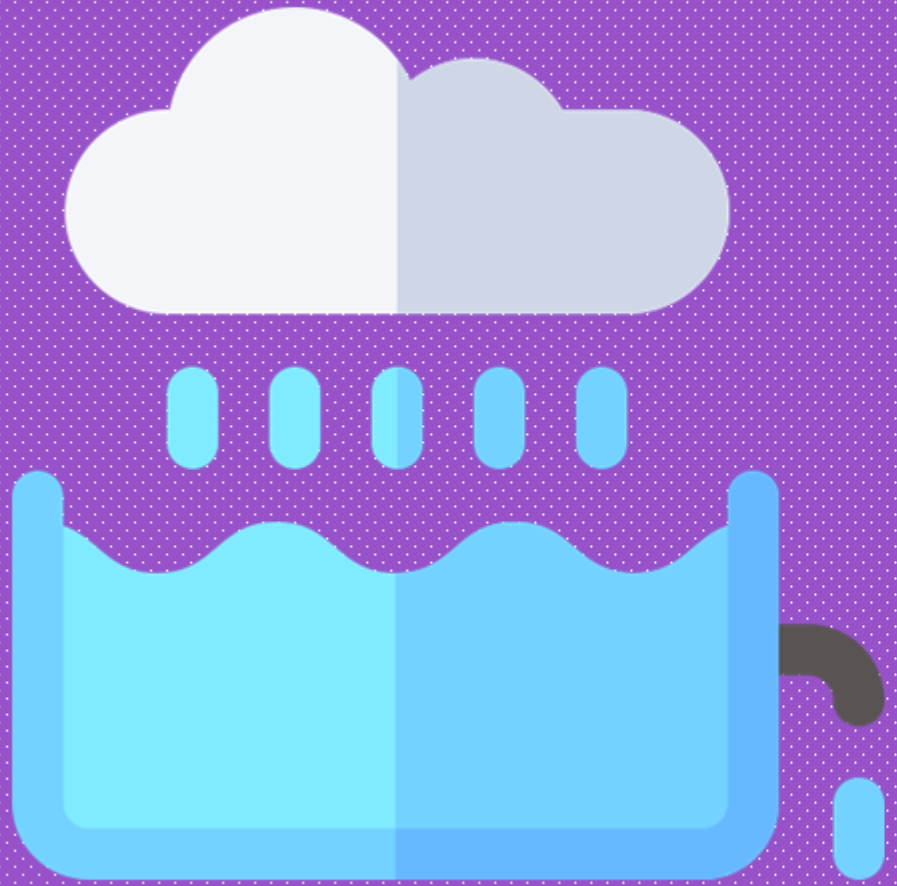

WES-BCA

WES-BCA Activity C1_N-LB-2:
Design of Nature-Based Solutions in a Pilot area in Lebanon

Validation Workshop for confirming the selected site and proposed NBS options, building consensus among institutional and local actors

8 September 2026

WES-BCA Workshop

C1_N-LB-2: Design of Nature-Based Solutions in a Pilot area in Lebanon

Validation workshop for confirming the selected site and proposed NBS options, building consensus among institutional and local actors

8 September 2026

Online

Introduction

Presented by: Ms Suzan TAHA, Water Key Expert, WES-BCA

WES-BCA in a snapshot

- Improve environmental protection, biodiversity restoration, and sustainable water management.تحسين حماية البيئة واستعادة التنوع البيولوجي والإدارة المستدامة للمياه
- Enhance climate resilience in the Mediterranean region. تعزيز القدرة على التكيف مع تغير المناخ في منطقة البحر الأبيض المتوسط.
- Strengthen policies and their implementation in Partner Countries, in line with UfM and Barcelona Convention frameworks. تعزيز السياسات وتنفيذها في الدول الشريكة بما يتماشى مع أطر الاتحاد من أجل المتوسط واتفاقية برشلونة.
- Build the capacity of key stakeholders to develop and implement relevant policies. بناء قدرات الجهات المعنية لتطوير وتنفيذ السياسات ذات الصلة.
- Raise awareness, increase knowledge, and promote behavioural change for climate action and environmental protection. رفع الوعي وتعزيز المعرفة وتشجيع التغيير السلوكي لدعم العمل

WES-BCA builds on the achievements and experience of previous EU-funded regional projects.
يستند المشروع الى إنجازات وخبرات المشاريع الإقليمية السابقة الممولة من الاتحاد الأوروبي

WES-BCA Components

The project is implemented through **two** complementary, closely related and mutually supportive **Components**:

- **Component I - focusing on Water, Biodiversity and Environment.**
- **Topics Addressed**

Topic 1: Prevention & reduction of pollution (urban and industrial solid waste) الوقاية من التلوث والحد من النفايات الصلبة البلدية والصناعية

Topic 2: Curbing Plastic Pollution & Marine Litter الحد من التلوث البلاستيكي والنفايات البحرية

WES-BCA Components

- **Component I - focusing on Water, Biodiversity and Environment.**
- **Topics Addressed (Continued)**

Topic 3: Promoting the Water-Energy-Food-Ecosystems (WEFE) Nexus approach تعزيز نهج ترابط المياه والطاقة والغذاء والنظم البيئية

Topic 4: Water Efficiency تحسين كفاءة استخدام المياه

Topic 5: Climate Change mitigation and adaptation actions إجراءات التخفيف من آثار تغير المناخ والتكيف معه

WES-BCA Components

- **Component II - focusing on Communication and Outreach** التركيز على التواصل والتوعية العامة

Under Component II, the project aims to raise awareness and improve understanding by the general public (and specific segments of the population), including youth and women, stimulating adoption of appropriate behaviours and attitudes towards improved Climate Action and effective Environmental Protection.

في إطار المكوّن الثاني، يهدف المشروع إلى رفع مستوى الوعي وتعزيز فهم الجمهور العام (وفئات محددة من المجتمع)، بما في ذلك الشباب والنساء، وتشجيع تبني السلوكيات والممارسات المناسبة لدعم العمل المناخي وتعزيز حماية البيئة بشكل فعّال.

WES-BCA Identity

WES-BCA
Water and Environment Support - Biodiversity and Climate Action
in the Neighbourhood South region

Partner Countries: 8 Countries in North Africa and the Middle East

Duration: November 2024 - November 2027

Budget: 7.000.000 Euros

Team Leader: Professor Michael Scoullos, scoullos@wes-med.eu
Environment Key Expert: Mr Anis Ismail, a.ismail@wes-med.eu
Water Key Expert: Ms Suzan Taha, taha@wes-med.eu
Communication Key Expert: Ms Lisa Papadogeorgaki, lpa@ldk.gr

WES-BCA Consortium

LDK CONSULTANTS S.A. (Leader)

Arab Network for Environment and Development (RAED)

Association of Cities and Regions for Sustainable Resource Management (ACR+)

Mediterranean Agronomic Institute of Bari (CIHEAM Bari)

Mediterranean Information Office for Environment, Culture and Sustainable Development (MIO-ECSDE)

MedWaves, the Regional Activity Centre of UNEP/MAP for Sustainable Consumption and Production

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Introducing the Activity C1_LB-2
Design of Nature-Based Solutions in a Pilot area in Lebanon
تصميم حلول قائمة على الطبيعة في منطقة تجريبية في لبنان

Building on Previous WES Experience

The Lebanon activity builds on experience gained under the previous WES project in Jordan, where Natural Water Retention Measures (NWRM) were explored in two pilot areas.

- Azraq – Peri-urban / Natural Catchment
- Ajloun – Urban Pilot

Azraq – Peri-urban / Natural Catchment	Ajloun – Urban Pilot
Gabion check dam for flood attenuation and sediment control	Contour-aligned vegetated swales to capture and slow runoff
Retention pond for floodwater storage and infiltration	Soakaway for infiltration and groundwater recharge
Small upstream check dams	
Riparian afforestation	
Drought-resistant vegetation	

Key lessons carried forward

Stormwater as a resource

Manage stormwater not only as a flood risk, but also as a potential water resource.

Solutions tailored to context

NbS/NWRM need to respond to local conditions, challenges and opportunities.

Stakeholder involvement

Local & institutional stakeholders are important in identifying and validating suitable solutions.

Multiple benefits

NbS can support water management, climate resilience and ecosystems at the same time.

From Jordan to Lebanon: building on the experience while developing solutions adapted to the Lebanese context.

Objectives of the activity and overview of the proposed actions

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in the Neighbourhood South region

Overall objective:

Demonstrate how stormwater flood/rainwater can be managed as a resource through site-specific design and feasibility analysis of NBS with consideration for local ecosystems and biodiversity protection.

إظهار كيفية إدارة مياه الأمطار ومياه الفيضانات الناتجة عن العواصف المطرية كمورد مائي، من خلال تصميم حلول قائمة على الطبيعة (NbS)ملائمة لخصائص الموقع وإجراء تحليل لجدواها، مع مراعاة النظم البيئية المحلية وحماية التنوع البيولوجي.

Specific objectives

- engage institutional and local stakeholders in the identification and validation of a pilot area for NBS implementation based on technical, environmental, and institutional feasibility.

إشراك الجهات المؤسسية وأصحاب المصلحة المحليين في تحديد منطقة تجريبية لتنفيذ الحلول القائمة على الطبيعة (NbS)والتحقق من ملاءمتها، استناداً إلى الجدوى الفنية والبيئية والمؤسسية.

- conduct hydrological and ecological assessments and develop a shortlist of one or more suitable NBS options tailored to the selected pilot area.

إجراء تقييمات هيدرولوجية وإيكولوجية وإعداد قائمة مختصرة تضم حلاً واحداً أو أكثر من الحلول القائمة على الطبيعة الملائمة للمنطقة التجريبية المختارة.

Objectives of the activity and overview of the proposed actions

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Specific objectives (Continued)

- develop a Pre-Feasibility Study for the selected intervention(s), integrating stormwater management functions with biodiversity support and implementation considerations.

عداد دراسة ما قبل الجدوى للتدخل أو التدخلات المختارة، بحيث تراعي الدراسة، إلى جانب دور الحلول المقترحة في إدارة مياه الأمطار، ساهمتها في دعم التنوع البيولوجي والمتطلبات العملية لتنفيذها

- enhance knowledge of Best Management Practices (BMPs) in NBS and promote their adaptation for arid and semi-arid contexts.

عزيز المعرفة بأفضل ممارسات الإدارة (BMPs) في مجال الحلول القائمة على الطبيعة، وتشجيع تكييفها بما يتناسب مع ظروف المناطق لجافة وشبه الجافة.

- strengthen stakeholder capacities for planning, implementing, and maintaining NBS, through a series of consultations and a concluding workshop.

عزيز قدرات أصحاب المصلحة على تخطيط وتنفيذ وصيانة الحلول القائمة على الطبيعة، من خلال سلسلة من المشاورات وورشة عمل ختامية.

Ministry of Water and Irrigation

Proposed actions/tasks

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in the Neighbourhood South region

Task 1: Site Selection and Identification of Suitable NBS Intervention(s) (in coordination with local stakeholders)

المهمة 1: اختيار الموقع وتحديد التدخل أو التدخلات المناسبة القائمة على الطبيعة (بالتنسيق مع أصحاب المصلحة المحليين)

Task 2: Development of a Pre-Feasibility Study

المهمة 2: إعداد دراسة ما قبل الجدوى

Task 3: Concluding Workshop

تنظيم الورشة الختامية

Objectives of the meeting

- **Overall objective:** أهداف ورشة العمل
  Validate the selected pilot site and reach stakeholder agreement on the **NbS option(s) to advance to conceptual design**.
- التحقق من ملاءمة الموقع التجريبي المختار والتوصل إلى توافق بين أصحاب المصلحة بشأن خيار/خيارات الحلول القائمة على الطبيعة (NbS)التي سيتم الانتقال بها إلى مرحلة التصميم المفاهيمي.

The workshop will:تهدف ورشة العمل إلى

- Present the **site-selection process, baseline conditions and key considerations**.
- عرض عملية اختيار الموقع، والظروف الأساسية للموقع، والاعتبارات الرئيسية.
- Validate/refine site conditions using **local and institutional knowledge**.
- التحقق من و تحسين فهم ظروف الموقع بالاستناد إلى المعرفة المحلية والمؤسسية.
- Present the **preliminary NbS options and their protective and restorative functions**.
- عرض الخيارات الأولية للحلول القائمة على الطبيعة ووظائفها الوقائية والاستصلاحية.
- Discuss their feasibility across **technical, environmental, social, institutional, economic and O&M dimensions**.
- مناقشة جدوى الخيارات المقترحة من النواحي الفنية والبيئية والاجتماعية والمؤسسية والاقتصادية، والتشغيل والصيانة.
- Identify **required modifications, additional information and field investigations**.
- تحديد التعديلات المطلوبة والمعلومات الإضافية و التحريات الميدانية اللازمة.
- Build consensus on the **preferred intervention(s) and immediate next steps**.
- بناء توافق حول التدخل أو مجموعة التدخلات المفضلة والخطوات الفورية التالية.

