Water and Environment Support
in the ENI Southern Neighbourhood region

Explore the Potential of Natural Water Retention Measures (NWRM) at the catchment scale
Activity No. : N-W-JO-2

Introducing the WES Activity in Jordan and the Terminology - Natural Water Retention Measures

Stakeholders' Consultation Workshop

15 May 2024 (from 10hr to 13:45hr)

Kempinski Hotel, Amman, Jordan

Presented by: Dr. D. ZARRIS, WES Non-Key Expert

LDK CONSULTANTS S.A.

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Introduction

The subject of the National Activity was planned under the following WES topics/subtopics:

- Topic 2: "Investigation and Introduction of Water Efficiency Gains at the **Decentralized Level**",
- Subtopic 3 "**Non-Conventional** Water Resources" and Dimension 2 "Capacity Building".
- **"Decentralized Level":** means generally "small – scale" interventions where the distance between source (of water) and end-user is short. It is not expensive (lack of water transfer works) and is democratic since everyone has the capability to manage these interventions (from a single user to a community of users).
- **"Non-Conventional"**: means that source of water, mainly not directly for human consumption", is not in the context of traditional engineering & water management (e.g. dams/reservoirs and/or GW pumping) but involves a variety of sources ranging from reclaimed wastewater to rainwater harvesting in plot scale.

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Introduction

- European Commission (2012) define NWRMs as intervention techniques over water related ecosystems that are **designed to replicate nature's capacity of adaptation**. The principal objective in terms of water management is to regulate water flow so that the hydrologic extremes such as floods, droughts or desertification can be mitigated as well as achieving better water storage.
- NWRMs can be regarded as adaptation tools to climate change, preferably as natural adaptation mechanisms in contrast to hard engineering solutions (such as large dams/reservoirs). In this respect, NWRMS are more "cost effective", they are more flexible or reversible, are low or no – regret measures, have reduced decision time horizons, etc.

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Introduction

- WH and NWRMs can be implemented in both urban and natural environments. Urban developments are responsible for flood production since large areas are sealed by impervious materials that transforms rainfall to runoff to over 90% and to significantly decrease concentration times on catchments, thus increase flood peaks.
- WH and NWRMs can also be applied within the context of the **combat against desertification** minimizing soil erosion in sensitive areas, promoting green and blue infrastructure to mitigate climate change effects, etc.

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Definitions

Natural Water Retention Measures (NWRMs)

NWRMs are multi-functional measures that aim to protect water resources and address water-related challenges by restoring or maintaining ecosystems, as well as natural features and characteristics of water bodies using natural means and processes (EU Policy Document).

- ✓ Retain water (runoff or river flows) beyond the existing capacity of systems, releasing it at a controlled rate, or infiltrating it to groundwater;
- ✓ Use the retention capacity of soils and of aquatic ecosystems to provide other environmental and well-being improvements, such as water quality, biodiversity, amenity value or resilience and adaptation to climate change impacts;
- ✓ Are usually applied at relatively 'small scale', in comparison to the size of the water catchment or territory in which they are implemented;
- ✓ Emulate a natural process, although are not always 'natural' features themselves (as clearly illustrated by green roofs, check dams, etc.).

