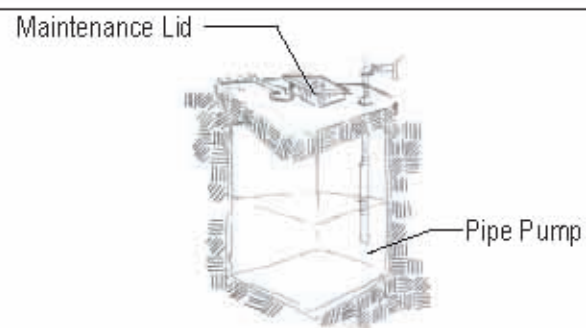
Roads provide large surface areas where (RWH) can occur. This collection technique utilizes water that would otherwise not be used.

*[trough section]*

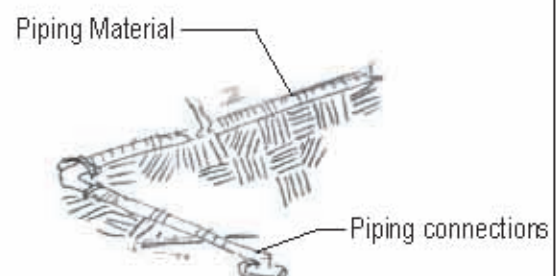
Building structures such as these is optimal for having them run for miles and miles. The larger the structure the more rainwater can be collected. The more rain water collected the less reliability on municipal water source is needed.

*[retention basins]*

Large retention basins benefit farmers. Constructing basins at large scales can supplement irrigation needs of farmers for up to three months. Build retention basins as large as possible and according to personal needs.

*[piping]*

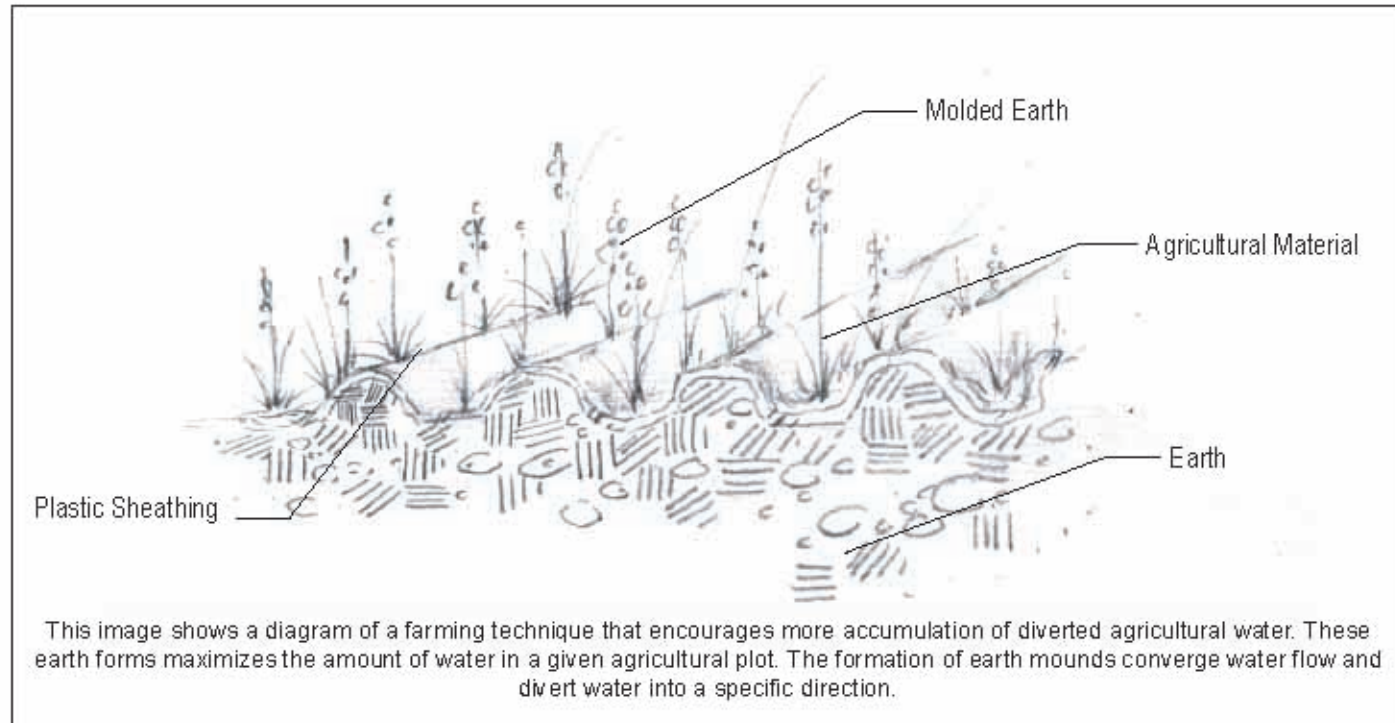
Piping is essential for the transportation of water from retention basins. Using sturdy material is important to prevent moisture loss through seepage and leaks.



