SWIM and Horizon 2020 Support Mechanism

Working for a Sustainable Mediterranean, Caring for our Future

SWIM-H2020 SM EFH-JO-2

Using NCWRs as a vehicle for applying ESD

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ESD
SESSION 4
NCWR

SUSTAINABLE DEVELOPMENT GOAL 6

Ensure availability and sustainable management of water and sanitation for all

6A. By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies

Suggested topics for SDG6 (UNESCO 2017)

Box 1.2.6a. Suggested topics for SDG 6 "Clean Water and Sanitation"

The global water cycle and water distribution

The importance of equitable access to safe and affordable drinking water (achieving water security under climate change: e.g. coping with social and economic pressure caused by frequent waves of droughts and hence water shortages, and by floods and hence too much water)

The importance of adequate and equitable sanitation and hygiene, water quality and quantity parameters for health

The human right to water and water as a global common good

Impacts of pollution, dumping and release of hazardous chemicals and materials on water quality

Water scarcity and water use efficiency

Importance of water-related ecosystems

Water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies, water patents, landscaping for groundwater recharge as well as integrated water resources management

Water exports (virtual water)

Water and sustainable development (e.g. water and gender, water and inequality, water and health, water and cities, water and energy, water and food security, water and disaster risk reduction, water and climate change, water and the green economy, water and jobs)

In our small survey….

Water & Non Conventional Water Resources =
Among your top-concerns as an issue for your country
& as a topic within Education for Sustainable Development

Plenary Q1:
What is “non conventional water resources (NCWRs)?

NCWRs: sources of water not originating from natural fresh surface water or groundwater

- **Rainwater harvesting / Storm water management**
- **Greywater recycling** water resulting from showers, baths, washing basins and laundry once properly treated can be used for flushing toilets and to irrigate the garden.
- **Wastewater recycling** , once properly treated can be used mainly for irrigation in agriculture.
- **Desalination** through the use of reverse osmosis plants, salts from saline or brackish water are removed

Other aquifer recharge, exploitation of undersea freshwater springs, cloud seeding

Rainwater harvesting

Stormwater management

Reuse of treated greywater

Reuse of treated wastewater

Desalination plant (reverse osmosis)

Plenary Q2.

Which one do you think is:

a. The most **known**

b. The most **applied**

in your country?

Q2. NCWRs: an outline in the Arab countries (UNDP Report, 2014)

Desalination

Q2. NCWRs: an outline in the Arab countries (UNDP Report, 2014)

Wastewater

Q2. NCWRs: an outline in the Arab countries (UNDP Report, 2014)

- *To explore grey water potential in the region, the Canadian International Development Research Centre has supported grey water treatment in **Jordan**, Lebanon, **State of Palestine** and Yemen, equipping more than 2,000 houses with grey water treatment systems over 1998–2008. These projects revealed not only the high regional potential for using such forms of treated wastewater but also the absence of any health risks. Annual economic saving was estimated at more than $300 per family, but successful implementation will require government incentives, continuous quality monitoring and enforcement of local standards and regulations*.

Group question Q3 (5′)

In your group, discuss & decide on **which NCWR** would you choose as a **topic** for an ESD project ?

Why? Give 2 reasons.

Group question Q4 (10′)

In your group, think, discuss & decide:

a. What would be you **Target Group**?

b. What **type** of activity/ies would you run?

c. Write it on a piece of paper.

NCWRM in the Mediterranean Programme

Greece , Malta , Cyprus , Italy

- **Aims** at advancing the use of NCWR, mainly rainwater harvesting and greywater reuse in water scarce communities in the Mediterranean islands, as a cost-effective method to locally increase water availability and to adapt to climate change.

- The Program's **objectives** are:
  - To demonstrate smart, innovative & cost-effective NCWR solutions
  - To educate students, teachers and the public on NCWRs.
  - To enhance local technical expertise on modern NCWR systems.

While

- Promoting multi-stakeholder partnerships
- Providing a best practice for further replication

NCWRM in the Mediterranean Programme - The approach

GWP-Mediterranean is the Coordinator

Duration:2008 - 2018

primarily Coca-Cola Foundation Grants

Overall NCWR Outcomes & Results in the Mediterranean, 2008-2016

- **33 islands** (29 Greek Islands, 2 Maltese islands, Cyprus, Sardinia)
- More than **95 NCWR systems** have been installed or reinstated
- **Annual water yield ~ 280 million L /yr**
- More than **22,000 students**, and **3,500** teachers
- More than **110,000 beneficiaries**

What students know about the NCWRs?