Resources

- Professor Michael SCOULLOS, Team Leader, WES-BCA – on-line
- بروفيسور مايكل سكولوس، قائد فريق مشروع WES-BCA - **عن بعد**
- Dr Abbas FAYAD, Senior Local Hydrologist - in person
- **الدكتور عباس فياض** ، خبير محلي في الهيدرولوجيا –**حضورياً**
- Mr Ioannis VASILAKOS , Senior Civil/Environmental Engineer- online
- **السيد يانيس فاسيلاكوس** ، مهندس مدني/بيئي –**عن بُعد**
- Ms Eleni AVRAMIDI , Senior Biodiversity Expert – online
- **السيدة إليني أفراميدي** ، خبيرة في التنوع البيولوجي –**عن بُعد**
- Ms Mona Fakih, WES-BCA focal Point, Director of Water, General Directorate of Hydraulic and Electric Resources - in person
- **السيدة منى فقيه** ، نقطة الاتصال لمشروع WES-BCA، مديرة المياه، المديرية العامة للموارد المائية والكهربائية –**حضورياً**
- Ms Suzan TAHA, Key Water Expert, WES-BCA - on-line
- **السيدة سوزان طه** –خبيرة المياه الرئيسية، مشروع WES-BCA - **عن بُعد**

Agenda

Time	Session / Main Topics	Lead / Speakers
09:45–10:20	Presentation of the Activity • Activity in Lebanon • Introduction to NbS & Natural Water Retention Measures (NWRM)	Suzan Taha Ioannis Vasilakos
10:20–11:20	Technical Findings • Site-selection methodology & candidate sites • Selected pilot area: characteristics & justification • Preliminary NbS concept & proposed interventions • Issues for stakeholder feedback & validation	Abbas Fayad Ioannis Vasilakos
11:20–11:40	**Coffee Break**	
11:40–13:00	Interactive Working Session • Validation of pilot area • Technical suitability of NbS • Biodiversity & ecological considerations • Social, institutional & implementation considerations • O&M • Opportunities, constraints, cost implications & scaling	Moderator: Abbas Fayad Technical inputs: Ioannis Vasilakos & Eleni Avramidi
13:00–13:20	Conclusions & Next Steps • Key recommendations • Finalisation of Pilot Site Selection Report • Preparation of Pre-Feasibility Study	Abbas Fayad Ioannis Vasilakos
13:20–13:30	**Workshop Evaluation**	**All participants**
13:30–14:30	**Lunch**	

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in the Neighbourhood South region

Thank you for your attention!

WES-BCA Workshop

C1_N-LB-2: Design of Nature-Based Solutions in a Pilot area in Lebanon

Validation workshop for confirming the selected site and proposed NBS options, building consensus among institutional and local actors

8 September 2026

Online

Introduction to Nature-Based Solutions (NBS) & Natural Water Retention Measures (NWRM)

Presented by: **Ioannis VASILAKOS**, Civil Engineer,
Water Resources Science & Environmental Technology

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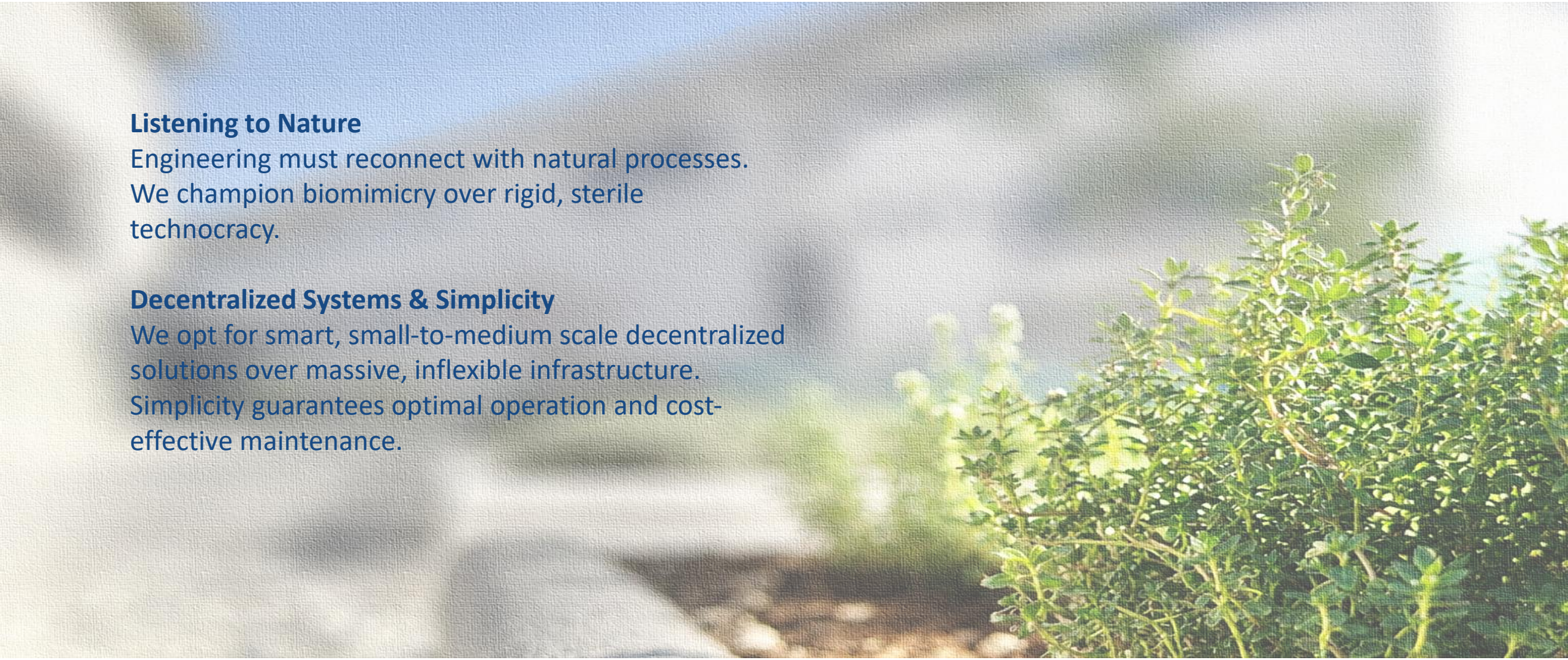
The Core Challenge - The Mediterranean Paradox

- **Climate Change & Urbanization:** Increasing temperatures, unpredictable storms, and intense soil sealing**.**
- **The Water Paradox:** We face severe water scarcity during dry seasons, yet we allow valuable rainwater to become destructive runoff during winters.
- **The Consequence:** Flooding, soil erosion, and pollutants transported into natural water bodies.

Towards Biomimicry



Listening to Nature
Engineering must reconnect with natural processes. We champion biomimicry over rigid, sterile technocracy.

Decentralized Systems & Simplicity
We opt for smart, small-to-medium scale decentralized solutions over massive, inflexible infrastructure. Simplicity guarantees optimal operation and cost-effective maintenance.

Demystifying NBS & NWRM

- **NBS (Nature-Based Solutions)**
  - Sustainable approaches that work with natural processes rather than against them
  - Solutions that emulate nature to manage water, delivering co-benefits for human well-being and ecosystems.
- **NWRM (Natural Water Retention Measures)**
  - Multi-functional measures that emulate natural hydrology
    - ✓ Goal 1: Slow down water runoff.
    - ✓ Goal 2: Enhance soil infiltration.
    - ✓ Goal 3: Reduce vulnerability to floods and droughts.
- **The "Blue-Green Shield“**
  - Protecting communities while restoring ecosystems.

The WEFE Nexus Approach (Multifunctional Benefits)

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Water – Energy – Food – Ecosystems (WEFE) Nexus:

A dynamic, circular balance

NBS never perform a single function:

- **Water: Harvests rainwater and recharges aquifers.**
- **Energy: Low construction and maintenance energy requirements.**
- **Food: Provides non-conventional water for irrigation & agriculture.**
- **Ecosystem: Enhances biodiversity, creates habitats, and improves microclimates.**

Every intervention is inextricably linked to the WEFE dynamic nexus.

This "Blue-Green Shield": Low energy requirements, high climate resilience.

Society & Co-creation

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From Theory to Practice

Cutting-edge research must move beyond sterile exercises. When civil society feels the tangible benefits and aesthetics of NBS, they actively participate in co-creation.

Applied Research & Real-World Impact

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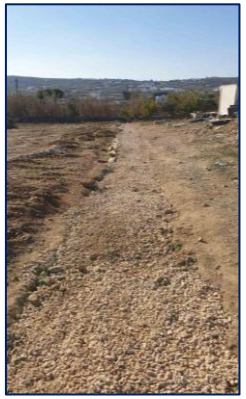
- **Project HYDROUSA (Greece) - Turning theory into practice**
  - Key Interventions:
    - ✓ Innovative subsurface rainwater harvesting system.
    - ✓ Hybrid xeriscape bioswales for flood prevention.
    - ✓ Precision agriculture (e.g., oregano, lavender) utilizing collected runoff.
  - Result:
    - ✓ Closing the water loop in water-scarce communities.

HYDROUSA



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Applied Research & Real-World Impact

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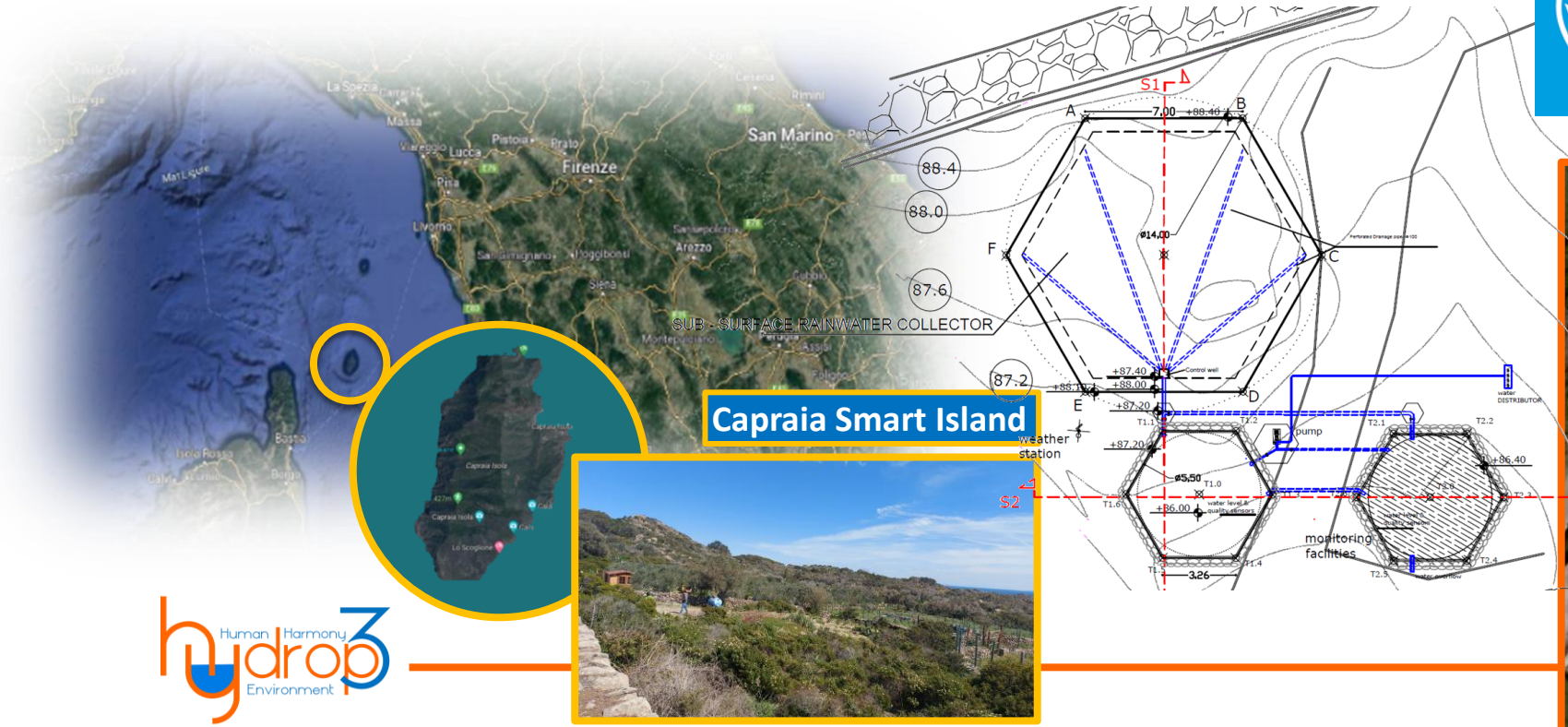
- **Project HYDROUSA - Turning theory into practice**

Research, Development & Innovation – “TRANSFERRING” Knowledge & Solutions

CAPRAIA Island, Tuscan Archipelago, ITALY



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Applied Research & Scaling Up Across the Mediterranean