## FARMING TECHNIQUE: SHEATHING MOUNDS

Rain Water Harvesting (RWH) can be applied to many different levels and scales in agriculture. Agriculture and farming practices depend heavily on the use of water. Water often times can be scarce for many reasons especially after disasters or during times of drought. During these times, self sustainable harvesting can be crucial for the life support of a community. (RWH) provides farmers and agriculturalist to use alternative, more efficient techniques in obtaining water.

materials and components +  
maintenance +  
installation +

**1. Materials and components**

Materials needed to create this technology include:

- impervious surfacing material. Long sheets preferred; plastic sheeting recommended
- earth molding tools
- piping to channel collected run-off
- optional basins to catch run off water

Materials can be supplemented with optional materials that are readily available for any specific region. Factors that determine material includes cost, availability, and quality of given material.

**2. Maintenance**

Maintenance issues are relatively minimal with agricultural techniques such as this one. Maintenance issues include:

- removal of debris on molded earth
- avoidance of invasive non-agricultural plants
- removal of large rocks or debris that prevent infiltration
- annual clearing of sheathing mounds
- reformation of disturbed molded earth

These maintenance issues are relatively quick and low in cost. Basins can be cleaned with one teaspoon of bleach to every 50 gallons of water.

financial

human

social

physical

natural



## FARMING TECHNIQUE: SHEATHING MOUNDS

## Water Supplies

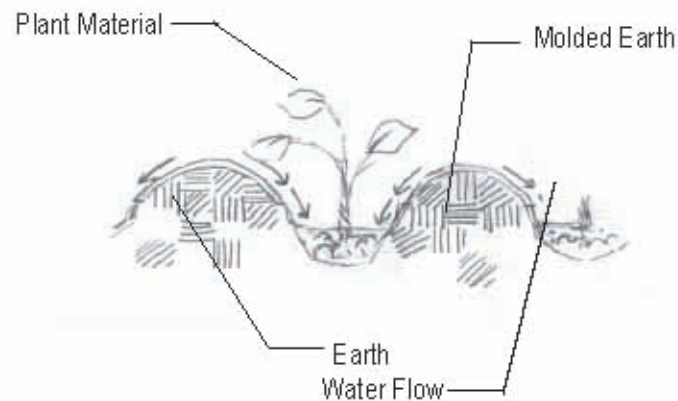
**3. Installation**

Installation of these techniques requires in-situ training with farming communities. Techniques such as these have been practiced for thousands of years. In many cases, these techniques have either been forgotten about or abandoned over time. By providing education and training, these old techniques can be used once again.