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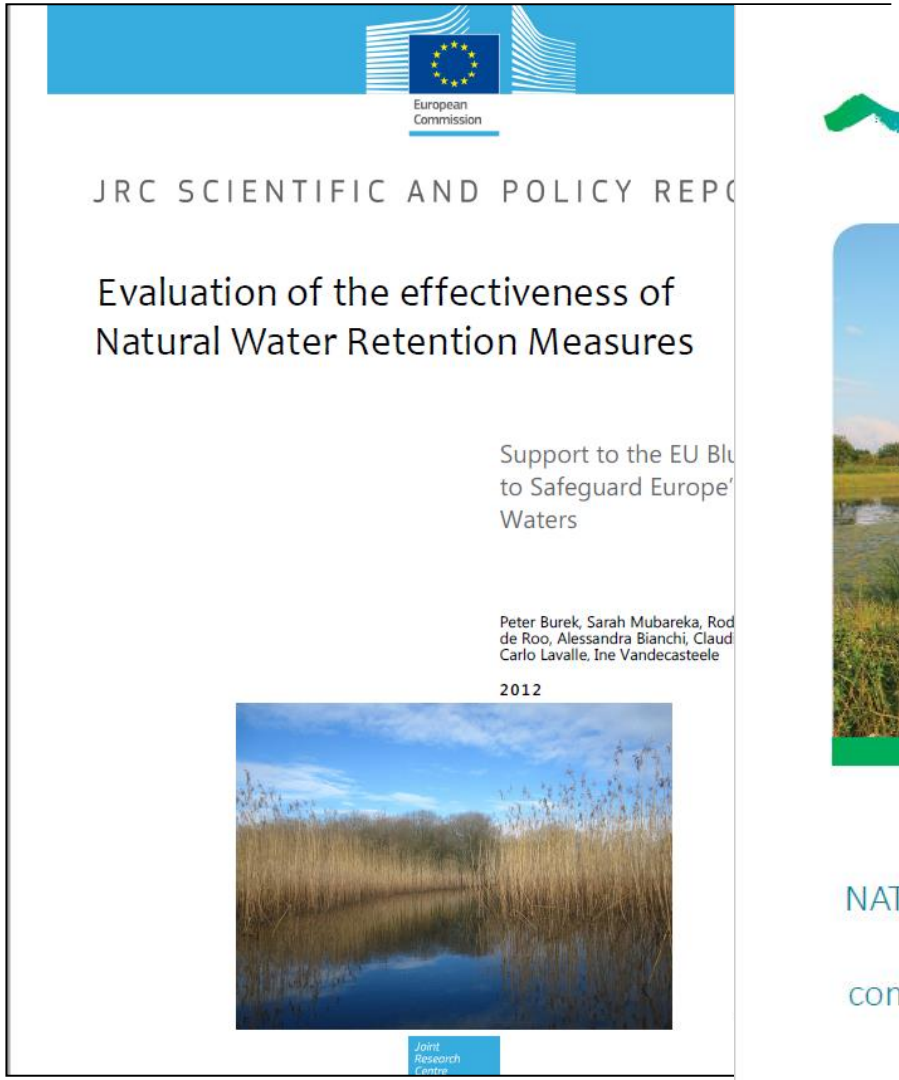
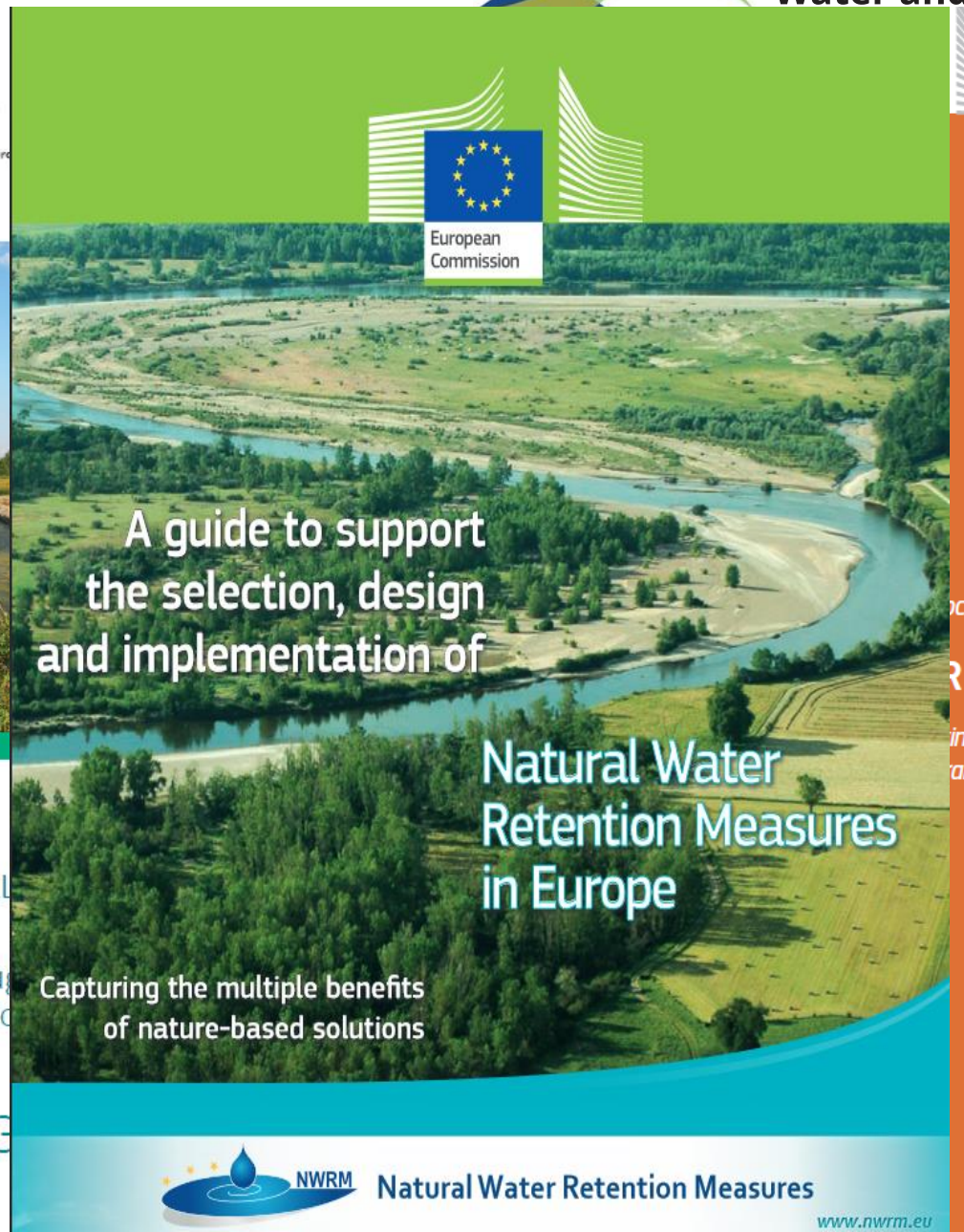
Definitions

