

# AquaSmart Dam

## Big Idea

**A smart dam that includes a drip irrigation system, hydropower, and water filtration system in arid communities.**

## Essential Question

**How can smart technology manage water efficiency while supporting clean energy, clean drinkable water, and agriculture?**

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**DAR AL FIKR SCHOOLS**  
*Faith, Righteousness and Wisdom*

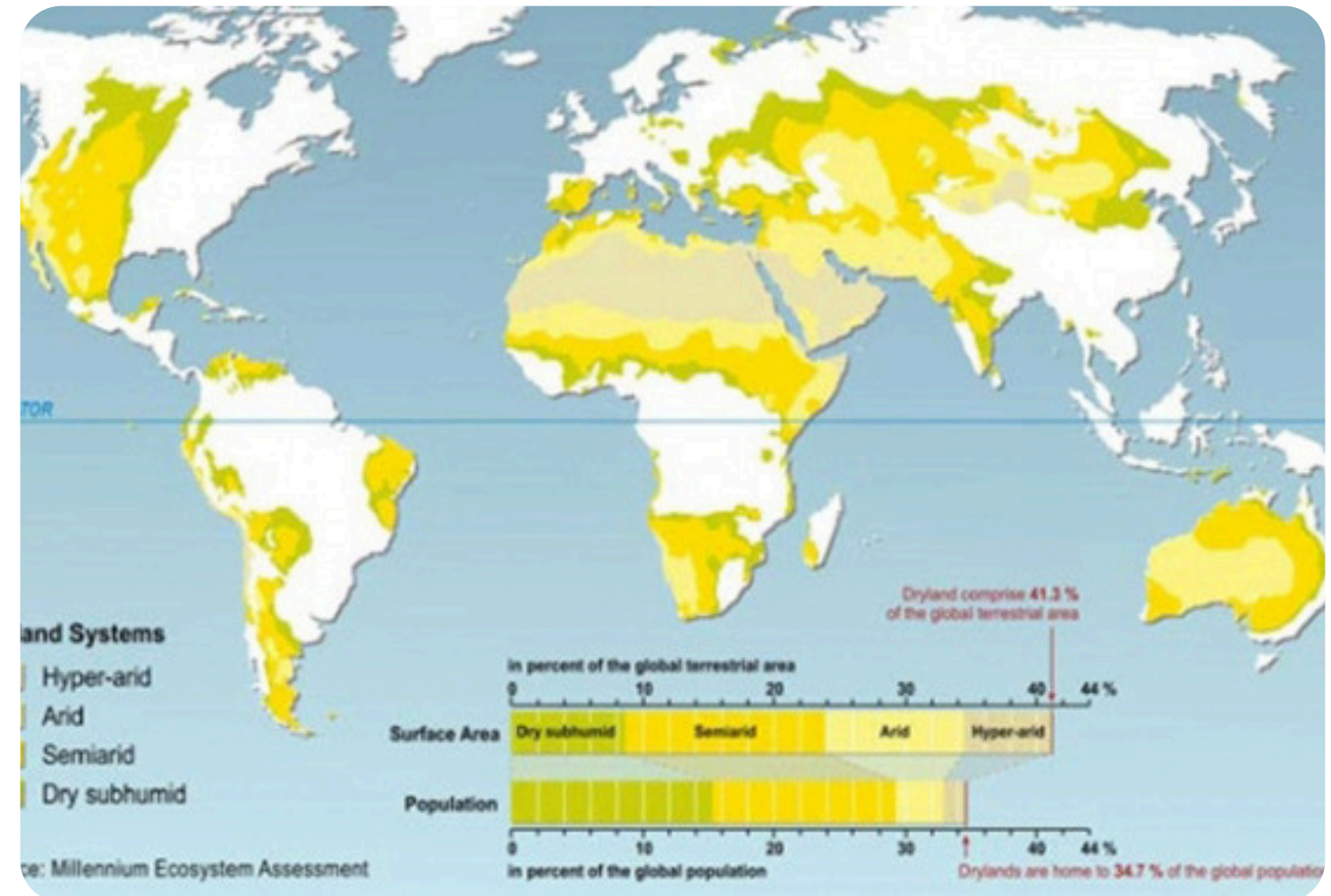
# The Challenge/Problem

Arid regions cover around 30% of Earth's land where they face severe water scarcity due to low rainfall and high evaporation, leading to physical shortages and agricultural tension, importantly irrigation.