*[Side view]*

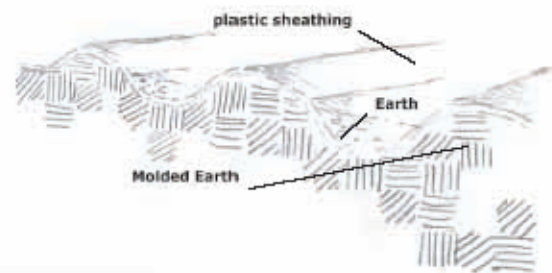
This image shows an enlarged section of the earth form and directional flow of the rainwater and or irrigation water. Plants planted on the top of the trough retain less water due to gravity that pulls the water away from the higher points.

-Molding Earth into an inverted U shape between agricultural plots forms runoff space.

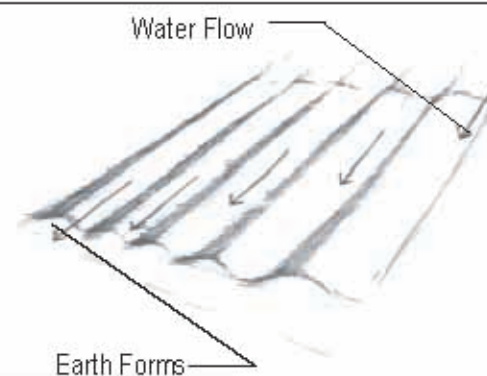
*[Side view]*

Catchment areas are created in undulating spaces between landforms. These small landforms channel water movement.

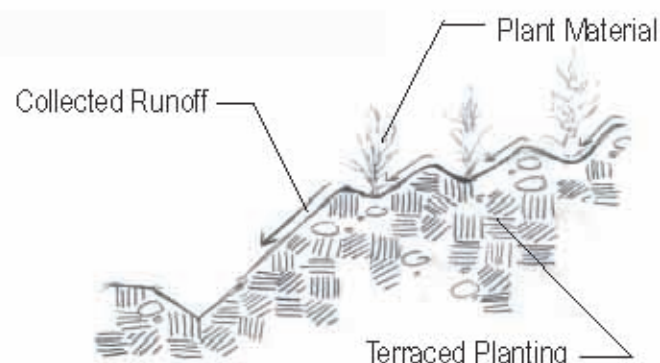
-Plastic sheathing or impervious material line molded earth forms to direct more water and runoff capabilities.

*[Water movement]*

Less water is needed for irrigation due to the concentration of water into diverted areas. This diagram shows the next step that can be taken to increase water collection. Water runoff from un-infiltrated water can be directed by sloping the land and diverting runoff water into a concentrated area.

*[Elevated View]*

Combining this process with the techniques of using a trough to recycle any water runoff from these landforms maximizes the potential harvesting of rain water and surface runoff. After collection or runoff water, water can be diverted into retention basins and used again in agriculture.