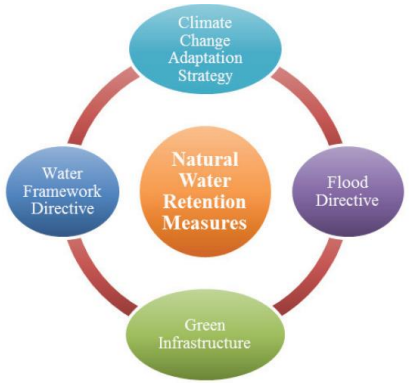




Definitions

Table 1. Illustrating the diversity of measures classified as NWRM[1]

Type	Class	Non-exhaustive list of examples
Direct modification in ecosystems	**Hydro-morphology (Rivers, Lakes, Aquifers, connected wetlands)**	Restoration and maintenance of rivers, lakes, aquifers and connected wetlands; Reconnection and restoration of floodplains and disconnected meanders, elimination of riverbank protection…
Change & adaptation in land-use & water management practice	**Agriculture**	Restoration and maintenance of meadows, pastures, buffer strips and shelter belts; soil conservation practices (crop rotation, intercropping, conservation tillage…), green cover, mulching…
	Forestry and Pastures	Afforestation of upstream catchments; targeted planting for "catching" precipitation; Continuous cover forestry; maintenance of riparian buffers; urban forests; Land-use conversion for water quality improvements…
	Urban development	Green roofs, rainwater harvesting, permeable paving, swales, soakaways, infiltration trenches, rain gardens, detention basins, retention ponds, urban channel restoration…



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NWRMs Applicability

- NWRM offer a variety of measures that are relevant EU wide. But:
  - Their design needs to be tailored for each eco-region.
  - Benefit depends on type, location, implementation design and combination with other measures.
- NWRM are far from being applied in all cases in which they would be an option/the best option. There is a need for a change of thinking to ensure NWRM are duly considered in planning processes.
- Enhanced knowledge is required for supporting the optimisation of NWRM and their combination with other measures, for quantifying their impacts at large scale, and for estimating all their benefits.

