OL 332 Assignment Five Discussion.
Online Learning: OL 332 Water Conservation & Management
Center for Sustainable Development. https://csd-i.org/ol-332-water-conservation-management/

Assignment Five. Survey of Activities for Infrastructure and Water Harvesting
In this assignment we will be looking at ways of collecting and storing water for future use. We've already looked at low technology ways of collecting water in Climate Smart Agriculture by placing barriers across farm fields to slow down the downhill movement of water and allowing the water to percolate into the soil. Last week, in this course, we looked at check dams to slow down the movement of water in gullies. Although these check dams were porous (the main reason that they were porous is so that we don't need an engineer to design a solid dam—as porous dams let water flow through they are less likely to collapse) they will catch eroded soil which will slowly build up behind the check dam making a level area which can be used for planting.

More high tech ways of harvesting water in last week's assignment would be to build a concrete check dam across a gully which would fill up with water like a small reservoir. The water could be used on site by transporting it to a farm plot with buckets, or it could be piped downhill for use elsewhere. In several of the resources that I provided last week on check dams are design criteria for these more sophisticated concrete check dams. It would be best however to work with an engineering expert before attempting to build one—and this may be expensive.

Developing plumbing infrastructure will bring a different set of challenges. In reading studies many people discover, for example, in projects that install water systems like connecting water pipes to individuals homes—50% of the installed systems have failed within two years. The reasons cited are that they were designed by amateurs, installed by amateurs, the community members weren't engaged in the decision-making process of where to locate the system and how it should be designed—and the community members were not trained in maintenance and repair.

An infrastructure project such as these will may take a year or two to design and fund. It will likely be expensive and involve hiring professionals to do the installation. Community members will also need to be trained in maintenance and repair—and a funding mechanism will need to be established to cover those costs.

Nonetheless, I am providing resources this week which will help you look at more sophisticated water systems which could include piping water to individual homes, building wells and fitting them with pumps, building proper dams and developing reservoirs—all of which may be expensive and which will require long-term maintenance and repair. They will also require a different kind of water management committee: A more professional committee which can collect monthly fees to pay for maintenance, repair and electricity. There are a couple of resources provided that show how to set up these types of committees.

However, in this assignment were going to look more specifically at low-cost/no-cost water harvesting systems which community members can install either individually on their homes or collectively for the community. For example, individual homeowners can install a gutter on the edge of their roof and direct collected rainwater to a barrel or to a small reservoir. The expensive part of this is not in the gutter—but might be in constructing the reservoir. Conversely, on a community basis, a river that runs seasonally may actually have water running several feet below the surface during the dry season. By constructing a subsurface dam at the level where the water is running, water will be collected there and can be extracted with a simple well built alongside of the river. Both of these two approaches to harvesting water can be low-cost, can be installed by the community, and can be maintained over the long term by the community. Look below in the list of resources under "The water man of Rajasthan" for several articles and videos showing examples of this thousands of earthen check dams that he has built.

I've also included several resources on more challenging ways of harvesting water such as in the document entitled "Water from Rock Outcrops". The idea is that stone outcrops that have a depression will collect water and much like a check dam you can build a concrete dam which turns the depression into a reservoir. By doing rain calculations you can determine if this new reservoir is sufficient in size—or if a larger reservoir needs to be built to store the water. A larger reservoir will also need the guidance of an engineer—and could be quite expensive.

Consequently, this week were going to concentrate on techniques which can be implemented by community members.

I'm including excerpt from a field guide (to be used in Assignment 7) in this discussion in order to give you an overview of household rooftop rainwater harvesting systems.

Excerpt from OL 332 Field Guide Household Rooftop Rainwater Harvesting.

Field Guide: Household Rooftop Rainwater Harvesting.
Tim Magee

Introduction. Access to household water has become increasingly challenging in many parts of the world. Frequently women and children must walk several kilometers to collect water—taking time away from livelihood tasks and from school. Rainwater harvesting systems can be easy to build, inexpensive, and provide a meaningful quantity of water. They consist of a roof, a gutter, a downspout and a tank. Organize a workshop for 12 to 15 community members on rainwater harvesting.

Notes. Determine two things prior to offering the workshop. One: that rooftop rainwater harvesting is a viable option for your locale based upon types of roofing, annual rainfall, length of the dry season, and family water consumption. Two: determine local costs for installations and local material options for use in construction, and investigate water storage system designs that are appropriate for your community context. You should contact a local expert for assistance in designing the systems and in designing the workshop.

The catchment surface: The roof of your home. The size of a roof determines how much water can potentially be collected in a year. For example, a 24 m² roof in an area with an annual average of 400 mm of annual rainfall can collect and store a three month supply of water for a family of six. Most roof systems work well for capturing rainwater: the best are concrete, tile or corrugated sheet metal. Thatched roofs can be dirty and difficult to attach a gutter to. However, water collected from thatched roofs can be used in home vegetable gardens. Even “flat” concrete roofs have a slope and a low point where you can collect water.

Gutters and downspouts. At the low edge of the roof it is necessary to install a gutter to collect rainwater before it falls to the ground. Gutters can be made of V-shaped pieces of sheet metal, strips of corrugated roofing bent into a C-shape, or PVC or bamboo tubes split in half. These gutters need to be suspended from the roof edge such that all of the rainwater flows into the gutter. The gutter needs to slope downhill from one end to the other end in the

direction of your storage tank. Watch during the first few rainstorms to see if your gutter is working effectively. Downspout: Connect one end of a piece of tubing to the end of the gutter and the other end to an opening in your tank.