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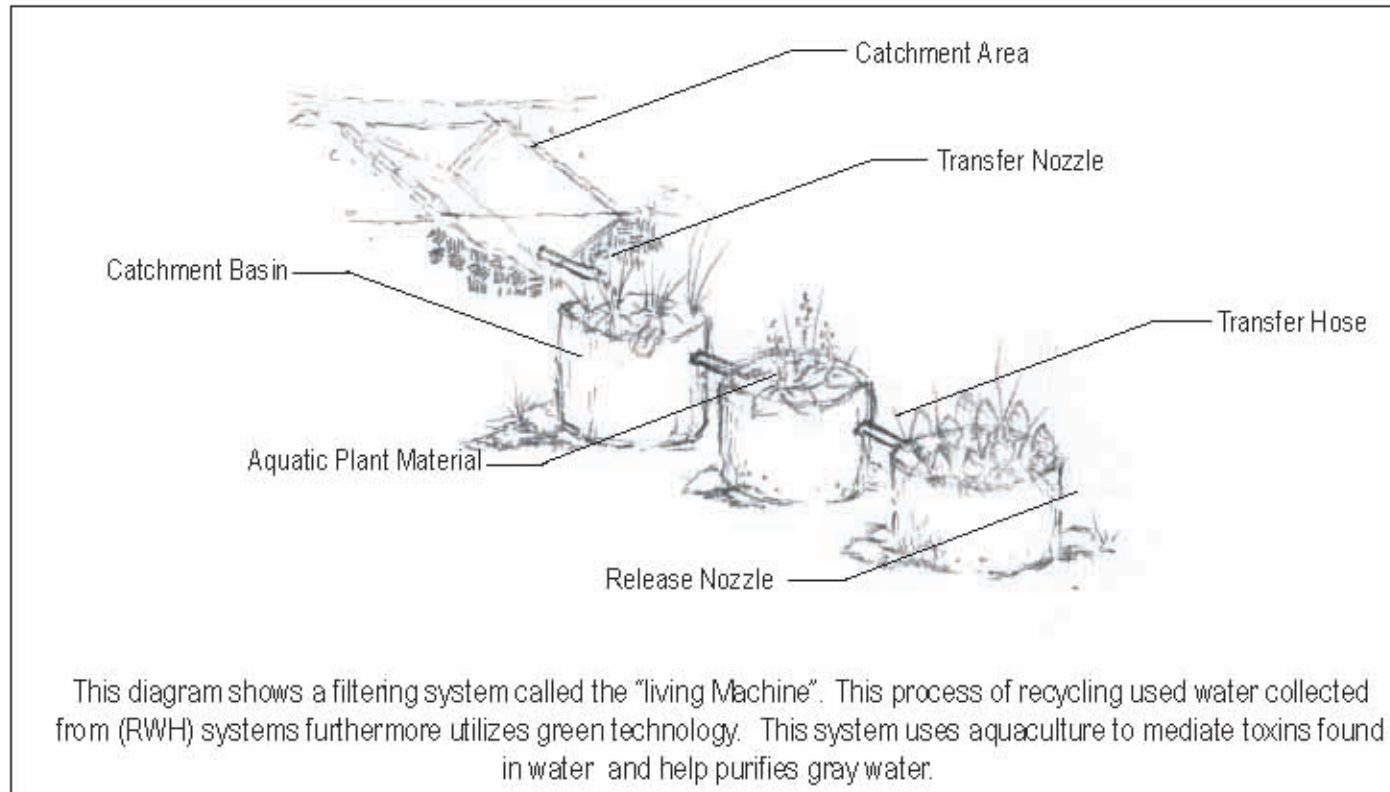


## THE LIVING MACHINE

## Water Supplies

Recycling rain water through (RWH) techniques does not stop after utilizing water only once after it is recycled. The living machine, through aquatic remediation furthermore enhances the green technology in obtaining water. After collected rain water is used once, the gray water can be recycled once more in a "living machine" type system, which allows people to use water once again, specifically for agriculture, to flush out waste water and even more household consumption needs. Water can be directly poured into basins are retained through large catchment areas.

materials and components +  
maintenance +  
installation +  
renewing a resource +



### 1. Materials and Components

Materials needed to create this technology include:

- |                                |                                          |
|--------------------------------|------------------------------------------|
| -impervious surfacing material | -catchment/basin system to collect water |
| -catch basin to hold water     | -gutter system to collect rainwater      |
| -piping to channel rain water  | -catch basin to hold water               |
| -release nozzle                | -transfer Nozzle                         |
| -water release hose            | -optional-filter meshes                  |

Materials can be supplemented with optional materials that are readily available for a given specific region. Factors that determine material includes cost, availability, and durability.