NWRMs Applicability

- Research and demonstration in pilot activities is to be promoted to gather further evidence on the (real) effects of NWRM on flood mitigation at the catchment scale.
- There is no integrated framework to assess the net benefits and the cost-effectiveness of strategies for achieving multiple policy goals.
- Funding sources are available at the European and at other levels. But the utilisation of available financial resources for financing NWRM remains limited.
- Smart financial engineering is essential to the implementation of NWRM – searching for synergies between different funding instruments including innovative financing instruments.

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NWRMs Applicability

- Raising awareness on the potential role of NWRM remains essential – including with local communities and across sectors.
- NWRM can help achieving the objectives of different EU and national policies. However, their contributions to different objectives are rarely assessed because of the absence of multiple impact monitoring.
- The multifunctional and multi-sector character of NWRM requires enhanced collaboration between stakeholders representing different sectors.
- Enhanced coordination between planning processes across different policy areas (e.g. River Basin and Flood Risk Management, but also nature protection, rural development and land use/spatial planning) will provide more opportunities for NWRM and for their multiple benefits to be considered.

NWRMs Applicability

- Spatial planning is key for the successful implementation of NWRM.
- Urban planners should make the water cycle explicit in their territorial planning. The concept has now shifted from “design against nature” to “design with nature”.
- NWRM offer multiple benefits and opportunities for achieving WFD and FDs objectives and as such should be included in the RBMPs and FRMPs. NWRM often represent a "better environmental option".

NWRMs Applicability vs Dams

- Policy and Decision makers are often (if not always) reluctant to use NWRMs instead of "traditional" practices namely "a dam construction". Dams as flood protection units are indeed efficient in term of routing flood peaks downstream by attenuating and translating flood peaks even in the case that water level is on the overflow level at the onset of a flood event.
- However, the construction of a (multipurpose) dam includes a lot of uncertainties (e.g. hydrological, geological, geotechnical, financial) that may disproportionally enhance the total cost of the project and the construction period, if not to abolish any plans.
- The "million dollar question" is if cumulatively the effects of many small-scale NWRMs may have a –more- significant effect on flood peaks attenuation and storage in the catchment with less economic costs.

Objectives of WH & NWRMs

- **Flood Volume**: Minimize flood volume by (a) increase artificial surface storage of the catchment (e.g., water harvesting, retention basins), (b) increase natural surface storage (e.g., afforestation), (c) increase artificial subsurface storage of the catchment (e.g., GW artificial recharge, infiltration basins, raingardens).
- **Flood Peak:** Minimize flood peak by (a) decrease flood volume, and (b) increase the concentration time of the catchment. When rainfall duration equals the concentration time, then higher rainfall duration is associated with lower intensity and thus lower runoff peak.

Travel (Concentration) Time: Concentration time is a function of (a) catchment surface roughness, (b) flow travel distance in the stream network and (c) storage in the stream network.

Objectives of WH & NWRMs

- **Minimize Flood Volume**: It is important to lead storm runoff to infiltrate instead of storage in surface reservoirs since water will be lost from evaporation.
  - Water harvesting: in households, neighborhoods, small communities, small agricultural plots, office complexes, etc. Efficiency grows with the increase of storage and decreases with the rainfall severity.
  - Artificial Groundwater recharge: Either on surface in areas with high permeability to groundwater or inverted wells directly to the GW aquifers.
  - Sand Dams: A sand dam is a low reinforced-block wall that is built, using basic and locally-available materials, across a seasonal riverbed; usually to the height of the riverbank. Appropriate locations are selected where water has channeled through rocky substrata.