ESD Programme: Hands-on activities in schools, Teachers' trainings, a School contest (Greece)

https://www.google.com/maps/d/viewer?ll=37.51992917965458%2C24.6002529296857&z=6&mid=1WSNGseSb55yyg40IWiWN9kfkKXo

Students & the NCWRs

The application of the project with school students so far outlines the following:

✓Students show great **interest** in the topic and enjoy very much the activities;

✓They declare that they gained **knowledge** on water cycle, rainwater harvesting, runoff, cisterns, greywater, etc.

✓ **Younger pupils** show preference on the general topic of the «water cycle»

✓**Older students** seem to be more interested in and "impressed" by technologies of rainwater harvesting and greywater systems

✓Some of them are aware of the rainwater harvesting; however very few one knows about "grey water" and "black water" & how they can be recycled.

✓The majority **commits** that will be in favor of the NCWRs and water saving; they propose practical ideas of reusing the water in everyday life (after washing the vegetables or dishes, or after washing their bicycles,

✓**General comment**: Students in urban areas are not familiarized with the older systems (cisterns) for harvesting rainwater in contrast with the pupils in rural areas, coastal/islands.

Students & the NCWRs: some quotes

Ερ. 1: Μπορώ να «προστατεύσω» το νερό με το να [illegible]

μα το κα το μαζευω σε δεξαμενή

σταν βρεχει

κάναμε σήμερα, το πιο ενδιαφέρον για εμένα ήταν

ο τρόπος με τον οποίο ξανακαθίνεται το νερό χρήσιμο

Ερ. 1: Μπορώ να «προστατεύσω» το νερό με το να αποθηκεύω βρόχινο νερο με το σπιτι μα ή να χρησιμοποιήσω το σπιτι μα του Μαυρου και του Γκρι νερου

Ερ. 2: Από όσα κάναμε σήμερα, το πιο ενδιαφέρον για εμένα ήταν

με το συστημα μαζεμου νερου

Ερ. 2: Από όσα κάναμε σήμερα, το πιο ενδιαφέρον για εμένα ήταν

οι δεξαμενές πριν 500 χρόνια τις οποίες είχαν στα μοστρα.

MEdIES approach on learning about the NCWRS

- Grab attention …
- Raise ideas and initial knowledge
- Connect with everyday life, experiences, choices, hobbies/activities, …
- Hands-on activities: games, experiments, discussions …
- Feedback: Check initial ideas and knowledge
- What about our behaviours related to.. ? Stay the same ? Need to adapt ? Discuss
- Commit to …

MEdIES hands-on activities in schools about NCWRs

1. Water cycle / Urban water cycle
2. Rainwater harvesting system
3. Desalination
4. What is greywater?
5. Greywater system
6. Set of experiments
7. Connecting past water wisdom with the present technologies (i) the old cisterns (ii) HYDRIA web-tool
8. **Reflection exercise**: Why discuss about these issues? Why is water important? What about our behaviour; Do we need to change something towards water sustainable use? What? Are we committed to do so?

Group activity Q5 (15′)

- In your groups you will work on one characteristic hand on activity about NCWR!
- Then, you will share your results with the rest!

Activity 1. The (urban) water cycle

Activity 1. The (urban) water cycle
We discuss . . .

- Evaporation & transpiration
- Condensation
- Precipitation (rain, hail, snow)
- Surface run-off
- Percolation & groundwater
- **Human activities & their impact** on the water cycle: Groundwater exploitation (seawater intrusion); Agricultural runoff (pollution by nitrates, etc.) ; Fires & deforestation (soil degradation/erosion, floods. etc.) ; Urbanization and population growth (reduction of soil permeability and floods risks, etc) ; Overconsumption of water (decrease in the amount of the available freshwater of good quality)

Activity 1. The (urban) water cycle

Activity 2. The RWH system

- We hand out the concepts of a basic RWH system (in groups of 3 students)
- Each group should discuss and trace where its concept should be placed on the floor mat
- Group by group we need to place all elements correctly
- We end with plenary discussion on maintenance of such a system

Activity 2. The RWH system

Activity 3. Getting to know grey water

- Share in small groups targeted photos
- Learners discuss and decide whether the photo depicts a “grey water” resources
- They reply with YES or NO
- We make clear what greywater is