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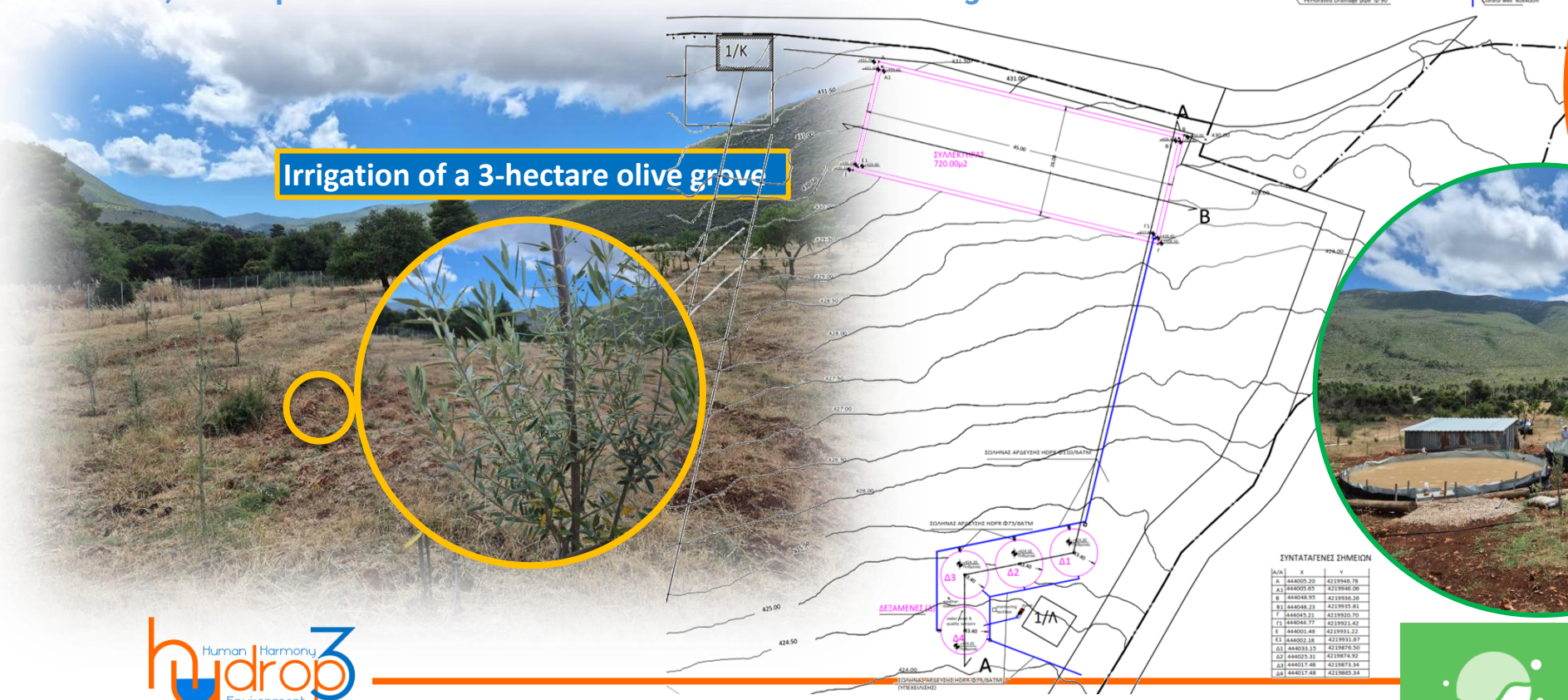
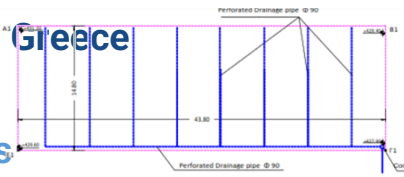
in the Neighbourhood South region

- **INNO4CFIs Project: Regenerative and Nature-Based Solutions – Closing the Water Loops**
  - **Some examples – Rainwater & Nature-Based Solutions (NBS) - Mandra, Attica, Greece**

Research, Development & Innovation – "TRANSFERRING" Knowledge & Solutions





Human Harmony hydrop3 Environment

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INNO4CFIs
Regenerative Carbon Farming

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Applied Research & Scaling Up Across the Mediterranean

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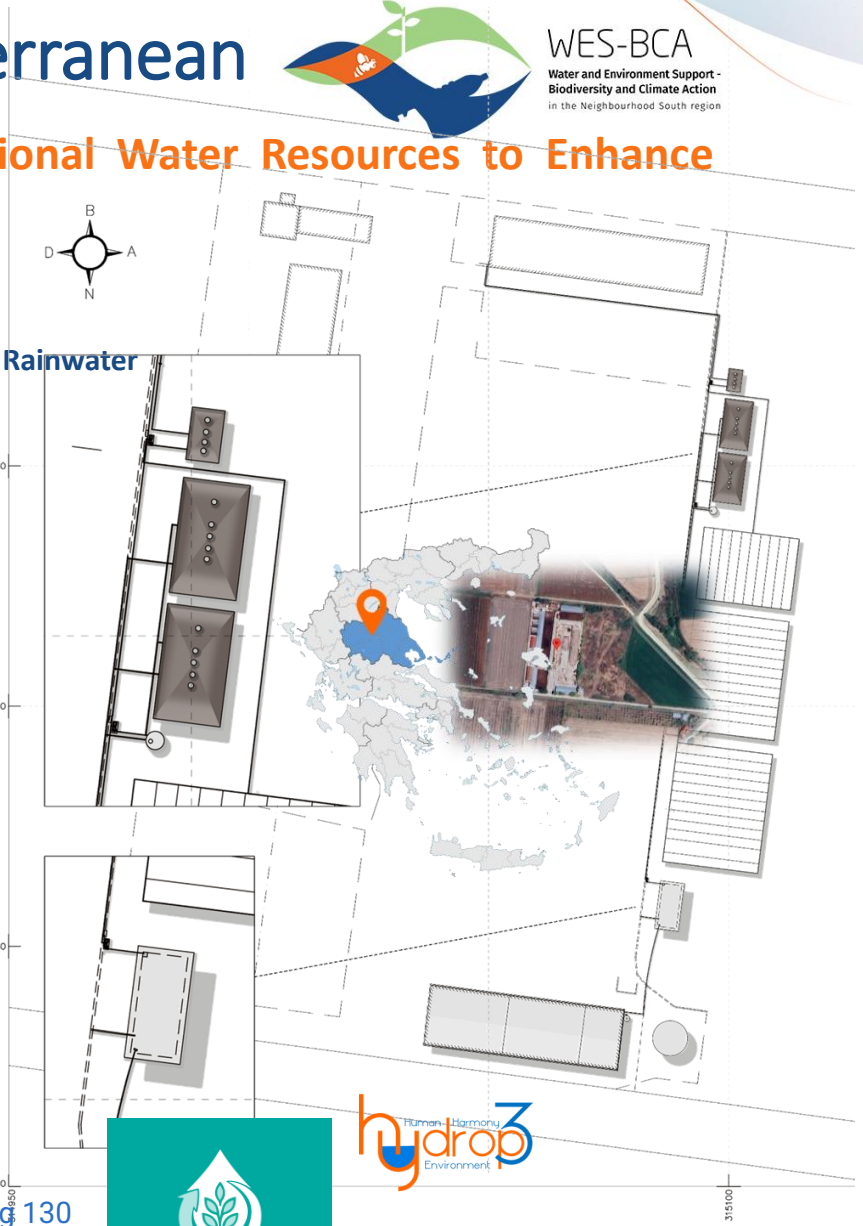
- **AquaLoops4Med Project: Smart Decentralized Management of Non-Conventional Water Resources to Enhance Water Circularity in the Agri-Livestock Sector**
  - **Some examples – Xrisavgi village, Trikala, GREECE**
    - ✓ **Design and Implementation of an Innovative Hudro-System for the Collection, Storage, and Utilization of Rainwater**

Sub-system 1: Rainwater Collection from Rooftops

Sub-system 2: Innovative Subsurface Rainwater Collection System

Utilization of the Collected Water: Irrigation of a Maize (Corn) Crop for Feed Production

Storage Tanks: Total Storage Capacity Exceeding 130 m³/year



hydrop3 Human-Harmony Environment

AquaLoops4Med

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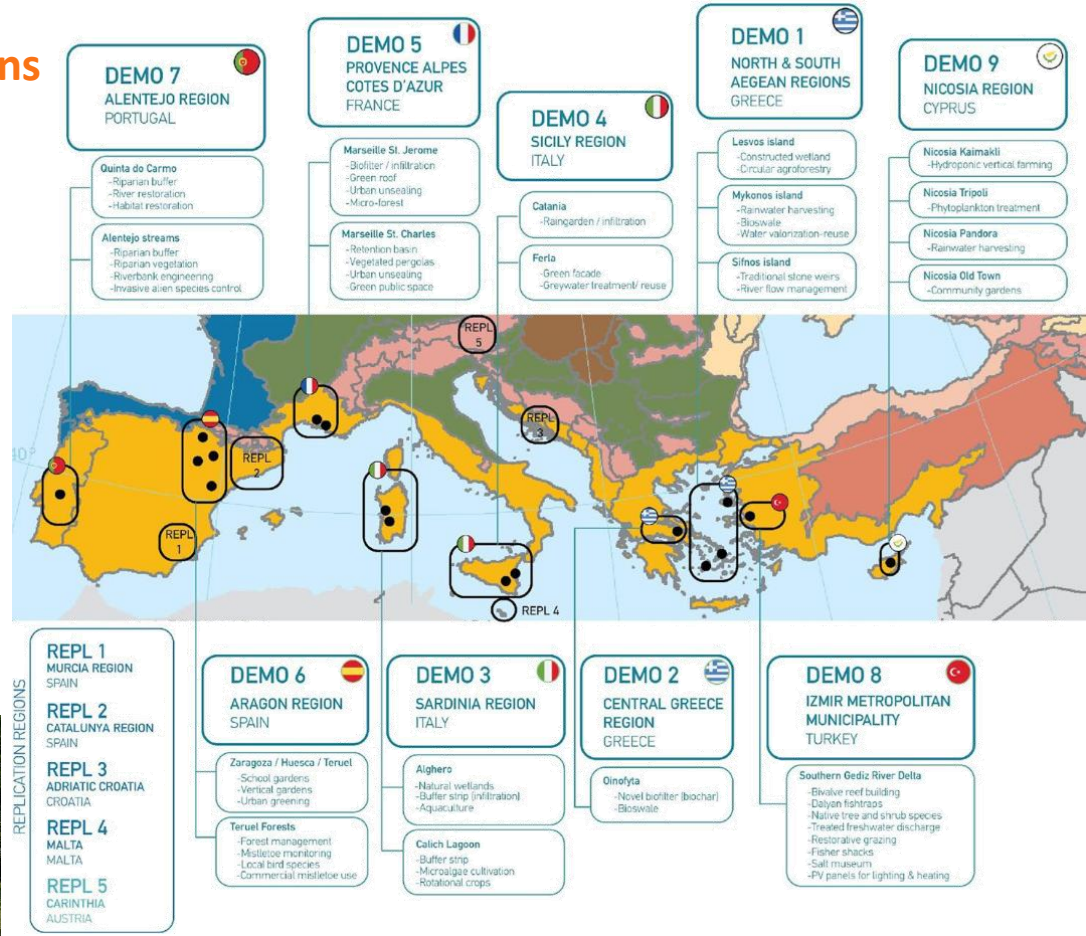
- **CARDIMED Project: 90 interventions across 20 Mediterranean locations**
  - **Some examples – SIFNOS ISLAND, GREECE**
    - ✓ **Rejuvenation of seasonal streams using micro-dams to slow water and recharge aquifers**

CARDIMED



Applied Research & Scaling Up Across the Mediterranean

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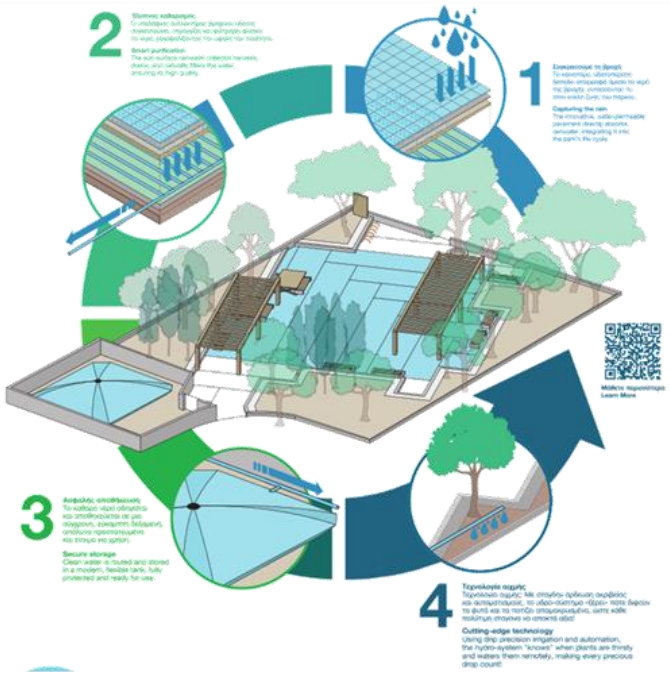
in the Neighbourhood South region

- **CARDIMED Project: 90 interventions across 20 Mediterranean locations**
  - **Some examples – Nicosia, Cyprus – RAINWATER HARVESTING FOR SUSTAINABLE WATER MANAGEMENT IN THE 21ST CENTURY**

Hydropark*

Making Rain, Life! A pioneering, nature-inspired hydro-system captures rainwater for a green park. Innovation meets architectural vision in a total renovation, designed with absolute respect for the existing trees. Our park is changing!



CARDIMED

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Explore the potential of Natural Water Retention Measures (NWRM) at the catchment scale in Jordan - WES Project

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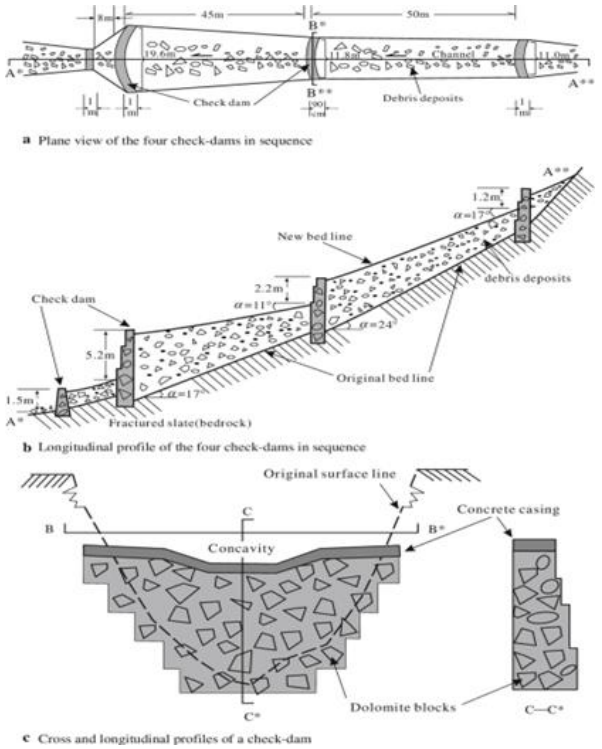

Check Dams:

- Slow flash floods and reduce peak runoff.
- Increase infiltration and groundwater recharge.
- Trap sediments and improve water quality.
- Provide low-cost, nature-based water retention.
- Boost drought resilience by capturing rare storm flows.