Irrigation wastes water through inefficient methods like sprinklers because it evaporates quickly and applies water faster than the soil can absorb, leading to over flooded crops.

Energy powers the entire cycle by **extracting** water, **transporting** it, **filtering** it, and **heating** it for use

Solving these problems separately increases wastes and costs. Additionally its less efficient.



# Why we choose this challenge

Agriculture uses about 70% of the world's freshwater, but the majority of that water, more than 40%, is wasted due to inefficient irrigation. This leads to depletion and water scarcity. Additionally, globally 2.1 billion people don't have access to clean drinkable water which can lead to dehydration, and malnutrition. In our region, we also noticed the overconsumption & inefficient use of water.

This brought to our attention the deep impact inefficient systems can have on multiple regions around the world.



# Real world connection

- **Agriculture:** Farmers are directly affected because unreliable water supply makes it hard to irrigate crops properly.
- **Communities:** Local communities depend on agriculture for food, jobs, and income. When irrigation fails, food prices can rise, and access to clean water can become limited.
- **Environment:** Poor water management can dry up rivers, damage soil quality, and harm ecosystems.

Better water and energy management helps make sure resources aren't wasted and are available when they're needed most. It supports reliable irrigation, protects the environment, and helps communities stay stable and secure in the long term.



What did we discover

# Global Renewable Energy Growth

- **Declining Costs**

Solar panel prices dropped by 80% since 2010.

- **Rising Adoption**

Wind & solar capacity quadrupled since 2010.

**Filtration:** We found out that filtration and boiling are essential for making water clean and safe for drinking and irrigation.

**Energy generation:** We discovered that hydropower provides clean, renewable energy to run pumps, sensors, and displays.

**Sensors and automation:** Sensors help control water use automatically by measuring soil moisture, rainfall, and water quality, which reduces waste and effort.

**Combining systems:** Combining energy, water treatment, irrigation, and sensors creates a more efficient, sustainable system that saves resources and works reliably.

**Our innovation is integrating filtration, hydropower, and smart irrigation in one automated system.**

# What We Investigated

**We investigated :**

Dams – Store water for supply, irrigation, flood control, and electricity.

Water Flow – Movement of water through rivers or pipes, affected by gravity and pressure.

Filtration – Removes solids, leaving water clean.

Hydropower – Uses moving water to generate electricity with turbines.

Automation – Sensors and smart systems control irrigation, water, and energy efficiently.

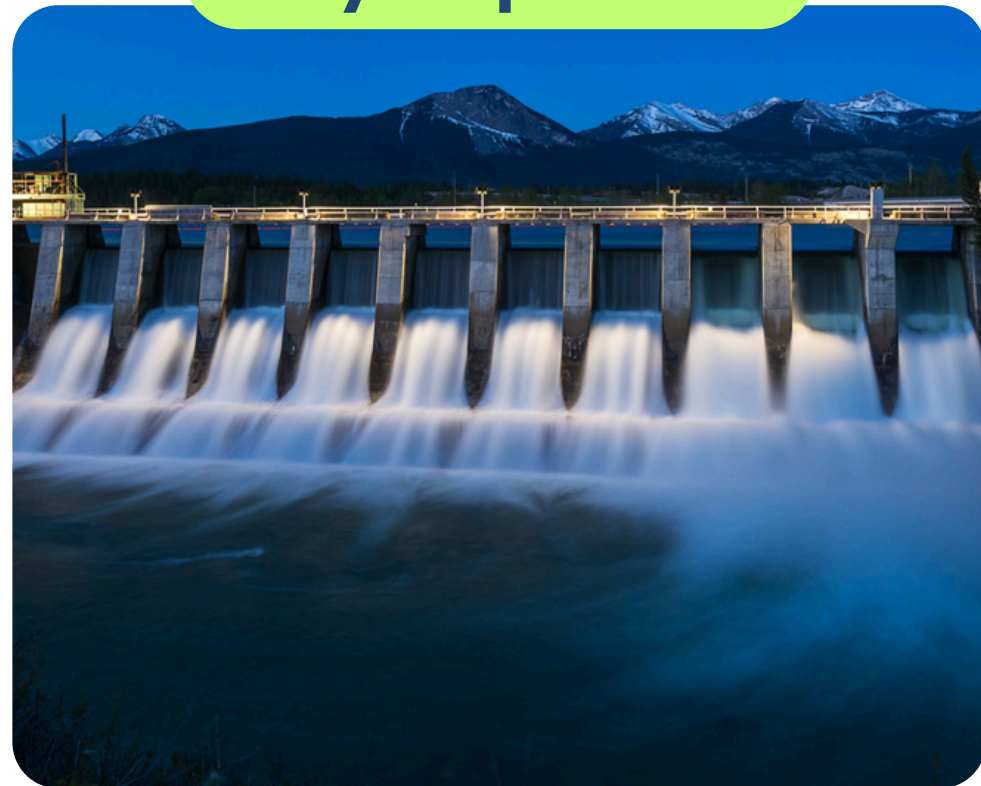
**Video of the working process : [click here](#)**