Activity 4. Greywater system

- We hand out the concepts of a basic greywater system (in groups of 3 students)
- Each group should discuss and trace where its concept should be placed on the floor mat
- Group by group we need to place all elements correctly
- We end with plenary discussion on maintenance of such a system

Activity 4. Greywater system

Activity 5. Desalination

- The teacher/educator hands out the cards to small groups of students (e.g. 3) standing around the mat.
- The teacher/educator asks the students to discuss the meaning of the term they are given and then, try to identify <u>where</u> this process is located on the mat.
- In plenary, each group describes their term and places it in the correct place on the mat. All unknown terms, disagreements and doubts are discussed and clarified.
- We pay <u>attention</u> to the following points:
- ** Pre-treatment of salt water mainly includes filtration to remove debris, solids and floating particles.*
- ** Post treatment of desalinated water includes disinfection to avoid bacterial infection and/or taste improvement (i.e. by passing it through carbonate rock).*
- ** The output volume of the desalinated water is approximately half the incoming volume.*
- ** The remaining half volume of water including the high salinity brine is used in the operation of the plant (energy producing turbine). Then, it is discharged back to the sea.*

Activity 5. Desalination

6. Simple experiments

a) Creating a model of the water cycle
b) Building a water tank - Testing water permeability
c) Setting up a rainwater “meter”
d) Filtering grey water

6A. Creating a model of the water cycle

- Students construct a model of the water cycle and interpret its functions and capacities: evaporation, condensation and precipitation.
- Impact of human activities (e.g. pollution) is also discussed. .

6B. Testing water permeability

- Using a pipette students add some drops of water on materials to check of they are water proof.
- Their task is to advice YES/NO to someone that wishes to build a cistern today using:
- Cement, ceramic, porcelain, aluminum, plastic, geo-fabric, etc.

6c. Setting up a rainwater “meter”

1. Set up the apparatus according to the sketch. Make sure that the funnel and the bottle have the same diameter.
2. Place the rain-gauge in an open area. Fix it to a pot filled with sand, so that

it cannot be overturned by wind or heavy rain.

3. Measure the height of the water in the bottle immediatel after a rainfall.

Record your data in a table. Calculate the monthly average rainfall.

4. Compare your monthly data to those published by the meteorological office. Are there any variations? Try to explain why.
5. Compare your monthly or annual estimates with publishe data of average rainfall of previous months/years. Try to explain any differences

6d. Filtering greywater

Construct a filter using a plastic bottle with its bottom cut off as presented in the sketch:

Clean the filter by slowly pouring 3 litres of clean drinking water.

- Allow your hands to become very dirty by rubbing soil, mud, etc. Wash your hands using a lot of soap and collect the water in a bucket. Wait for 30 minutes. Then stir the dirty water (greywater) using the stick.
- Pour the greywater through the filter and collect the filtrate in a beaker. What do you notice? Stir the content of the beaker. What do you notice now? Compare the filtrate with the greywater you collected . *What can you use the filtrate for?* ….

7. Linking the present with the past

Unveiling cisterns, aqueducts, reservoirs…

A. The 3D model of an old cistern (discussion on the shape, process of building and maintenance, uses of water, materials

B. How old is this cistern? (analysis of photos, group work)

7A. The old cisterns (a) the model

Who has seen a cistern ?

- Is it above or below ground? Why?
- How does it fill? How big is it?
- Do you know how it was built?
- How did people know the proper spot to build it? (e.g. impermeable rock with natural cavity)
- What Building material did they use ?(Rocks and binding material)
- How was it made impermeable (Use of glazing material)
- How did they check that water was clear (e.g. eels, lime, etc)
- How did they use their water (to drink, wash to water, irrigate, etc.)

Group activity 7B. The old cisterns/photos

- What is it?
- What material is it built with?
- What are the main parts i.e. pipes, reservoir, basin/s, taps, openings, etc.
- Shape and architecture. Are there any decorations?
- Can you guess Where & When was it built?
- Where does the water come from? Where does it go?
- Why do you think was it built? Which purpose to serve? Did it serve one or more houses?
- Is it still in use? For what?