### 2. Maintenance

Issues of maintenance will be found throughout the pamphlet. The most important maintenance issue is keeping basins clean. Steps to keeping basins clean include:

- removal of overgrown and plants in basins
- avoidance of algae growth
- removal of mosquito larvae
- annual cleaning of retention basin
- removal of debris from catchment areas

Basins can be cleaned with one teaspoon of bleach to every 50 gallons of water.

for more information please visit <http://courses.washington.edu/larescue>

financial

human

social

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natural

# Water Supplies

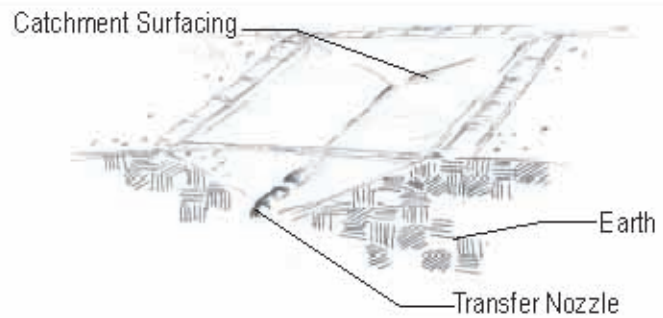
## THE LIVING MACHINE (Continued)

### 3. Installation

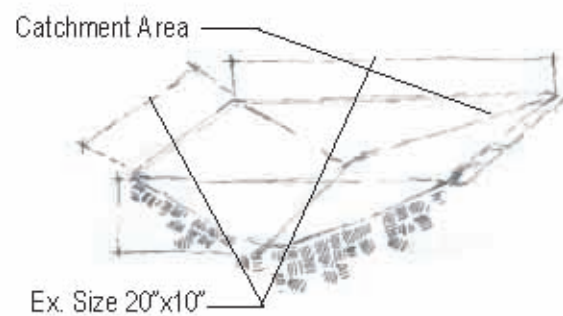
Installation programs start with education. Educating those who will utilize these technologies and apply it to actual construction is the most important aspect of installation. Educating people with the knowledge of how to build an organic purification and rainwater catchment machine builds a sense of community and ownership. This also trains people in understanding how green technologies work. This also instills the community a sense of ownership which helps promote maintenances. Having community members construct these structures saves money on labor and maintenance cost.

#### [Rain Water Catchment areas]

This system requires rainwater or gray water to be collected into an initial holding area. These areas can often times require large amounts of space to retain water. Catchment areas and holding tanks need to be free of debris and contaminants.

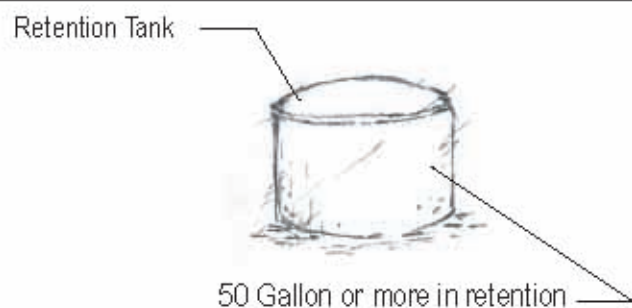


When using the living machine as a catchment technology, catchment areas need to be large enough to capture as much water as possible during any given rain storm. These areas need to be approximately 20' by at least 20'

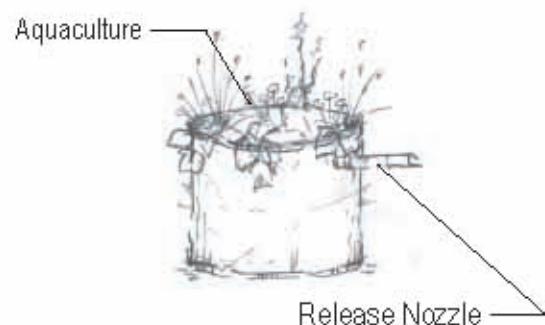


#### [Basins]

Water basins can be constructed out of any container that will hold large amounts of water. Containers need to be preferably large enough to hold 50 gallons of water or more. Containers made of plastic, clay, or concrete are more efficient than other materials. Having community members construct these basin structures dramatically reduces the cost of implementation.