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Bringing the Vision to Lebanon (WES-BCA)

- The Goal for Lebanon: Apply Best Management Practices (BMPs) in a local pilot area.
- Our Focus: The Shouf Biosphere Reserve (SBR) and its buffer zones.
- The Objective:
  - Address steep terrain and localized erosion.
  - Design basic concepts for stormwater detention and reuse.
  - Empower local stakeholders through capacity building.

Bringing the Vision to Lebanon (WES-BCA)

- Instead of Conclusion…just a few sincere words
  - Water is not just a resource; it is the foundation of life and community
  - Nature show us the right way
    - ✓ Our Commitment: To design with absolute respect for pre-existing nature, local identity, and human needs.

The Ultimate Truth

«Εν το Παν»	"One is all, All is One"
Ζήνων ο Ελεάτης, 490 – 425 π.Χ. Η Φύση ως Ολότητα	Xenon from Elea, 490 - 425 b.C. Nature as Totality

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in the Neighbourhood South region

Ioannis VASILAKOS, Civil Engineer,
Water Resources Science & Environmental Technology

Thank you for your attention!

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Presentation of the Technical Findings 1

1. Site selection methodology and assessment of candidate sites

Mr Abbas FAYAD, Senior Local Hydrologist

Funded by the European Union

Purpose of the Workshop and Expected Outcomes

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Why are we meeting today?

- **Project:** Design of Nature-Based Solutions for Stormwater and Rainwater Management in Lebanon
- **Scope**: Site Selection Methodology, Candidate-Site Assessment, and Validation of the Preferred Pilot Area
- **Overall objective**: Validate the preferred pilot site and obtain stakeholder agreement on the Nature-Based Solutions (NbS) options to be advanced to conceptual design.
- **Stakeholders**: relevant ministries and public institutions, water establishments, municipalities, universities/research centers, NGOs, local stakeholders, and potential implementation partners.

The project in a nutshell

Identify the problem(s).

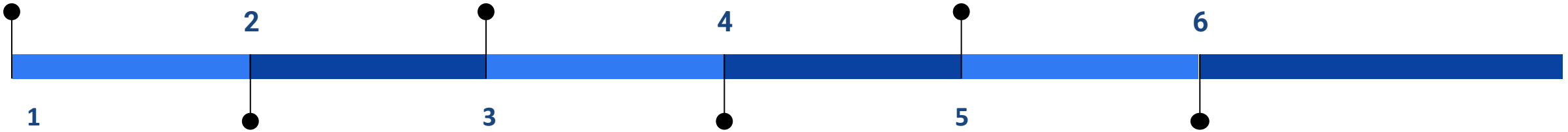
We identified where stormwater, runoff, and erosion problems are recurring after major rainfall events.

Validate findings.

Test those findings against institutional and local knowledge.

Identify NbS options.

Identified appropriate low-cost and scalable NBS options



Assess NbS potentials.

Assessed where NBS could technically and environmentally work.

Pilot area selection.

Identified the preferred pilot site.

Stakeholder validation.

We are now asking stakeholders to validate the site and agree on which options should proceed to conceptual design.

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What do we need to agree on?

1. **Confirm the preferred pilot area** or identify modifications.
2. Confirm whether the **baseline understanding of the site is correct.**
3. **Identify missing information or local knowledge** that should be incorporated.
4. Agree on the **priority stormwater/environmental/ecological problems** to address.
5. Agree on the **NbS/BMP options worth advancing to conceptual design.**
6. Confirm key institutional constraints and implementation considerations.
7. Agree on the next steps toward conceptual design.

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Outline

PART I — PROJECT ACTIVITIES AND NBS/BMP CONTEXT (S. TAHA & I. VASILAKOS)

PART II — SITE-SELECTION METHODOLOGY (This Presentation)

PART III — CANDIDATE-SITE ASSESSMENT (This Presentation)

PART IV — SELECTED BASELINE CHARACTERISTICS (Next Presentation)

PART V — SITE JUSTIFICATION & STAKEHOLDER VALIDATION (Next Presentation)

PART VI — NbS OPTIONS TO ADVANCE (I. VASILAKOS Presentations)

PART VII — INTERACTIVE WORKING SESSION & NEXT STEPS

Why NbS for Lebanese stormwater management?

01	Climate drivers	• Highly seasonal rainfall. • Short-duration, intense rainfall events. • Long dry periods.
02	Hydrological processes	• Localized pluvial flooding. • Erosion and sediment transport. • Loss of natural infiltration/storage.
03	Anthropogenic challenges	• Increasing imperviousness and urbanization. • Water scarcity during dry periods.
04	Management pitfalls	• Limited drainage capacity in some urban areas. • Limited municipal resources for large infrastructure. • Need for solutions that can be implemented incrementally.

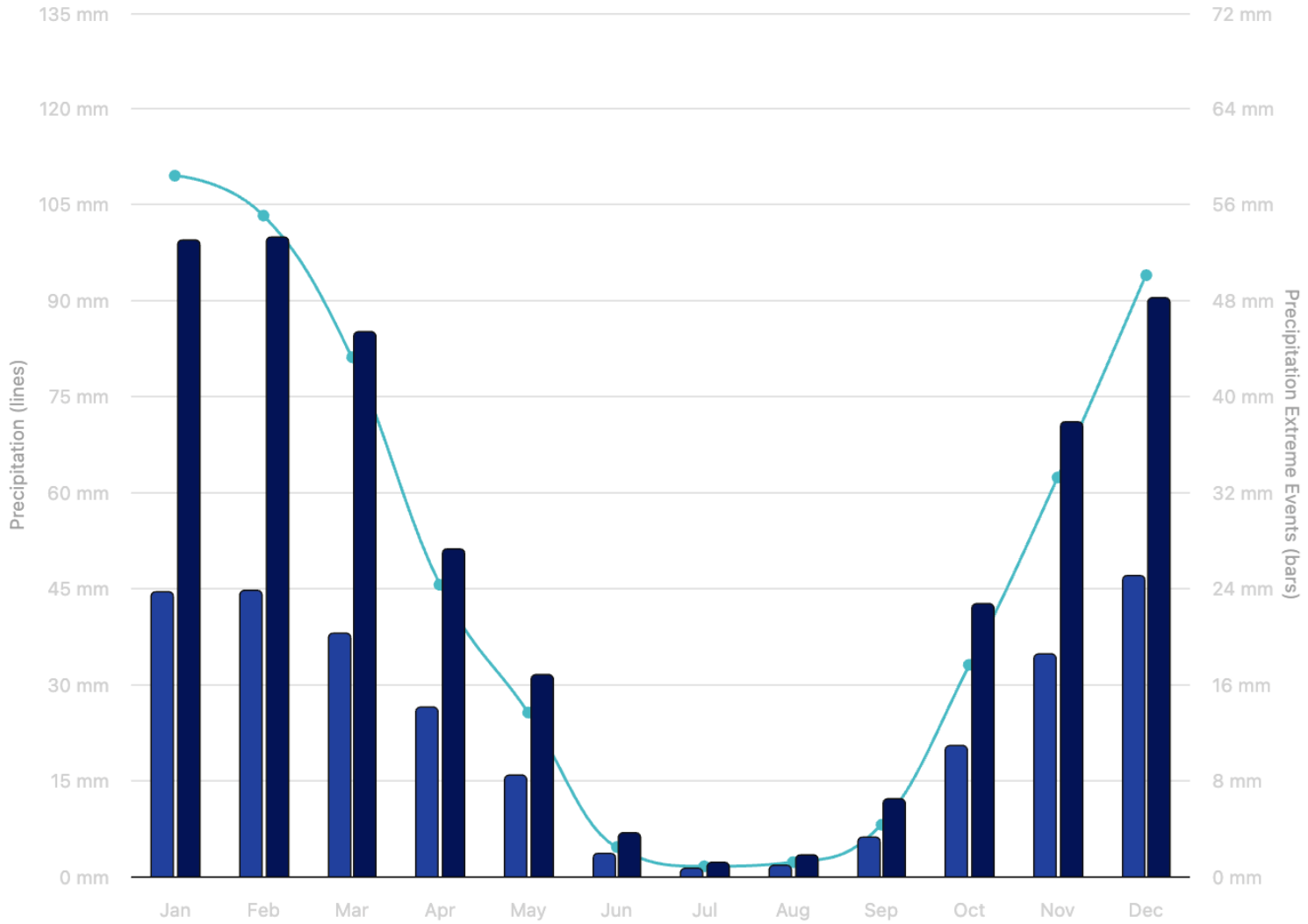

Figure. Precipitation and extreme precipitation events for Lebanon (1991-2020) using data derived from ERA5 reanalysis products.

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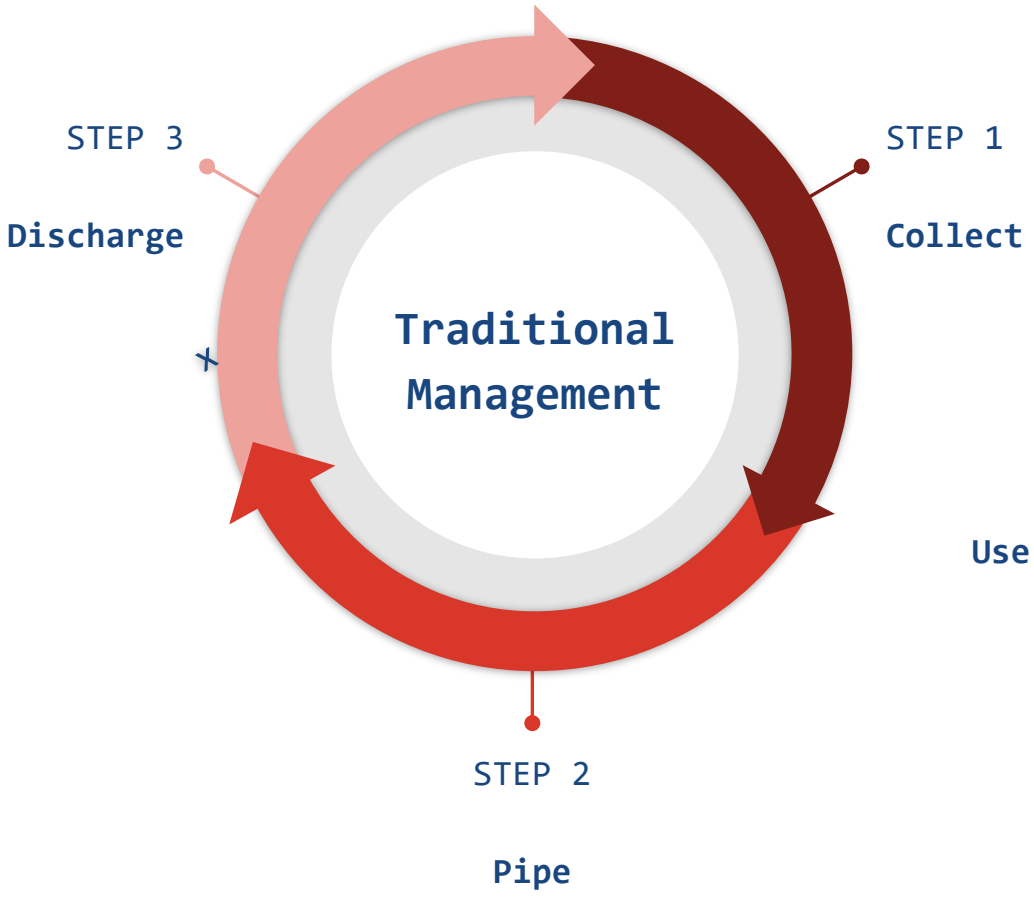
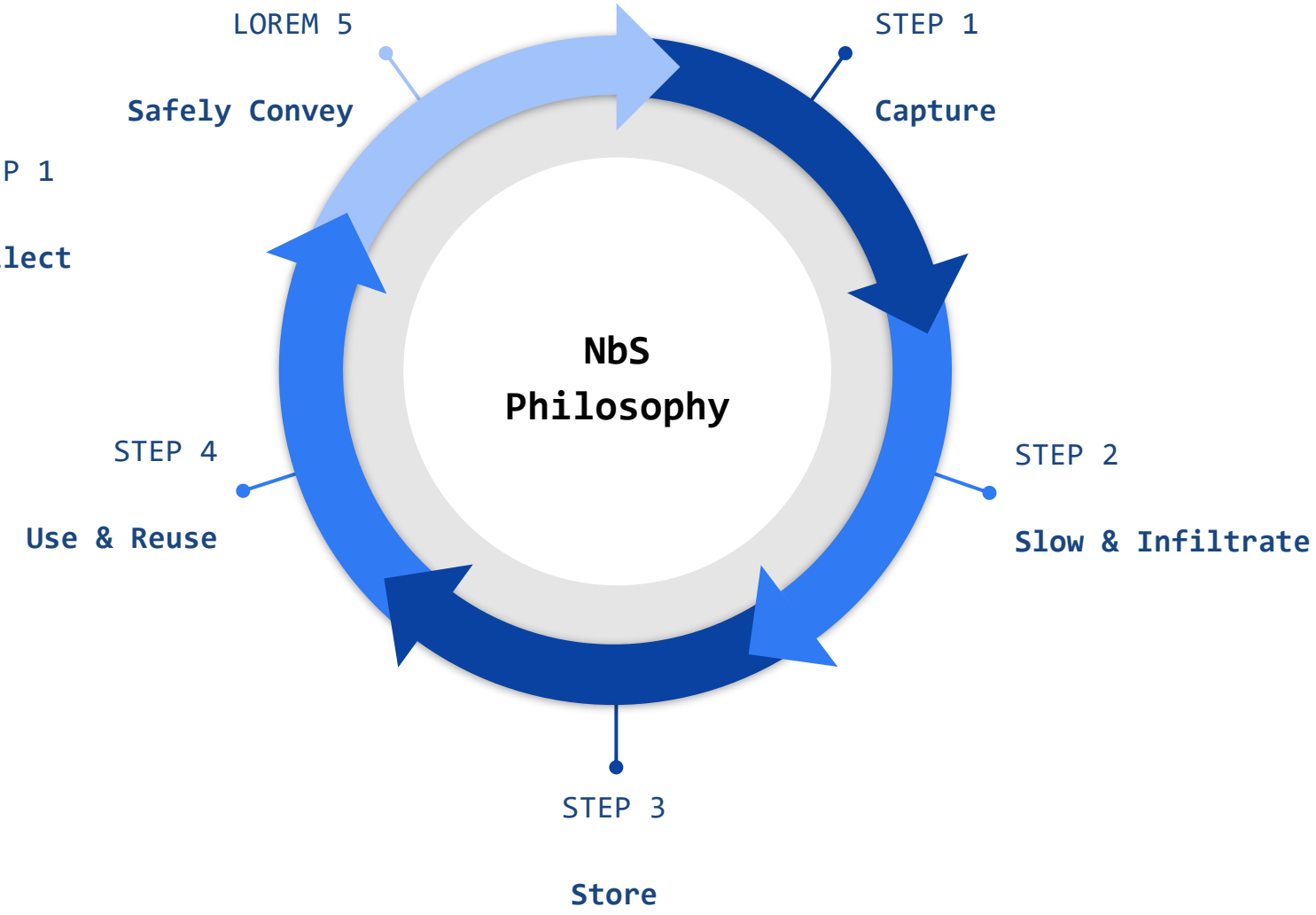
The NbS Philosophy