**We learned that AquaSmart Dam uses hydropower for renewable energy, drip irrigation to water plants efficiently, and filtration, boiling, and pumps to provide safe drinking water. It uses sensors, soil moisture, rain, and nano sensors, to monitor soil and water quality, and an LCD display shows real-time data clearly, making the system smart, automated, and easy to manage.**

# Solution: AquaSmart Dam

Our smart dam integrates:

## Hydropower



*Renewable Energy Generation*

## Filteration



*Clean, Drinkable Water*

## Drip Irrigation System



*Controlled Irrigation System*

# How It Works (Path 1)

## Energy Generation:

Water flows through the dam

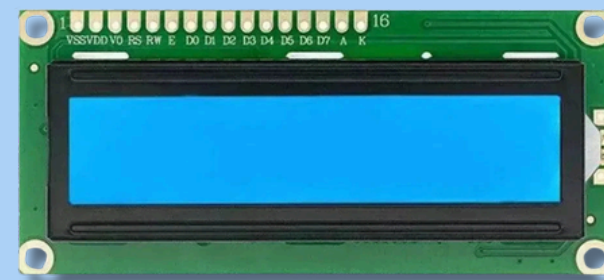
Moving water turns a turbine

The turbine generates

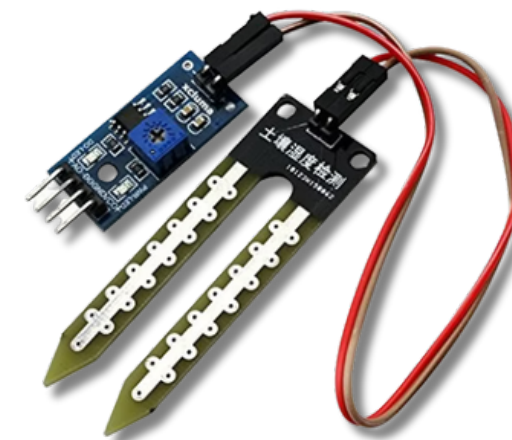
hydropower

## Electricity powers:

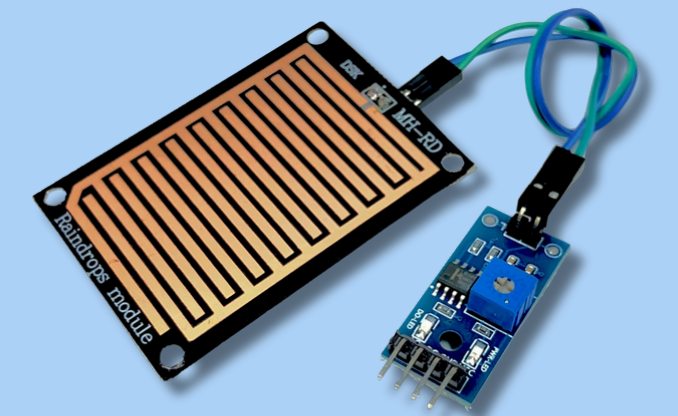
- Water pumps
- Sensors
- LCD display



**LCD Display:** Shows real-time soil, water quality, and water level data



**Soil Moisture Sensor :** Measures soil humidity to control irrigation



**Rain Sensor:** Detects rainfall and stops unnecessary watering

# Path 2 : Water Treatment & Irrigation



Stored water is directed to:

- Filtration system (removes impurities)
- Boiling process (kills bacteria)



Clean water is:

- Supplied as safe drinking water
- Delivered to farms through drip irrigation
- Pumps control water flow efficiently

# Automation Logic



When soil is dry:  
→ Irrigation system  
turns ON



When soil is wet:  
→ Irrigation system  
turns OFF



When it rains:  
→ Irrigation is paused  
automatically to  
prevent water waste

# Technology Used

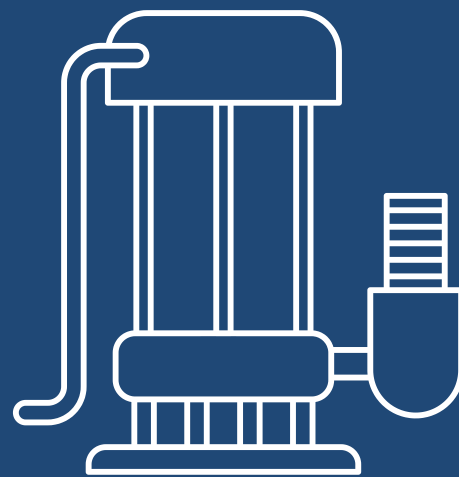
- Microcontroller
- Arduino (Uno / Nano)

## Sensors

- Soil moisture sensor
- Rain sensor

## Water pump

Relay module (controls ON/OFF)



Turbine / DC motor for hydropower

- Decision Logic (ON / OFF)

Sensors send data to the microcontroller

The microcontroller processes the data

Relay turns the pump ON or OFF based on soil moisture and rain conditions

# How Water Supports Multiple Systems

Generate clean energy

Irrigate crops efficiently

Provide safe drinking water

This reduces waste and increases efficiency

# Impact

## How does this save water?

It uses drip irrigation to give water directly to plant roots and sensors to stop watering when it's not needed. This reduces water waste.

## How does this use clean energy?

Flowing water turns a turbine to make hydropower, which runs the pumps, sensors, and filtration system without pollution.

## Who can use this solution?

Farmers, rural communities, and dry regions that need clean water, energy, and better irrigation.

## How we solved a real world problem?

We combined water storage, clean energy, filtration, and smart irrigation into one system to reduce waste and solve water scarcity.

## Skills or knowledge we gained

We learned about renewable energy, water conservation, sensors, teamwork, and problem-solving.

# Sustainable Development Goals

Solar Power

Renewables Now

**2** ZERO HUNGER



**3** GOOD HEALTH AND WELL-BEING



**6** CLEAN WATER AND SANITATION



**7** AFFORDABLE AND CLEAN ENERGY



**9** INDUSTRY, INNOVATION AND INFRASTRUCTURE



**11** SUSTAINABLE CITIES AND COMMUNITIES



**12** RESPONSIBLE CONSUMPTION AND PRODUCTION



**13** CLIMATE ACTION



This project supports these SDGs by allowing agricultural production to increase providing more food, giving access to clean water which is essential to health, its cost effective using solar energy, its an innovative building, and the sensors aid in avoiding over use.

## How can this system be improved in the future?

- Add solar panels to support hydropower.
- Use more advanced sensors and AI for better water control.
- Increase water storage and filtration capacity.
- Use mobile or remote monitoring systems.

## Where can it be used on a larger scale?

- Large farms in arid and dry regions.
- Rural and developing communities.
- Desert areas facing water scarcity.
- Countries with limited water and energy resources.

**AquaSmart Dam is a scalable and sustainable solution that saves water, produces clean energy, and supports agriculture and communities in the long term.**