The storage tank. The tank is the most expensive portion of the system. Because of this, and to simply get started, you can begin collecting rainwater in found containers such as jerry cans or barrels.

The optimal size of the tank will vary based on how large your roof is, what the annual rainfall is, how long the dry season is, how large your family is, and how much of the captured water is to be stored for future use. Three months of water (a large tank) for a family of six represents half the water they need during a six-month dry season. During unpredictable rainy seasons, a rainwater harvesting system can provide supplemental water during short dry periods with smaller storage containers. Tanks can be aboveground tanks made of concrete blocks, reinforced concrete, or pre-purchased plastic tanks. In-ground cisterns can be as simple as an earth reservoir lined with sheet plastic—or a brick lined excavated hole.

Planning. Help each participant determine the amount of potential water they can harvest during the course of a year and how much water they need for their family during the dry period. Realizing that costs for building a tank can range from $50 for a plastic lined excavated hole up to $500 for an aboveground tank of concrete block, work with the participants to determined what their best plan would be for their home and resources. Discuss how you decided which materials to use for the gutter, for the tank—and for the size of the tank for the demonstration installation.

Construction. Deliver the construction materials to the site in advance. Check that you have the correct tools that you need and that you have extras so that several people can participate at the same time. In order to build a system with the time allowed in a workshop, the tank should already have been installed. You should have examples of several types of gutters, downspouts, containers and plastic sheeting used for lining an excavated hole.

Begin by showing the correct placement of the gutter so that it will effectively catch the water as it flows off of the roof—and how the gutter needs to slope downhill from one end to the other towards the tank. Let the participants install the gutter and the downspout that leads to the tank. Place a piece of wire mesh where the gutter meets the downspout to catch leaves and debris. Run a trial by pouring a bucket of water on the roof to see that the gutter catches the water and that the water flows easily to the tank without leaks.

First Flush. The first rainfall of the season will clean the roof and can potentially flush dirt into the tank. Disconnect the downspout from the tank during the dry season until the first rain can completely clean the roof and the gutters. If the tank is empty—it should also be cleaned out at this time. After the first rain, reconnect the downspout to the tank.

Water Purification. Rainwater collected from rooftops may have impurities and it such as windblown dust or bird droppings. Secondly, storage conditions may not be optimal. Rodents may get into the storage tank. Water stored for several months may become mildly contaminated. The water needs to be purified or filtered. This could be with point of use water filters, with the addition of chlorine, or by using a solar disinfection system.

Maintenance. Roof surfaces need to be kept free from dirt; gutters, drain pipes and wire mesh cleared of leaves & dirt.

Assignment 5 Resources

Water Harvesting and Systems Management

International Water Management Institute: Agricultural Water Management Technologies for Small-Scale Farmers In Southern Africa.
ttp://www.fanrpan.org/documents/d00509/

IFPRI: Opportunities and Challenges of Community-Based Rural Drinking Water Supplies
http://www.ifpri.org/publication/opportunities-and-challenges-community-based-rural-drinking-water-supplies

UWEP: Community-Based Solid Waste Management and Water Supply Projects: Problems and Solutions Compared
http://www.ilo.org/wcmsp5/groups/public/@ed_emp/@emp_policy/@invest/documents/publication/wcms_asist_5125.pdf

Community WASH Committee Manual
http://sirwash.weebly.com/uploads/4/2/7/6/42764129/4_wash_committee_manual_revised_compressed.pdf

Dieter Prinz: Water Harvesting -- Past and Future
http://digbib.ubka.uni-karlsruhe.de/volltexte/documents/1132

Dieter Prinz: The Concept, Components and Methods of Rainwater Harvesting
https://www.scribd.com/document/190464323/water-harvesting-concept-pdf

Agrodok 43: Rainwater harvesting for domestic use
https://www.samsamwater.com/library/AD43E.pdf

DANIDA: Water from Rock Outcrops
https://www.samsamwater.com/library/Book1_Water_from_Rock_Outcrops.pdf

Erik Nissen-Petersen: How to Construct Subsurface Dams of Soil
https://ngo.csd-i.org/wp-content/uploads/Elective-Courses/332/Erik-Nissen-Petersen-How-to-Construct-Subsurface-Dams-of-Soil-1.doc

Erik Nissen-Petersen: Water from Small Dams
http://www.slideshare.net/PlanHuerta/nissen-peterson-erik-water-from-small-dams

The water man of Rajasthan

Here is a popular article on Rajendra Singh a man who has built 4500 earthen check dams in India
https://frontline.thehindu.com/static/html/fl1817/18170810.htm

ILEIA: Water harvesting, a review of different techniques
http://www.metafro.be/leisa/1986/1-5-7.pdf

FAO: Water Harvesting
http://www.fao.org/docrep/U3160E/u3160e00.htm

CAWST: Household Rainwater Harvesting - Workshop Participant Manual
https://resources.cawst.org/training-toolkit/c3391998/rainwater-harvesting-workshop

Point of Use Water Purification
Sodis
https://www.cdc.gov/safewater/solardisinfection.html

CDC - Household Water Treatment & Safe Water Storage
http://www.cdc.gov/healthywater/global/household.html

Point-Of-Use Water Treatment Systems In Rural Haiti
http://web.mit.edu/watsan/Docs/Student%20Theses/Haiti/Varghese2002.pdf

Good luck—I look forward to hearing about your project—please move on to Assignment Four.