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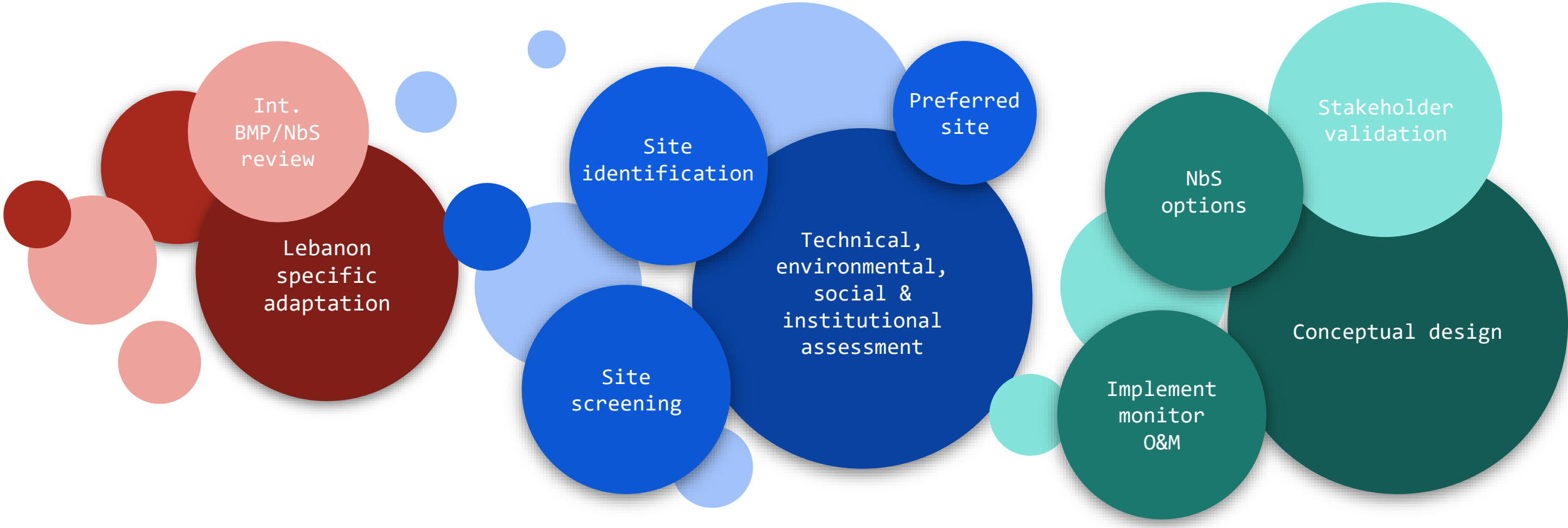
From site selection to NbS implementation



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Literature review of BMP/NbS adapted to Lebanon

Hydrological function	Potential BMP/NbS
Capture	Rainwater harvesting, green roofs
Infiltrate	Infiltration gardens, soakaways, infiltration trenches
Filter	Bioretention, rain gardens, vegetated filter strips
Convey slowly	Bioswales, vegetated channels
Store	Detention/retention basins, landscape storage
Reuse	Cisterns for irrigation/non-potable uses
Reduce imperviousness	Permeable pavements
Restore ecological functioning	Riparian buffers, wetlands, green corridors

Key findings of the literature review

- The implementation of nature-based solutions (NbS) remains limited in Lebanon, with most applications still at the pilot, research, or feasibility-study stage rather than being implemented at scale.
- Their growing relevance reflects increasing water stress, uncontrolled urban and stormwater runoff, and widespread untreated wastewater.
- Existing initiatives demonstrate a range of approaches, including domestic water reuse, constructed wetlands and living green walls, rainwater harvesting, watershed and flood-risk restoration, and managed aquifer recharge.

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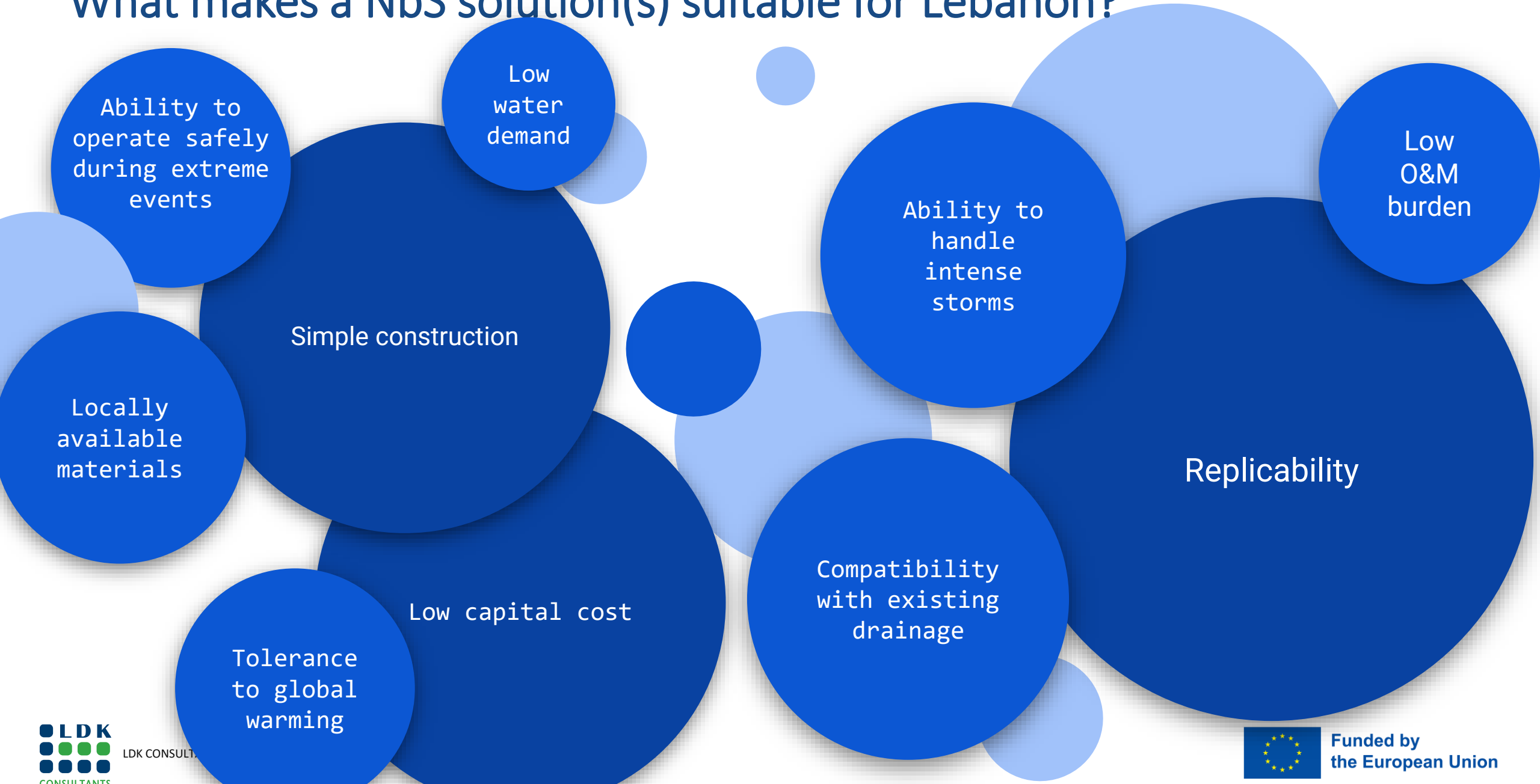
Key findings of the literature review (Cntd.)

- Projects such as NAWAMED, Al Murunah, the Ola Initiative, UN-Habitat interventions in Zahle, and household rainwater harvesting in Akkar illustrate some of the potential of NbS to reduce pressure on conventional water resources while contributing to the reduction of water pollution.
- The literature also identifies other initiatives addressing basin-scale drought and flood management and ecosystem restoration; however, these interventions similarly fall outside the scope of the current activity.

What makes a NbS solution(s) suitable for Lebanon?



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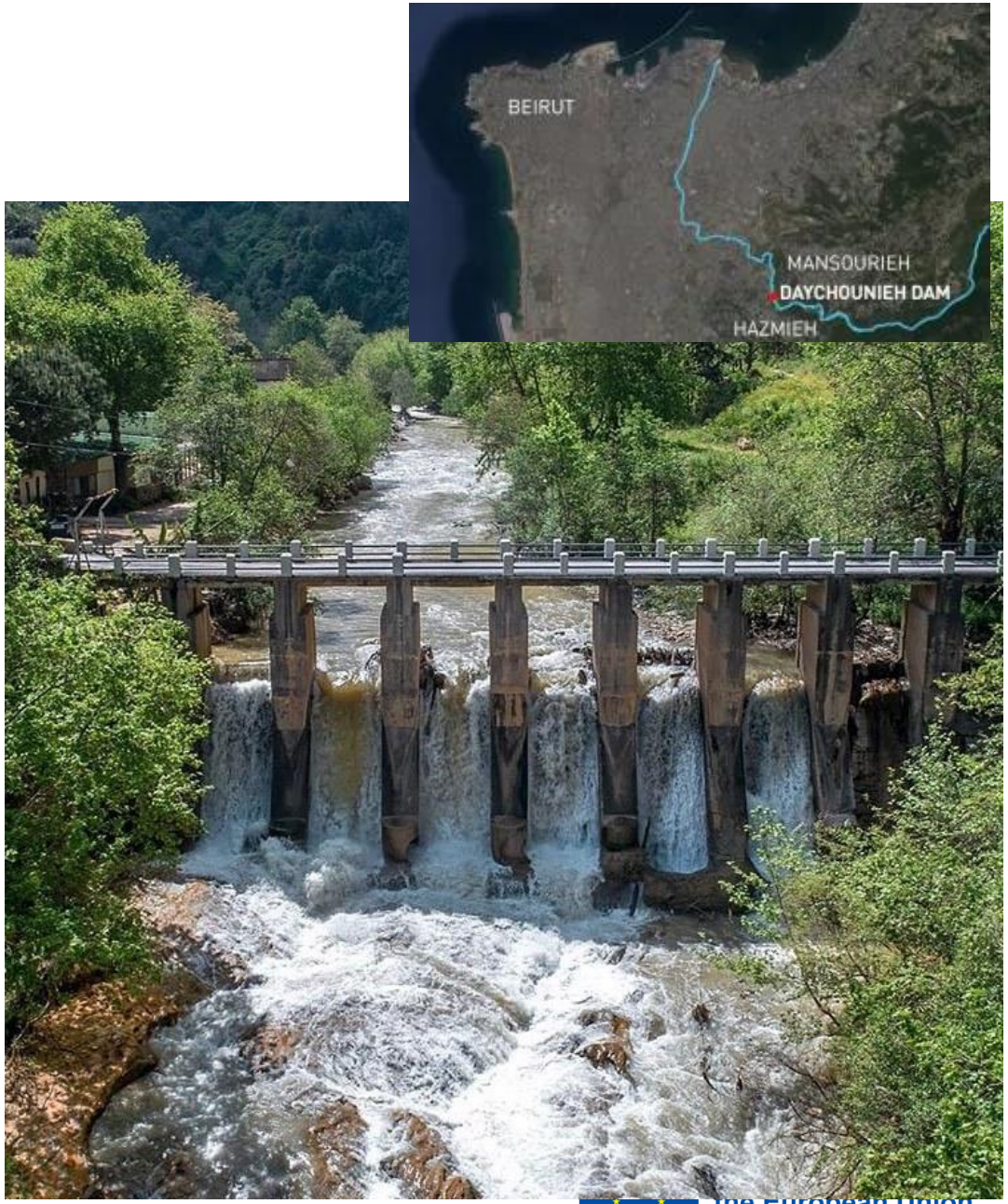
Seven Dimensions of Site-Selection Framework

1	Regional screening	• How can we narrow study areas from national to NBS potential sites?
2	Hydrological and hydraulic screening	• Where can NbS provide the greatest reduction in runoff, peak flow, and erosion risks while remaining technically feasible? • Where is NbS most needed and hydraulically effective?
3-5	Technical, environmental, social & institutional feasibility	• Can NbS physically work here? • Can NbS deliver environmental benefits without creating risks? • Proin in tellus felis volutpat
6	Stakeholder-informed	• Can stakeholders support and approve it? • What does local knowledge confirm, challenge, or add to the analysis?
7	Implementation feasibility and replicability	• Can we implement, maintain, and replicate it? • Pharetra luctus felis • Proin in tellus felis volutpat

Candidate Site:
Upper Basin of the Beirut River

1. **Hydrology and water resources**: Headwater of the Beirut River.
2. **Biodiversity**: The valley benefits from a diverse range of habitats, including (a) flora (e.g., Mediterranean shrubs, forests of oak and pine, and fertile agricultural lands), (b) several endemic plant species, and (c) fauna (e.g., mammals, birds, and reptiles).
3. **Ecology and ecosystem**: The Upper Beirut River Valley plays a crucial role in maintaining ecological balance in the region. Its diverse ecosystems contribute to soil conservation, water regulation, and the overall health of the local environment.
4. **Ecotourism**: an amazing nature to visit and enjoy with its unique biodiversity and views.