An option that helps reduce levels of toxic contamination in the water can be mediated through aquaculture. Selecting plants that specifically live in wet environments or in anaerobic conditions is desirable. Plants will vary depending on region, location, and climate. Utilizing aquatic plants that synthesizes toxin levels in water is vital to aquaculture rendition to work. Finding plants within a local region is mandatory for plant survival.



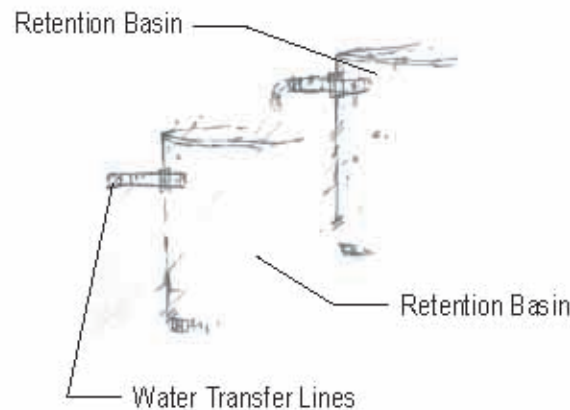
CAUTION: open water or standing water acts as breeding grounds for mosquitoes and their larvae. It is important to continually check water and water structures. Clean accordingly or do not leave water standing.



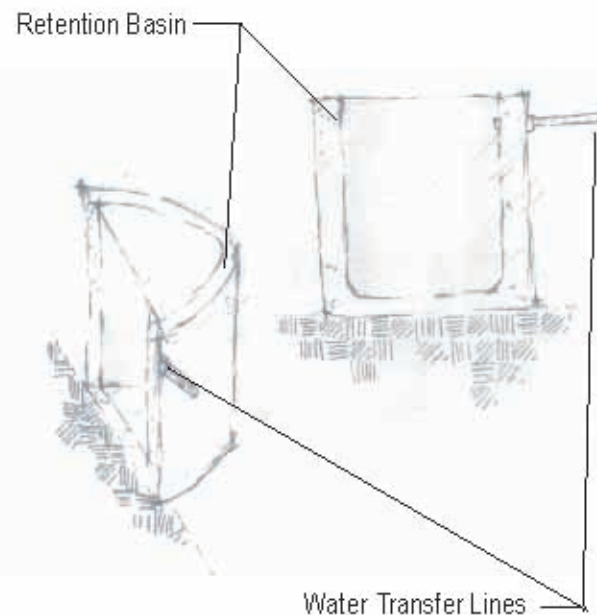
*[Basins Continued]*

Water transfer from basin to basin is important in the aquaculture re-mediation process. Theoretically as water is transferred from barrel to barrel more toxins and or contaminants are removed from the retained water. Having clear distinguished basins and distinguishing purification levels help minimize contamination of old water to newly processed water in adjacent basins.

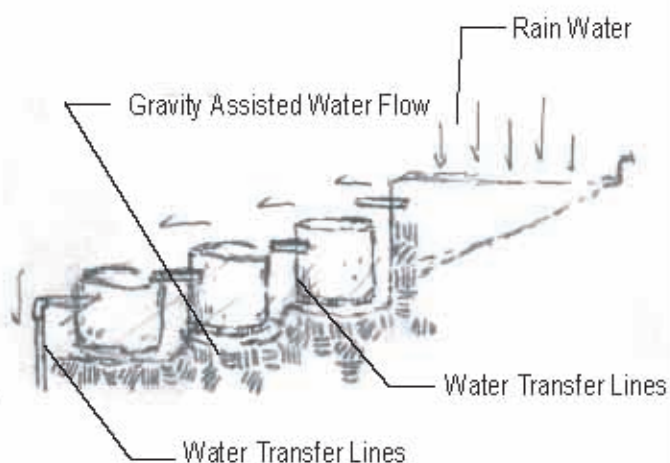
- Connect water transfer hoses away from base of basin
- Retention basins can be placed as near or as far as transfer lines will reach



This image shows a cross section of a basin. Basins can be made of any non pervious material that can withstand holding more than at least 50 gallons of water. This ensures that there is enough water to be used after the purification process. Purified water should be used for household purposes only. Consuming water after purification process is not recommended.