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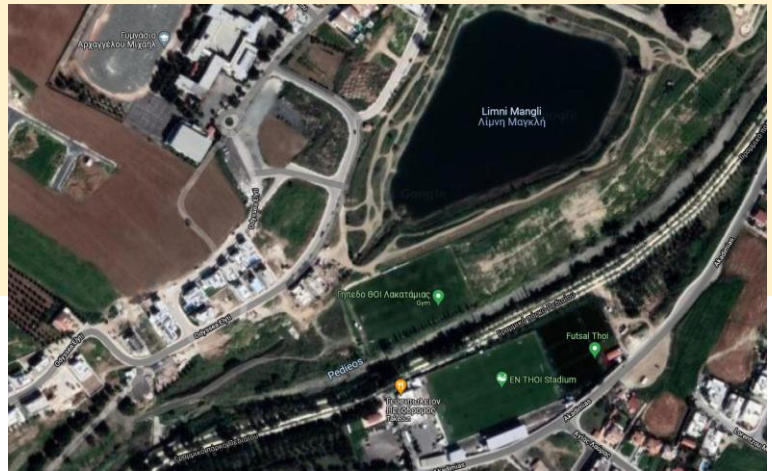
Objectives of WH & NWRMs

- **Minimize Flood Volume**: It is important to lead storm runoff to infiltrate instead of storage in surface reservoirs since water will be lost from evaporation.
  - Raingardens: In urban areas raingardens are used to store water in the pool storage, soil storage and infiltration.
  - Infiltration Basins: Either on surface in areas with high permeability to groundwater or inverted wells directly to the GW aquifers.
  - Off-Stream Retention Basins: A small basin (lake) can be created by a diversion of a stream.



Objectives of WH & NWRMs

- **Minimize Flood Peak**: The flood peak is reduced by decreasing travel times in the catchment and stream network and increase storage in the river bed.
  - Check-dams in upland areas: Check-dams have low storage potential but create a new milder stream slope.
  - Traditional Terracing: Valuable for preserving soil resources but also reducing slopes in the catchment.
  - Stream Bed re-Naturalization: Streambed re-naturalization consists in removing some concrete or inert constructions in the riverbed and on riverbanks, then replacing them with vegetation structures, in order to avoid these damages and restore biodiversity.

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The Activity so far…

- Kick – off Meeting (15/12/2020) by tele-conference.
- Meeting with the Greater Amman Municipality (GAM) in Amman with physical presence (10/06/2021). The objective was to identify the urban or peri-urban pilot area with the Greater Amman Area. A field visit had taken place to investigate in situ the possible areas identified by the Consultant.
- The Stakeholders' Consultation Workshop in Amman with physical presence (21/12/2021). The objective was to discuss and finalize the selection of the two pilot areas in Jordan that NWRMs are going to be implemented at the feasibility level. The **Azraq Mudflat** area was identified as the natural pilot area. For the peri-urban the Greater Amman Area was rejected as a pilot area and there was still a pending issue after the end of the workshop.

The Activity so far…

- Zoom Meeting (06/10/2022) with the Ministry of Water and Irrigation (MWI) to finalize the peri – urban pilot area selection where new alternatives were proposed.
- The peri-urban pilot area was finally decided by email from the MWI (24/10/2022). The **Ain Janna** area at the Ajloun Governorate, that is a hilly area, was finally selected.
- The Activity Reports, according to the Terms Of Reference (TOR) Document were submitted to the MWI accordingly.

Proposed actions & Expected Results

Task 1: Review of Best Management Practices (BMP) in Natural Water Retention Measures (NWRM) for storm water management, aquifer recharge, debris retention transported by runoff, direct use in agriculture etc., and holding a workshop.

Because NWRMs is a relative novel term and approach on stormwater management, it is essential to fill a list of available measures from international literature adjusted to arid and semi-arid regions with flush flood characteristics that fits better to hydrological conditions in Jordan.