Daychounieh Dam. Photo courtesy of Rami Rizk

Candidate Site: Aammiq Wetland, Bekaa Valley

Photo courtesy of Abbas Fayad and Spyro Klitira

Figure. The drying of the Ammiq Wetlands, a vital Ramsar site in the Bekaa Valley. A section of the wetland is shown in March 2021 (left) and December 2025 (right).

Candidate Site: Shouf Biosphere Reserve (SBR)

Photo courtesy of Abbas Fayad

Comparison matrix: example key priority areas

Key Priority Area	Knowledge and interest in NbS	Description	Potential local stakeholder support (based on meetings and personal communication with stakeholders)
Shouf Biosphere Reserve and its buffer zone (municipalities)	Very High	There exists interest and identified local initiatives in the use of NbS for bioswales, rainwater harvesting, groundwater recharge, and mitigating floods and landslides through reforestation and restoring traditional agricultural terraces.	Shouf Biosphere Reserve, local municipalities, MoEW, and the Beirut and Mount Lebanon Water Establishment.
City of Zahle	High	There exist interest and local initiatives for NbS in rainwater harvesting, wastewater reuse, and permaculture integration.	Bekaa Water Establishment, Zahle Municipality, and MoEW
Beirut City	Moderate/ High	Local initiatives are led by research institutes and focus primarily on water quality and aquifer recharge (theoretical).	MoEW. However, there exist multiple stakeholders involved in the management of water with overlapping roles in Beirut, including but not limited to the Ministry of Public Works & Transport, CDR, and Beirut Municipality.

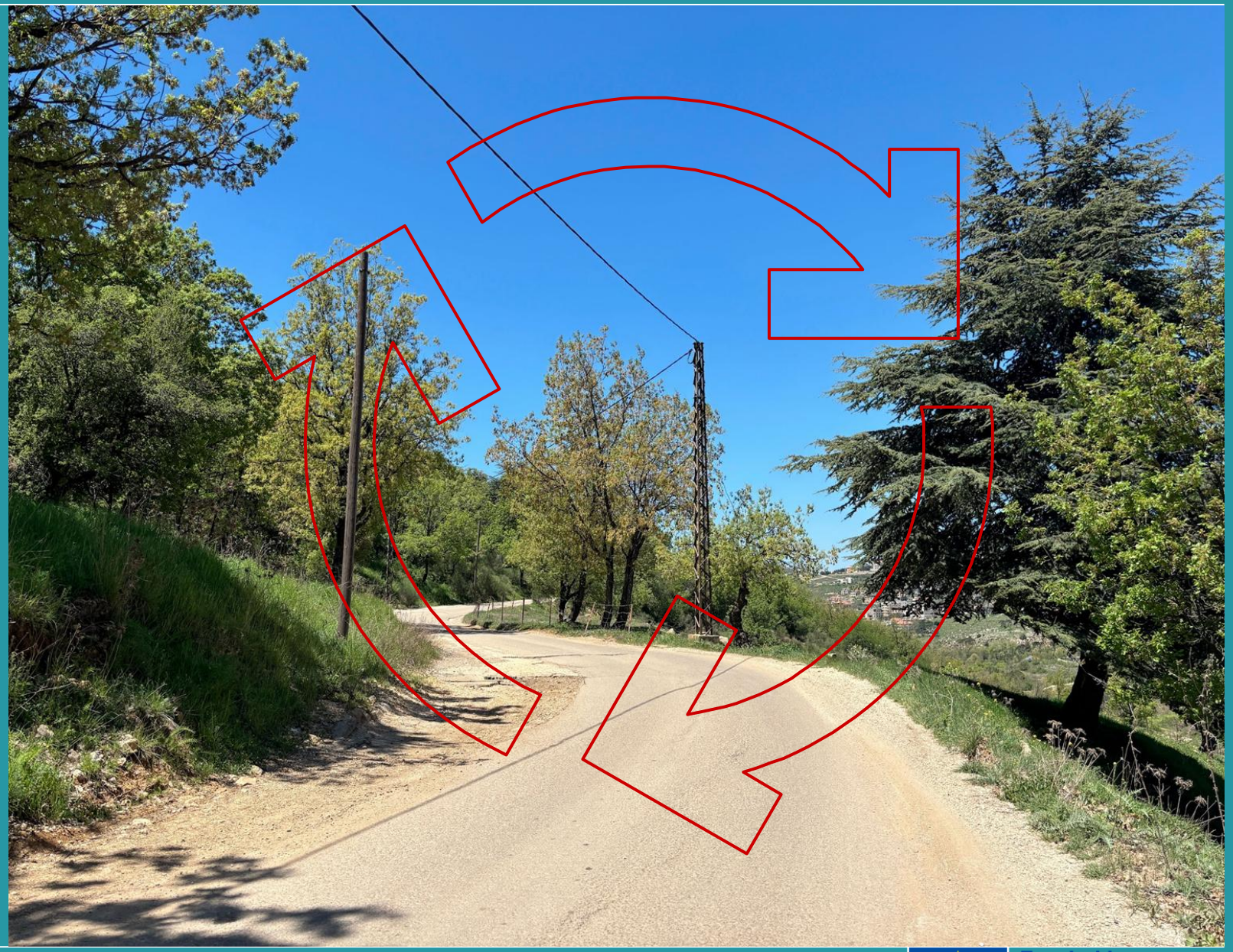
The one million dollar question

“Do we agree that the preferred pilot area and proposed NbS options provide the best combination of hydrological need, technical feasibility, environmental benefit, stakeholder acceptance, and implementation potential?”

Q&A

Ask away!

Advance agreed to NbS options for conceptual design, including preliminary sizing, hydraulic performance, costs, O&M, and implementation responsibilities.



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Presentation of the Technical Findings 2

2. Selected pilot area and its characteristics and justification

Mr Abbas FAYAD, Senior Local Hydrologist

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Figure. Aerial view of the Shouf Biosphere Reserve and its buffer zone, showing the locations of the potential sites identified during the field visits.

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Shouf Biosphere Reserve and its Buffer Zone

Figure. Shouf Biosphere Reserve and Buffer Zone (Photo courtesy of Abbas Fayad and Hanan Hassan)

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Shouf Biosphere Reserve and its Buffer Zone (Cntd.)

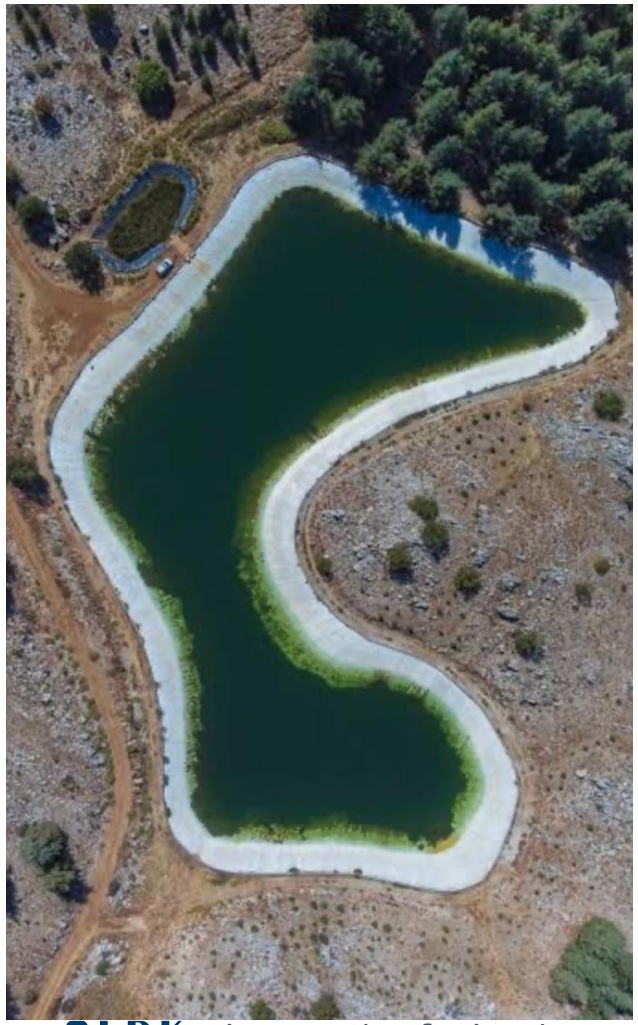


Figure. Shouf Biosphere Reserve and Buffer Zone (Photo courtesy of Abbas Fayad and Hanan Hassan)

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Shouf Biosphere Reserve and its Buffer Zone (Cntd.)

Figure. Shouf Biosphere Reserve and Buffer Zone (Photo courtesy of Abbas Fayad and Hanan Hassan)

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Key Challenges

- Flooding occurs at specific locations within the study area.
- Certain drainage structures are known to fail or overflow during storm events.
- Erosion and sediment hotspots have been identified.
- Some areas become inaccessible during intense rainfall and flooding events.
- Recurring maintenance problems affect parts of the existing drainage and road systems.
- Certain land parcels are available or potentially suitable for NBS implementation.
- Responsibilities for long-term NBS operation and maintenance need to be clearly assigned among relevant institutions and local stakeholders.

Key Questions to be Addressed

- Where does flooding actually occur?
- Which drainage structures fail or overflow?
- Where does erosion occur?
- Which areas become inaccessible during storms?
- Which areas have recurring maintenance problems?
- Which land parcels are realistically available?
- What existing/future projects may affect the site?
- Which interventions are socially acceptable?
- Who could maintain the NBS after implementation?

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Potential site—Shouf Biosphere & its Buffer Zone

Water Harvesting, Erosion Control, Wetland and Pond Restoration (Development)

Photo courtesy of Abbas Fayad

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Potential site—Shouf Biosphere & its Buffer Zone

Water Harvesting and Erosion Control

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Photo courtesy of Abbas Fayad

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Potential site—Shouf Biosphere & its Buffer Zone

Restoration Wetlands and Ponds

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Photo courtesy of Abbas Fayad

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Potential site—Shouf Biosphere & its Buffer Zone

Road Runoff Harvesting and Erosion Control Site

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Photo courtesy of Abbas Fayad

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Criterion	Key assessment question/Description
Hydrological / Hydraulic Need	- How significant are the runoff, flooding, drainage, and erosion problems? - Potential to slow, retain, infiltrate, divert, store, or reuse runoff using NBS/NWRM measures
Technical Feasibility	- Can NbS be safely and effectively implemented at the site? - Degree to which the site has available data and is accessible for site visits
NbS Performance Potential	- How effectively can NbS reduce runoff, peak flows, and erosion and improve water management?
Environmental Benefits	- What ecological, water-quality, biodiversity, and urban-environment benefits can be achieved? - Potential to avoid ecological harm and enhance vegetation, habitat quality, soil stability, or ecosystem services.

Criterion	Key assessment question/Description (Cntd.)
Land Availability / Ownership	- Is suitable land available, and can it be secured for the intervention?
Institutional Feasibility	- Is there sufficient institutional support, authority, and capacity to implement the pilot?
Social / Stakeholder Acceptance	- Do local communities and stakeholders support the proposed intervention?
Implementation / O&M Feasibility	- Can the solution be constructed, financed, and maintained over the long term? - Relative simplicity of implementation, maintenance requirements, and cost logic.
Replication / Scalability	- Can the approach be replicated cost-effectively in other Lebanese contexts? - Visibility, communication value, and relevance to similar Lebanese mountain areas.

Multi-Criteria Assessment

Criterion	Weight	Barouk Road	Rainwater Harvesting Pond Candidate Site(s)	Maasser-Kefraya Road	Constructed Wetland for Agro-processing Wastewater
Hydrological/Hydraulic Need	25%	+++	+++	++	+
Technical Feasibility	15%	+++	++	+++	++
NbS Performance Potential	10%	+++	++	++	++
Environmental Benefits	10%	++	+++	++	+++
Land Availability/Ownership	10%	+++	++	+++	+
Institutional Feasibility	5%	+++	+++	+++	+++
Social/Stakeholder Acceptance	5%	+++	+++	+++	+++
Implementation/O&M Feasibility	10%	+++	+++	+++	++
Replication/Scalability	10%	+++	+++	+++	++

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Figure. Aerial view of the Barouk Road

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Figure. Local view of the Barouk Road (Photo courtesy of Abbas Fayad)

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Figure. Local view of the pilot site drainage network (Photo courtesy of Abbas Fayad)

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Figure. Local view of the pilot site drainage network (Photo courtesy of Abbas Fayad)

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Figure. Local view of the pilot site land use and topography (Photo courtesy of Abbas Fayad)

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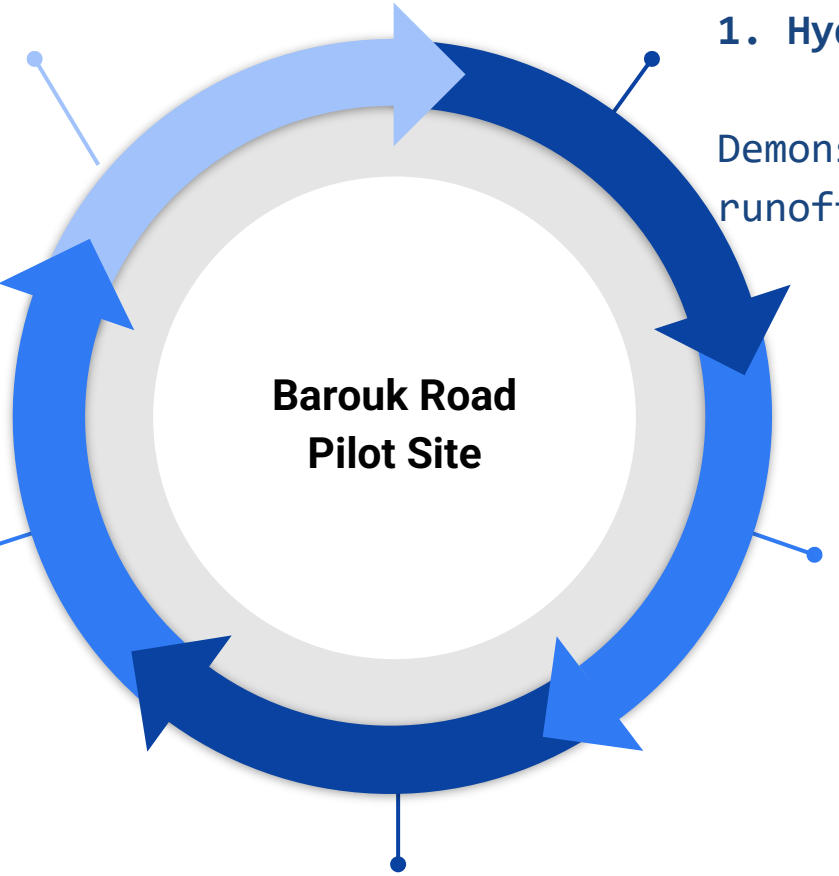
So why is this area the preferred pilot?