This diagram shows the use of gravity to convey water. This procedure eliminates any and all manual work, work from this system in the re-mediation process. Using elevated heights allows for proper flow and water movement. The more movement within the basins the less likely the basins will turn into mosquito breeding grounds. Water Transfer lines connect purified water into basin for later use. Covered secured retention is important to avoid further contamination.



financial

human

social

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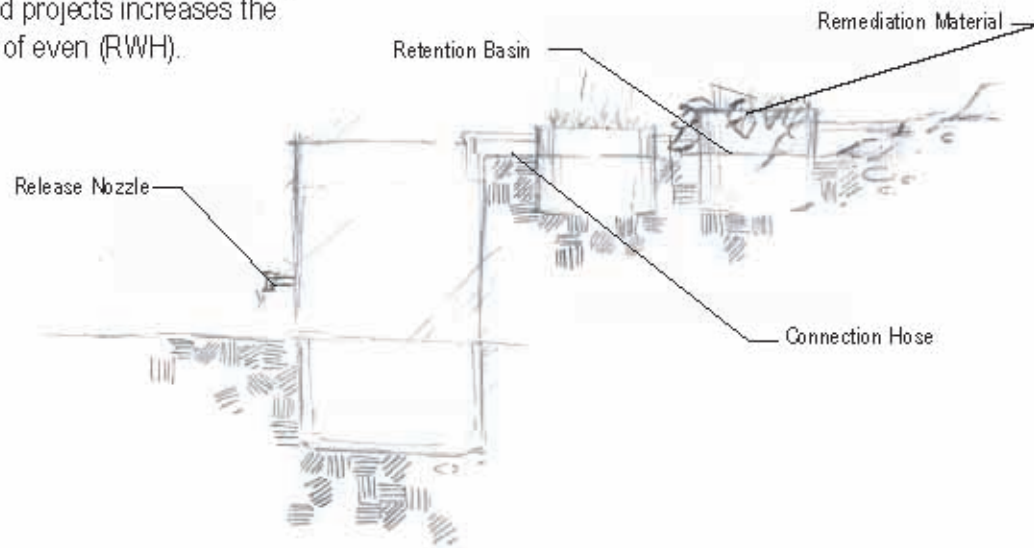
natural

# Water Supplies

## The Living Machine (continued)

### [Renewing a Resource]

Connecting technologies from farming to water sources for village scaled projects increases the renewability of even (RWH).



\*(Please See pamphlet labeled "Living Machine" for more information.)