Basilika cistern, Istanbul (Turkey)

- 6th century AD by the Emperor Justinian.
- Large scale underground cistern; One protected access point and very few other openings, keeping light, rubbish, and rodents out. The cistern, measures 141 × 66,5 metres with a total capacity of 78,000 cubic metres.
- Impressive vaulted structure with a forest of 336 columns (9 metres high).
- Fed by a water reservoir 20 km away, the cistern provided the precious resource especially during draughts or sieges.
- The capitals of the columns are mainly of Ionic and Corinthian styles. Built with the ruins of older constructions. Some of these components are unique, such as the two carved Medusa heads (coming from a *nymphaeum*, a sort of Roman monumental fountain), which support two of its pillars. *It is said that the Medusa heads, one of which is placed upside down and the other one sideways, were placed in the cistern to ward off evil spirits.*
- Nowadays: Unique touristic attraction.

“Sarnitsi”: traditional cistern in rural areas of Crete (Greece)

- Typical traditional cistern built in the rural areas of Crete for the last centuries - near slightly inclined areas, it collects the rainwater that it is led to the cistern through a small channel.
- Underground cistern with vaulted structure; usually hewn in the rock at 4m depth. Built with stone. It includes a smaller cistern, an *antechamber,* where the solids included in the water settle, and the cleaned water is then collected in the main cistern. Usually it had a small window for aeration.
- “Gourna”, a small basin to water the animals.
- The collected amounts used for irrigating the nearby fields and for watering the animals.
- Nowadays: Most of them are still in use.

Cisterna dei carcerati, Italy

- The cistern "of convicts“ was built in 1st – 2nd century BC the small island of Ventotene in Italy (in Pontine archipelago between Rome and Naples).
- As there weren’t fresh water natural springs on the island human settlement has always depended on collecting rainwater. Huge reservoir carved directly into the tuff about 10 meters below ground level. It includes an open air space for harvesting rainwater, underneath which there are two vaulted tunnels communicating with each other, used for storage.
- The area near the cisterns was slowly inclined to convey most rainwater towards the collecting basin called “impluvium” and to the containers (~ 700-800 m^3).
- The name of this cistern *dei carcerati* (= of convicts) comes from the fact that its rooms were used during the Bourbon period as a place to house labourers forced to do construction work on the island (jail).
- Still shows evidence of the use of the cistern in the centuries that followed, by its *wall paintings and drawings*, etc.

Collection, Storage & Distribution of Water in Antiquity
Linking Ancient Wisdom to Modern Needs

HYDRIA Project

- HYDRIA (www.hydriaproject.net) is a knowledge management tool.
- It is a bilingual (EN-AR) website showcasing 39 distinctive examples of water management wisdom of the distant and more recent past.
- The project aims to demonstrate the wisdom of our ancestors, and their respect and adaptability to water availability and geo-climatic peculiarities.
- Further to promoting our cultural heritage, the research aims to unlock the possibilities of combining the past wisdom in the area of water collection, storage and transfer with modern technological innovations towards addressing today's needs in harmony with the environment.

http://www.hydriaproject.info/

a. Restoration of a roman pond in Al Huson town of Jordan
b. Water management at the Qatraneh site, Jordan
c. Al-Birketein Roman pools of Jerash (Gerasa), Jordan

HYDRIA features:

- Engaging experience to the user including maps, animations, timelines and extensive photographic material.
- Targets young people and the formal and non formal educational community (teachers, NGOs, museums staff, etc) especially in the Mediterranean.
- Active since 2008.
- So far, the project has been funded by UNESCO, ALF, GWP-Med and MIO-ECSDE.

More ideas for NCWRs within ESD

Box 1.2.6b. Examples of learning approaches and methods for SDG 6 "Clean Water and Sanitation"

Calculate one's own water footprint (WF)[4]

Develop a concept for local sustainable water use and supply based on success stories

Develop school partnerships between schools in regions with abundance or scarcity of water

Organize excursions and field trips to local water infrastructures, and monitor water quality at school and home

Plan and run an awareness campaign or youth action project on water and its importance

Develop a project work on the invisible water, e.g. how much water in a litre of beer, a kilo of beef, a teeshirt, etc.

Develop an enquiry-based project: "What human activity can happen without water?"

Learning objectives of ESD for the SDGs
UNESCO 2017

More ideas for NCWRs within ESD

More ideas for NCWRs/ESD at: www.medies.net

“Establishing a rainwater harvesting system in my home” Manos, 8yrs old student

What ABOUT YOU?

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Thank you for your attention.

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Solomon's Pools and relating aqueducts, the heart of Jerusalem's past water supply

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