1. Hydrological priority

Demonstrated runoff/flood/erosion problem.

2. Technical feasibility

Suitable terrain, drainage connectivity, and land and soil conditions.

3. Environmental opportunity

Potential for clean water-quality, biodiversity, and ecosystem restoration.

4. Institutional feasibility

Clear municipal/ institutional engagement and potential O&M arrangements.

5. Replication potential

Low-cost and scalable interventions applicable to other sites.

Take-home message: The pilot is not necessarily the site with the largest problem—it is the site with the strongest combination of need, feasibility, impact, and replicability.

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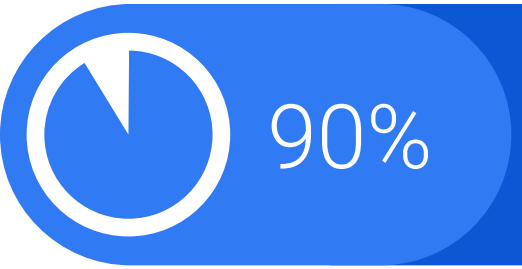
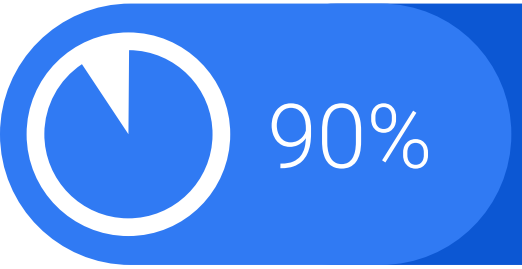
Pilot Area Boundaries: Municipality / Basin



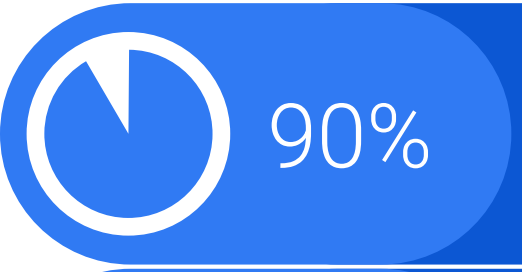
Administrative

- Municipality boundary



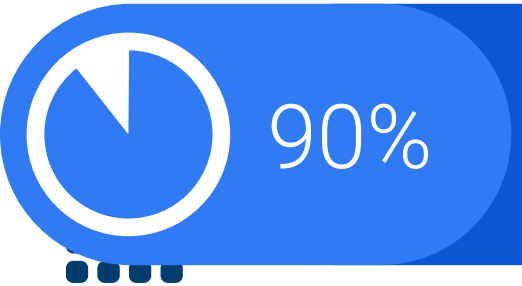
Basin

- Catchment boundary
- Drainage network
- Watercourse/outfall



Infrastructure

- Main roads
- Proposed intervention areas



Land cover/use

- Built-up areas
- Green/open spaces

Catchment and hydrological characteristics

Catchment

- Area
- Elevation range
- Mean/maximum slope
- Land cover
- Imperviousness

Rainfall

- Hourly rainfall
- Seasonal distribution
- Design rainfall
- Critical storm duration

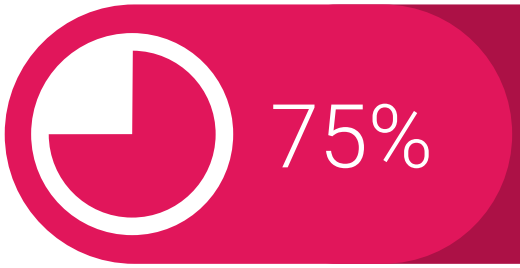
Runoff

- Estimated runoff coefficient
- Runoff volume
- Peak flow
- Critical sub-catchments

Flooding

- Known flood points
- Flood extent/depth, where available
- Critical flow paths

Drainage, erosion, and sediment-management conditions



Infrastructure

- Stormwater pipes/manholes/inlets
- Gullies/channels/culverts/outfalls Channel instability
- Steep slopes

Drainage/Hydraulics

- Areas of concentrated runoff
- Capacity limitations
- Overflow routes/connections to receiving water bodies

Erosion

- Erosion hotspots
- Roadside erosion

Sediment transport

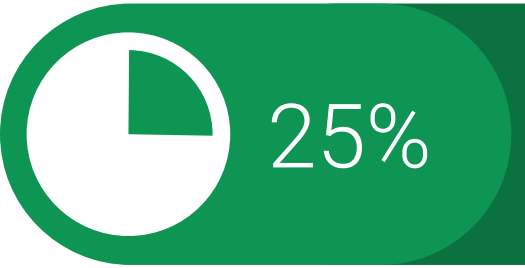
- Blockage/sediment issues.
- Sediment deposition.
- Sediment entering drainage systems.

Land use, ecology, and biodiversity

50%

Land use

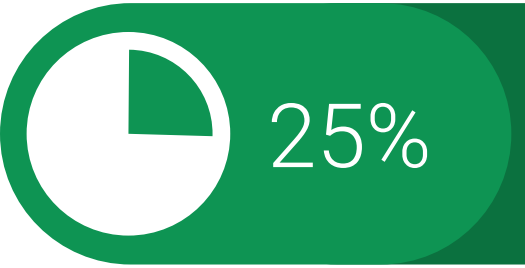
- Residential/commercial
- Public land/vacant land
- Agricultural areas where relevant



25%

Ecology

- Existing vegetation
- Ecological corridors
- Sensitive areas



25%

Biodiversity

- Biodiversity hotspots
- Native/adapted species

What do we know, and what needs validation?

01

CONFIRMED BY DATA

- Precipitation
- Catchment boundary
- Topography
- Land use/Existing green areas
- Drainage network
- Flood-prone locations
- Soil information

02

TO BE CONFIRMED BY STAKEHOLDERS

- Actual flooding frequency
- Critical drainage bottlenecks
- Erosion hotspots
- Land ownership
- Existing/future infrastructure
- Maintenance practices
- Community priorities

03

DATA GAPS

- Detailed infiltration testing
- Detailed drainage capacity
- Groundwater conditions
- Detailed biodiversity survey
- Utility mapping
- Detailed rainfall/runoff observations

Stakeholder validation questions.

01	**Site validation**	• Do stakeholders agree that this is the appropriate pilot area? • Are the mapped flood/runoff/erosion hotspots correct? • Are there additional problem locations?
02	**Technical validation**	• Are the existing drainage conditions correctly represented? • Are there known constraints not captured in the available data? • Are there areas unsuitable for infiltration?
03	**Environmental validation**	• Are important ecological areas missing? • Are there existing biodiversity assets that should be protected? • Are there opportunities for ecological restoration?
04	**Institutional validation**	• Who owns the land? • Who has authority to implement? • Who will maintain the intervention? • Are there planned projects that could conflict with the pilot?

Conclusions and decisions required today.

Deliverable

1. Preferred pilot area

2. Baseline conditions

3. Priority problems

4. NbS options

Decisions

☐ Confirm
☐ Refine boundary
☐ Request additional assessment

☐ Confirm
☐ Add local information
☐ Identify data gaps

☐ Flooding
☐ Runoff
☐ Erosion/sediment

☐ Rainwater harvesting
☐ Rain gardens
☐ Bioswales

☐ Water quality
☐ Water conservation
☐ Biodiv./green space

☐ Permeable surfaces
☐ Detention/storage
☐ Green corridors
☐ Riparian restoration
☐ Other

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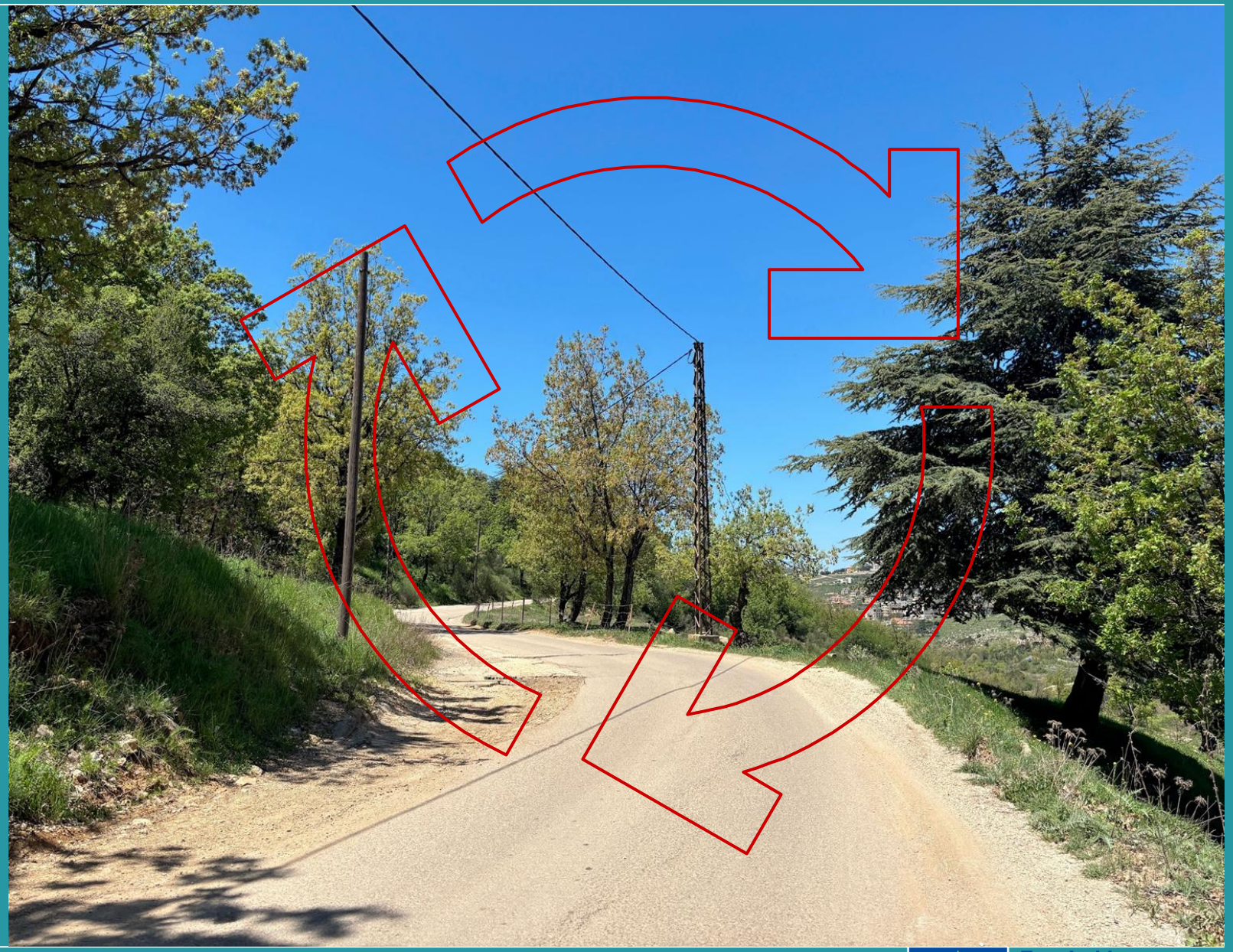
Q&A

Any questions?

Advance agreed to NbS options for conceptual design, including preliminary sizing, hydraulic performance, costs, O&M, and implementation responsibilities.



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WES-BCA
Water and Environment Support - Biodiversity and Climate Action
in the Neighbourhood South region

WES-BCA Workshop

C1_N-LB-2: Design of Nature-Based Solutions in a Pilot area in Lebanon

Validation workshop for confirming the selected site and proposed NBS options, building consensus among institutional and local actors

8 September 2026

Online

Preliminary Nature-Based Solution (NBS) Concept & Proposed Interventions

Presented by: **Ioannis VASILAKOS**, Civil Engineer,
Water Resources Science & Environmental Technology

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WES-BCA *We have the obligation to think & act loud & clear!*

human

research
innovation
project
science & technology
Utilization
Cultivation
high added value

Environ ment

Inspiration
Rain
soil
rock
euphoria
oregano

respect
biomimicry
tradition
aesthetics
low footprint
balanced
management
recourses saving

Harmony

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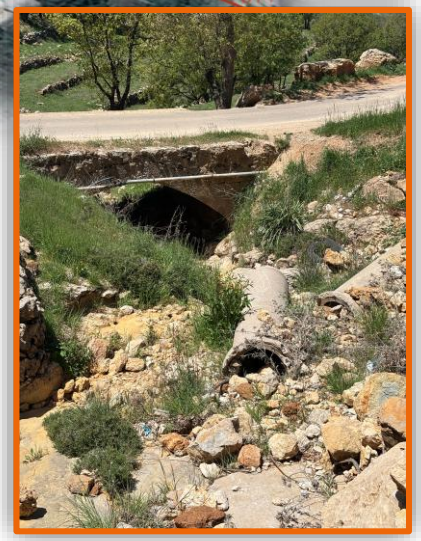
Pilot Site Selection

- **Selected Area**
  - Dalboun–Barouk road runoff corridor.
- **Assessment Score**
  - Ranked 1st (**95**/100) based on multi-criteria analysis.