1. Landscape agriculture in terracing format and allow for run-off to flow into one direction.

2. Collect water from run-off through trough systems and collect in basins.

3. To further recycle harvested rain water, allow diverted water to enter "living machine" like structure.

4. Filter Water through natural purification process and continue to use water until released back into watertable.

financial

human

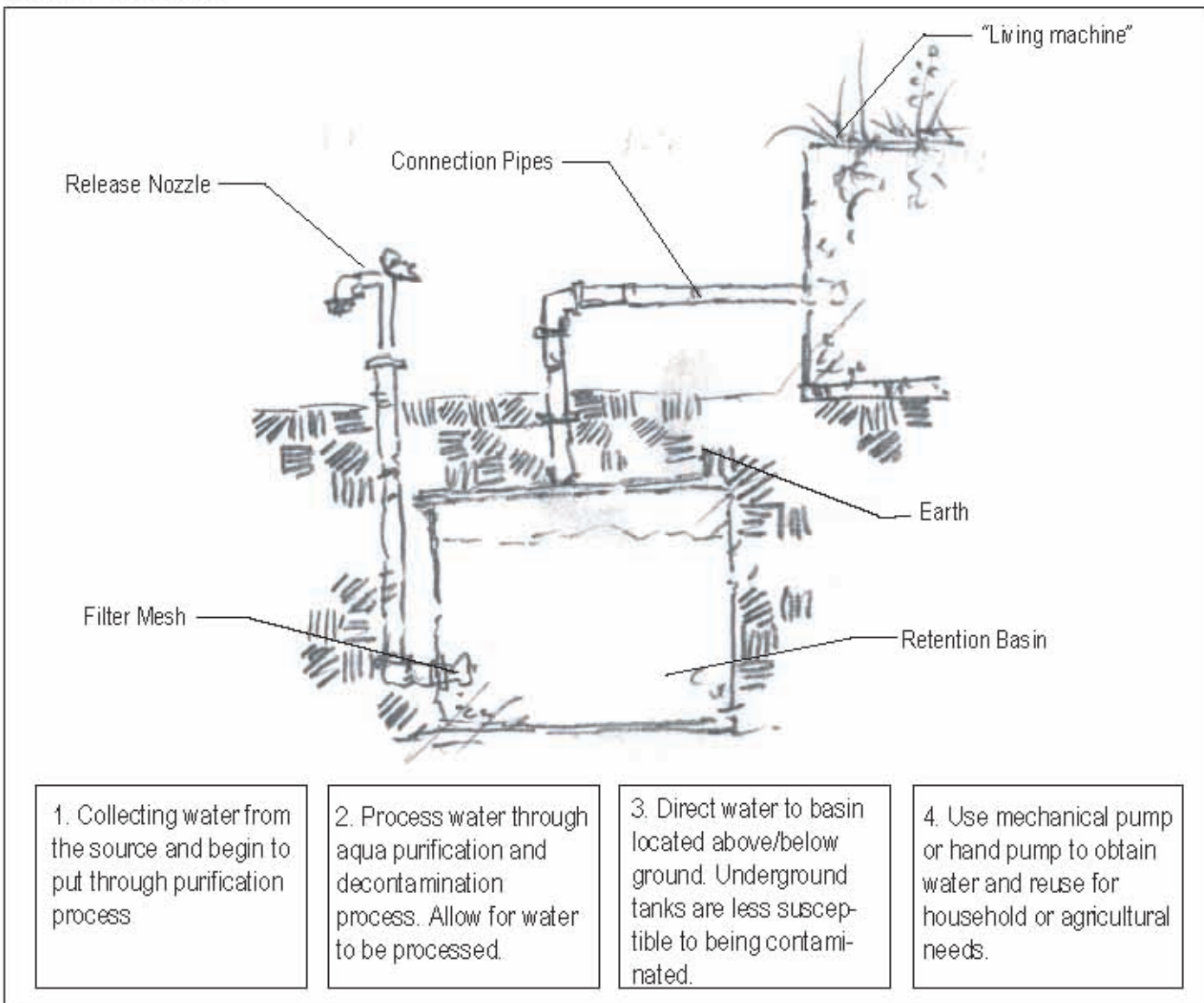
social

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natural



[filtered retention]



Retention after re-mediation is important. You can either use underground retention areas or above ground retention areas. Feeding water from the basins into a retention area of choice helps secure water from contamination.

-Having Water filtered and immediately transferred into a retention area is important in preserving overall water quality.

-Having water channeled into a non-exposed protected basin ensures that contaminants and other debris do not effect the water quality.

-Having underground basins further protects retained water.

-Basins above ground are susceptible to being tampered with or moved to where collected debris in the water is stirred.

Supplemental materials can be used to replace any suggested materials in the pamphlet. Local or regional materials can be used as long as materials are dependable and as of sustainable quality as suggested materials.