Results

- Case studies demonstrating the application of selected best practices in NWRMs for storm water management and aquifer recharge, etc.
- NWRMs classified according to different sources of water and areas of application focusing on arid and semi-arid climatic conditions.
- The **various stakeholders concerned are identified** and their role in the activity is agreed upon.
- A dialogue between the relevant stakeholders is established (during a one-day workshop), and an agreement is reached on the proposed measures to be applied in the different areas in Jordan also with a view to their applicability to arid or semiarid climatic conditions.
- 5. A document of NWRMs updated based on the workshop results.

Tools for deployment:

- Search for projects databases on the Internet
- The European Union Reports on NWRMs.

Proposed actions & Expected Results

Task 2: Selection of pilot case studies in Jordan

Two pilot cases (one peri-urban area and one rural/natural area) in Jordan will be carefully selected to further accommodate the applicability of the measures and the objective to produce a framework guide for similar projects in the future.

Results

- Report describing the selection process, the adopted criteria, the specific characteristics of the selected areas, etc.
- Data collection, processing and storage in GIS database and timeseries databases.

Tools for deployment:

- Development of GIS databases.
- Development of database with timeseries.

Proposed actions & Expected Results

Task 3: Basic design of NWRMs in the selected pilot areas

For the selected pilot cases, the conceptual design of the selected NWRMs will take place by means of (a) hydrologic modelling and (b) hydraulic design. The conceptual design will estimate how much of the mean annual water runoff can be retained in natural or artificial storages, and how much can be diverted into the groundwater by percolation and will include the design of the basic infrastructure to accomplish that. Landscape Architecture will provide guidance for the design according to the prevailing semi-arid landscape and building tradition.

Results

- Design of NWRMs in both pilot areas - by means of hydrologic modelling and hydraulic design (according to the prevailing semi-arid landscape and building tradition).
- Estimation of storm water volume retained in natural or artificial storages.
- Design of proposed work at the feasibility level

Tools for deployment:

- Hydrologic Modelling with HEC – HMS (Soil Moisture Accounting (SMA)) method.
- Hydraulic Modelling with HEC-RAS for open channel flows and SWMM for sewer modelling

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Proposed actions

Task 4: Review of economic incentives and regulation regarding storm water management

A cost–benefit analysis will be performed for the selected NWRMs, comparing the economic and environmental **benefits** of the water retained in natural and/or artificial storages (economically by the associated usage (irrigation, water supply, etc.), flood defense and environmentally by the water quality of the recipients) with the **costs** of applying the NWRMs. According to the analysis and the sustainability of the concept in general, the economic incentives for further adopting NWRMs will be proposed and a regulation framework on the application of the NWRMs for the whole of the country will be prepared.

Results

- Cost – benefit analyses of NWRMs comparing the costs (cost of construction, pollution, etc.) with the benefits per m^3 retained in storage (including benefits from flood defence).
- Assessment of funding options according to the nature of retention (groundwater, surface water) and purpose of water use.
- Economic incentives for the application of NWRM
- Basic structure of regulation manual regarding application of NWRM in Jordan.

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Proposed actions

Task 5: Concluding workshop

A closing workshop is expected to be organized involving relevant national and local stakeholders in order to present and further promote the sustainability of NWRMs in Jordan.

The results of the activity including those from both pilot cases will be presented alongside the cost – benefit analyses to illustrate the viability for the general application of NRWM in the country.

Guidelines/criteria for the selection of appropriate sites of retention and detention systems will also be prepared and be presented during the workshop.

Results

- The results of the activity are presented to the beneficiaries (in a one-day national consultation workshop), and evaluated, and priorities of NWRM options are selected
- A dialogue between the different stakeholders is established (in a one-day workshop) and a set of actions is selected for which the country commits to implement during the WES project.
- Guidelines/criteria for the selection of appropriate sites of retention and detention systems.

Tools for deployment:

- Presentations with Q&A
- Consultation among stakeholders on the applicability of the NWRMs in Jordan.

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Thank you for your attention