Criterion	Weight	Dalboun-Barouk road runoff	Rainwater harvesting pond	Maasser-Kefraya rockfall / erosion	Constructed wetland
A. Direct fit with stormwater/rainwater activity scope	20%	5	5	3	2
B. Hydrological relevance and runoff-control benefit	20%	5	4	4	2
C. Spatial definition and catchment tractability	15%	5	3	3	2
D. Availability of hydro-spatial data	15%	5	3	2	2
E. Preliminary technical feasibility	15%	4	4	3	2
F. Technical implementation and O&M simplicity	10%	4	3	3	2
G. Demonstration and replication potential	5%	5	4	3	3
Weighted technical score / 100	100%	**95**	76	61	41
Technical rank	-	**1**	2	3	4

- **The Problem:**

  Unmanaged concentrated road runoff, severe soil erosion, and sediment transport disrupting access and local ecosystems.



Hydrological & Spatial Reality

3.07

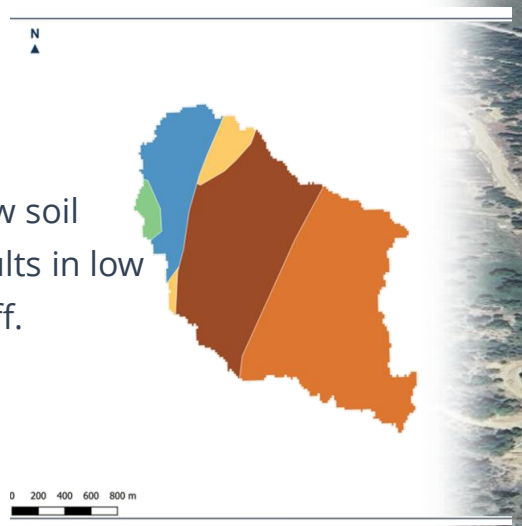
km²/ Catchment Area

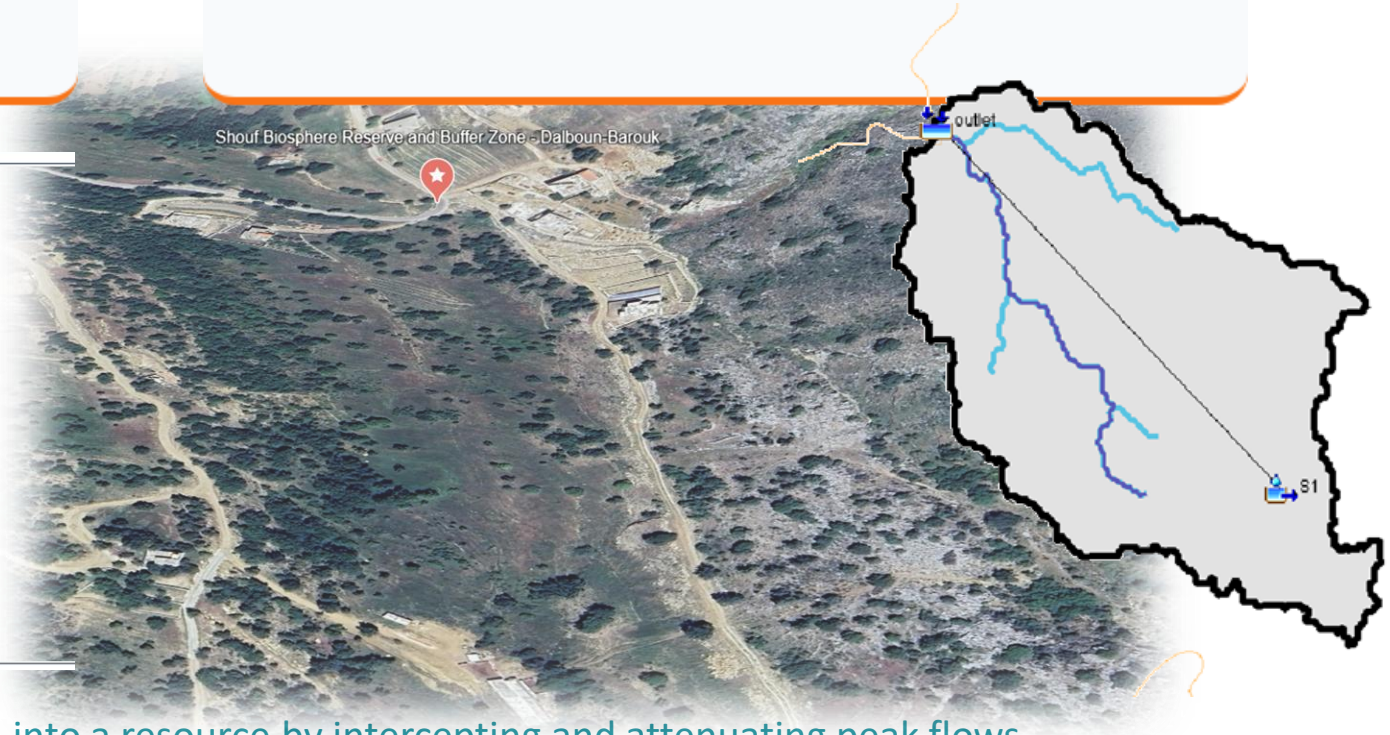
1.7

m³/s (T=50) / Peak Flow

Soil Constraints

Dominated by 'Terra rossa' (shallow soil over compact limestone). This results in low infiltration and rapid surface runoff.





- **The Goal** → Transform the hazard into a resource by intercepting and attenuating peak flows

The Conceptual Design

Design philosophy A Modular Approach

We propose a progressive, gravity-driven chain of interventions rather than a single massive structure.

- Intercept & Slow
- Sediment Control
- Infiltration & Detention
- Safe Overflow

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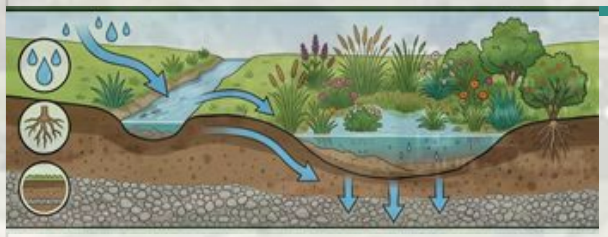
The Conceptual Design - NBS Integrated Interventions

Dalboun-Barouk, Shouf Biosphere Reserve - Proposed Modular System



Vegetated Swales & Rain Gardens

- Intercepts runoff
- Traps sediments
- Filters pollutants

Check rabble stone walling Dams & Gabions

- Reduces water energy
- Stabilizes natural drainage lines

Bioengineered Slope Stabilization

- Protects infrastructure
- Uses native flora & natural materials

Runoff Harvesting Storage supportive Units

- Provides seasonal water storage
- Supports local agriculture

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in the Neighbourhood South region

Ioannis VASILAKOS, Civil Engineer,
Water Resources Science & Environmental Technology

Thank you for your patience & attention!

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WES-BCA Workshop

C1_N-LB-2: Design of Nature-Based Solutions in a Pilot area in Lebanon

Validation workshop for confirming the selected site and proposed NBS options, building consensus among institutional and local actors

8 September 2026

Online

Issues Requiring Stakeholder Feedback & Validation

Presented by: **Ioannis VASILAKOS**, Civil Engineer,
Water Resources Science & Environmental Technology

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Co-Creation & Social Consciousness

WES-BCA
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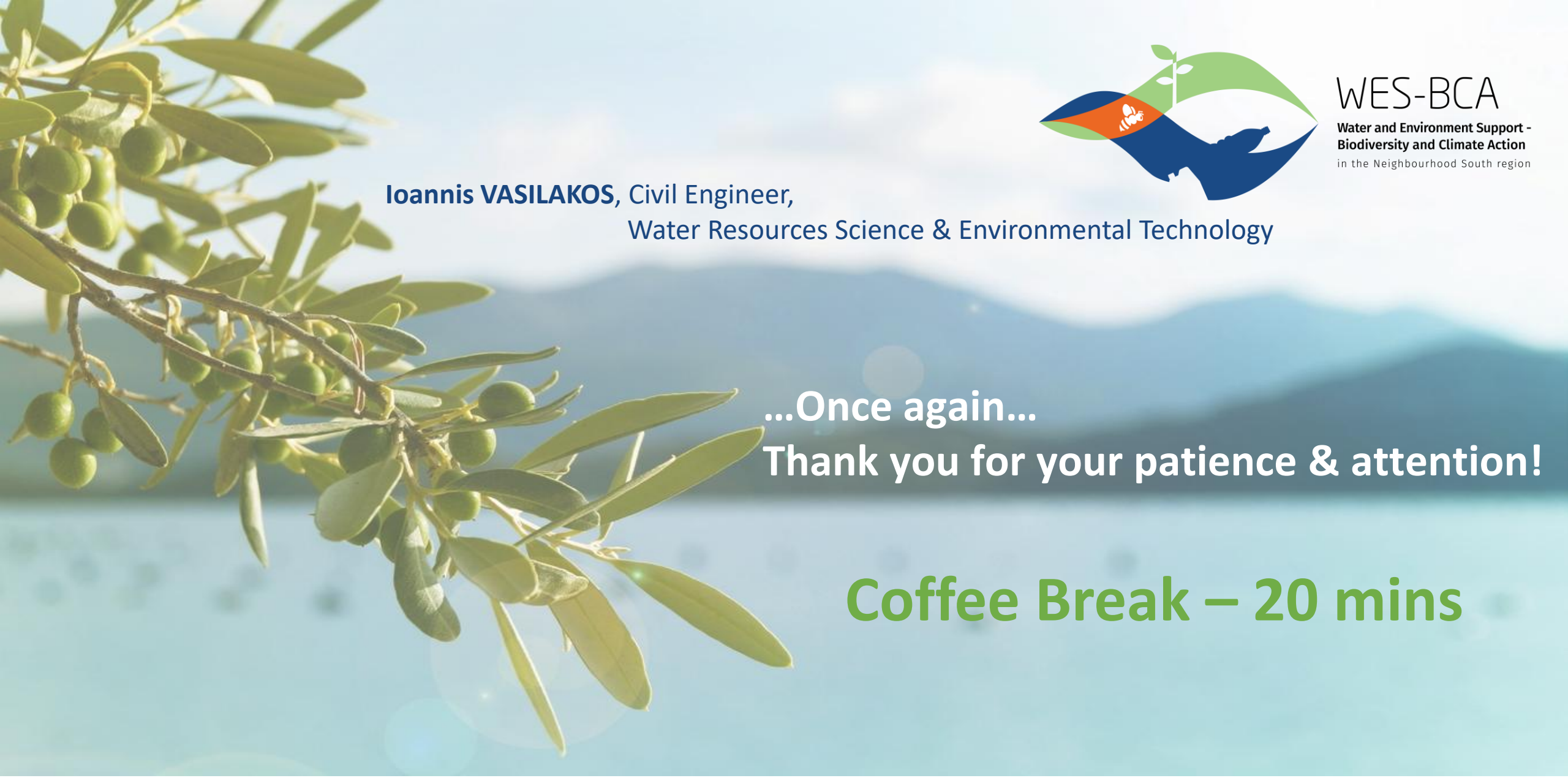
When civil society feels the tangible benefits and aesthetics of these solutions, they will embrace them

Our goal is co-creation for a sustainable future.

Critical Discussion Points

1. Land Jurisdiction & Synergies
   - Clarifying ownership across Municipalities, private landowners, and the Shouf Biosphere Reserve (SBR).Water is not just a resource; it is the foundation of life and community
2. Validating Local Hotspots
   - Identifying hidden flooding or landslide risks based on your local experience.
3. Biodiversity Enhancement
   - Selecting resilient, native plant species that reflect the local identity.
4. Resource Utilization
   - How can the harvested water optimally support local agriculture, livestock, and rural production?
5. Operation & Maintenance
   - Who will take responsibility for sediment removal and routine maintenance?



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Water Resources Science & Environmental Technology

…Once again…
Thank you for your patience & attention!

Coffee Break – 20 mins

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Interactive Working Session

Moderated by:

- Mr Abbas FAYAD, Senior Local Hydrologist

With technical inputs from:

- Mr Ioannis VASILAKOS, Senior Civil/Environmental Engineer
- Ms Eleni AVRAMIDI, Senior Biodiversity Expert

Interactive Working Session

1. Validation of the selected pilot area
2. Technical suitability of the proposed NbS interventions
3. Biodiversity and ecological considerations, including suitable native/local plant species, surrounding land uses and cropping patterns
4. Social, Institutional and implementation considerations
5. Operation and maintenance aspects
6. Implementation Opportunities and constraints, including stakeholder interest, cost implications and potential for scaling

Summary of the Discussion, Conclusions and Next Steps

1. Key recommendations from the validation session

- Mr Abbas FAYAD, Senior Local Hydrologist

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Summary of the Discussion, Conclusions and Next Steps

2. Finalisation of the Pilot Site Selection Report & Preparation of the Pre-feasibility Report

- Mr Ioannis VASILAKOS, Senior Civil/Environmental Engineer

Workshop Evaluation (10 min)

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